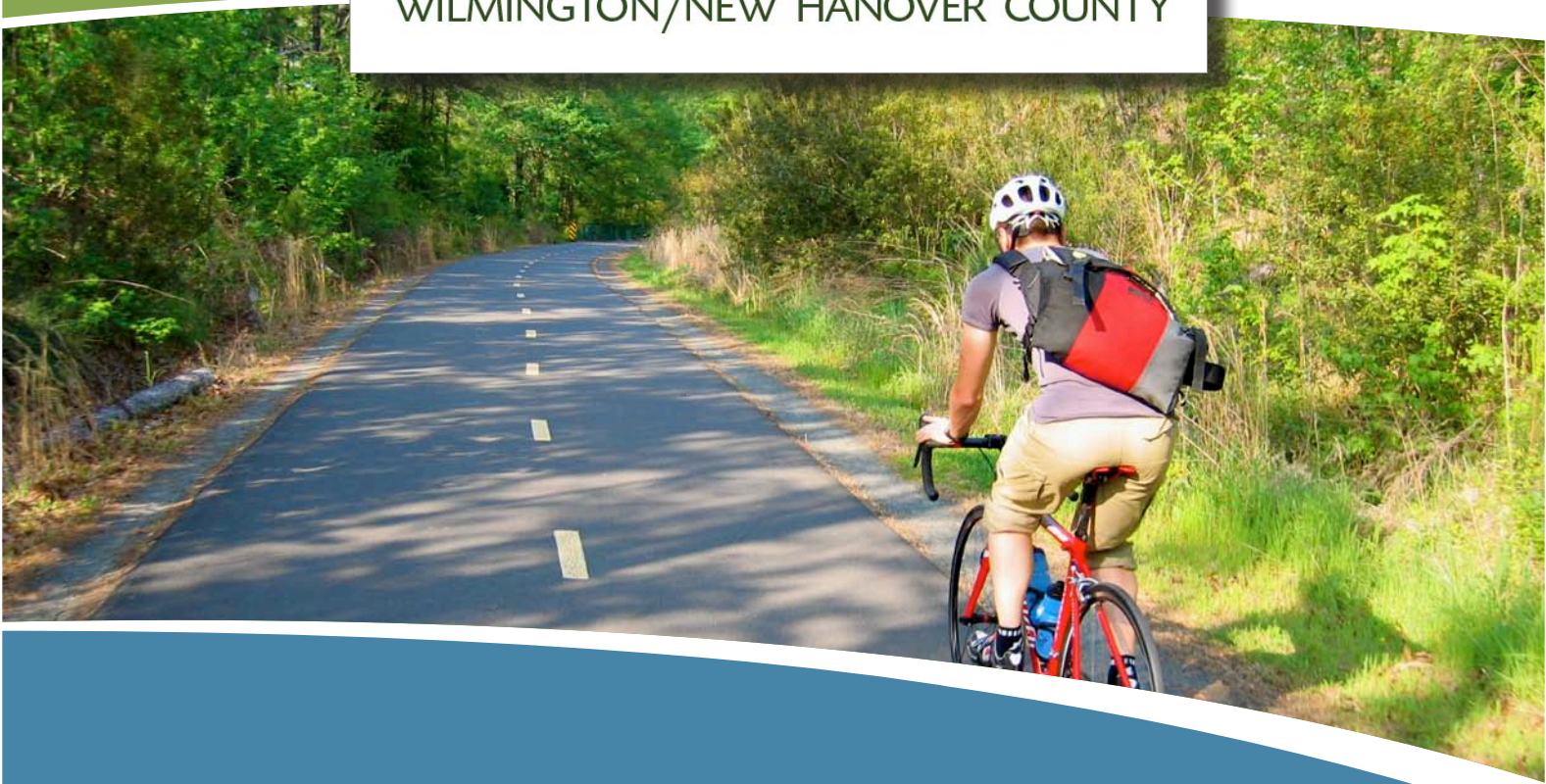




MOVE. PLAY. CONNECT.

COMPREHENSIVE GREENWAY PLAN

WILMINGTON/NEW HANOVER COUNTY



January 2013
Final Plan for Adoption + Approval

ACKNOWLEDGEMENTS

PUBLIC PARTICIPANTS

Thank you to the **3,600+** people who participated in this planning process through public comment forms, the online input map, interviews and meetings. Thanks also to the many individuals of the press and those engaged in social media throughout the process.

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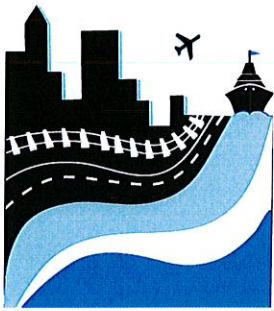
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WILMINGTON URBAN AREA Metropolitan Planning Organization

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910 341 3258 910 341 7801 FAX

Members:

To our community,

City of
WILMINGTON
Lead Planning Agency

To paraphrase the ancient philosopher, Seneca: "To the community that does not know where it wants to go there is no favorable wind."

Town of
CAROLINA BEACH

This Comprehensive Greenway Plan, completed in the fall of 2012, will provide a vision for our community for the future. How we envision and use the open, green and blue spaces in our community defines not only who we are but also how we see ourselves and want others to see us.

Town of
KURE BEACH

Town of
WRIGHTSVILLE BEACH

Communities around the world are looking more and more at ways to use open spaces to help their citizens connect, become healthier, and create value both economically and individually. Attractive, seamless trails and welcoming public spaces contribute to economic development by appealing to businesses to locate here and by making existing businesses glad they are here. Our citizens depend on jobs with those businesses; so the creation of those spaces should be an important part of our economic development efforts.

NEW HANOVER
County

Town of
BELVILLE

Town of
LELAND

Town of
NAVASSA

This Comprehensive Greenway Plan has been an excellent example of public participation and cooperative spirit in our community. Every local government within New Hanover County has signed onto this plan and made a commitment to see it through to reality, creating seamless trails and green and blue public spaces. There have been unprecedented numbers of responses to requests for suggestions, showing that people want a grand community with grand public spaces that are welcoming and accessible.

BRUNSWICK
County

PENDER
County

CAPE FEAR
Public Transportation
Authority

Some people may feel that creating plans for what we want in New Hanover County is a waste of money and time and effort. In truth, plans provide the opportunities we need to actually create, with funding, what we have planned. Those opportunities provide for action, the next important step. We must be ready to act on our plan and make it a reality. "In the long run men hit only what they aim at." (Henry David Thoreau)


North Carolina
BOARD OF
TRANSPORTATION

*Opposite page:
New Hanover County Park
on River Road*

In 2006, the citizens of New Hanover County, including those in the City of Wilmington, voted overwhelmingly to support the Parks and Green Space Referendum. That provided the funding for dreams of how our community could improve its quality of life. This Comprehensive Plan is a suitable outgrowth of that effort. We have shown that when you have a plan, the plan can become reality. Dreams do come true!

I would like to thank everyone who participated in this planning, who responded with their dreams and suggestions. I would also like to thank the members of the Steering Committee who committed their time and effort and the members of the Executive Committee who provided leadership. The willingness of local government and elected officials to support this process is also much appreciated. And most of all for their personal zeal in this effort, I would like to thank Mike Kozlosky, Executive Director of the Metropolitan Planning Organization, Amy Beatty, City of Wilmington Parks and Recreation, and Karyn Crichton, New Hanover County Planning and Inspections.

Sincerely,



Laura W. Padgett
Chair, Wilmington Metropolitan Planning Organization
Wilmington City Council

INTRODUCTION

Chapter Contents:

Project Background

Definition of Greenways

Plan Vision and Goals

Guiding Principles

Benefits of Greenways

The Planning Process

Public Input

PROJECT BACKGROUND

In January 2012, the Wilmington Urban Area Metropolitan Planning Organization (WMPO), in partnership with the City of Wilmington and New Hanover County, began preparation of this Comprehensive Greenway Plan for the City of Wilmington and New Hanover County. Project consultants (Alta/Greenways, Sage Design, and Biohabitats) were selected to lead the planning process, with guidance from a project Steering Committee and direction from an Executive Committee. This was a transparent and participatory planning process, with multiple avenues for public involvement.

DEFINITION OF GREENWAYS

Greenways are corridors of land recognized for their ability to connect people and places together. Most greenways contain walking and bicycling trails (called blueways when they feature canoeing and kayaking) that enhance opportunities for multi-modal transportation and recreation.

In this plan, the terms ‘trails’ and ‘greenways’ are used interchangeably. They are located within linear corridors that are either natural, such as rivers and streams, or manmade, such as railroad corridors and utility corridors. As vegetated buffers, greenways also protect natural habitats, improve water quality and reduce the impacts of flooding in floodplain areas. Altogether, the many functions that greenways serve will benefit all involved: from residents to visitors, and from local businesses to the natural environment, an expanded and interconnected system of greenways will improve overall quality of life.

PLAN VISION AND GOALS

Plan Vision: This plan provides a framework for local governments and project partners to successfully establish a comprehensive network of greenways throughout Wilmington and New Hanover County.

Plan Goals: The goals of this plan were developed based on input received from public comment forms, the project Steering Committee, and stakeholder interviews.

1. Develop new trails that complement and expand upon existing trails.
2. Create safe connections for bicycling and walking between existing and planned parks, schools, commercial and employment centers, and neighborhoods.
3. Establish new non-motorized water trail access points and amenities for canoes and kayaks.
4. Develop a marketing/promotional plan for local trails.
5. Improve health and wellness of residents by offering more opportunities for physical activity through recreation and active transportation.
6. Improve transportation options by offering safe and connected bicycle and pedestrian facilities; increase overall mode-share for walking and bicycling.

GUIDING PRINCIPLES

The following are guiding principles for this plan:

THE WALKING AND BICYCLING ENVIRONMENT SHOULD BE SAFE.

All bicycling and walking routes should be physically safe and perceived as safe by all users. Safe means minimal conflicts with external factors, such as noise, vehicular traffic and protruding architectural elements. Safe also means routes are clear and well marked with appropriate pavement markings and directional signage.

THE PEDESTRIAN AND BICYCLE NETWORK SHOULD BE ACCESSIBLE.

Sidewalks, shared-use paths, bike routes and crosswalks should permit the mobility of residents of all ages and abilities. The pedestrian and bicycle network should employ principles of universal design. Bicyclists have a range of skill levels, and facilities should be designed with a goal of providing for inexperienced/recreational bicyclists (especially children and seniors) to the greatest extent possible.

PEDESTRIAN AND BICYCLE NETWORK IMPROVEMENTS SHOULD BE ECONOMICAL.

Pedestrian and bicycle improvements should achieve the maximum benefit for their cost, including initial cost and maintenance cost, as well as a reduced reliance on more expensive modes of transportation. Where possible, improvements in the right-of-way should stimulate, reinforce and connect with adjacent private improvements.

THE PEDESTRIAN AND BICYCLE NETWORK SHOULD CONNECT TO PLACES PEOPLE WANT TO GO.

The pedestrian and bicycle network should provide continuous direct routes and convenient connections between destinations such as homes, schools, shopping areas, public services, recreational opportunities and transit. A complete network of on-street bicycling facilities should connect seamlessly to existing and proposed multi-use trails to complete recreational and commuting routes.

THE WALKING AND BICYCLING ENVIRONMENT SHOULD BE CLEAR AND EASY TO USE.

Shared-use paths and crossings should allow all people to easily find a direct route to a destination with minimal delays, regardless of whether these persons have mobility, sensory, or cognitive disability impairments. All roads are legal for the use of pedestrians and bicyclists (except freeways, from which each is prohibited unless a separate facility on that right of way is provided). This means that most streets are bicycle facilities and should be designed, marked and maintained accordingly.

*The River to the Sea Bikeway
at Park Avenue and Camelia
Drive, in Wilmington, NC.*



THE WALKING AND BICYCLING ENVIRONMENT SHOULD BE ATTRACTIVE AND ENHANCE COMMUNITY LIVABILITY.

The walking and bicycling facilities should be compatible with the nature, history and character of the environment. Context and scale should be given thoughtful consideration. Good design should integrate with and support the development of complementary uses and should encourage preservation and construction of art, landscaping and other items that add value to communities. These components might include open spaces such as plazas, courtyards and squares, and amenities like street furniture, banners, art, plantings and special paving. These along with historical elements and cultural references, should promote a sense of place. Public activities should be encouraged and the municipal code should permit commercial activities such as dining, vending and advertising when they do not interfere with safety and accessibility.

DESIGN GUIDELINES ARE FLEXIBLE AND SHOULD BE APPLIED USING PROFESSIONAL JUDGMENT.

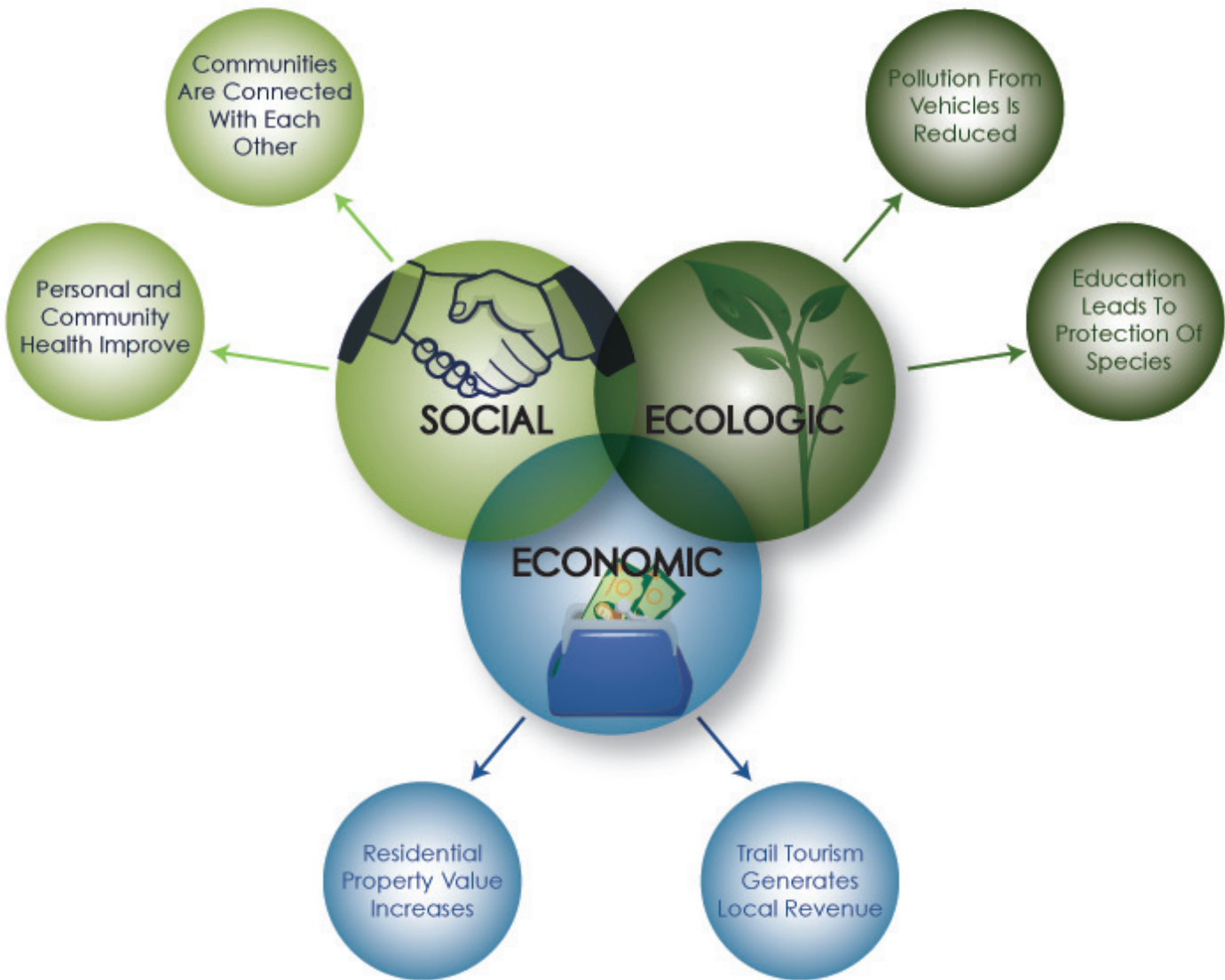
This document references specific national guidelines for bicycle and pedestrian facility design, as well as a number of design treatments not specifically covered under current guidelines. Statutory and regulatory guidance may change. For this reason, the guidance and recommendations in this document function to complement other resources considered during a design process, and in all cases sound engineering judgment should be used.

BLUEWAYS AND BLUEWAY ACCESS POINTS (FOR CANOEING AND KAYAKING) SHOULD FEATURE WAYFINDING, SAFETY AND ENVIRONMENTAL EDUCATIONAL INFORMATION.

This document contains recommendations for new non-motorized water access points, including best practices for designing such sites. Further, this plan recommends wayfinding for blueway routes, and safety information for how to use blueways and monitor changing tides. Access sites should be constructed in a manner that minimizes environmental impact, and local programs should continue to focus on water quality and river clean-up outings.

BENEFITS OF GREENWAYS

Given the hard work involved in the planning, design, and development of a comprehensive trails system, it is important for all those involved in this effort to periodically remind themselves, and others, of the meaning behind this work and the tremendous value it brings to the broader community. Communities across the U.S. and throughout the world are investing in trails as a factor of overall livability. They do this because of their obligation to promote health, safety, and welfare, and also because of the growing awareness of the many benefits of having a connected system of trails and greenways, which include social, ecologic, and economic benefits.



The following pages provide a brief overview and a few examples of each of these benefits of greenways. A more detailed review of the extensive literature supporting these benefits is provided in **Appendix B**, along with examples from around the country.

GREENWAYS CREATE VALUE + GENERATE ECONOMIC ACTIVITY

The economic benefits of trails are generated from several sources and accrue to many different local groups, including residents, businesses, and government agencies. First, trails increase adjacent property values, which benefits property owners as well as local government agencies that see increased property tax revenues. Second, trails attract both businesses and tourists, spurring economic development that benefits all residents. Third, improved bicycle and pedestrian access near businesses, through trails or other means, has been shown to increase sales while reducing the need for expensive parking. Finally, trails are less expensive to construct than roadways and allow residents to travel by bike or foot, saving money on gas and car maintenance.

Right: Example of a bicycle, canoe, and kayak rental operation, combined with a trailhead refreshment stand (photo by Jason Reyes, at the Capital Crescent Trail).



Left: Image of the Riverwalk in Downtown Wilmington, serving as a hub for local event activity.

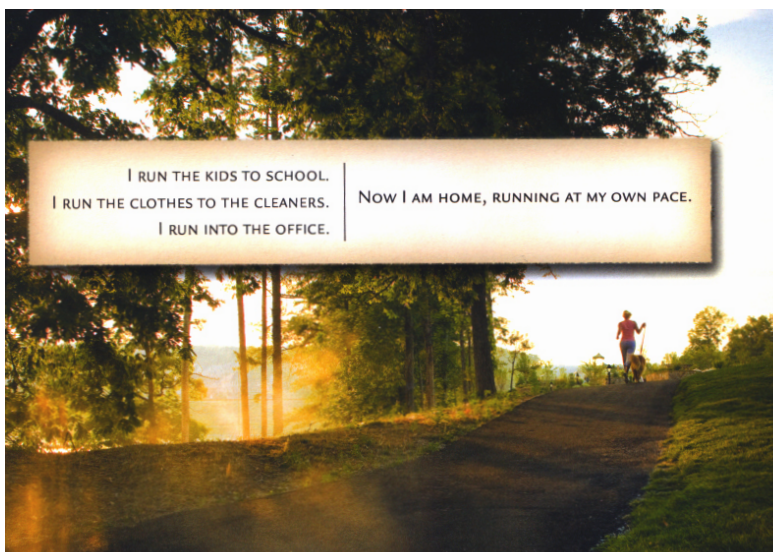
Right: Example of a connected greenway system in Greenville, SC, that serves as a hub of activity for residents and visitors alike.



GREENWAYS INCREASE REAL PROPERTY VALUES

There are many examples, both nationally and locally, that affirm the positive connection between trails, walkability, and property values.¹ Residential properties will realize a greater gain in value the closer they are located to trails and greenspace. In a survey of home buyers by the National Association of Realtors and the National Association of Home Builders, trails ranked as the second most important community amenity out of a list of 18 choices (highway access was number one).² Similarly, the 2009 report “Walking the Walk” by CEO’s for Cities, which looked at 94,000 real estate transactions in 15 markets, found that in 13 of those markets, higher levels of “walkability” were directly linked to higher home values. For example, in Apex, North Carolina, the Shepard’s Vineyard housing development added \$5,000 to the price of each of the 40 homes adjacent to the regional greenway – and those homes were still the first to sell.³ Other findings from the Trust for Public Land’s ‘Economic Benefits of Parks and Open Space’ and the Rails-to-Trails Conservancy’s ‘Economic Benefits of Trails and Greenways’, are highlighted in **Appendix B**, illustrating how trails have positively impacted property values across the country.

Developers understand the positive impact of trails on property values, and they use them to market their projects; left and below are examples of two magazine advertisements from developers that focus their marketing on greenways. These images are from ads in North Carolina and Florida.



At the award-winning Fishhawk Ranch, nearly 30 miles of trails weave throughout the community, connecting the many parks, amenities, villages and neighbors.

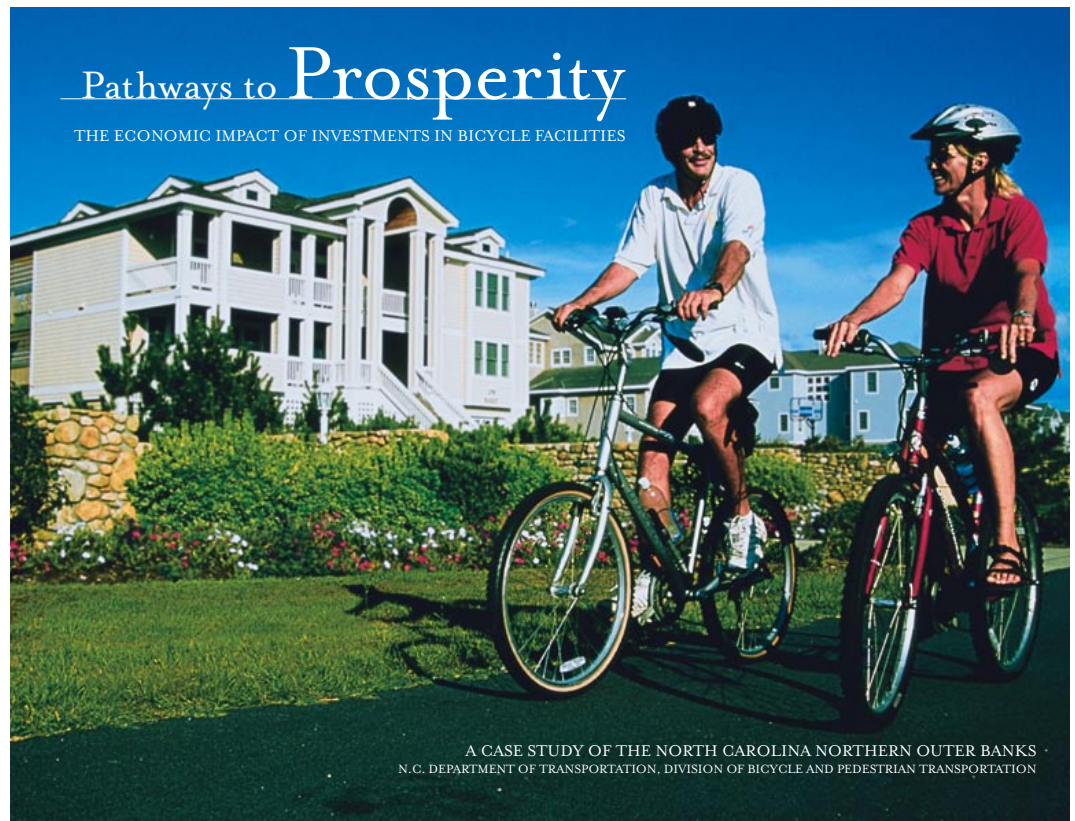
Soon to be one of the largest community trail systems in the country, each pathway was carefully positioned to minimize the impact on the existing plant life.

GREENWAYS SPUR ECONOMIC GROWTH

In addition to real estate values, trails also create positive economic impacts from tourism and recreation-related revenue. Trails and greenways create opportunities in construction and maintenance, recreation rentals (such as bicycles, kayaks, and canoes), recreation services (such as shuttle buses, ferry services, and guided tours), historic preservation, restaurants, and lodging. The industry rule of thumb is that for every one dollar of investment, there is a three dollar return on that investment, if not more. One of the most relevant tourism examples that saw an even higher return on investment is from the North Carolina coast. In the Outer Banks, bicycling is estimated to have an annual economic impact of \$60 million, and 1,407 jobs are supported by the 40,800 visitors for whom bicycling was an important reason for choosing to vacation in the area. The annual return on bicycle facility development in the Outer Banks is approximately nine times higher than the initial investment.⁴ Another study in Kansas City found an even higher return of \$11.80 for every \$1 invested.

Like the Outer Banks, New Hanover County is currently a significant draw to tourists, with over 500 jobs directly attributable to tourists and many more supported through indirect effects.⁵ The majority of tourists visit the three beach towns of Wrightsville Beach, Carolina Beach, and Kure Beach. A comprehensive trail system could both build upon this existing base and provide a safe and enjoyable way for tourists to visit downtown Wilmington and other parts of the county, so that these areas can share in the economic gains of tourism.

Download the full report,
"Pathways to Prosperity", from:
[http://www.ncdot.gov/
bikeped/researchreports](http://www.ncdot.gov/bikeped/researchreports)



Recreational facilities also attract businesses seeking a place to locate with a high quality of life for their employees. In Morgantown, West Virginia, the 45-mile Mon River trail system is credited by the Convention and Visitors Bureau for revitalizing an entire district of the city, with a reported \$200 million in private investment as a direct result of the trail.⁶ Similarly, Chicago's Millennium Park is credited with one-quarter of all new retail, commercial, and residential development that has taken place in the East Loop since the park's creation.⁷ At the street scale, pedestrian and bicycle access have been shown to increase retail sales. High quality walking and cycling conditions tend to attract retail customers.^{8,9} Further, consumers report a willingness to pay approximately 11 percent more for goods in landscaped business districts than in non-landscaped districts. They are willing to pay as much as 50 percent more in these districts for convenience goods.¹⁰ One of the goals of the greenway system in Wilmington and New Hanover County will be to link commercial and residential areas, in order to reap these benefits for local businesses.

GREENWAYS OFFER TRANSPORTATION COST SAVINGS

When looking at the returns on investment noted above, it is also important to put into perspective the massive differences in costs inherent in the transportation decisions we make, both as individuals and as a region. Consider the individual costs associated with various forms of transportation. Walking is virtually free and the cost of operating a bicycle is far less than operating a car. A study cited by the Victoria Transport Policy Institute found that households in automobile-dependent communities devote 50 percent more of their income to transportation (more than \$8,500 annually) than households in communities with more accessible land use and more multi-modal transportation systems (less than \$5,500 annually).

On a broader scale, consider the regional costs of our transportation infrastructure investments. According to the Federal Highway Administration, the basic cost of a single mile of urban, four-lane highway is between \$20 million and \$80 million. In urban bottlenecks where congestion is the worst, common restrictions such as the high costs of right of ways and the need to control high traffic volumes can boost that figure to \$290 million or more.¹¹ By contrast, the costs of bicycle and pedestrian facilities range anywhere from a few thousand dollars per mile to rarely more than \$1 million, with great variability between types of infrastructure and local circumstances.¹²

Bicycling and walking are affordable forms of transportation, and with the relatively low cost and high return on investment for trails, it is hard to argue against developing a regional system that creates value and generates economic activity.

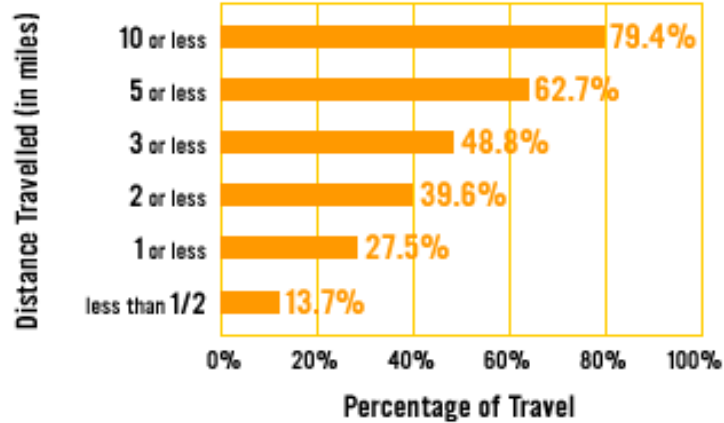
GREENWAYS ENHANCE BICYCLE AND PEDESTRIAN TRANSPORTATION OPTIONS

Communities that invest in trail systems will be better prepared to accommodate shifting modes of travel, especially as driving becomes more expensive. Provided there are viable alternatives to driving, Americans are willing to change their travel habits, as shown during the dramatic increases in gas prices in 2008. According to the Rails to Trails Conservancy and the Bikes Belong Coalition, *"Every day, more commuters switch to public transportation, bicycling and walking in places where prior infrastructure investments have made these options safe and convenient"*.¹³

Choosing to bike or walk rather than to drive, however, is often made difficult by the way our cities and towns have developed. The sprawling nature of many land development patterns often leaves residents and visitors with little choice but to drive, even for short trips. In fact, nearly two-thirds (62.7 percent) of all driving trips we make are for a distance of five miles or less.

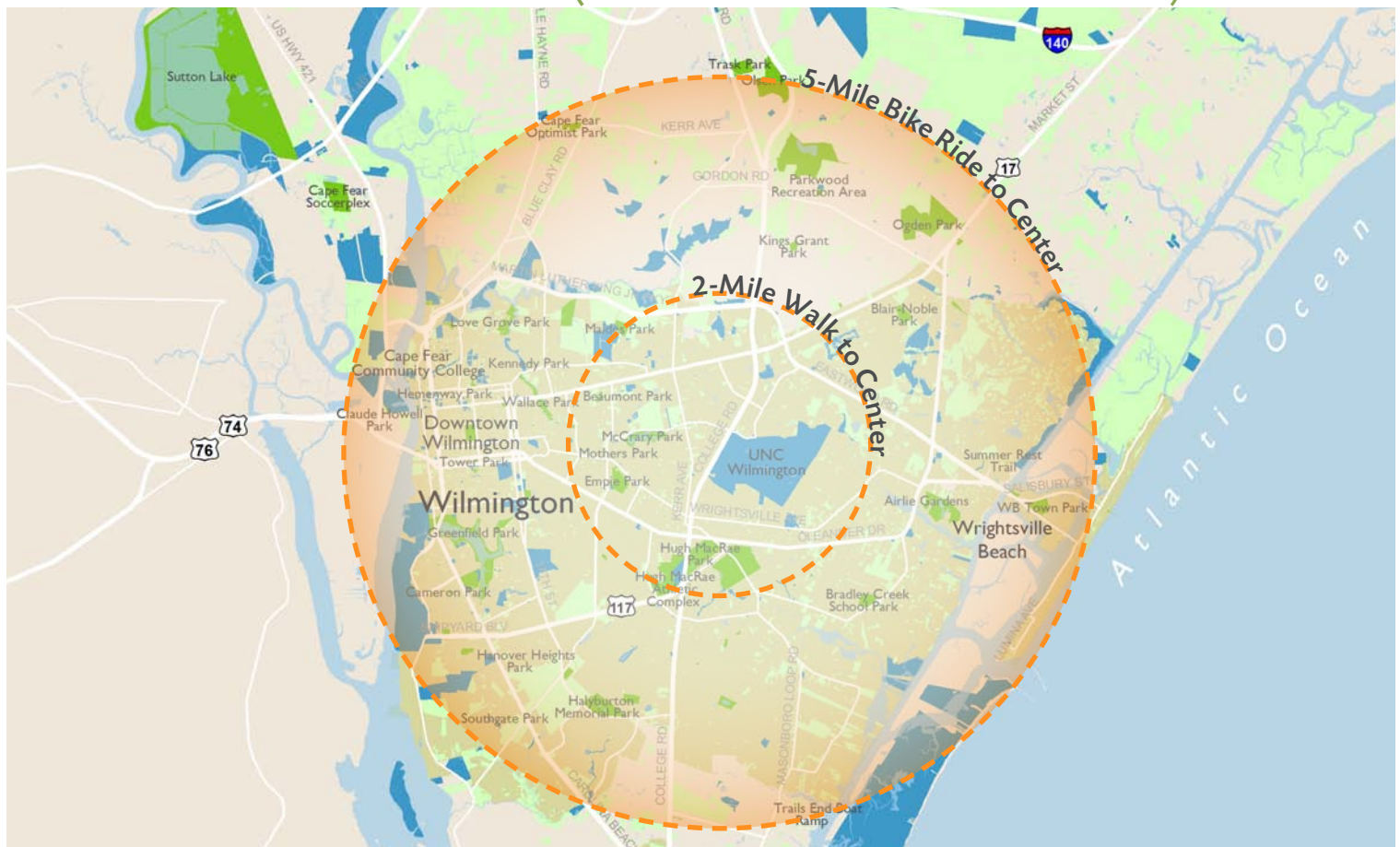
Surveys by the Federal Highway Administration show that Americans are willing to walk as far as two miles to a destination and bicycle as far as five miles. A complete system of trails in Wilmington and New Hanover County, combined with other bicycle and pedestrian infrastructure, will offer viable opportunities for walking and biking to homes, workplaces, schools, parks, downtowns, and cultural attractions.

Daily Trip Distances



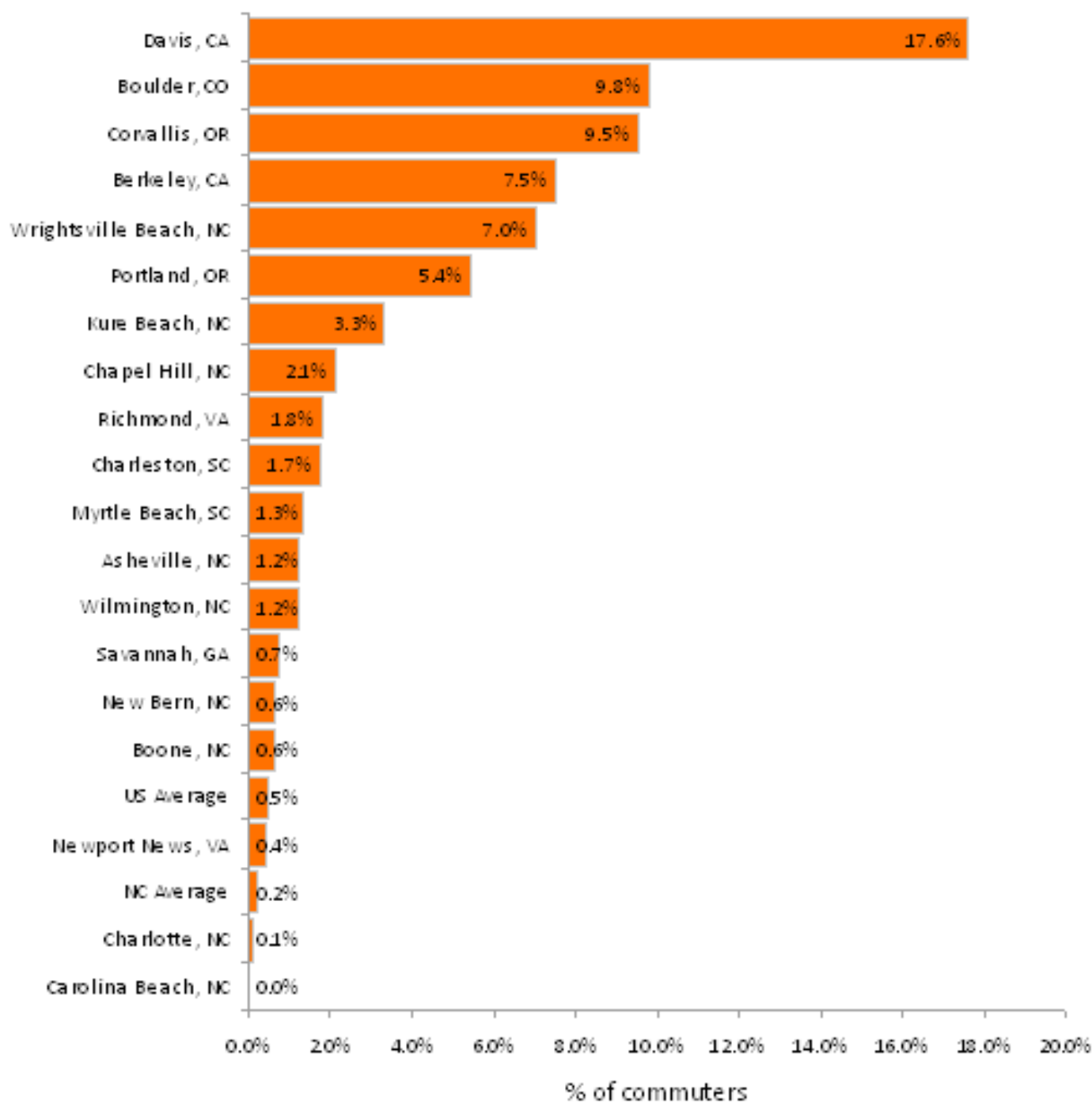
Right: Most driving trips are for a distance of five miles or less.
Chart from the Bicycle and Pedestrian Information Center website, www.pedbikeinfo.org

EXAMPLE WALK AND BIKE RANGES (TWO AND FIVE-MILES FROM CENTER)



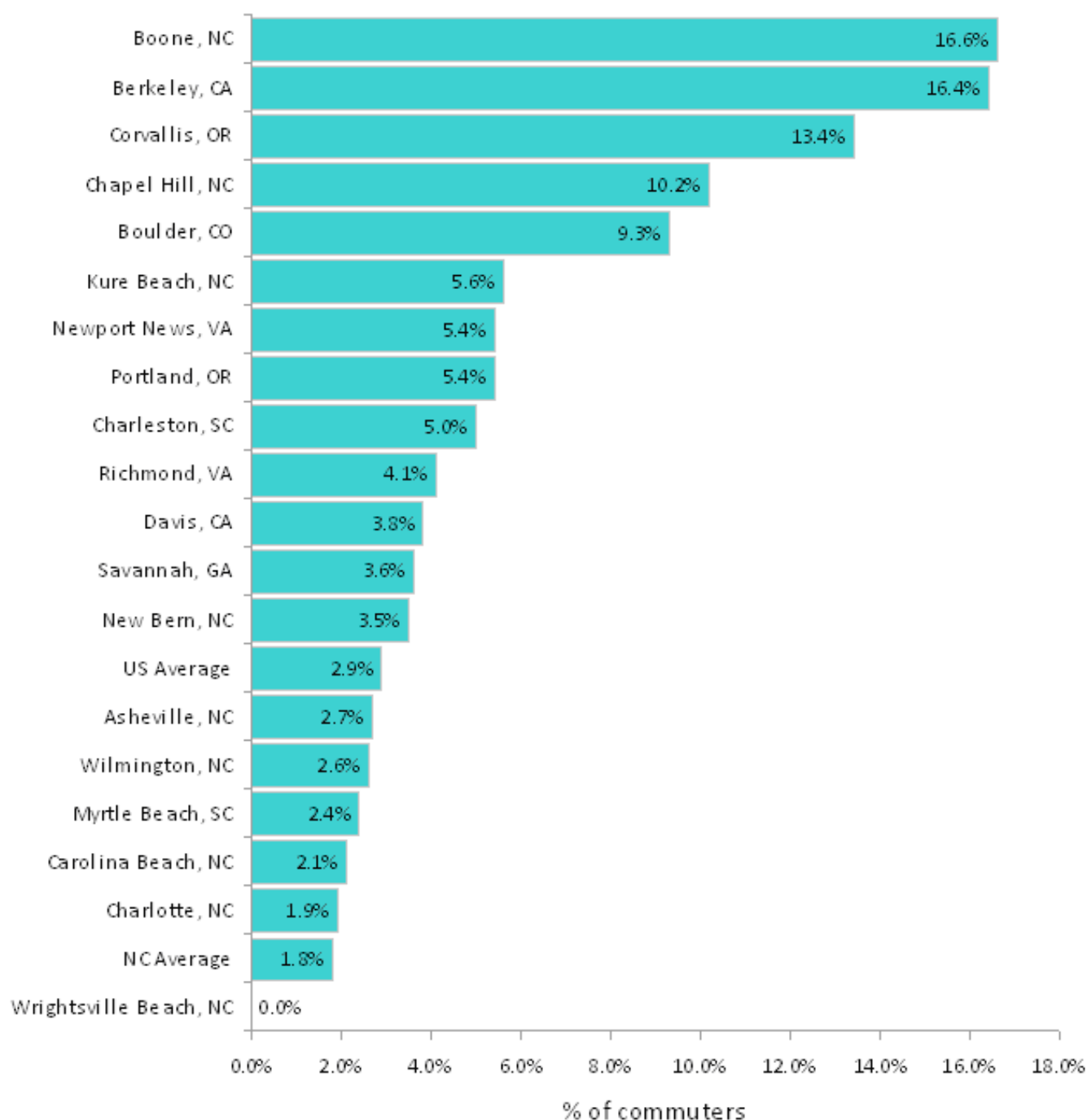
Given the relative density of development in New Hanover County, and the concentration of development in and around Wilmington, many daily trips are within reach of a two-mile walk or a five-mile bike ride.

SHARE OF COMMUTERS WHO BIKE TO WORK: A COMPARISON WITH SELECT LOCAL, SOUTHEASTERN COASTAL AND U.S. CITIES



Source: 2006-2010 American Community Survey 5 year estimates. <http://factfinder2.census.gov>

SHARE OF COMMUTERS WHO WALK TO WORK: A COMPARISON WITH SELECT LOCAL, SOUTHEASTERN COASTAL AND U.S. CITIES



Source: 2006-2010 American Community Survey 5 year estimates. <http://factfinder2.census.gov>

GREENWAYS IMPROVE HEALTH THROUGH ACTIVE LIVING

Land and water trails throughout New Hanover County will contribute to the overall health of residents by offering people attractive, safe, and accessible places to bike, walk, hike, jog, skate, canoe, and kayak. In short, regional trails will create better opportunities for active lifestyles. The design of our communities—including towns, subdivisions, transportation systems, parks, trails, and other public recreational facilities—affects people’s ability to reach the recommended 30 minutes each day of moderately intense physical activity (60 minutes for youth). According to the Centers for Disease Control and Prevention (CDC), *“Physical inactivity causes numerous physical and mental health problems, is responsible for an estimated 200,000 deaths per year, and contributes to the obesity epidemic.”*¹⁴ In the 2011 Gallup-Healthways Well-Being Index, Wilmington ranked significantly below Charlotte, Durham, Raleigh, and Fayetteville in the Physical Health category, landing at 136 out of 190 US Cities considered.¹⁵

In identifying a solution, the CDC determined that by creating and improving places in our communities to be physically active, there could be a 25 percent increase in the percentage of people who exercise at least three times a week.¹⁶ This is significant considering that for people who are inactive, even small increases in physical activity can bring measurable health benefits.¹⁷ In a December 2010 article published by the Mayo Clinic, it is suggested that:

“Walking, like other exercise, can help you achieve a number of important health benefits such as:

- Lowered low-density lipoprotein (LDL) cholesterol (the “bad” cholesterol),*
- Elevated high-density lipoprotein (HDL) cholesterol (the “good” cholesterol),*
- Lowered blood pressure,*
- Reduced risk of or managed type 2 diabetes,*
- Improved mood, and*
- Increased feelings of strength and fitness.”*

Many public agencies are teaming up with foundations, universities, and private companies to launch a new kind of health campaign that focuses on improving people’s options instead of reforming their behavior. A 2005 Newsweek Magazine feature, “Designing Heart-Healthy Communities,” cites the goals of such programs: *“The goals range from updating restaurant menus to restoring mass transit, but the most visible efforts focus on making the built environment more conducive to walking and cycling.”*¹⁸ Clearly, the connection between health and greenways is becoming common knowledge. The Rails-to-Trails Conservancy puts it simply: *“Individuals must choose to exercise, but communities can make that choice easier.”*

See **Appendix A: Health Impact Assessment** for more on how this plan would impact the overall health of the community.



Left: Students and teachers from a nearby school using the Gary Shell Cross-City Trail in Wilmington for exercise.

See **Appendix G: Greenways as Ecological Assets** for more on how this plan could support environmental health.

GREENWAYS SUPPORT CLEAR SKIES, CLEAN RIVERS, AND WILDLIFE

There are a multitude of environmental benefits from trails, greenways, and open spaces that help to protect the essential functions performed by natural ecosystems. Greenways protect and link fragmented habitats and provide opportunities for protecting plant and animal species. Trails and greenways reduce air pollution by two significant means: first, they provide enjoyable and safe alternatives to the automobile, which reduces the burning of fossil fuels; second, they protect large areas of plants that create oxygen and filter air pollutants, such as ozone, sulfur dioxide, carbon monoxide, and airborne particles of heavy metal. Greenways improve water quality by creating a natural buffer zone that protects streams, rivers, and lakes, preventing soil erosion and filtering pollution caused by agricultural and road runoff. As of 2009, the Cape Fear River Basin, of which New Hanover County is a part, had over 300 miles of streams impaired from urban runoff.¹⁹

As an educational tool, greenway and blueway trail signage can be designed to inform trail users about water quality issues particular to each watershed. Such signs could also include tips on how to improve water quality. Similarly, a greenways and blueways can serve as a hands-on environmental classroom for people of all ages to experience natural landscapes, conduct river clean-ups, and further environmental awareness.

GREENWAYS PROTECT PEOPLE AND PROPERTY FROM FLOOD DAMAGE

The protection of open spaces associated with greenway development can also protect natural floodplains along rivers and streams. According to the Federal Emergency Management Agency (FEMA), the implementation of floodplain ordinances is estimated to prevent \$1.1 billion in flood damages annually. By restoring developed floodplains to their natural state and protecting them as greenways, many riverside communities are preventing potential flood damages and related costs.²⁰

GREENWAYS ENHANCE CULTURAL AWARENESS AND COMMUNITY IDENTITY

Trails, greenways, and open space can serve as connections to local heritage by preserving historic places and by providing access to them. They provide a sense of place and an understanding of past events by drawing greater public attention to historic and cultural locations and events. Trails often provide access to historic sites such as battlegrounds, bridges, buildings, and canals that otherwise would be difficult to access or interpret. Each community or region has its own unique history, its own features and destinations, and its own landscapes. For example, in Wilmington and New Hanover County, some historic features could include Gullah Geechee, rice plantations, or the Race Riot of 1898. Cultural and historic groups like the Historic Wilmington Foundation and Greater Wilmington Historical Society could help identify the most relevant events for different sites. By recognizing, honoring, and connecting these features, the combined results serve to enhance cultural awareness and community identity, potentially attracting tourism. Being aware of the historical and cultural context when naming parks and trails and designing features will further enhance the overall trail and park user experience.

Finally, greenways and trails provide opportunities for people to interact with one another outside of work and their immediate neighborhood. Positive interaction (such as through exercising, strolling, or even just saying ‘hello’) among people from a wider community helps to build trust and awareness of others, which strengthens the overall sense of community.

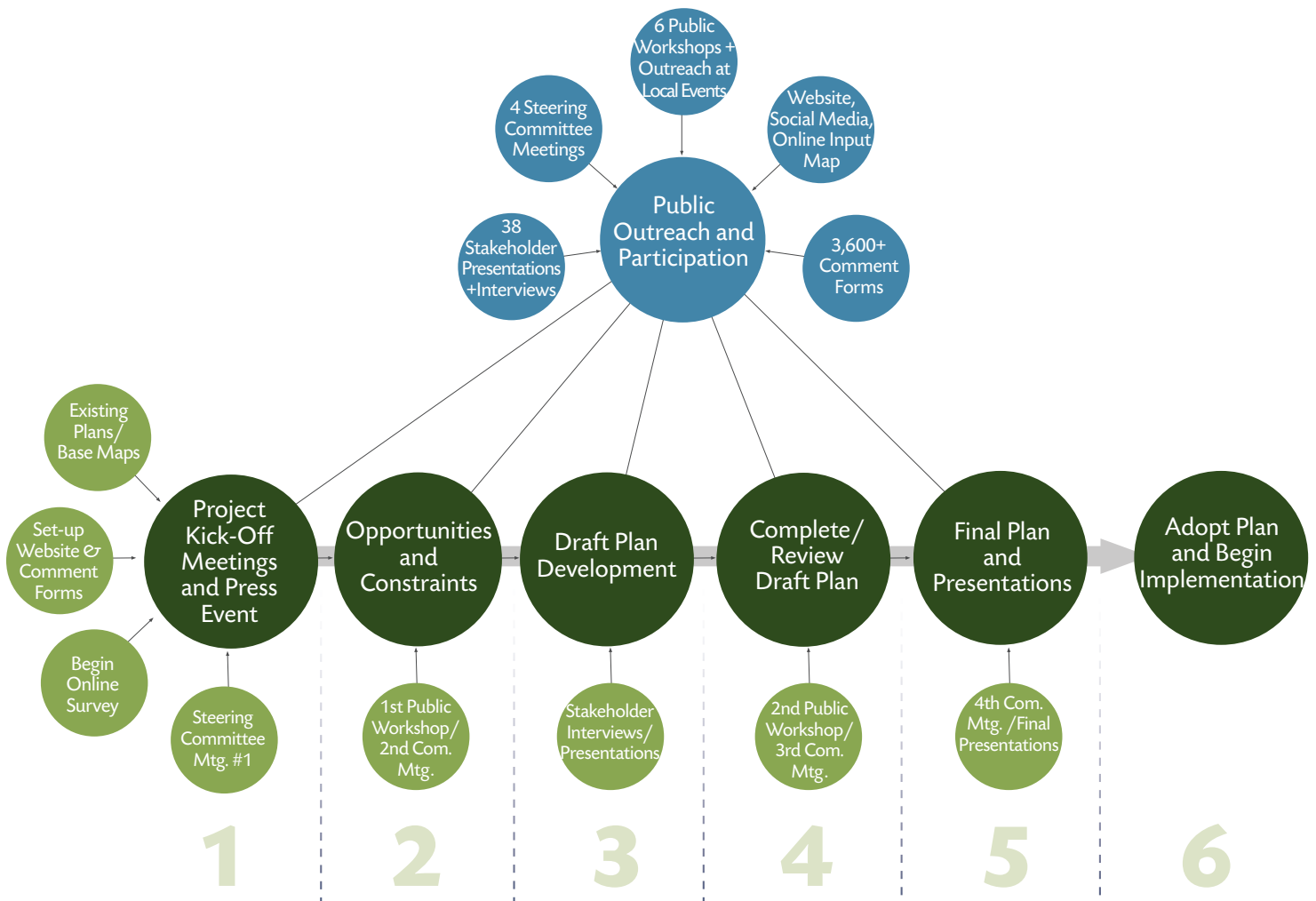
THE PLANNING PROCESS

PROJECT KICK-OFF

The first project steering committee meeting was in January 2012 to review the scope of work, to share ideas and goals for the plan, and to discuss current conditions. Shortly thereafter, project partners hosted a public kick-off event in February 2012, with members of the press and public in attendance to learn about the plan and hear from speakers including elected officials, local stakeholders, and project consultants.

OPPORTUNITIES AND CONSTRAINTS

In February and March 2012, project consultants began researching existing conditions by drawing upon input received during the kick-off events and public outreach efforts. They accomplished this by analyzing geographic information system (GIS) data, reviewing locally adopted plans, and by reviewing existing conditions throughout the study area in an on-the-ground field review. Please refer to Chapter 2 of this plan for more on this topic.





Clockwise from top left: Mayor Bill Saffo speaking at the Kick-off Event in February 2012; the project Steering Committee discussing opportunities and constraints; and the audience at the Kick-off event, including members of public and the local press.

SPRING + FALL 2012 PUBLIC WORKSHOPS

The planning process included two sets of public workshops to receive feedback and input from the community. Each set included three public workshops around the study area. The first round was on the evenings of April 16, 18, and 19, 2012, and they were held at the Wilmington City Council Chambers, Carolina Beach Town Hall, and Ogden Elementary School, respectively. The second set of workshops were at the same locations, on September 11, 12 and 13, 2012. See **Appendix B** for more information about public outreach used throughout the planning process.

DRAFT PLAN DEVELOPMENT

Public input, stakeholder interviews, committee direction, and the findings of the opportunities and constraints analysis were all used to form the recommendations of the draft plan. A health impact assessment (HIA) was also conducted to inform the plan and planning process. The draft plan was also available online for public comment, and was presented during the September Public Workshops.

FINAL PLAN, PRESENTATIONS AND ADOPTION

This plan was finalized in October 2012. A final report was presented to elected officials and local committees for approval and adoption. A plan brochure that summarizes the plan and key recommendations was also developed as part of the final plan.



Clockwise from top left: Public workshops at Ogden Elementary School, Carolina Beach Town Hall, and the Wilmington City Council Chambers.

PUBLIC INPUT

In addition to the public workshops mentioned above, a communications plan was also launched early in the planning process, including but not limited to: a project website, online and hardcopy public comment forms, an online public input map, Facebook page, stakeholder interviews, and presentations. *Please refer to the appendix for more information about public involvement.*

PROJECT WEBSITE (www.WilmingtonGreenway.com)

The website features information about the plan, schedule, background documents, maps, social media links, a comment form, and a public input map. As of August 2012, the project website had more than **5,100** visits and more than **4,500** unique visitors ('unique visitors' are the number of visitors to a website counted only once).

PUBLIC COMMENT FORM

The public comment form sought input to build a better understanding of needs and priorities for this plan. It covered current bicycle and pedestrian travel behavior and preferences, and asked what factors discourage and encourage people to use trails and greenways. There were more than **3,600** comment forms collected, with about a third filled-out online, with the remaining filled out in person by mail and during local events, presentations and workshops.



The Executive Committee developed brochures, flyers and other marketing materials to provide information to the public. These materials include the slogan "Move. Play. Connect." to market the greenway plan.

PUBLIC PRESENTATIONS, INTERVIEWS, AND EVENTS

The following community organizations and public agencies provided input and learned about the plan during special presentations and interview sessions:

1. Bicycle and Pedestrian Advisory Committee (BPAC) (WMPO)
2. Cape Fear Audubon Society
3. Cape Fear Center For Inquiry
4. Cape Fear Community College (CFCC)
5. Cape Fear Cyclists
6. Cape Fear Economic Development Council
7. Cape Fear Futures
8. Cape Fear Green Building Alliance
9. Cape Fear Group of the Sierra Club
10. Cape Fear Public Utility Authority (CFPUA)
11. Cape Fear River Watch
12. Town of Carolina Beach
13. Chamber of Commerce Infrastructure Committee
14. Citizen Advisory Committee (CAC) (WMPO)
15. Corning Incorporated
16. Downtown Rotary Club
17. Eagles Island Coalition
18. Friends School of Wilmington
19. GE
20. Town of Kure Beach
21. North Carolina Department of Transportation (NCDOT)
22. New Hanover County Schools
23. New Hanover County Planning Staff
24. New Hanover County Parks Staff
25. New Hanover Regional Medical Center
26. Obesity Prevention Committee
27. Pharmaceutical Product Development (PPD)
28. Progress Energy
29. Residents of Old Wilmington, Inc.
30. St. Mary School
31. St. Marks School
32. Technical Coordinating Committee (TCC) (WMPO)
33. Tourism Development Authority
34. Transportation Advisory Committee (TAC) (WMPO)
35. University of North Carolina Wilmington (UNCW)
36. Wave Transit
37. Wilmington Area Hospitality Association
38. Wilmington Civitan Club
39. Wilmington Christian Academy
40. Wilmington Health Associates and Hospital
41. Wilmington Housing Authority
42. Wilmington Downtown, Inc.
43. Wilmington Film Commission
44. Wilmington Parks Advisory Committee
45. Wilmington Parks Staff
46. Wilmington Planning Staff
47. Wrightsville Beach Parks Staff
48. Wrightsville Beach Board of Aldermen

In addition to the above presentations and interviews, input was also gathered at **28 local events** throughout 2012.



Left: Virginia Weir, a volunteer, begins to ask patrons of the Farmers' Market to complete the Wilmington Greenway survey.
Right: River to Sea 2012, one of dozens of local events where public input was gathered.





Chapter Contents:

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Photographic Summary
of Existing Conditions

Existing Conditions Maps

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and Greenway
Organizations and
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and Greenway
Programs and ProjectsPublic Comments
on Existing ConditionsStakeholder
Comments
on Existing ConditionsExisting Conditions
Conclusions

EXISTING CONDITIONS

OVERVIEW

Wilmington, Wrightsville Beach, Carolina Beach, Kure Beach and New Hanover County have made significant progress in recent years in their efforts to create more livable communities. The planning, development and management of greenways and other improvements for bicycling and walking have played a key role in such efforts.

This region has much to offer its residents and visitors in terms of trails and greenways as they relate to active transportation, recreation and connections to the outdoors. To-date there are:

- over 30 miles of existing trails (mostly within parks),
- almost 50 miles of on-road bicycle facilities,
- at least 650 miles of sidewalk, and
- extensive waterways suitable for kayaking and canoeing.



Some existing facilities include trails like the Gary Shell Cross City Trail (left) ...



...and public canoe/kayak launches (right).

As an added bonus, there are also well-established, high-quality destinations and attractions throughout area that have the potential to be connected by this non-motorized infrastructure. Perhaps most importantly, this region features an indispensable component of a successful greenway system: *people who want to make it happen*. A supportive network of community groups, business leaders, elected officials and local government departments is needed to ensure trails are promoted, funded, built and maintained to provide safe connections to desired destinations. This chapter highlights the public support for greenways from more than 3,600 responses to this plan's public comment form.

There are also many opportunities for improvement and some key constraints to trail development that are important to consider. The purpose of this chapter is to outline such opportunities and constraints in a way that informs this plan's recommendations and implementation.

Opposite page: Example of a typical paved multi-use trail.

PHOTOGRAPHIC SUMMARY OF EXISTING CONDITIONS

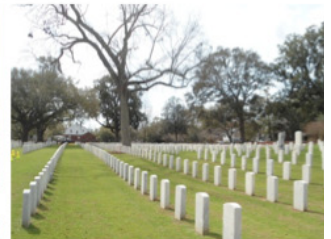
EXCELLENT, HIGH QUALITY OPPORTUNITIES FOR TRAIL DESTINATIONS

Examples include beaches and marinas, historic Downtown Wilmington, shopping centers, Cape Fear Community College, UNC Wilmington, and parks such as Halyburton Memorial Park.



PARKS, BEACHES, AND EXISTING TRAILS ARE DESIRED TRAIL DESTINATIONS

See public comment form results for more on the topic of desired trail destinations.



EXISTING TRAILS

Most existing trails are of high quality and are located along roadways or in parks. Some are too narrow to function for multi-use.



EXISTING BICYCLE ROUTES

Existing bicycle routes vary in quality and consistency. Examples: River Road, 421 /Fort Fisher Rd, and the River to the Sea Bikeway.



EXISTING CONDITIONS MAPS

The series of maps on the following pages tell the story of where we stand today in terms of existing conditions for land- and water-based trails. The maps are annotated with the key points relevant to each map, and a brief description of each map is provided below. Data sources for these maps include NCDOT, the City of Wilmington, New Hanover County, and the U.S. Census Bureau.

MAP 2.1 AREA OVERVIEW Features municipalities, major roadways (with major road names), parks (with park names), publicly-owned land, and undeveloped areas throughout the county.

MAP 2.2 DESTINATIONS Features key centers of activity, points of interest, commercial business areas, major employers, schools, and some popular areas for walking and biking.

MAP 2.3 EXISTING FACILITIES Features existing sidewalks, on-road bicycle facilities, and existing trails, such as the Gary Shell Cross-City Trail, the Military Cutoff Road sidepath, and trails with parks.

MAP 2.4 TRAIL SERVICE AREAS Features existing trails with quarter-mile and one-mile buffers. Areas of higher population density that are outside of these buffers indicate under-served areas for trails.

MAP 2.5 SAFETY CHALLENGES Drawing upon NCDOT crash data involving bicyclists and pedestrians, this map shows the resulting fatalities and higher crash intersections from 2000-2012.

MAP 2.6 EXISTING BLUEWAYS Features floatable waterways, existing boat launch sites for motorized and non-motorized boats, and the amounts of public frontage along floatable waterways.

MAP 2.7 NATURAL FEATURES Features wetlands and managed pinelands, which are often ideal for conservation purposes. However, wetlands also constrain trail development, requiring boardwalk and trail bridges.

MAP 2.8 CENSUS ANALYSIS Cross-references U.S. Census data for areas with lower median incomes, higher percentages of people bicycling or walking to work, and lower vehicle ownership, indicating a greater need for trails.

MAP 2.9 ONLINE INPUT MAP Features a summary of public comments collected from this plan's interactive online map. This represents only one of many forms of public input collected.

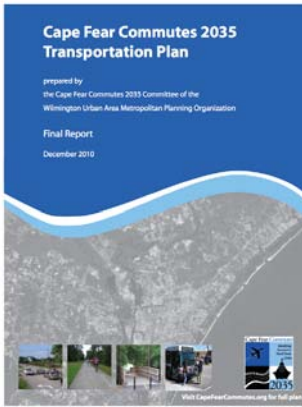
MAP 2.10 PREVIOUS PLANS Highlights key points that are relevant to trail planning from previous plans. These plans are also listed and summarized at the end of this chapter.

MAP 2.11 STAKEHOLDER INPUT MAP Displays some highlights from comments collected during stakeholder interviews that took place in early 2012.

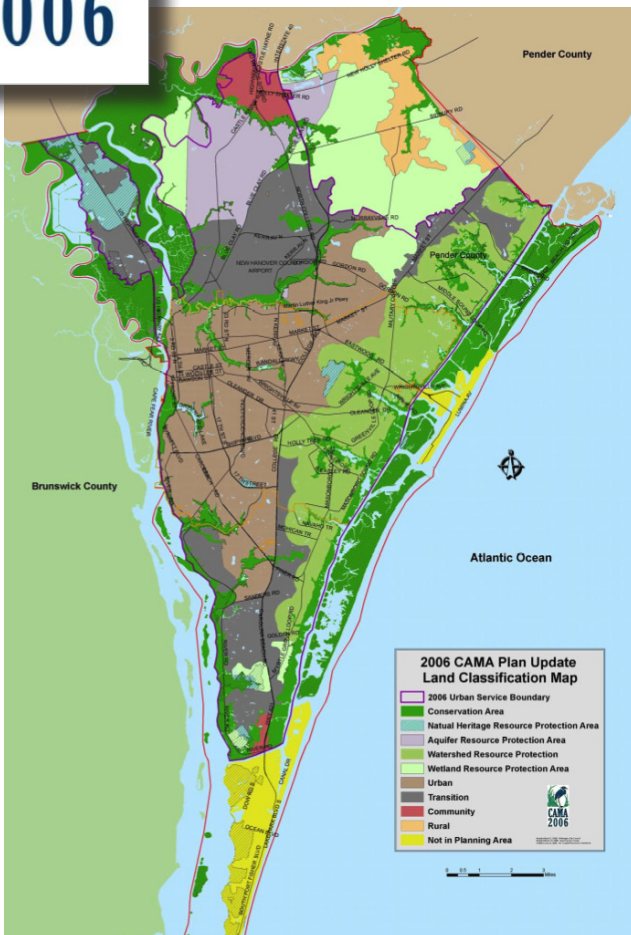
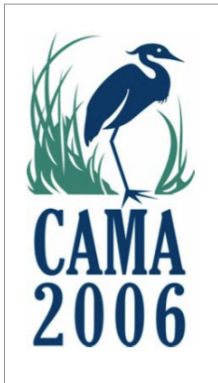
MAP 2.12 HEALTH IMPACT ASSESSMENT (HIA) MAP Features key information related to the HIA that was conducted as part of this planning process. See Appendix A: Health Impact Assessment for details.

**INSERT CHAPTER 2
11X17 MAPS**

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for 11x17 map layout*



Cover of the Cape Fear Commutes 2035 Transportation Plan.



EXISTING PLANS RELATED TO BICYCLE, PEDESTRIAN AND GREENWAY DEVELOPMENT

Numerous plans, guidelines, and strategies have addressed topics related to trails and greenways in Wilmington and New Hanover County. They have addressed improvements to existing parks and facilities, and have made suggestions for new parks, trails, and other facilities. All of these documents represent important efforts, provide valuable insight and background, and have influenced the development of this plan.

The following plans are reviewed and summarized below only as they relate to existing conditions and future needs for trails and greenways. For further information, please consult the reviewed document in its entirety.

CAPE FEAR COMMUTES 2035 TRANSPORTATION PLAN (2010)

The Cape Fear Commutes 2035 Transportation Plan is the long-range transportation plan for the WMPO. The plan establishes the goals and objectives for the improvement of travel conditions within the WMPO planning area and makes specific recommendations for transportation projects and funding sources. No greenway recommendations are specifically called out.

Recommendations related to greenway planning:

- Appendix 4: Bicycle Recommendations (pages 3-5; pages 11-24)
- Appendix 7: Pedestrian Recommendations (page 9; pages 25-36)

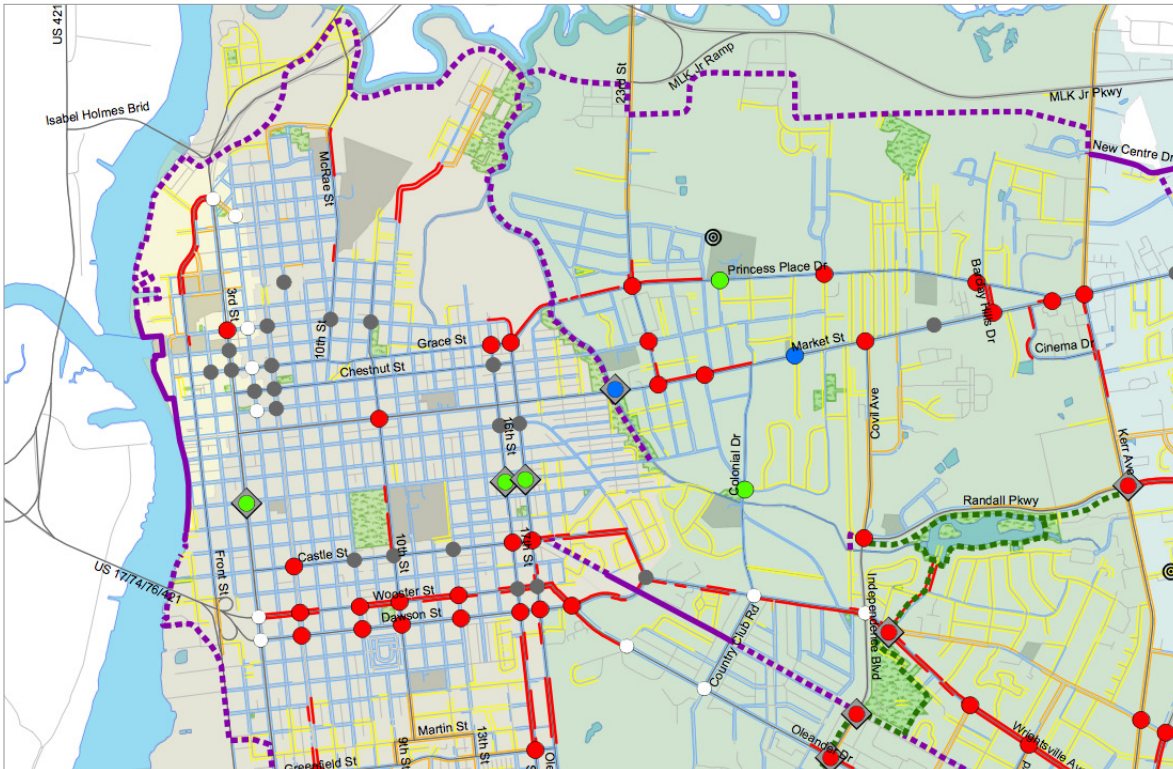
COASTAL AREA MANAGEMENT PLAN WILMINGTON – NEW HANOVER COUNTY (2006 UPDATE)

The primary focus of the Plan is the protection and appropriate development of coastal areas of environmental concern on a countywide perspective. The CAMA is a land use plan that provides for the protection, preservation, orderly development, and management of the coastal area of North Carolina.

Recommendations related to greenway planning:

- Issues, Policies, Implementation Strategies: Section A – Natural Resources, Issue #2 Open Space, Policies 2.1, 2.2, 2.4, 2.5, 6.8, 6.9, 13.1, 13.3, 13.4, 13.5 (Various Pages 14 -46)

Left: The 2006 CAMA Land Classification Map identifies conservation areas in dark green.



Left: Sample portion of the Wilmington's Pedestrian Plan recommendations, featuring proposed multi-use trails in dashed purple lines (see maps starting on page 156 of that plan for the full study area).

WALK WILMINGTON: A COMPREHENSIVE PEDESTRIAN PLAN (2009)

The primary focus of the Walk Wilmington is to address challenges that pedestrians face, such as access, connectivity and safety. It strives to improve pedestrian conditions on all roads, including large commercial arterial roads, through specific sidewalk, trail and road crossing recommendations, policy recommendations and changes to the way streets and intersections are designed and built.

Recommendations related to greenway planning:

- Full Plan Document: Chapter 6 "Pedestrian Facility Recommendations" (Page 144)
- Full Plan Document: Chapter 6 "Pedestrian Facility Recommendations" "Recommended Sidewalk and Pedestrian Signal Improvements" Map (Pages 156 – 160)

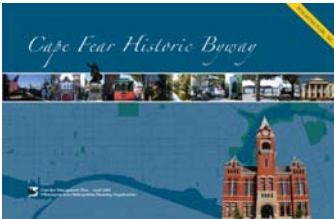
CITY OF WILMINGTON PARKS AND RECREATION MASTER PLAN (2011-2015)

The purpose of the Plan is to assess the current state of affairs regarding the provision of community parks, recreation and open space services, stimulate an open public discussion of future needs for community parks, recreation and open space programs, services, areas and facilities, and establish a plan of action for the future growth and development of community parks, recreation and open space services.

Recommendations related to greenway planning:

- Chapter 7 "Master Plan Proposals and Recommendations" Section 1: Land Acquisition #3 (Pages 105-106)
- Chapter 7 "Master Plan Proposals and Recommendations" Section 1: Land Acquisition #6 (Page 107)

- Chapter 7 “Master Plan Proposals and Recommendations” Section 2: Area and Facility Development #2 (Page 109)
- Chapter 7 “Master Plan Proposals and Recommendations” Section 2: Area and Facility Development #4 (Page 109)
- Chapter 7 “Master Plan Proposals and Recommendations” Section 4: Policy and Procedure Considerations “Closing & Redesign of a Portion of Water Street” (Page 117)
- Project Recommendation Tables (Pages 125 - 126)

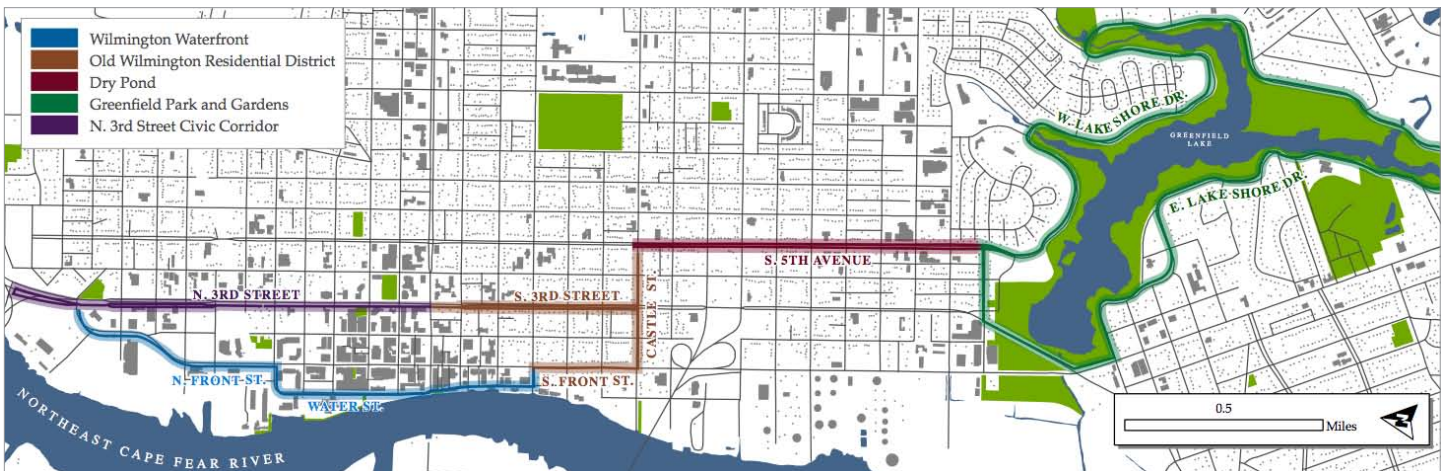


CAPE FEAR HISTORIC BYWAY CORRIDOR MANAGEMENT PLAN (2008)

The purpose of the Corridor Management Plan is to highlight the qualities of the byway related to scenic beauty, nature, history, culture, archaeology, and recreation. Opportunities and constraints for the byway are outlined; those factors are used to form the basis for recommended corridor improvements; and guidance is provided for marketing, way-finding, interpretation and funding of the byway and improvement projects.

Recommendations related to greenway planning:

- Chapter 4 “Recommended Corridor Improvements” (Pages 43, 44, 49)
- Chapter 7 (Pages 6 - 7) Table of Prioritized Recommendations



Above: Official Route of the Cape Fear Historic Byway.

BICYCLE FACILITIES STUDY FOR THE BLUE CLAY CORRIDOR (2008)

The purpose of the study is to develop design alternatives for bicycle facilities along the Blue Clay Road Corridor in unincorporated northern New Hanover County.

Recommendations related to greenway planning:

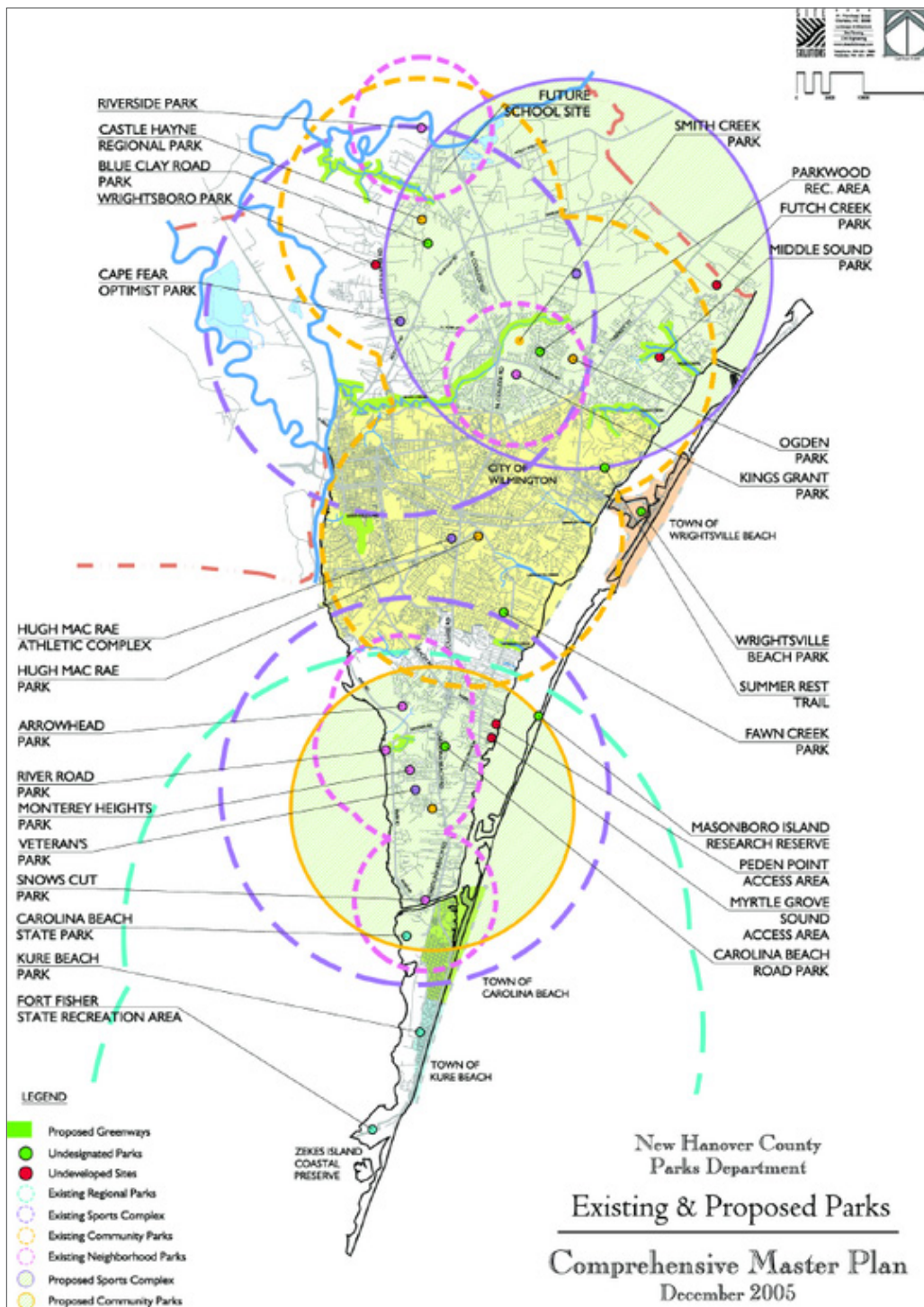
- Chapter 3 “Proposed Alternatives” (Pages 3-11 thru 3-15)
- Chapter 4 “Preferred Alternative” (entire chapter discusses multi-use trails as the preferred project alternative for the corridor)

NEW HANOVER COUNTY MASTER PLAN FOR PARKS, RECREATION, AND OPEN SPACE (2006)

The purpose of this Master Plan is to review recent changes throughout the county, initiate a public discussion on future needs for park and recreation facilities, and establish standards for future park development.

Recommendations related to greenway planning:

- Current and Projected Needs (Page 69)
- Section 4 Proposal and Recommendation (Pages 4-8 thru 4-13)
- Bike Route Network Map (Page 4-14)



Left: The Existing and Proposed Parks Map from the County's 2006 plan, featuring proposed greenways in bright green.

JOINT SAFE ROUTES TO SCHOOL (SRTS) WORKSHOP FOR BRADLEY CREEK, HOLLY TREE AND PARSLEY ELEMENTARY SCHOOLS (2007)

A simultaneous SRTS workshop was held at Bradley Creek, Holly Tree and Parsley Elementary Schools and attendees were presented with health and safety data and potential education, encouragement, enforcement, engineering and evaluation (5Es) strategies to increase the number of students riding bicycles and walking to school.

Recommendations related to greenway planning:

- Page 5-6 – Bradley Creek Elementary School Recommendations Map
- Page 6 -7 – Holly Tree Elementary School Recommendations (map on page 8)
- Page 9 – Parsley Elementary School Recommendations (maps on page 10-11)

PELICAN DRIVE/SALISBURY STREET BICYCLE PLAN FOR THE TOWN OF WRIGHTSVILLE BEACH (2009)

The purpose of this Plan is to explore options for extending bicycle connectivity along Salisbury Street from the Heide-Trask drawbridge to the existing bike lanes on the northern-most section of North Lumina Avenue.

Recommendations related to greenway planning focus on connections to Wrightsville Beach:

- Option A, Section 1 connections from Cross-City Trail to Heide-Trask drawbridge (Page 8)
- Option B, Section 1 connections from Cross-City Trail to Heide-Trask drawbridge, using 10ft multi-use path (Page 9)
- Page 11-12 are conceptual drawings of multi-use path along Salisbury Street

WILMINGTON MPO TIP*

Enhancement (Call Projects):

- Carolina Beach: Construct an off-road bike/multi-use trail connecting Carolina Beach's Inner City Bikeway Path to Dow Road
- Carolina Beach: Construct multi-use facility (Carolina Beach Avenue, Harper Avenue to Sandpiper Lane and Canal Drive, Seagull Lane to Virginia Avenue)
- Wilmington: Construct multi-use trail (US 74 (Eastwood Road), SR 1409 (Military Cutoff Road) to Cardinal Lane)
- Wilmington: Construct a bike path connecting the River to the Sea Bikeway to the Eastwood Road Path
- Public Transportation Projects
- Cape Fear Public Transportation – Multimodal transportation center – design, land acquisition, construction

CAROLINA BEACH BICYCLE / MULTI-USE TRANSPORTATION PLAN (2011)

The purpose of this Plan is to create a mechanism and instrument that supports the vision statement: "Create a more bicycle multi-use path friendly environment and provide interconnectivity to the various town destinations." This required the need to evaluate current conditions, opportunities, and constraints. Opportunities included linkage nodes, existing bicycle multi-use plans and proposed bicycle multi-use plans, i.e. integrate the Dow Road Corridor Study and Island Greenway, respectively.

Recommendations related to greenway planning:

- Section 4 “Strategic Bicycle Plan” Town of Carolina Beach Bicycle/Multi-use Trail: Overall Projects Priority Table (Page 93)
- Section 4 “Strategic Bicycle Plan” Town of Carolina Beach Bicycle/Multi-use Trail: Description of Overall Projects Priorities (Pages 95 – 102)
- Recommended Bicycle/Multi-use Network Map (Page 103 & 109)
- Recommended Bicycle/Multi-use Network Map (saved in same folder on TP2)

CITY OF WILMINGTON VISION 2020 PLAN (2011)

The purpose of this Plan is to focus on implementation and reclaiming the waterfront as the urban foundation for *downtown Wilmington’s character and identity*.

Recommendations related to greenway planning:

- Chapter 3 “The Waterfront Downtown Plan” Map (Page 29)
- Chapter 4 “Strategy 1” page 33

GARY SHELL CROSS-CITY TRAIL MASTER PLAN (2012)

The Gary Shell Cross-City Trail (GSCCT) is primarily an off-road, 15-mile multi-use trail which will provide bicycle and pedestrian access to numerous recreational, cultural and educational destinations in Wilmington.



Left: Route of the GSCCT (north orientation is to the left).

SEAGATE NEIGHBORHOOD PLAN (2007)

The purpose of this Plan is to provide a blueprint that will help the community evolve in a way that residents desire. Sidewalks and bike paths were key parts of infrastructure improvements desired.

Recommendations related to greenway planning:

- Page 8 – Sidewalks needed but limited right-of-way and space. Sidewalks could potentially be accommodated along portions of Hinton, Park, and Bagley Avenues.
- Page 14 – Extend the existing bikepath along Park Avenue, including the Bradley Creek crossing; Encourage dedication of land along Bradley Creek (currently private) for public access to the water, including active and passive recreation areas.
- Page 16 – Protect Bradley Creek by minimizing water quality dedication and protecting wetlands.

SOUTHSIDE SMALL AREA PLAN (2009)

The purpose of this Plan is to identify specific long-term goals aimed at improving the quality of life, building social capital, building a sense of place, etc.

Recommendations related to greenway planning:

- Page 39 (Plan Elements.pdf) – Install a greenway connection between the southern end of the Riverwalk and Greenfield Lake Trail via S. Front Street, Nesbitt Court, and S. 5th Avenue.

US 17 BUSINESS CORRIDOR STUDY (3RD STREET TO COVIL AVENUE), WILMINGTON, NC (2007)

This Plan's preferred alternative for this corridor is to reduce Market Street from four lanes of traffic down to one lane in either direction with a landscaped median, bike lanes, and limited on-street parking.

Recommendations related to greenway planning:

- Appendix A (maps/drawings)

CASTLE HAYNE COMMUNITY PLAN (2008)

This Plan was developed to help guide long term growth of Castle Hayne with significant public involvement. Residents supported the addition of bicycle and pedestrian facilities and connectivity.

Recommendations related to greenway planning:

- Encourage water access through canoe/kayak trails on the Cape Fear River and Prince George Creek
- Castle Hayne Commercial corridor – link the corridor and residential destination points with a network of sidewalks and bike paths
- Blue Clay Road Bike Facilities Study – Work with MPO, NCDOT to implement the recommendations from this Plan

MARKET STREET CORRIDOR STUDY

The purpose of this Plan is to integrate transportation and land use planning in an effort to improve safety and mobility along the Market Street corridor from Colonial Drive to the Pender County line.

Recommendations related to greenway planning:

- Integrate pedestrian and bicyclist amenities along Market Street during construction of the proposed median treatment.
- Provide an alternate network of pedestrian and cyclist amenities through neighborhoods and collector streets.

DOW ROAD CORRIDOR PLAN

The purpose of this Plan is to evaluate alternative scenarios for Dow Road from its northern terminus at US 421 (Lake Park Boulevard) to K Avenue in Kure Beach and the feasibility and impacts of extending Dow Road from K Avenue south to Fort Fisher.

Recommendations related to greenway planning:

- This plan recommends bike lanes along Dow Road and K Avenue, width and pavement markings shall follow AASHTO Guidelines for the Development of Bicycle Facilities.
- The plan recommends that a 10 foot wide multi-use path be constructed along the west side of Dow Road from the Carolina Beach State Park to approximately 1.0 mile south of Ocean Boulevard then transition to the east side of Dow Road to K Avenue. The proposed bicycle lanes and 5 foot grass buffer provide sufficient buffer distance for pedestrians utilizing the proposed path. Bike lanes and multi-use paths will strengthen linkages and connect destinations within Carolina Beach and Kure Beach.

RIVER ROAD SMALL AREA PLAN

The purpose of this Plan is to identify the future transportation improvements required to serve the fast-growing area of southern New Hanover County bounded by Independence Boulevard, Carolina Beach Road, Sanders Road and the Cape Fear River.

Recommendations related to greenway planning:

- The plan highlights existing conditions including neighborhoods, schools, parks, and community facilities within the study area. The Plan recommends future planning efforts work to better connect these key features through sidewalk improvements and a proposed greenway corridor along River Road and connecting areas.
- Opportunities for greenways along the Cape Fear River and the two tributary creeks should be identified and considered as development occurs.

WRIGHTSVILLE AVENUE CORRIDOR STUDY

The purpose of this Plan update is to guide future development, help foster a sustainable pattern of development, and assist in the prioritization of capital investment within the Wrightsville Avenue Corridor. Plan Objective: Improve the effectiveness of alternative modes of transportation including bicycle, pedestrian, and public transit.

Recommendations related to greenway planning:

- Include pedestrian and bicycle facilities as a component of all transportation related capital projects and programs when feasible.
- Construct sidewalks throughout the corridor in accordance with Walk Wilmington: A Comprehensive Pedestrian Plan.
- Implements bicycle and pedestrian improvements along the corridor in accordance with the Recommended Transportation Improvements Map.
- Continue to improve the River to the Sea Bikeway and Cross City Trail bicycle and pedestrian facilities.
- Install wayfinding signage along Wrightsville Avenue to direct bicyclists and pedestrians to the River to the Sea Bikeway and Cross City Trail.

WRIGHTSVILLE SOUND SMALL AREA PLAN

The purpose of this Plan is to identify the vision for the future of the Wrightsville Sound community and present developed goals, objectives and strategies on how to achieve that vision. This plan conveys the community's preferred development pattern and desired public improvements for the area.

Recommendations related to greenway planning:

The need for Bicycle and Pedestrian facilities was identified as one of the 11 major issues for the area. As such, a primary goal for the plan is to provide safe and viable bicycle and pedestrian facilities throughout the area.

In order to accomplish this goal the following strategies were presented:

- Provide signalized pedestrian crossings and high-visibility crosswalks at all major intersections.
- Evaluate potential for sidewalks and/or a bike path along Airlie Road. Minimize tree disturbance with any future bicycle and/or pedestrian improvements.
- Support the completion of the Gary Shell Cross City Trail.
- Construct sidewalks throughout the area in accordance with Walk Wilmington: A Comprehensive Pedestrian Plan.
- Provide bicycle and pedestrian connections between existing residential and commercial areas.
- Provide a bicycle and pedestrian connection between the Gary Shell Cross City Trail and Airlie Gardens.
- Support efforts to improve the safety and function of bicycle and pedestrian access to Wrightsville Beach.
- Support the construction of a public walkway/pier underneath the Heidi Trask Drawbridge to provide a safe alternative for cyclists and pedestrians wishing to cross Wrightsville Avenue.

- Explore the potential to acquire additional right-of-way, while protecting existing trees, along Airlie Road for bicycle and pedestrian improvements.
- Implement bicycle and pedestrian improvements in accordance with the
- Recommended Transportation Improvements Map.

WRIGHTSVILLE BEACH PARKS, RECREATION AND OPEN SPACE MASTER PLAN (2007 – 2012)

This plan makes recommendations for bicycle and pedestrian facilities and water access. The town is currently in the process of updating this plan. The purpose is to assess the current state of affairs regarding the provision of community parks, recreation and open space services, stimulate an open public discussion of future needs for community parks, recreation and open space programs, services, areas and facilities, and establish a plan of action responding to the findings.

Recommendations related to greenway planning:

- The need and recommendation for the planning and initial development of a system of non-vehicular, pedestrian and bicycle transportation network connecting public areas. This network would include sidewalks, biking paths, walking trails, greenways and other non-vehicular corridors. This need was identified repeatedly during the needs assessment process by advisory board members, the public and staff members.
- Related to blueway development, the Town also identified the need to develop facilities for additional public beach and coastal waterfront access, particularly access to the creeks, Atlantic Intracoastal Waterway (AIWW), and sound areas surrounding Wrightsville Beach. Additional public beach and coastal waterfront access facilities are desirable, especially those accommodating small, motorized boats, canoes, kayaks and other recreational vehicles and uses. These public beach and coastal waterfront access sites should include boat ramps, fishing piers and observation decks, and provide little more than limited parking and restroom facilities if at all. Strong consideration should be given to developing access facilities that allow for progressive and continual ingress and egress of users along Banks Channel, Motts Channel, Lee's Cut and the AIWW.

CURRENT BICYCLE, PEDESTRIAN AND GREENWAY ORGANIZATIONS AND RESOURCES

The organizations and resources listed below represent the current core capacity for managing greenway and trail related programs in Wilmington and New Hanover County. For more details on these organizations, including descriptions of their current levels of involvement and web site addresses, please refer to **Appendix C: Program Resources**.

STATE ORGANIZATIONS AND RESOURCES

- North Carolina Department of Transportation (NCDOT)
- Carolina Youth Mountain Bike League
- Eat Smart Move More NC
- North Carolina Paddle Trails Association
- North Carolina Blueways

REGIONAL ORGANIZATIONS AND RESOURCES

- Wilmington Cape Fear Coast, NC
- Wilmington Urban Area Metropolitan Planning Organization (MPO)
- Cape Fear Paddlers Association

LOCAL ORGANIZATIONS AND RESOURCES

- City of Wilmington, New Hanover County, Town of Wrightsville Beach, Town of Carolina Beach, and Town of Kure Beach
- Wilmington, NC Roadrunners
- Cape Fear Cyclists
- Cape Fear SORBA
- Sir Bikes-a-Lot
- LiveFit Cape Fear
- Cape Fear Riverwatch



BICYCLE, PEDESTRIAN AND GREENWAY PROGRAMS AND PROJECTS

Listed below are the most well-known programs available in Wilmington and New Hanover County that relate to bicycling, walking, and trails and greenways. These are either existing today or recently active. For more details on these programs, including descriptions and web site addresses, please refer to **Appendix C: Program Resources**.

REGIONAL PROGRAMS/PROJECTS

- WMPO Bike/Ped Committee
- Gary Shell Cross-City Trail
- See, Share and Be Aware
- Cape Fear Mountain Bike Patrol
- Island Greenway
- River to the Sea Bikeway




LOCAL PROGRAMS/PROJECTS





- Safe Routes to School
- Wilmington Bike Friendly
- Bicycle Friendly University
- Youth Bicycle Rodeos
- Getting Connected





PUBLIC COMMENTS ON EXISTING CONDITIONS

Comment forms for this plan were filled-out by more than 3,600 area residents, visitors, business owners, and other community stakeholders. Although it is not a statistical survey, the comment form still represents the opinions of thousands of local area residents. For more on the public input process, see **Appendix B: Communications + Public Outreach**.






How important to you is the goal of creating more greenways in Wilmington and New Hanover County? Select one.			
		Response Percent	Response Count
Very Important		79.9%	2,872
Somewhat Important		17.0%	612
Not Important		3.1%	111
answered question			3,595
skipped question			36

How often do you use a greenway now? Select one.			
		Response Percent	Response Count
Never		15.3%	549
Few times a year		32.6%	1,172
Few times per month		32.7%	1,175
Several times a week		19.4%	697
answered question			3,593
skipped question			38

Would you use greenways more often if you were closer to them, or if there were more of them?

		Response Percent	Response Count
Yes		95.0%	3,382
No		5.0%	178
answered question			3,560
skipped question			71

What is your preferred greenway/blueway transportation/recreation mode? Select all that apply.

		Response Percent	Response Count
Walking		75.1%	2,647
Biking		77.0%	2,715
Rollerblading		6.2%	217
Canoeing/kayaking		24.1%	851
Wheelchair or other mobility assistance device		2.0%	70
Other (please specify)			281
answered question			3,525
skipped question			106

What do you think are the biggest factors that discourage greenway use? Rank your top 3 choices.

	First Priority	Second Priority	Third Priority	Rating Average	Response Count
Lack of safe connections to greenways	52.2% (1,214)	26.4% (614)	21.4% (499)	1.69	2,327
Lack of information about existing greenways	35.6% (481)	30.7% (415)	33.6% (454)	1.98	1,350
Unsafe street crossings	29.8% (547)	46.0% (845)	24.3% (446)	1.95	1,838
Motor vehicle traffic	33.5% (593)	32.9% (581)	33.6% (594)	2.00	1,768
Lack of interest	33.6% (134)	35.6% (142)	30.8% (123)	1.97	399
Lack of time	25.5% (110)	39.6% (171)	35.0% (151)	2.09	432
Lack of nearby destinations	21.0% (186)	33.6% (297)	45.4% (401)	2.24	884
Personal safety concerns	21.9% (194)	25.1% (222)	52.9% (468)	2.31	884
answered question					3,464
skipped question					167

For full comment form results, see **Appendix B: Communications + Public Outreach.**

STAKEHOLDER PRESENTATIONS AND INVOLVEMENT

The following community organizations and public agencies provided input and learned about the plan during special presentations and interview sessions:

- | | |
|--|--|
| 1. Bicycle and Pedestrian Advisory Committee (BPAC) (WMPO) | 25. New Hanover Regional Medical Center |
| 2. Cape Fear Audubon Society | 26. Obesity Prevention Committee |
| 3. Cape Fear Center For Inquiry | 27. Pharmaceutical Product Development (PPD) |
| 4. Cape Fear Community College (CFCC) | 28. Progress Energy |
| 5. Cape Fear Cyclists | 29. Residents of Old Wilmington, Inc. |
| 6. Cape Fear Economic Development Council | 30. St. Mary School |
| 7. Cape Fear Futures | 31. St. Marks School |
| 8. Cape Fear Green Building Alliance | 32. Technical Coordinating Committee (TCC) (WMPO) |
| 9. Cape Fear Group of the Sierra Club | 33. Tourism Development Authority |
| 10. Cape Fear Public Utility Authority (CFPUA) | 34. Transportation Advisory Committee (TAC) (WMPO) |
| 11. Cape Fear River Watch | 35. University of North Carolina Wilmington (UNCW) |
| 12. Town of Carolina Beach | 36. Wave Transit |
| 13. Chamber of Commerce Infrastructure Committee | 37. Wilmington Area Hospitality Association |
| 14. Citizen Advisory Committee (CAC) (WMPO) | 38. Wilmington Civitan Club |
| 15. Corning Incorporated | 39. Wilmington Christian Academy |
| 16. Downtown Rotary Club | 40. Wilmington Health Associates and Hospital |
| 17. Eagles Island Coalition | 41. Wilmington Housing Authority |
| 18. Friends School of Wilmington | 42. Wilmington Downtown, Inc. |
| 19. GE | 43. Wilmington Film Commission |
| 20. Town of Kure Beach | 44. Wilmington Parks Advisory Committee |
| 21. North Carolina Department of Transportation (NCDOT) | 45. Wilmington Parks Staff |
| 22. New Hanover County Schools | 46. Wilmington Planning Staff |
| 23. New Hanover County Planning Staff | 47. Wrightsville Beach Parks Staff |
| 24. New Hanover County Parks Staff | 48. Wrightsville Beach Board of Aldermen |

TOP CORRIDORS NOTED BY STAKEHOLDERS FOR NEW TRAILS AND/OR IMPROVED CONNECTIVITY FOR BICYCLING AND WALKING

(listed alphabetically - not in order of priority)

- | | |
|---------------------|----------------------------------|
| • Carolina Beach Rd | • Middle Sound Loop Rd |
| • College Rd | • Military Cutoff Rd |
| • Dow Rd | • Ogden Park To Smith Creek Park |
| • Independence Blvd | • River Rd |
| • Market St | • Smith Creek |

EXISTING CONDITIONS CONCLUSIONS

In summary, while much progress has been made for trails in Wilmington and New Hanover County, there is also room for improvement. The table below summarizes the key findings of this chapter.

OVERALL STUDY AREA New Hanover County holds over 200,000 residents, over 80,000 employees, and attracts thousands of tourists every year. According to the “Economic Impact of Travel on North Carolina Counties” report, in the year 2011, the economic impact from domestic travel in New Hanover County was estimated at \$425.84 million. New Hanover ranks as number 9 among North Carolina’s 100 counties in tourism expenditures. Historic downtown Wilmington, beaches throughout the county, and the UNC Wilmington and Cape Fear Community College campuses are significant activity centers with potential for increasing bicycle and pedestrian activity, and could be enhanced with new trail connections. While the area’s coastal location is the source of many recreational opportunities and destinations, its extensive waterways and wetlands also impose environmental constraints on trail development. The area is also largely built-out, leaving limited right-of-way for new trail development.

BICYCLE, PEDESTRIAN, AND TRAIL INFRASTRUCTURE

New Hanover County currently contains over 30 miles of trails (mostly in parks), almost 50 miles of on-road bicycle facilities, 650 miles of sidewalk, and extensive waterways suitable for kayaking and canoeing. The quality of this infrastructure is variable. While Wilmington’s Gary Shell Cross-City Trail is a high quality, multi-use facility connecting many parks and destinations in the area, other trail segments are too narrow to function for multi-use. Existing on-road bicycle facilities also vary in quality and consistency, with gaps in the middle of some sections and a lack of system-wide connectivity.

BICYCLIST AND PEDESTRIAN SAFETY While the facilities described above are effectively creating space for cyclists and pedestrians in many parts of the County, challenges remain. Major roadways, such as Oleander Drive, can act as blockades to bicycle and pedestrian travel because of their heavy traffic volumes and lack of crossing facilities. Crossing improvements are currently funded in many locations to address this issue. Crashes on many of the major roads throughout the area, however, indicate that a broader system of off-road trails and neighborhood connections will be required to truly provide a safe space for all types of cyclists and pedestrians.

BICYCLE, PEDESTRIAN, AND TRAIL POLICIES While municipalities in the region have allocated resources to infrastructure and planning, several policies do not currently support trail implementation. Development regulations and subdivision ordinances, for example, do not currently require trail upgrades and improvements consistent with local plans during development. In addition, easement policies do not allow trails as-of-right, but instead require landowner approval. Trail maintenance policies will also be important to ensure trails are kept in the best condition possible.

BICYCLE, PEDESTRIAN, AND TRAIL PROGRAMS There are many programs and groups supportive of bicycle and pedestrian activity and greenway and blueway development in the region. Advocacy groups such as the Cape Fear Paddlers Association, Cape Fear Riverwatch, and Cape Fear Cyclists are active in programs such as river clean-up outings and “Wilmington Bike Friendly”, Wilmington’s Bicycle Friendly Community campaign. Municipalities support programs such as Safe Routes to School and Youth Bicycle Rodeos. Joint efforts have included the “See, Share, Be Aware” campaign, which promotes roadway safety, and the annual River to the Sea Bike Ride.

PREVIOUS PLANS Trail recommendations have been included in many planning efforts throughout the County. The Wilmington Area MPO’s 2035 Long Range Transportation Plan, the Walk Wilmington Pedestrian Plan, and local plans for Carolina Beach and Wrightsville Beach have all made recommendations for trail facilities. Detailed planning has been completed for specific facilities such as the Cross-City Trail and River to the Sea Bikeway. Several corridor studies and small area plans have also considered bicycle and pedestrian facilities, such as the Southside Small Area Plan, the Seagate Neighborhood Plan, and the Bicycle Facilities Study for the Blue Clay Corridor.

PUBLIC FEEDBACK Extensive public feedback was sought and provided on the goals and preferences for the greenway and blueway system. More than 3,600 people filled-out comment forms and more than 4,500 people visited the project website. Top priorities from the public include trail connections to parks and beaches.

PARTNERSHIPS Some recent progress has been made in private partnerships for greenway development, such as with Blue Cross Blue Shield’s support in development of a section of the Gary Shell Cross City Trail. However, in the bigger picture, the lack of ongoing private partnerships is a major constraint.

3

Chapter Contents:

- Overview
- Methodology for Trail Planning
- Trail Network Components
- Greenways as Ecological Assets
- Trail Network Maps
- Prioritization Process
- Priority Trail Cut-Sheets

RECOMMENDATIONS

OVERVIEW

This chapter covers trail planning methodology, typical trail types, a proposed overall trail network, and project prioritization. The chapter concludes with individual cut-sheets for the top priority projects.

METHODOLOGY FOR TRAIL PLANNING

Project stakeholders, public participants, and planning consultants worked together to develop the recommendations of this plan. The recommendations build upon the analysis of existing conditions and current plans (**Chapter 2**). In order to gather input on potential trail projects and desired outcomes, project staff and consultants also conducted public workshops, collected thousands of public comment forms, and interviewed and presented to dozens of local organizations. The results of this extensive outreach effort are summarized in **Appendix B**. Consultants and local planners then used the various inputs (shown below) to develop the recommendation presented in this chapter.



TRAIL NETWORK COMPONENTS

A variety of trail facilities are recommended due to 1) the range of skill and comfort levels involved in bicycling and walking, and 2) the range of conditions for bicycling and walking in different environments.

The proposed trail network is made up several core types of trails. While greenways are the focus of this Plan, there are some bicycle and pedestrian connections that must be made using on-road facilities, such as bicycle lanes, sidewalks, paved shoulders, signed bicycle routes, shared-lane markings, and improved crossings. Water trails, or 'blueways' as they are sometimes called, are also described below as a featured trail type.

The images and descriptions below are provided for a quick reference when viewing the Proposed Trail Network Maps. Full descriptions and guidelines for each of these are described in **Chapter 5: Design Guidelines**.



Color corresponds to Chapter 3 Maps

MULTI-USE PATHS

Multi-use paths are physically separated from motor vehicle traffic, and can be either within the highway right-of-way or within an independent right-of-way. By definition, they accommodate multiple types of users, most notably, bicyclists and pedestrians and are typically bi-directional. The presence of multi-use paths should not necessarily preclude the provision of parallel on-road bicycle facilities (such as paved shoulders or bicycle lanes). Similarly, a cyclist is not required to use the trail instead of the roadway.



Color corresponds to Chapter 3 Maps

MULTI-USE PATHS ALONG ROADWAYS

Multi-use paths located within the highway right-of-way are also referred to as 'Sidepaths'. Sidepaths provide a comfortable walking space for pedestrians and enables children and recreational bicyclists to ride without the discomfort of riding in a busy street. This configuration works best along roadways with limited driveway crossings and with services primarily located on one side of the roadway, or along a riverfront or other natural feature.



Color corresponds to Chapter 3 Maps

BOARDWALK

Typically, this plan recommends paved asphalt surface for multi-use paths although an alternative type of boardwalk design is required in some areas. Boardwalk or wood surfaces are typically required when crossing wetlands or other poorly drained areas. They are constructed of wooden planks or recycled material planks that form the top layer of the boardwalk. The recycled material has gained popularity in recent years since it lasts much longer than wood, especially in wet conditions. A number of low-impact support systems are also available that reduce the disturbance within wetland areas to the greatest extent possible.

Note: The on-road bicycle recommendations in this plan feature some of the key routes to complement the overall trail network and do not represent all bicycle recommendations for the WMPO jurisdiction. Sidewalks should also be provided as the pedestrian component of these on-road connectors.



Color corresponds to Map 3.2 + Zoom-In Maps

BICYCLE LANES

A bicycle lane is a portion of the roadway that has been designated by striping, signing, and pavement markings for the preferential and exclusive use of bicyclists. The minimum recommended width for a bicycle lane is four feet; five- and six-foot bike lanes are typical for roads with higher speeds or carrying higher levels of traffic. Bicycle lanes can be striped on existing roadways, sometimes with modifications to travel lane widths and configuration.



Color corresponds to Map 3.2 + Zoom-In Maps

PAVED SHOULDER

Paved shoulders are the part of a roadway which is contiguous and on the same level as the regularly traveled portion of the roadway. While there is no minimum width in paved shoulders, a minimum width of four feet is preferred for safe and comfortable bicycling. Ideally, paved shoulders should be included in the construction of new roadways and/or the upgrade of existing roadways, especially where there is a need to more safely accommodate bicycles.



Color corresponds to Map 3.2 + Zoom-In Maps

SIGNED BICYCLE ROUTES AND SHARED-LANE MARKINGS

Signed bicycle routes can be used to connect the overall network in areas with lower traffic speeds and volumes. A more comprehensive wayfinding system is recommended after significant portions of the overall network are complete. Shared-lane markings (a.k.a. Sharrows) are on-street pavement markings that could enhance the signed route locations. With sharrows, motorists more aware of the potential presence of cyclists; they direct cyclists to ride in the proper direction; and they remind cyclists to ride further from parked cars to avoid 'dooring' collisions.

WATER-BASED TRAILS/BLEWAYS

Water based trails, or 'blue ways', provide recreational non-motorized boating opportunities along waterways. North Carolina's coastal plain, comprised of small creeks and rivers, sheltered estuarine waters and open expanses of large rivers and sounds offers a variety of paddling experiences. These diverse waterways provide opportunities for all levels of paddling skills, from beginners to experts. For this plan, a key aspect of blueway recommendations is where to site new non-motorized boat launches.



Symbols correspond to Maps 3.2, 3.3 + Zoom-In Maps



Symbol corresponds to Map 3.4

BIKE/PED CROSSING IMPROVEMENTS

This plan recommends crossing improvements for existing intersections and future trail-roadway crossings. Improvements to existing intersections include high visibility crosswalks, count-down signals, and signage, such as 'No Right on Red When Peds Present'. High visibility crosswalks and signs that alert motorists are also recommended for trail-roadway crossings.

Below are intersection improvements recommended along the **on-road** bicycle network.

13th St + Castle St	Castle Hayne Rd + College Rd
13th St + Dawson St	Castle Hayne Rd + Holly Shelter Rd
13th St + Wooster St	College Rd + New Centre Dr
16th St + Robin Hood Rd	Gordon Rd + Market St
17th St + Robin Hood Rd	Gordon Rd + Netherlands Dr
5th Ave + Dawson St	MacMillan Ave + Pine Grove Dr
5th Ave + Wooster St	Oleander Dr + College Rd
Carolina Beach Rd + Bell St/Medical Center Dr	Oleander Dr + Dogwood Ln
Carolina Beach Rd + George Anderson Dr	Oleander Dr + Wallace Ave
Carolina Beach Rd + Marion Dr/Holbrook Ave	Wrightsville Ave + Wallace Ave
Carolina Beach Rd + Raleigh St/Parkway Blvd	

For intersection and crossing improvements for the recommended **greenway** network, please see **Map 3.4**.

GREENWAYS AS ECOLOGICAL ASSETS

ECOLOGICAL HABITAT, PATCHES AND CORRIDORS

Urban green spaces, including greenways, have a key role to play in the ecological sustainability of urban areas. They are able to provide certain habitat needs that support biodiversity and a range of ecosystem services for a relatively broad range of species. Greenways can supply habitat corridors between habitat patches, and in some cases they can serve as habitat patches in themselves.

The physical geometry of habitat patches and corridors affects their overall quality. Large patches with wide, forested or naturally vegetated corridors provide the best habitat in developed/disturbed areas. Recent research conducted at North Carolina State University (NCSU) has shown that wider, forested greenway widths maximize habitat value for development-sensitive species such as neo-tropical migratory birds and forest interior birds.

Landscape and urban planners can facilitate habitat conservation for development-sensitive birds in greenways by minimizing the width of the trail and any associated mown and landscaped surfaces adjacent to the trail, locating trails near the edge of greenway forest corridors, and giving priority to the protection of greenway corridors at least 100 meters (328 feet) wide, with low levels of impervious surface (pavement, buildings) and bare earth in the adjacent landscape.

ECOLOGICALLY SUSTAINABLE TRAIL DESIGN

Trails are our most important tool for linking conservation, recreation and transportation. As such, they must be developed and maintained in ways that avoid negative impacts to the ecological resources of the area. The following guidance is recommended for developing and maintaining trail systems:

1. Sustainability of natural systems should be prioritized in design and construction of trails.
2. Ecologically Sensitive Areas should be preserved or protected whenever possible.
3. Develop trails in areas already influenced by human activity, including existing infrastructure rights of way
4. Design should avoid or minimize erosion associated both with trail treads and stormwater runoff.
5. Use natural infiltration and best management practices for stormwater management
6. Stewardship of trails is an ongoing responsibility/activity.

If the greenway is to be ADA compliant, then paved surfaces will be required in most areas for access and use. In limited cases, packed gravel fines can be used, where there is little to no slope. However packed surfaces require much more maintenance effort and cost, and may not be desirable. Concrete or asphalt tread surfaces have traditionally been used for multiuse greenways. When properly constructed and maintained on a regular basis, concrete can last 25 years or more. Asphalt is less expensive than concrete. When installed properly on suitable sub-grade, asphalt products typically have a life span less than half that of a concrete trail, averaging approximately 10 years.

Recent advances in pervious pavement (concrete and asphalt) make them reasonable alternatives to their traditional counterparts. Pervious surfaces have advantages and disadvantages, and each must be weighed to determine which surface is appropriate in any given location. Pervious concrete provides a safe, firm, level, nonskid surface. Its ability to maintain this safe surface in all conditions including heavy rain, its durability, and its low maintenance requirements meet most greenway application requirements. Pervious asphalt is similar to standard asphalt. The permeability allows stormwater to infiltrate the asphalt and flow down to the aggregate base below it, promoting stormwater infiltration into the soil. Similar to pervious concrete, pervious asphalt can effectively cleanse and reduce the volume of stormwater runoff, a valuable environmental characteristic. This ability can potentially reduce additional expenditures and land consumption for conventional collection, conveyance, and detention in stormwater infrastructure. Both pervious concrete and asphalt require vacuuming/sweeping maintenance periodically, in order to ensure that the void space remains open, allowing stormwater to flow through it. Three case studies in **Appendix G** discuss the advantages, disadvantages and cost-effectiveness of utilizing pervious paving over conventional paving options. Asphalt's service life span is about half that of concrete, so that the total long-term cost of asphalt vs. concrete is about 70% higher. Based on a simple analysis, over the long term pervious concrete may be the better value than traditional asphalt, and it has important environmental and ecological benefits.

ECOLOGICAL STEWARDSHIP + VEGETATION MANAGEMENT

Greenways are more effective at providing wildlife habitat and corridors when they have trees and shrubs present. In locations where trees and shrubs are lacking and can be planted, native species are the most ecologically sustainable choice. Topography and soil moisture regime largely determine where different plant species occur. The topography of New Hanover County generally can be characterized as an area of sandhills along the western side of the county, a broad terrace in the central portion (with uplands and wetlands), and a series of barrier islands along the eastern coastal edge. There is also a large area of riverine tidal wetlands along the Cape Fear River. A list of example species for the sandhills area and central terrace areas are included in **Appendix G**.

Invasive species are well-established in the project area. They aggressively colonize areas, and force out native species, degrading habitat and aesthetic appearance. Common invasive species include privet (*Ligustrum* sp.), multiflora rose (*Rosa multiflora*). These species cannot be completely eradicated permanently, but they can and should be controlled while trails are being implemented and during long-term maintenance of the greenway trail system.

TRAIL NETWORK MAPS

The following maps are included in the remainder of chapter. These recommendations are at a planning level only and will require further analysis before implementation.

- Map 3.1 Proposed Trail Network
- Map 3.2 Proposed Trail Network with On-Road Connectors and Blueways
- Map 3.3 Proposed Blueway Launch Sites
- Map 3.4 Proposed Trail Network: Intersections Improvements
- Map 3.5 Proposed Trail Network: Short Connections
- Maps 3.6 -3.11 Proposed Trail Network: Zoom-in Maps
- Map 3.12 Proposed Trail Network: Prioritized Segments
- Priority Trail Cut-Sheets

TRAIL NETWORK PRIORITIZATION CRITERIA *(Prioritization Table on page 3-18)*

The prioritization process began by making a list of all the trail recommendations proposed in this plan. The trail segments were broken down at logical points, such as at major destinations and at connections to existing facilities. Weighted criteria were then used to rank each segment. These criteria were custom designed for Wilmington and New Hanover County, based on public input, committee input, and available data (assigned weight in parentheses):

Overall Connectivity and Key Destinations

- Direct Access to/from a Park or Recreation Center (5)
- Direct Access to/from Local Beach Community (5)
- Direct Access to/from an Existing or Funded Trail (4)
- Direct Access to College/University (4)
- Direct Access to/from a Elem., Middle, High School or Library (4)
- Fills gap/connects to existing or funded trail or bikeway on both sides (4)
- Direct Access to/from Major Transit Routes (4)
- Direct Access to/from Downtown Wilmington (3)
- Direct Access to/from Higher Density Residential Areas (3)
- Direct Access to/from Proposed Multi-Modal Center (3)
- Direct Access to Higher Density Employment Areas or Major Employer Centers (3)
- Direct Access to Major Shopping Centers (3)

Equity

- Majority of proposed trail serves areas outside of the existing trail service areas (4)
- Serves Lower Income Areas with Lower Car-Ownership Rates (3)

Safety

- Corridor contains High Number of Bike/Ped Accidents (5)

Public Support

- Proposed trail is also recommended in a previously adopted plan (3)
- Relates to the top 10 recommended trail locations from Online Comment Form (3)
- Relates to the top 10 recommended trail locations from Stakeholder Interviews (3)

Constructability/Ease of Construction

- Significant portion of proposed trail lies within existing public property or easement (5)
- Less than 10% of the proposed trail corridor lies within a wetland area (2)
- Lower relative number of roadway crossings for the proposed trail corridor (2)
- Lower relative number of streams crossings for the proposed trail corridor (2)

While it is ideal to develop bicycle facilities in order of priority, it is best to also consider opportunities as they arise. Some of the most cost-effective opportunities to provide trail facilities are during new roadway construction or reconstruction. Similarly, new commercial and residential developments provide opportunities to build trail facilities as a component of an existing effort, regardless of priority ranking through this process.

PRIORITY TRAIL CUT SHEETS *(starting page 3-21)*

The trail cut sheets at the end of this chapter are provided for anyone who wishes to better understand the priority projects of this plan. The cut sheets are particularly useful for state and local agencies as they begin developing more detailed design work for these projects. They will also help planning and transportation agencies as they explain these projects to various parties, such as local elected officials, potential funding agencies, and interested citizens.

**INSERT CHAPTER 3
11X17 MAPS + PRIORITIZATION TABLE**

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for 11x17 map layout*

CUTSHEET #1: DOWNTOWN TRAIL

This **5.9-mile** trail connects Downtown Wilmington to parks and neighborhoods east of Downtown.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. Downtown Wilmington
 2. Proposed Multi-Modal Center
 3. College/University
 4. An Existing or Funded Trail
 5. An Elem., Middle, High School or Library
 6. Major Transit Routes
 7. Higher Density Residential Areas
 8. Higher Density Employment Areas or Major Employer Centers
 9. A Park or Recreation Center
 10. Major Shopping Area
- Fills gap (connects to existing or funded trail or bikeway on both sides)
- Serves Lower Income Areas with Lower Car-Ownership Rates
- Corridor contains High Number of Bike/Ped Accidents
- Recommended in a previously adopted plan
- Relates to the top 10 recommended trail locations from Stakeholder Interviews
- Less than 10% of the proposed trail corridor lies within a wetland area
- Significant portion of proposed trail lies within existing public property or easement

WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level estimates at \$600K/mile come to **\$3.5M**. Additional costs may apply due to the constraints noted at right.

Riverfront portion to be tied-into and built as part of riverfront development.

Proposed trail in RR corridor is dependent upon compatibility with future passenger rail service

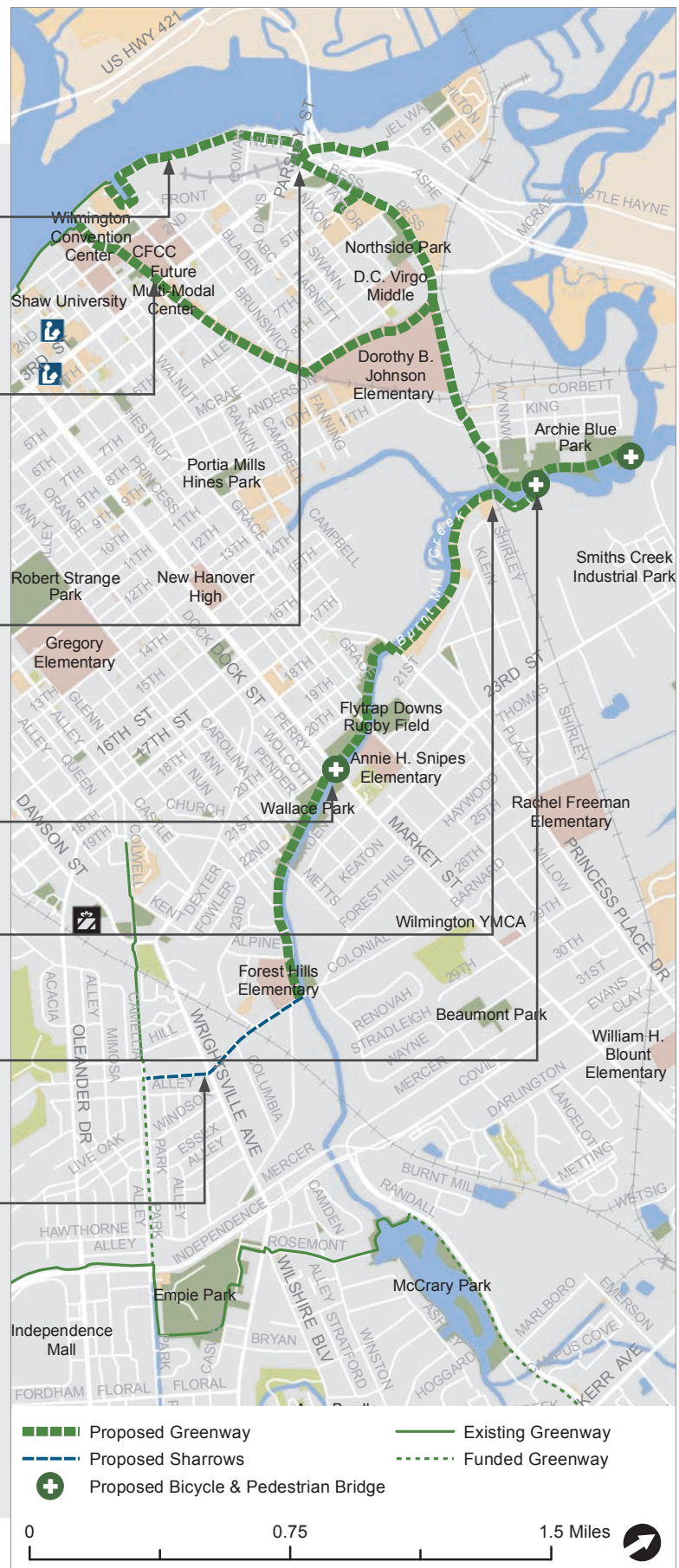
Constraint: Special design needed to attach trail to existing concrete apron under high-way.

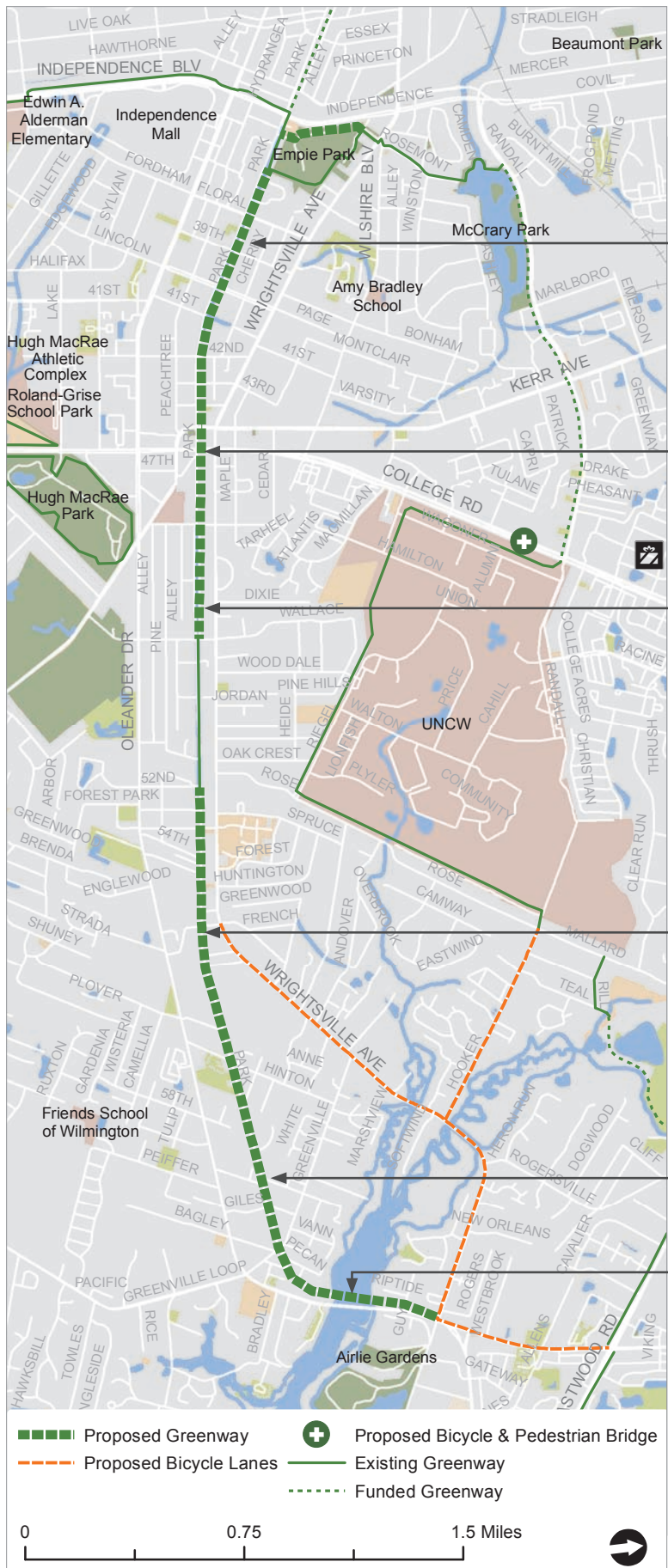
Proposed bike/ped bridge over Burnt Mill Creek near Market St.

Trail would pass under RR trestles on east side of Burnt Mill Creek.

Bridge required across Burnt Mill Creek to continue trail.

Connection to the River to the Sea Bikeway (on Park Ave) would be provided along Colonial with shared-lane markings, sidewalks and bike/ped intersection improvements.





#2: PARK AVENUE TRAIL

This 4.2-mile trail connects Wilmington neighborhoods to Wrightsville Beach.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. Local Beach Community
 2. An Existing or Funded Trail
 3. An Elem., Middle, High School or Library
 4. Major Transit Routes
 5. Higher Density Residential Areas
 6. Higher Density Employment Areas or Major Employer Centers
 7. A Park or Recreation Center
 8. Major Shopping Area
- Fills gap (connects to existing or funded trail or bikeway on both sides)
- Serves Lower Income Areas with Lower Car-Ownership Rates
- Corridor contains High Number of Bike/Ped Accidents
- Recommended in a previously adopted plan
- Relates to the top 10 recommended trail locations from the Public Comment Form

Trail on north side of Park Ave due to greater ROW

Trail routing to include parts of Kerr Ave and Peachtree Ave. Major intersection crossing improvements needed for trail users.

Trail would go along currently unpaved portion of Park Ave

Trail on south side of Park Ave due to greater ROW.

Due to driveway crossings and ROW, trail could switch to the north side of Park Ave east of Myrtle Ave.

Old bridge abutments and approaches may be able to be reused for a new bicycle and pedestrian bridge.

WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$2.5M**. Additional costs may apply due to the constraints noted at left, such as the bike/ped bridge and the intersection improvements at College Rd.

#3: INDEPENDENCE BLVD TRAIL

This 1.1-mile trail connects McCrary Park to Maides Park and its proposed connector trail to Downtown.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. An Existing or Funded Trail
 2. An Elem., Middle, High School or Library
 3. Major Transit Routes
 4. Higher Density Residential Areas
 5. Higher Density Employment Areas or Major Employer Centers
 6. A Park or Recreation Center
- Serves Lower Income Areas with Lower Car-Ownership Rates
- Provides an alternative to a corridor containing a High Number of Bike/Ped Accidents
- Recommended in a previously adopted plan
- Less than 10% of the proposed trail corridor lies within a wetland area
- Significant portion of proposed trail lies within existing public property or easement
- Corridor contains few stream crossings

WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$1.1M**. Costs may be slightly lower if designed and built as part of the new roadway.

Trail would be designed and built as part of the future roadway extension.

If built on the east side, then it could connect to both parks without crossing Independence Blvd. (though safe crossings would still be required to connect with destinations to the west, such as schools, the YMCA, and other parks).



#4: 17TH/INDEPENDENCE TRAIL

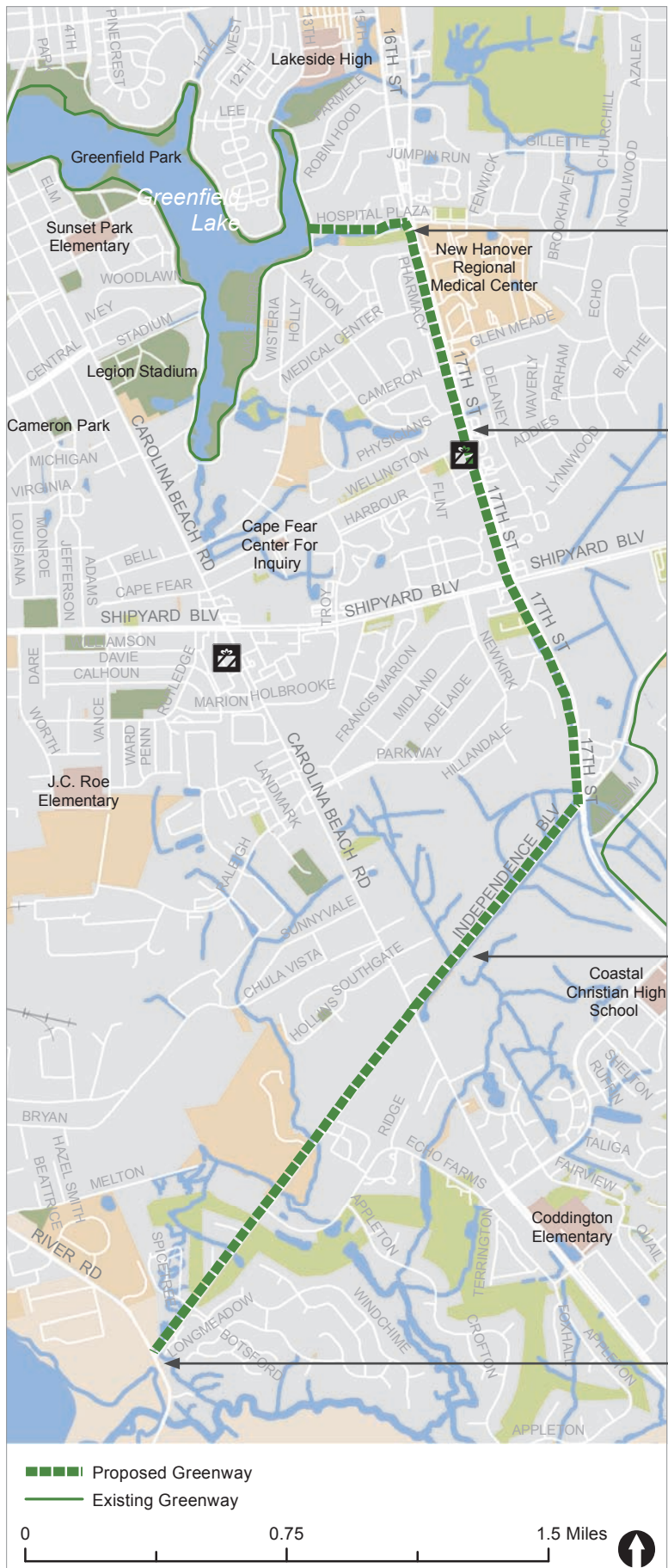
This **4-mile** trail connects Greenfield Lake and New Hanover Regional Medical Center to River Road.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. An Existing or Funded Trail
 2. Major Transit Routes
 3. Higher Density Residential Areas
 4. Higher Density Employment Areas or Major Employer Centers
 5. A Park or Recreation Center
 6. Major Shopping Area
- Fills gap (connects to existing or funded trail or bikeway on both sides)
- Serves Lower Income Areas with Lower Car-Ownership Rates
- Corridor contains High Number of Bike/Ped Accidents
- Recommended in a previously adopted plan
- Relates to the top 10 recommended trail locations from Stakeholder Interviews

WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$2.4M**. Additional costs may apply due to the constraints noted at left, including potential driveway closures and extra signage in commercial areas.

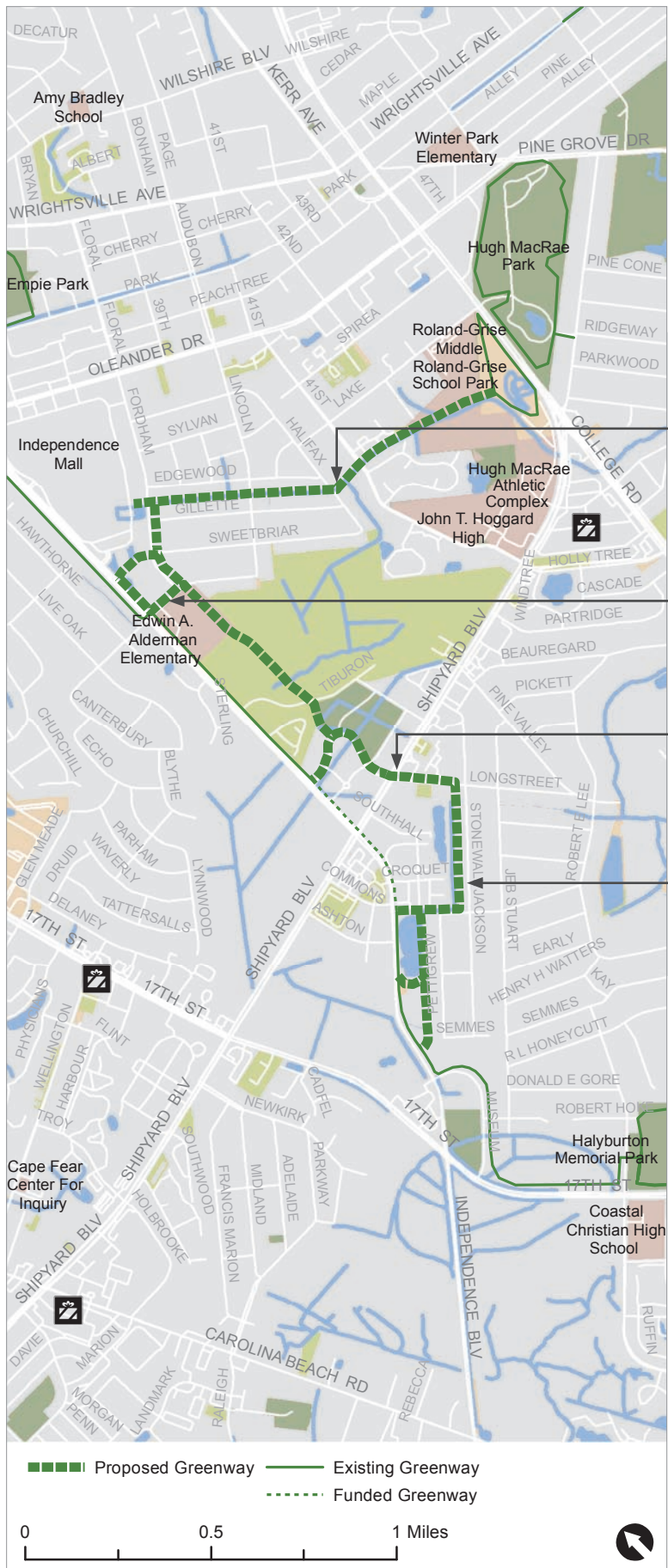


Trail on south side of Hospital Plaza Dr.

Trail on west side of 17th St. Work with local businesses on access management fronting 17th St. Reducing the number of driveway curb cuts will allow for a safer trail in this commercial section. Driveways that intersect the trail should be clearly marked for both motorists and trail users.

Trail on north side of Independence Blvd. Although currently largely undeveloped, future development should employ access management strategies to reduce curb cuts.

South end would connect with proposed trail on River Road.



#6: HUGH MCRAE PARK TRAIL

This 3.7-mile trail connects Hugh MacRae Park to several schools and neighborhoods.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. An Existing or Funded Trail
 2. An Elem., Middle, High School or Library
 3. Higher Density Employment Areas or Major Employer Centers
 4. A Park or Recreation Center
- Fills gap (connects to existing or funded trail or bikeway on both sides)
- Serves Lower Income Areas with Lower Car-Ownership Rates
- Recommended in a previously adopted plan
- Relates to the top 10 recommended trail locations from Stakeholder Interviews
- Significant portion of proposed trail lies within existing public property or easement

Trail would use existing ROW

Connections to the existing Gary Shell Cross City Trail

Trail would cross Shipyard Blvd at Longstreet Dr, where there is an existing traffic light.

Trail would use existing ROW



WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$2.2M**. Additional costs may apply due to the constraints noted at left.

#7: KERR AVE TRAIL

This **0.7-mile** trail connects the University to the Gary Shell Cross-City Trail

WHY IT'S IMPORTANT:

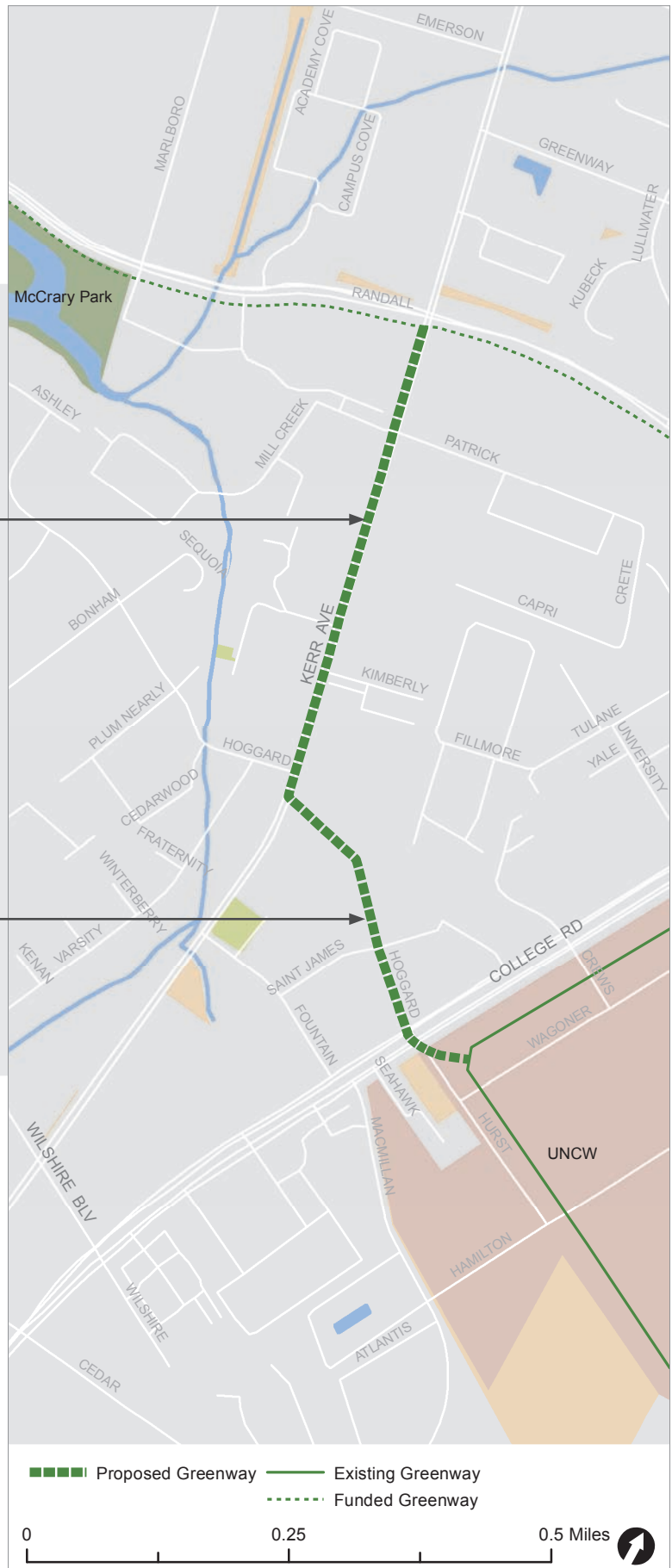
- Direct Access to/from
 1. College/University
 2. An Existing or Funded Trail
 3. Major Transit Routes
 4. Higher Density Residential Areas
 5. Higher Density Employment Areas or Major Employer Centers
- Fills gap (connects to existing or funded trail or bikeway on both sides)
- Serves Lower Income Areas with Lower Car-Ownership Rates
- Corridor contains High Number of Bike/Ped Accidents
- Recommended in a previously adopted plan
- Less than 10% of the proposed trail corridor lies within a wetland area
- Corridor contains no stream crossings

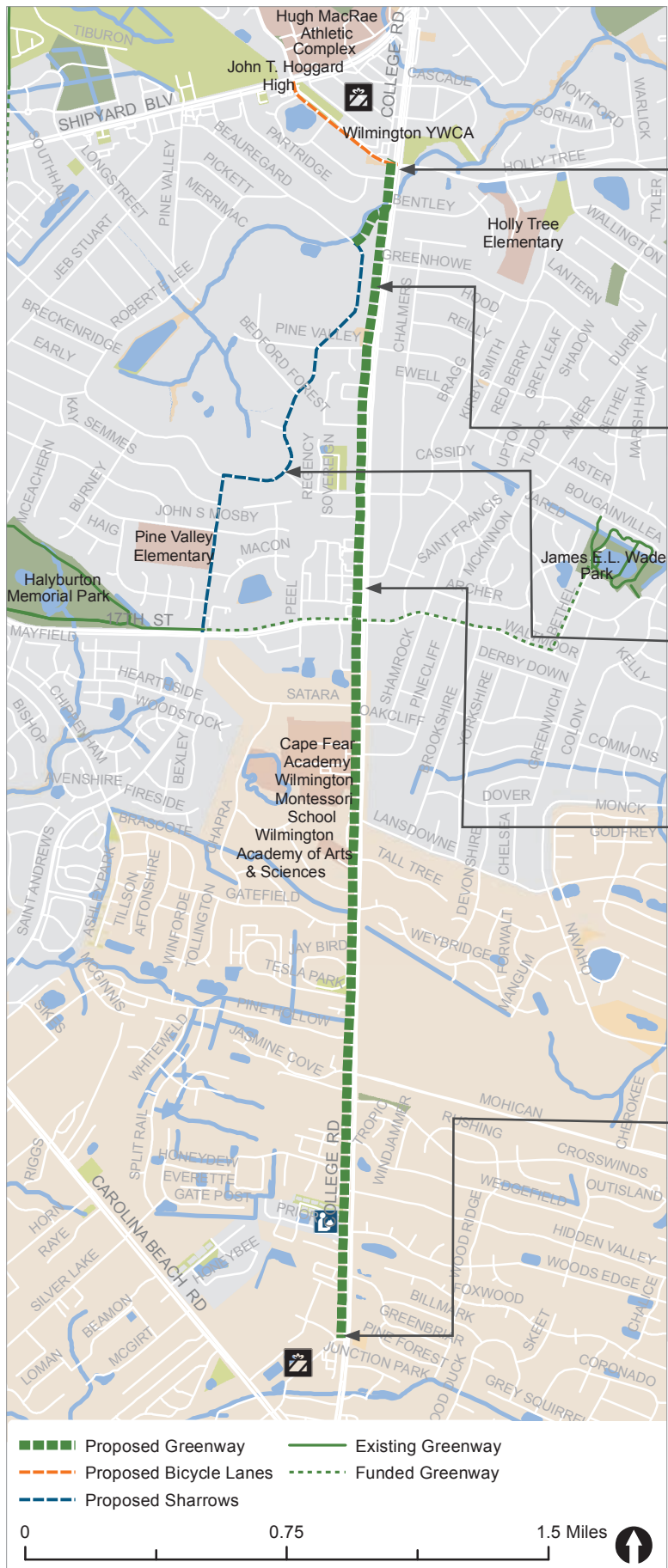
Greater building set backs and existing utility lines on the east side of Kerr Ave may allow for better trail alignment.

Trail would need to circumnavigate the existing parking lot at the end of Hoggard Dr.

WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$0.4M**. Additional costs may apply due to the constraints noted at right.





#8: CENTRAL COLLEGE TRAIL

This 3.5-mile trail connects the Hugh MacRae Complex with the Monkey Junction and Myrtle Grove neighborhoods.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. An Existing or Funded Trail
 2. An Elem., Middle, High School or Library
 3. Major Transit Routes
 4. Higher Density Residential Areas
 5. A Park or Recreation Center
 6. Major Shopping Area
- Corridor contains High Number of Bike/Ped Accidents
- Relates to the top 10 recommended trail locations from the Public Comment Form
- Relates to the top 10 recommended trail locations from Stakeholder Interviews
- Corridor contains few stream crossings

North end would connect with proposed trail to Greenville Loop Rd, and to bicycle lanes connecting to the High School and Athletic Complex.

Trail on west side of College Rd. (wide ROW, especially north of Pine Valley Dr).

Sharrows on residential roads would provide an alternate route in this section.

Driveways that intersect the trail should be clearly marked for both motorists and trail users, especially at commercial areas near Bragg Dr and 17th St.

South end would connect with shopping/employment centers and the proposed trail along Carolina Beach Rd.



WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$2.1M**. Additional costs may apply due to the constraints noted at left.

#9: MCCRARY PARK TRAIL

This 0.6-mile trail segment will create a loop trail at McCrary Park and link into the Cross-City Trail.

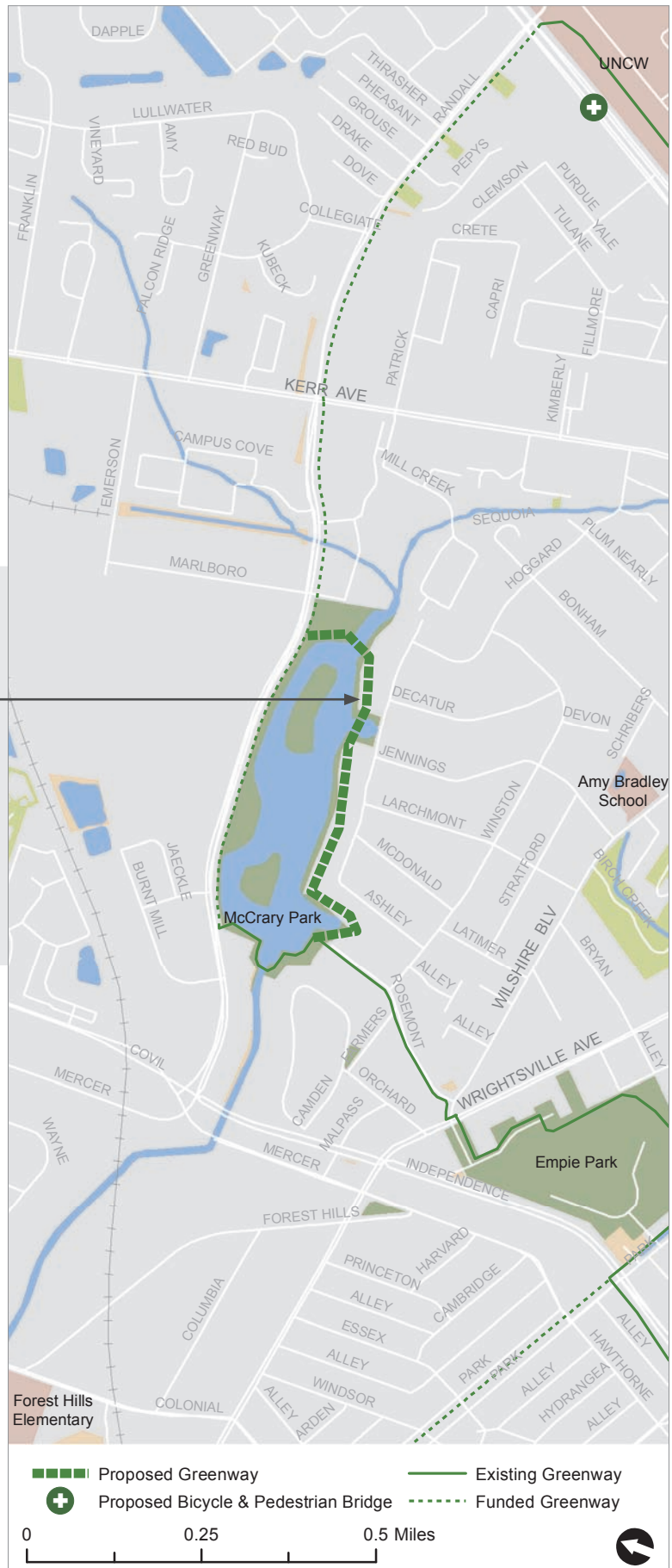
WHY IT'S IMPORTANT:

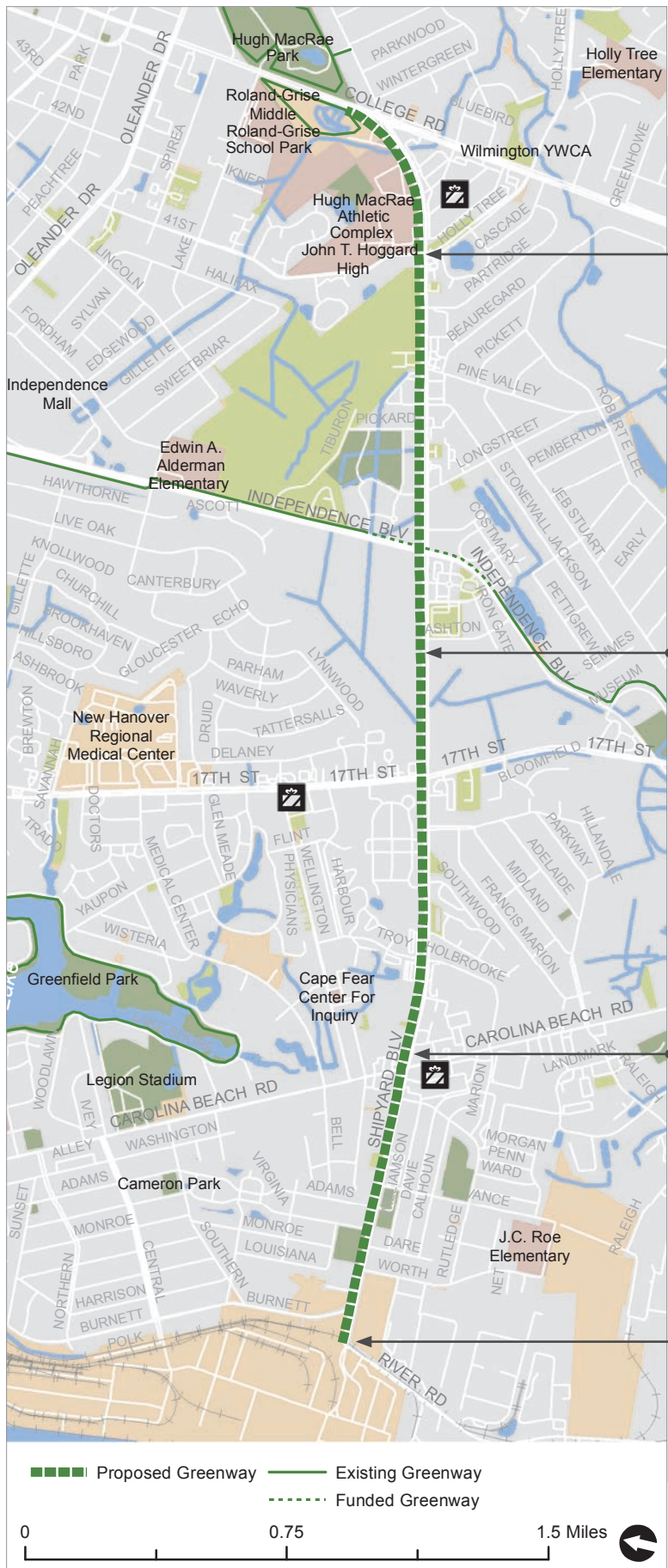
- Direct Access to/from
 1. An Existing or Funded Trail
 2. Major Transit Routes
 3. Higher Density Residential Areas
 4. Higher Density Employment Areas or Major Employer Centers
 5. A Park or Recreation Center
- Fills gap (connects to existing or funded trail or bikeway on both sides)
- Serves Lower Income Areas with Lower Car-Ownership Rates
- Recommended in a previously adopted plan
- Significant portion of proposed trail lies within existing public property or easement
- Corridor contains no roadway crossings

Trail would circumnavigate the south side of McCrary Park, creating a complete trail loop with the existing trail.

WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$0.4M**. Additional costs may apply if special park amenities are included, such as benches, etc.





#10: SHIPYARD TRAIL

This 3.6-mile trail connects the Hugh MacRae Complex with the neighborhoods and shopping along Shipyard Blvd.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. An Existing or Funded Trail
 2. An Elem., Middle, High School or Library
 3. Major Transit Routes
 4. Higher Density Residential Areas
 5. Higher Density Employment Areas or Major Employer Centers
 6. A Park or Recreation Center
 7. Major Shopping Area
- Fills gap (connects to existing or funded trail or bikeway on both sides)
- Serves Lower Income Areas with Lower Car-Ownership Rates
- Less than 10% of the proposed trail corridor lies within a wetland area

North end would connect with bi-cycle lanes on Holly Tree Rd, connecting to proposed trails on College Rd and Greenville Loop Rd.

Trail on north side of Shipyard Blvd. Although currently largely undeveloped between Independence Blvd and 17th St, future development should employ access management strategies to reduce curb cuts.

Work with local businesses on access management fronting the north side of Shipyard Blvd. Reducing the number of driveway curb cuts will allow for a safer trail in this commercial section. Driveways that intersect the trail should be clearly marked for both motorists and trail users.

South end would connect with proposed trail on River Road.

WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$2.2M**. Additional costs may apply due to the constraints noted at left.

#11: SOUTH SMITH CREEK TRAIL

This 5.7-mile trail connects Ogden Park, Smith Creek Park, and surrounding neighborhoods with central Wilmington.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. An Existing or Funded Trail
 2. An Elem., Middle, High School or Library
 3. Major Transit Routes
 4. Higher Density Residential Areas
 5. Higher Density Employment Areas or Major Employer Centers
 6. A Park or Recreation Center
- Alternative to a corridor containing a High Number of Bike/Ped Accidents
- Recommended in a previously adopted plan
- Relates to the top 10 recommended trail locations from the Public Comment Form
- Relates to the top 10 recommended trail locations from Stakeholder Interviews
- Significant portion of proposed trail lies within existing public property or easement

WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$3.4M**. Additional costs may apply due to the constraints noted at right.

Trail connects to Ogden Park via a power line easement.

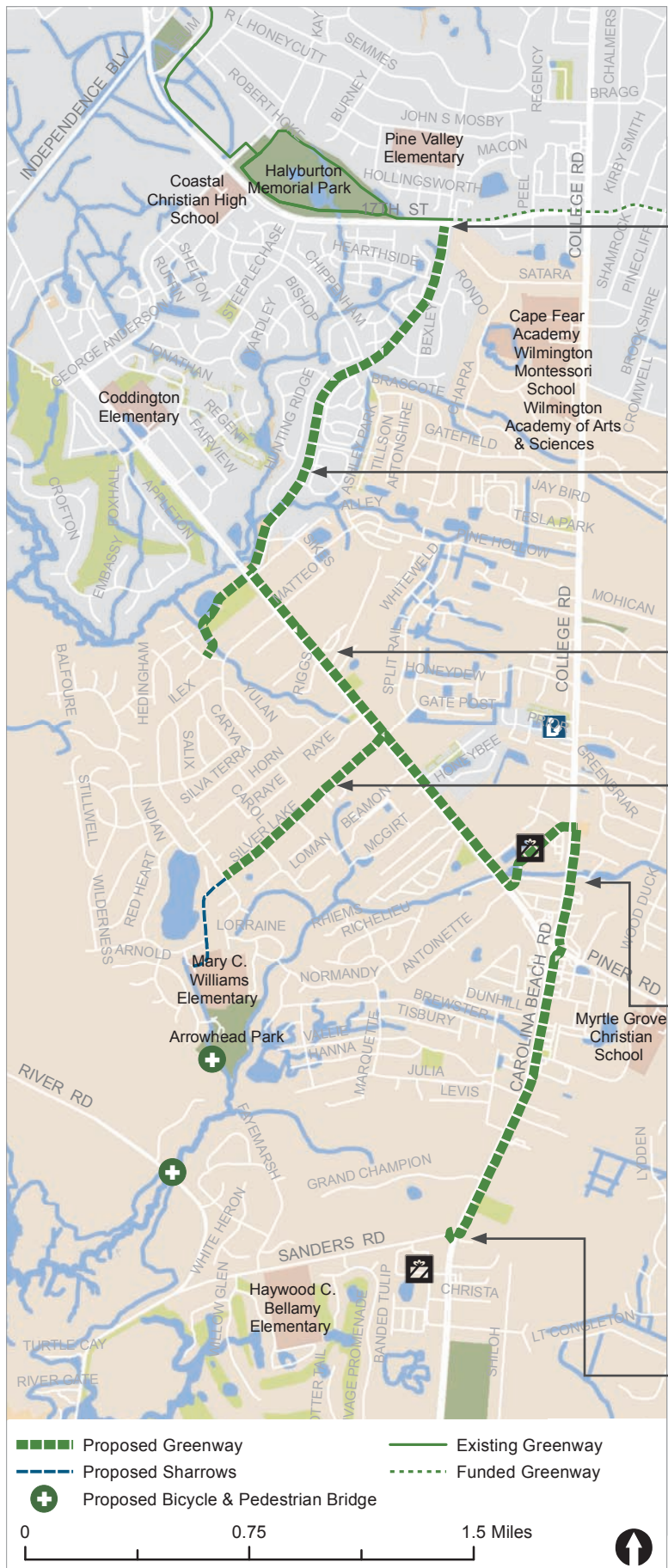
Corridor ties into the existing trail at Smith Creek Park

Trail follows an easement north along the east side of College Rd.

Trail would briefly parallel I-40 to cross at the traffic light at Kings Dr.

Wet areas along Smith Creek will require boardwalk in some sections, but much of the trail routing could take advantage of existing public property or easement along the creek.





#12: CAROLINA BEACH RD TRAIL

This 5.6-mile trail connects Halyburton Memorial Park to several neighborhoods and provides access to shopping centers across busy roadways.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. An Existing or Funded Trail
 2. An Elem., Middle, High School or Library
 3. Major Transit Routes
 4. Higher Density Residential Areas
 5. A Park or Recreation Center
 6. Major Shopping Area
- Serves areas outside of the existing trail service areas
- Corridor contains High Number of Bike/Ped Accidents
- Recommended in a previously adopted plan
- Relates to the top 10 recommended trail locations from the Public Comment Form
- Relates to the top 10 recommended trail locations from Stakeholder Interviews

North end would connect with Gary Shell Cross City Trail

Trail would follow the wide ROW on the west side of St. Andrews Dr.

Trail would go along the north side of Carolina Beach Rd

Trail would follow the wide ROW on the west side of Silver Lake Dr, connecting with the elementary school.

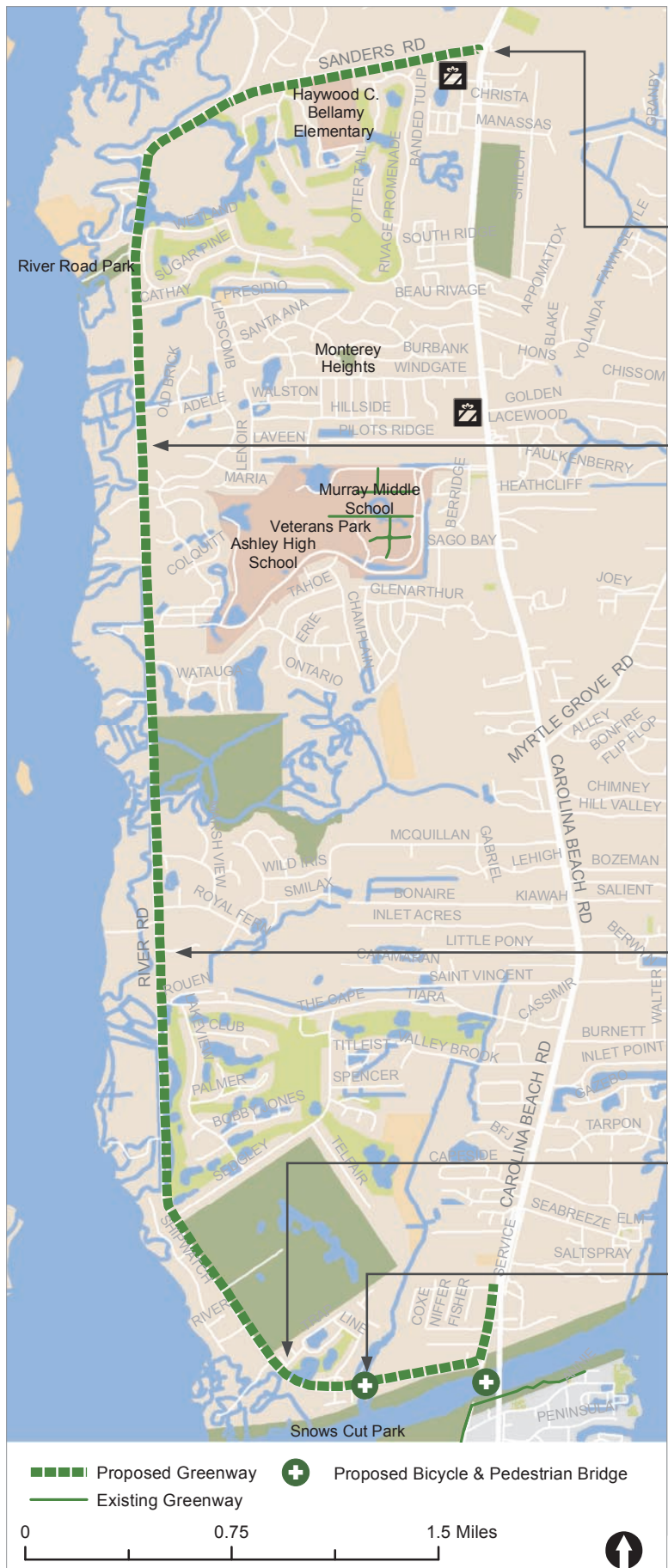
Rather than crossing at the major intersection of Carolina Beach Rd and College Rd, the trail would connect with businesses near this intersection and cross more directly at the first traffic light to the north of that intersection.

South end would connect with the proposed trail along River Road.



WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$3.4M**. Additional costs may apply due to the constraints noted at left



#14: SOUTH RIVER RD TRAIL

This 6.9-mile trail provides an off-road connection between Wilmington and Pleasure Island.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. Local Beach Community
 2. An Elem., Middle, High School or Library
 3. A Park or Recreation Center
 4. Major Shopping Area
- Fills gap (connects to existing or funded trail or bikeway on both sides)
- Serves areas outside of the existing trail service areas
- Provides an alternative to a corridor containing a High Number of Bike/Ped Accidents
- Recommended in a previously adopted plan
- Relates to the top 10 recommended trail locations from the Public Comment Form
- Relates to the top 10 recommended trail locations from Stakeholder Interviews

Trail would connect to proposed trails along Carolina Beach Rd and River Rd to the north.

Trail would follow the east side of River Rd for several reasons: 1) most residents in this area live on the east side, and they would not have to cross River Rd to use the trail; 2) more destinations are on the east side of the road; and 3) more public property is located on the east side of the road.

Wet areas along River Rd present challenges; extensive boardwalk will be required.

Other sections of River Rd offer more ideal conditions for trail construction.

Trail bridges will be required in some sections.



WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$4.1M**. Additional costs may apply due to the constraints noted at left

#15: NORTH RIVER RD TRAIL

This **5.0-mile** trail connects Wilmington to the South River Rd Trail and ultimately to Pleasure Island.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. An Elem., Middle, High School or Library
 2. A Park or Recreation Center
- Fills gap (connects to existing or funded trail or bikeway on both sides)
- Serves areas outside of the existing trail service areas
- Provides an alternative to a corridor containing a High Number of Bike/Ped Accidents
- Recommended in a previously adopted plan
- Relates to the top 10 recommended trail locations from the Public Comment Form
- Relates to the top 10 recommended trail locations from Stakeholder Interviews
- Significant portion of proposed trail lies within existing public property or easement
- Corridor contains few roadway crossings

WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$3.0M**. Additional costs may apply due to the constraints noted at right.

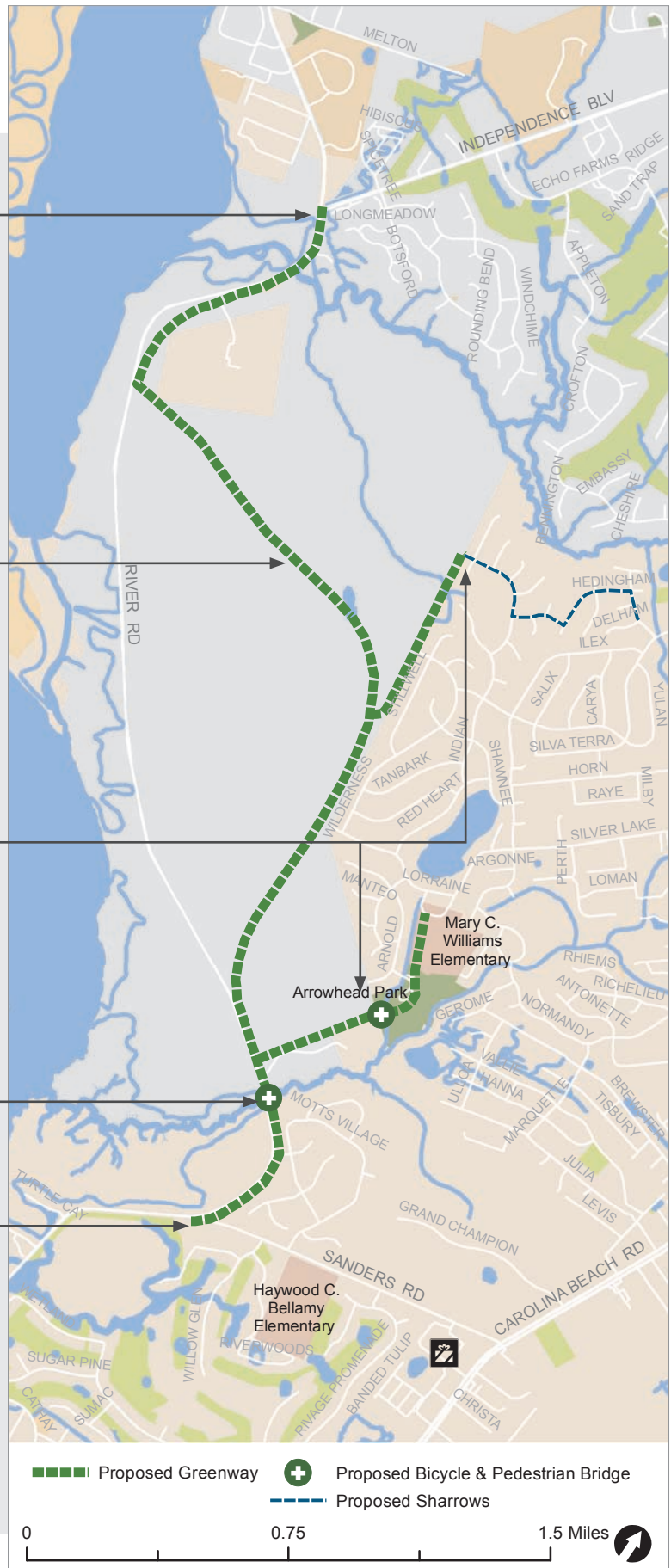
North end would connect to proposed trails on River Rd to the north and Independence Blvd to the east.

Most of this section of trail is proposed to be built as part of the future development in this area. See the River Road Small Area Plan for details.

Trail would connect to adjacent neighborhoods.

Trail bridges will be required in some sections.

South end would connect to proposed trail on southern portion of River Rd.



#16: ISLAND GREENWAY

This **3.4-mile** trail connects schools and parks to neighborhoods in Carolina Beach.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. Local Beach Community
 2. An Existing or Funded Trail
 3. An Elem., Middle, High School or Library
 4. A Park or Recreation Center
- Corridor contains High Number of Bike/Ped Accidents
- Recommended in a previously adopted plan
- Significant portion of proposed trail lies within existing public property or easement

**WHAT WILL IT COST?**

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$1.3M**. Additional costs may apply due to the constraints noted at left.

#17: DOW RD TRAIL

This **4.4-mile** trail connects Wilmington and New Hanover County to the south end of Pleasure Island.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. Local Beach Community
 2. An Existing or Funded Trail
 3. Higher Density Residential Areas
 4. A Park or Recreation Center
- Recommended in a previously adopted plan
- Relates to the top 10 recommended trail locations from the Public Comment Form
- Relates to the top 10 recommended trail locations from Stakeholder Interviews
- Significant portion of proposed trail lies within existing public property or easement

Northern end would connect to the existing trail along Dow Rd, Carolina Beach State Park, and to the shopping areas/grocery store near the park.

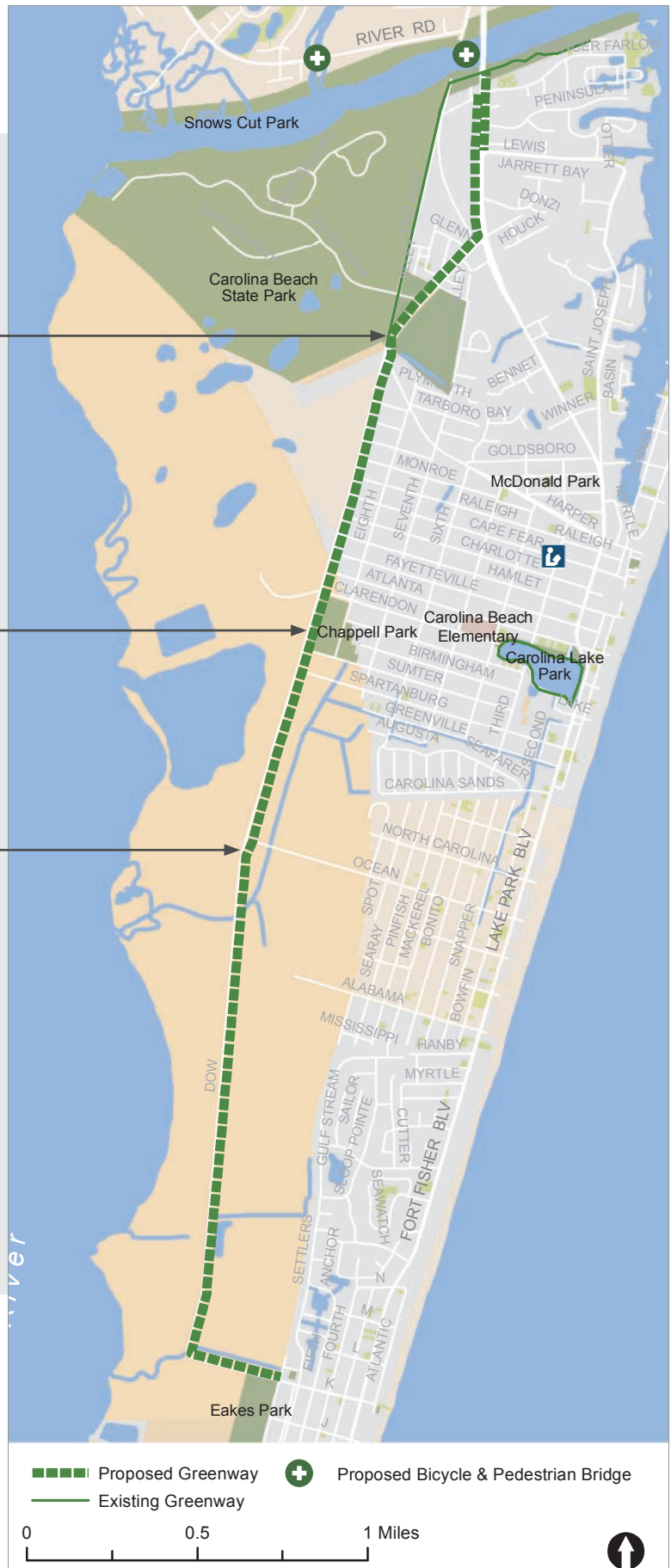
Most of this trail is located in public property (military, still requiring easements) and is already recommended in the Dow Road Corridor Plan.

Trail would run along the east side of Dow Rd for two main reasons: 1) most residents and destinations are already on the east side, reducing the need to cross Dow Rd, and 2) much of the ROW is already cleared due to utilities on the east side.



WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$2.6M**. Additional costs may apply due to the constraints noted at right.



#18: WRIGHTSVILLE BEACH TRAIL

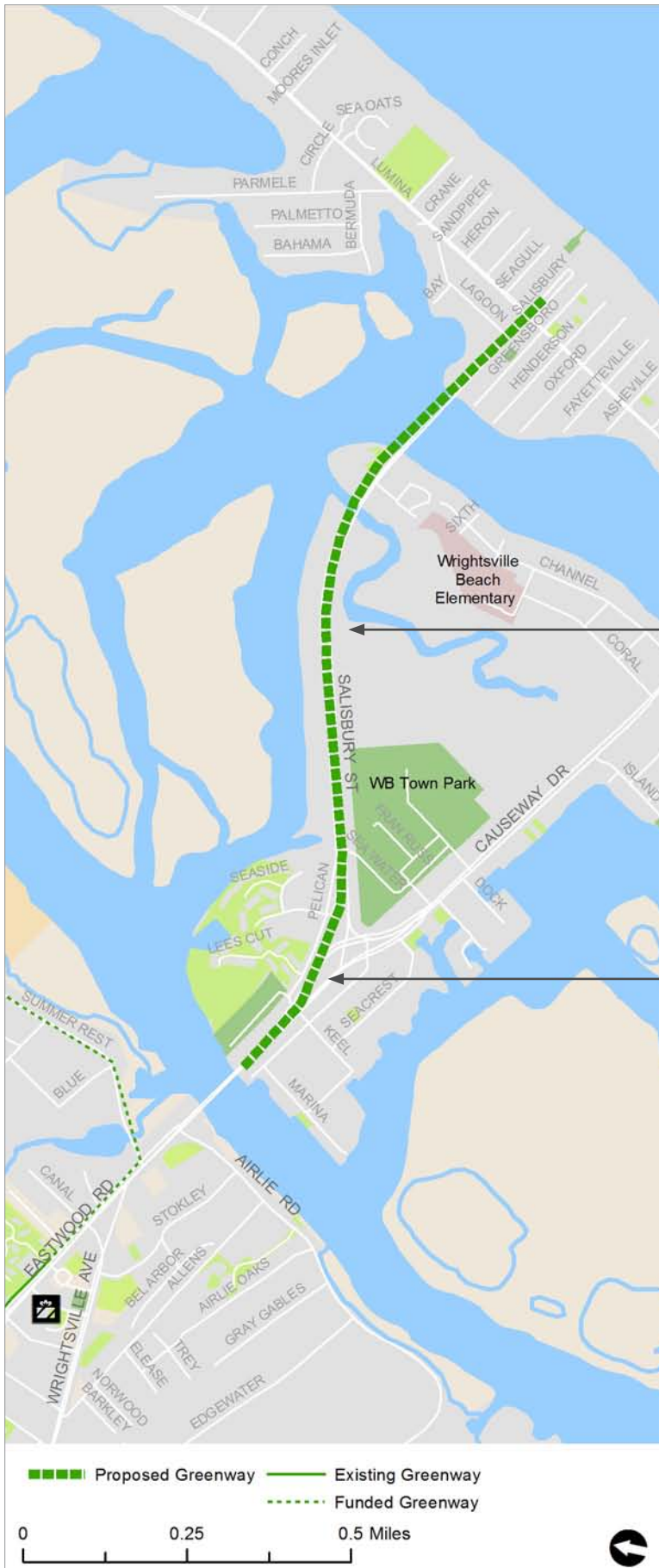
This 1.3-mile trail provides a connection between Wilmington and Wrightsville Beach.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. Local Beach Community
 2. An Elem., Middle, High School or Library
 3. A Park or Recreation Center
 4. Major Shopping Area
- Provides an alternative to a corridor containing a High Number of Bike/Ped Accidents
- Recommended in a previously adopted plan
- Less than 10% of the proposed trail corridor lies within a wetland area

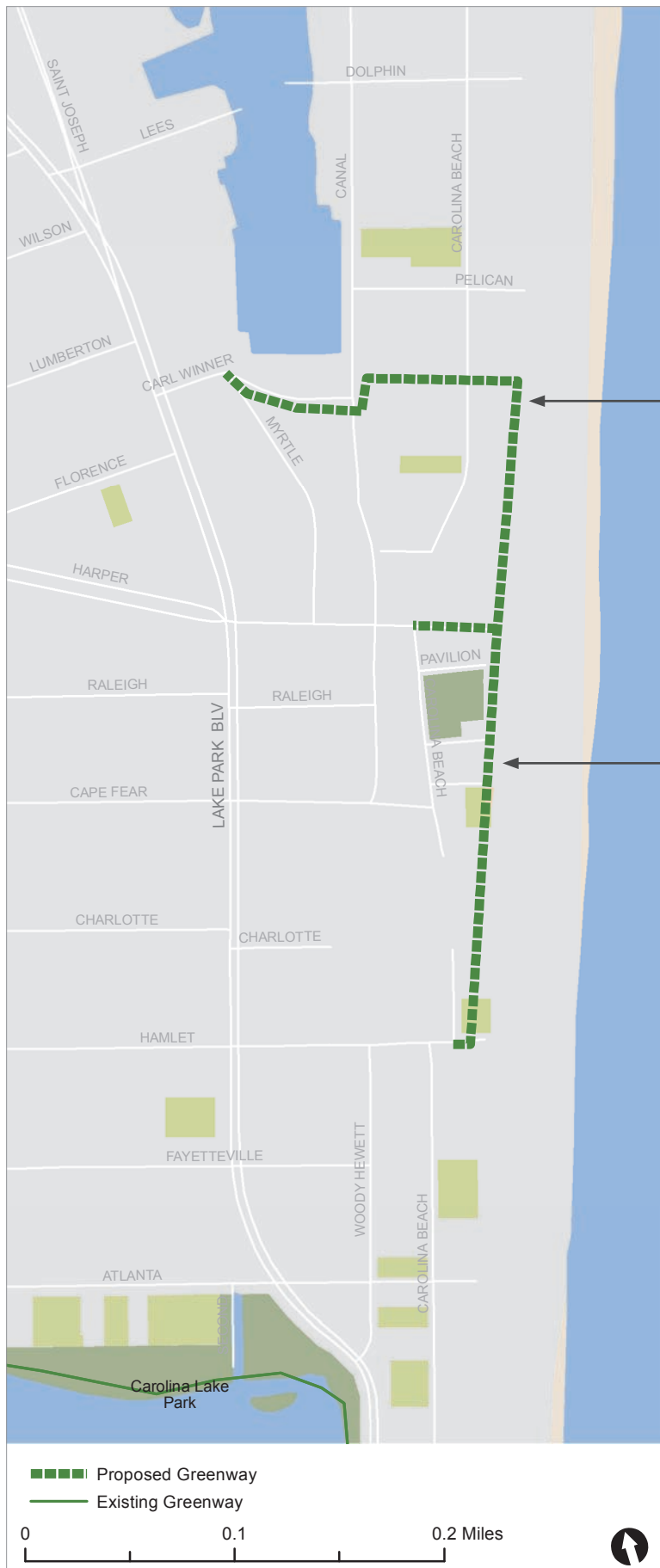
See the Pelican Drive/Salisbury Street Bicycle Plan for the Town of Wrightsville Beach (2009) for more information of this section of the proposed trail.

Careful planning and design will be required to route eastbound bicyclists from the bridge to the trail through this intersection.

**WHAT WILL IT COST?**

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$0.8M**. Additional costs may apply due to the constraints noted at left.





#20: CAROLINA BEACH WATERFRONT TRAIL

This **0.5-mile** trail will act as a destination in the center of Carolina Beach.

WHY IT'S IMPORTANT:

- Direct Access to/from
 1. Local Beach Community
 2. Higher Density Residential Areas
 3. A Park or Recreation Center
 4. Major Shopping Area
- Recommended in a previously adopted plan
- Less than 10% of the proposed trail corridor lies within a wetland area
- Corridor contains no stream crossings

Trail is shown as recommended in the locally adopted Carolina Beach Multi-Use Transportation Plan. Actual alignment on north end may need to be updated.

Waterfront trail will require extensive boardwalk (the existing portion between Harper and Charlotte is boardwalk).



WHAT WILL IT COST?

A corridor-specific study is needed for accurate costs. Planning-level costs at \$600K/mile come to **\$0.3M**. Additional costs may apply due to the need for a special trail type (boardwalk).

Chapter Contents:

Overview

Policy
Action StepsProgram
Action StepsInfrastructure
Action StepsAdministrative
StructureOverall
Action Steps Table

IMPLEMENTATION

OVERVIEW

This chapter defines a structure for managing the implementation of the Wilmington/New Hanover County greenways program. Implementing the recommendations within this plan will require leadership and dedication to trail development on the part of a variety of agencies. Equally critical, and perhaps more challenging, will be meeting the need for a recurring source of revenue. Even small amounts of local funding could be very useful and beneficial when matched with outside sources. Most importantly, the local governments within the region need not accomplish the recommendations of this Plan by acting alone; success will be realized through collaboration with state and federal agencies, the private sector, and non-profit organizations.

Given the present day economic challenges faced by local governments (as well as their state, federal, and private sector partners), it is difficult to know what financial resources will be available to implement this plan. However, there are still important actions to take in advance of major investments, including key organizational steps, the initiation of education and safety programs, and the development of strategic lower-cost trail projects. Following through on these priorities will allow the key stakeholders to be prepared for regional trail development over time while taking advantage of strategic opportunities, both now and as opportunities arise. Key Action Steps fall into three categories: policies, programs, and infrastructure. **More detailed action steps tied to each of these categories are found in the table at the end of this chapter** along with the responsible agency and expected timeframe for completion.

POLICY ACTION STEPS

Several policy steps are crucial to the success of future greenway development. These steps will legitimize the recommendations found in this plan and enable the right-of-way acquisition necessary to carry out those recommendations.

ADOPT THE PLAN

Adoption procedures vary from community to community depending on existing plans and policies. In each jurisdiction, the planning board (as applicable) should review and recommend the plan to its governing body, which in turn must consider and officially incorporate the recommended trails of this plan into its land-use plans. The following entities should adopt this plan:

- The Wilmington Urban Area Metropolitan Planning Organization
- The City of Wilmington
- New Hanover County
- The Town of Wrightsville Beach

- The Town of Carolina Beach
- The Town of Kure Beach
- The Cape Fear Public Utility Authority

Adoption of this plan also signifies that the design guidelines provided in **Chapter 5** are established as trail standards for each of the adopting agencies. This will establish consistency in design across jurisdictional boundaries and ensure that future trails will function as multi-use facilities accommodating a variety of user types.

For NCDOT and NCDENR, this plan and its recommended trail routes should be approved, and should be included in the future planning for each agency. For example, NCDOT should refer to this document when assessing impact for future projects and plans. Likewise, NCDENR's Division of Parks and Recreation should refer to this Plan in any projects relating to the state parks in New Hanover County, such as Carolina Beach State Park or the Fort Fisher State Recreation Area.

ESTABLISH LAND RIGHT-OF-WAY ACQUISITION MECHANISMS

It is recommended that each local zoning and subdivision ordinance be amended to ensure that, as developments are planned and reviewed, the greenway corridors and blue-way access areas identified in this plan are protected. This would entail amending development regulations to have developers set aside land for trails whenever a development proposal overlaps with the proposed routes, as adopted. In jurisdictions where applicable, compliance with the plan should be verified during the review of the Technical Review Committee (TRC). The WMPO staff member on the TRC of New Hanover County and the City of Wilmington should ensure that an effective review of all bicycle and pedestrian elements of proposed developments takes place.

In addition, local policies should be revised so that all new sewer and utility easements allow for public access as a matter of right. Although many easements do not currently prohibit greenway development, they do require the approval of landowners, increasing the complexity of trail development in these easements.

Trail right-of-way acquisition can be accomplished through a number of other methods where trail recommendations run through currently developed areas. Wherever acquisition is successful, property owners should be approached and informed by the implementing agency (e.g., the municipality, the county, NCDENR, etc.) in advance of the design process.

PROGRAM ACTION STEPS

While policies provide a legal basis for greenway development, the program recommendations of this plan will help to build community support for the greenways program and establish a strong bicycling and walking culture.

FORM A GREENWAYS ADVISORY COMMITTEE

Leadership from individuals representing key stakeholders is essential to move the trail system from concept to reality. These individuals will help advocate for the trail, and in their professional and personal capacity, they will seek out opportunities to utilize synergies with other projects, individuals, and organizations to keep the trail system a priority in the ever-present competition for resources.

It is advised that the steering committee and stakeholders for the planning process be reconstituted as a Greenways Advisory Committee (GAC) and that new leaders be invited to join, with an eye towards accomplishing the tasks that lie ahead. The GAC should be a forum for leaders to convene periodically to discuss progress, share resources and tools, and otherwise coordinate trail planning and development activities.

CONTINUE COMMUNICATIONS EFFORTS

A subgroup of the GAC should continue the communication campaign to assist in celebrating successes as greenway development occurs and otherwise raise awareness of the trail system and its benefits. The Friends of Blueways and Greenways Group described in this chapter could play a key role in this effort. A key first task of this group is the design and implementation of a bicycle and pedestrian wayfinding system - please refer to Chapter 5: Design Guidelines for more information about signage and wayfinding.

ESTABLISH A MONITORING PROGRAM

From the beginning, and continuously through the life of the GAC, it should brainstorm specific benchmarks to track through a monitoring program and honor their completion with public events and media coverage. Monitoring should be supported by programs recommended in Chapter 4, including an Annual Count Program and a Greenways Report Card. Benchmarks should be revisited and revised periodically as the greenways program evolves.

INFRASTRUCTURE ACTION STEPS

While establishing the policies and programs described, agencies should move forward on infrastructure development by proceeding with the design and construction of priority projects. They should also work to identify funding for longer-term, higher-cost projects.

IDENTIFY FUNDING

Achieving the vision that is defined within this plan will require, among other things, a stable and recurring source of funding. Communities across the country that have successfully engaged in trail programs have relied on multiple funding sources to achieve their goals. No single source of funding will meet the recommendations identified in this plan. Instead, stakeholders will need to work cooperatively with all the municipality, state, and federal partners to generate funds sufficient to implement the program.

A stable and recurring source of revenue is needed to generate funding that can then be used to leverage grant dollars from state, federal, and private sources. The ability of the local agencies to generate a source of funding for trails depends on a variety of factors, such as taxing capacity, budgetary resources, voter preferences, and political will. It is very important that these local agencies explore the ability to establish a stable and recurring source of revenue for trails.

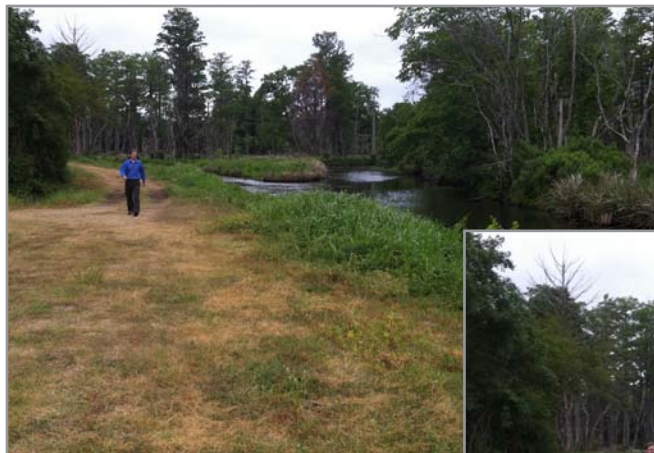
Donations from individuals or companies are another potential source of local funding. The Greenways Advisory Committee should establish an Adopt-A-Greenway program as a mechanism to collect these donations. In addition to a formalized program, a website should be set up as an easy way for individuals to donate smaller amounts. The need for a donation mechanism was identified during the stakeholder interviews that took place at the beginning of the planning process.

Federal and state grants should be pursued along with local funds to pay for trail ROW acquisition and trail design, construction, and maintenance expenses. “Shovel-ready” designed projects should be prepared in the event that future federal stimulus funds become available. Recommended funding sources may be found in **Appendix E: Funding Resources**.

COMPLETE PRIORITY TRAIL PROJECTS

By moving forward quickly on priority trail projects, agencies in the region will demonstrate their commitment to carrying out this plan and will better sustain enthusiasm generated during the public outreach stages of the planning process. Refer to **Chapter 3: Recommendations** for priority trail project ranking and prioritization methodology.

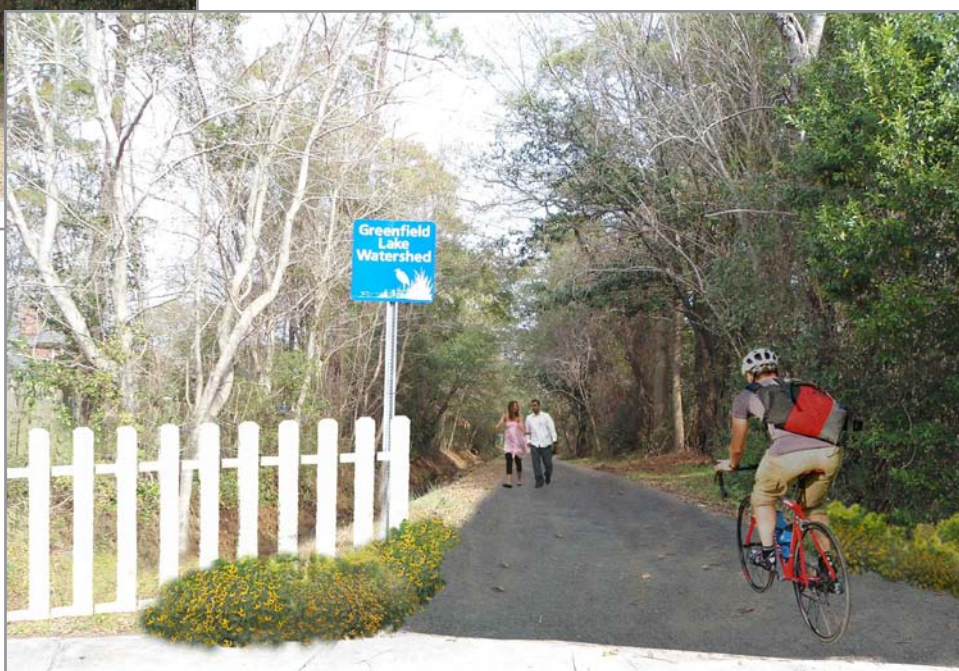




Priority Trail Example: Burnt Mill Creek, part of the proposed Downtown Trail. Existing conditions (left) and proposed trail rendering (below).



Priority Trail Example: Hugh McRae Park Trail. Existing conditions near Independence Mall (left) and proposed trail rendering (below).



Priority Trail Example: Carolina Beach Road Trail. Existing conditions (right) and proposed trail rendering (below).



Priority Trail Example: Dow Road Trail. Existing conditions (right) and proposed trail rendering (below).



DESIGN, CONSTRUCT, AND MAINTAIN TRAILS

Once a trail segment is selected and land is acquired, trail design typically follows. For this plan, some trail segments simply need to be signed, not requiring a full design phase. Other segments will require varying degrees of clearing and natural surface grading, but still may be able to be implemented without design or construction documents. It will be essential for County, City, and Town staff to determine the intended uses of a particular segment and to design and construct with those uses in mind. Intended uses of the trail will dictate the ideal trail surface and will have a direct bearing on the construction and maintenance costs.

Trail construction costs will vary, and until a project is put out for competitive bid, there is no way to accurately determine local prices. A competitive bid process should ask for the cost of trail construction using the three most common trail construction surfaces (granite screening, asphalt, and concrete) in order to fully understand the costs and potential savings when making a decision between one building material over another.

Preliminary design plans should be reviewed by multiple stakeholders, including emergency service personnel, so they can offer suggestions and have their voices heard from the very beginning. There is sometimes a disconnect between the designer and operating staff. Designs that are pleasing to the eye are not always conducive to good and inexpensive maintenance. Therefore, it is imperative that cost saving should be a part of any design, with a thorough review of the plans while they are still in a preliminary stage.

Security starts in the design phase as well. There is much that can be done in designing a trail system that greatly reduces the risk of crime. Local police departments should be consulted early on in order to seek their advice and to alert them that the trail will be built and that they need to plan for it as well. Well-placed lights, wide-open spaces along the trail, removal of underbrush, and easily accessible trailheads all add to the security matrix. Routine patrols and staff members in uniform will alert people that the trail is being watched. Security tips and procedures can be conveyed on bulletin boards, on brochures, and in informal gatherings led by park staff along the trail.

Annual operations and maintenance costs vary, depending upon the facility to be maintained, level of use, location, and standard of maintenance. Operations and maintenance budgets should take into account routine and remedial maintenance over the life cycle of the improvements and on-going administrative costs for the operations and maintenance program. **Appendix F: Operations and Maintenance** provides a comprehensive guideline for bicycle, pedestrian and greenway trail operations and maintenance services.

ADMINISTRATIVE STRUCTURE

The following are suggested roles for the core types of stakeholders involved in implementation. Actual roles may vary depending on how this Plan is implemented over time and the ongoing level of interest and involvement by specific stakeholders. The organizational framework described in this section is presented visually in the chart below, as discussed by this Plan's Steering Committee. The coordinator position is identified as a future WMPO staff member for several key reasons: 1) The WMPO already has representation from each of the municipalities and the county; 2) As the region grows in population, the WMPO's capacity will grow; 3) the WMPO can offer coordination for regional trails connecting outside county boundaries.

ORGANIZATIONAL FRAMEWORK FOR IMPLEMENTATION



ROLE OF THE WILMINGTON MPO

As the lead agency in regional trail development, the WMPO will have multiple roles, including the following:

- Appoint a Regional Bicycle, Pedestrian, and Trails coordinator. This coordinator would be responsible for implementing this plan and would work with local agencies and municipalities to seek funding. This coordinator could also manage and facilitate meetings for the Greenways Advisory Committee.
- Facilitate the implementation of this Plan by hosting semi-annual meetings (quarterly to start) of the GAC and fostering ongoing communication. Encourage trails as a priority for public infrastructure investment among all stakeholders.
- Develop a coordinated operations and maintenance plan with the various stakeholders. Operations and maintenance tasks need to be supported by adequate funding and staff levels.

ROLE OF THE GREENWAYS ADVISORY COMMITTEE

As mentioned previously, this committee would play a major role in championing the implementation of this Plan. Specially this group should:

- Advocate for implementing the trails program.
- Facilitate cooperation among jurisdictions for trail development.
- Communicate with the WMPO Bike/Ped Committee to complement each other's efforts and prevent a duplication of services to the community.
- Define and recommend sources of funding for trail development.
- Meet quarterly with an agenda that includes: A) Implementation progress updates from each of the member organizations, B) Confirmation of specific tasks to be completed by specific members before the next meeting, and C) Discussion of new opportunities and constraints and identification of ways to address them.
- Coordinate volunteer efforts with representatives from the necessary agencies.
- Develop educational programs and coordinate special events in conjunction with the citizen-driven Friends of Blueways and Greenways Group.
- Pursue funding and build partnerships with land owners for trail development.
- Keep local leaders informed about trail-related issues and developments through direct dialogue and personal e-mail; promote trail development among local leaders through creative approaches, such as organized tours of existing trails.
- Rally public support for key public hearings and coordinate mass e-mail campaigns for special votes.
- Assist counties and municipalities in the exchange of effective trail development strategies and other areas of regional trail coordination.
- Continue communication and build positive relationships with organizations such as the Cape Fear Public Utility Authority, Progress Energy, New Hanover County Schools, and others that can assist with issues related to potential trail ROW and trail development.

ROLE OF THE COUNTY AND MUNICIPALITIES

Many of the communities in this region have already been active in trail planning and development. Communities that are more experienced in trail building should share strategies (such as effective development ordinances and procedures, contractor references, and budget estimates) with their neighboring communities that have less

experience. The Greenways Advisory Committee would be the facilitator of such an exchange, and it could also offer guidance in several other areas, including the following municipal and county tasks:

- County and municipal parks and recreation directors should formulate an annual plan of action for the trails program.
- County and municipal planners should ensure trail connectivity between jurisdiction borders.
- County and municipal parks and recreation staff and related citizen boards and committees should participate in trail events that cross jurisdictional borders.
- County and municipal planners and engineers should ensure that the design guidelines of this plan are used in trail design and aim for uniform standards in trail facilities, such as signage and wayfinding.

Most importantly, prior to the beginning of each fiscal year, the county and local municipalities should adopt a budget for expenditures of funding that supports the trails program, even if only for small amounts. Local municipal and county staff should be prepared to provide supporting materials for the budget process, including any trail-related reports, estimates, and benchmarking statistics.

ROLE OF STATE AGENCIES (NCDENR AND NCDOT)

As key partners in the development of this Plan, NCDOT and NCDENR should continue to play a role in implementation, including participation in the following tasks:

- The NCDOT Division of Bicycle and Pedestrian Transportation should be prepared to provide guidance and technical support to local NCDOT offices that are implementing trail-related facilities, such as multi-use paths in roadway corridors, trail-roadway crossings, and improvements that increase safety for bicyclists and pedestrians crossing bridges on state roadways.
- NCDOT should also continue to work with local and regional planners on coordination of upcoming and future roadway projects with trail recommendations.
- NCDENR should continue to be a partner in providing guidance on recommendations such as trail interface with natural resource areas and proper alignment of trails through sensitive and regionally significant environmental features.

ROLE OF NON-PROFITS

Non-profit organizations can serve a variety of purposes and are already serving across the region and eastern North Carolina. For example,

- *Cape Fear Cyclists* serves as a bicycling advocacy group for Wilmington, NC and its surrounding communities, spearheading the Bicycle Friendly Community campaign and providing information about bike rides and routes online.
- *The East Coast Greenway Alliance* provides strategic assistance for states, counties, and municipalities that are building local trail sections of the East Coast Greenway by posting signage and making maps and guides to facilitate use of the trail.
- *The Cape Fear Paddlers Association* promotes kayaking and canoeing in the waters of the Cape Fear River Region, organizes paddling trips and races, and coordinates with local retailers to promote and support boat demonstrations.

- *The Cape Fear River Watch organizes monthly environmental seminars, river clean-up outings, maintenance, monitoring, research, and training for River Watch members to “adopt” rivers, streams, and tributaries.*

Specific tasks for non-profits related to the implementation of this Plan include:

- *Participate as members of the Greenways Advisory Committee.*
- *Advocate, promote, and encourage the development of trails throughout the region.*
- *Educate citizens as to the benefits of trails and greenways.*
- *Assist the WMPO and its counties and municipalities in raising funds and securing ROW for implementation.*
- *Help to organize volunteers to assist with implementation and management.*
- *Sponsor or co-sponsor greenway events.*

OVERALL ACTION STEPS TABLE

POLICY ACTION STEPS					
#	Task	Lead Agency	Support	Details	Phase
1	Present Plan for local adoption	WMPO	County, City, and Town Staff	The plan should be presented to locally elected officials in Fall 2012. Focus on the health and economic benefits of greenways (Chapter 1) and key trail recommendations (Chapter 3).	Short Term (early 2013)
2	Present Plan to NCDOT and NCDENR for approval	WMPO	NCDOT and NCDENR	This plan and the recommended trail routes should be officially recognized by NCDOT and NCDENR in the appropriate manner for each agency. For example, NCDOT should refer to this document when assessing the impact of future projects and plans.	Short Term (early 2013)
3	Amend local zoning and subdivision ordinances and technical standards	County, City, and Town Staff	WMPO	Each local zoning and subdivision ordinance should be considered for amendment to ensure that, as developments are planned and reviewed, the greenway corridors and blueway access areas identified in this plan are protected. This would entail amending development regulations to have developers set aside land for trails whenever a development proposal overlaps with the proposed routes, as adopted.	Short Term (mid 2013)
4	Revise sewer, stormwater and utility easement policies	County, City, and Town Staff	CFPUA	All new sewer, stormwater and utility easements should be considered for allowing public access as a matter of right. Such a consideration should allow for access that does not require landowner approval for each parcel the easement overlaps. As trails are developed, also review applicable existing easements for similar revision considerations.	Short Term (mid 2013)
5	Develop a corporate sponsorship policy	WMPO	County, City, and Town Staff	For a comprehensive sponsorship policy example, see that of Portland Parks and Recreation: www.portlandonline.com/shared/cfm/image.cfm?id=155570 . For a sponsorship brochure example, see that of the ‘Mountains to Sound Greenway’: http://mtsgreenway.org/events-calendar/greenway-365-sponsorship-brochure	Short Term (early 2013)

6	Develop a coordinated operations & maintenance plan	WMPO	County, City, and Town Staff	This plan will help to apportion responsibility between agencies where facilities cross jurisdictional boundaries or where pooled efforts can reduce costs. See the appendix of this plan for more information about best practices for operations and maintenance.	Medium Term (2013 - 2015)
7	Amend parking deck regulations and provide bicycle parking incentives to businesses	County, City, and Town Staff	WMPO	Parking deck regulations should require bicycle parking facilities on the first floor of all garages, near attendant stations. A bicycle parking incentive program for businesses should be established based on a best practice review of existing programs.	Medium Term (2013 - 2015)

PROGRAM ACTION STEPS					
#	Task	Lead Agency	Support	Details	Phase
1	Appoint a Regional Bicycle, Pedestrian, and Trails Coordinator.	WMPO		This coordinator would be responsible for implementing this Plan and would work with local agencies and municipalities to seek funding. This coordinator could also manage and facilitate meetings for the Greenways Advisory Committee.	Short Term (early 2013)
2	Form a Greenways Advisory Committee	WMPO	Representatives from key stakeholders during the planning process	The purpose of this group is to establish regional coordination for trail development. While the group would not carry authority for decision making, they would still play a critical coordinating role. The group could include members from the local counties and municipalities and the WMPO. Meetings should evaluate implementation progress and set goals to be achieved before the following meeting. The group should also make necessary plan updates.	Short Term (early 2013); Quarterly meetings to start, then semi-annual meetings.
3	Ensure planning efforts are integrated regionally.	Greenways Advisory Committee	WMPO	Combining resources and efforts with surrounding municipalities, regional entities, and stakeholders is mutually beneficial. Ongoing communication and coordination with neighboring counties and municipalities on regional trail corridors is essential. Partnerships for joint funding opportunities should also be pursued. After adoption by the local agencies, this document should also be recognized in regional transportation plans.	Ongoing
4	Support establishment of a Friends of Blueways and Greenways Group	Regional Bicycle, Pedestrian, and Trails Coordinator	Interested citizens, Greenways Advisory Committee	Establish citizen-led committee (allow two months for establishing committee mission and scope). A Friends of Blueways and Greenways Group would serve as a complement to and co-collaborator with the Greenways Advisory Committee.	Short Term (early 2013)
5	Continue and expand the 'See Share Be Aware' campaign or other safety campaign	TBD	WMPO	Determine appropriate entity to continue to foster the partnerships created through this effort and provide funding for the expansion of this campaign. With each analysis, that entity can determine which crash causes are most significant and develop targeted campaigns to address these concerns.	Ongoing

6	Establish Annual Evaluation Program	Regional Bicycle, Pedestrian, and Trails Coordinator	WMPO, Friends of Blueways and Greenways Group, UNCW	Establish Annual Evaluation Program that covers economic impacts, health impacts, and bike/ped counts. See the HIA appendix and Programs appendix for more information. Coordinate with UNCW for volunteer recruitment and identifying count locations. Count dates should fall on dates recommended by the National Pedestrian and Bicycle Documentation Project.	Short Term (2013); Continue annually
7	Safe Routes to School Regional Plan (Connecting Schools Initiative)	WMPO, County, City, and Towns	NCDOT Safe Routes to School Coordinator, WMPO	Per the WMPO Strategic Business Plan, one Safe Routes to School plan will be completed per year.	Ongoing
8	Schedule Bike Month Activities	Regional Bicycle, Pedestrian, and Trails Coordinator	WMPO Bike/Ped Committee	Begin January 2013: four-month planning process to develop Bike Month activity calendar and promotional materials. Bike Month occurs annually in May. Note that the WMPO Bike/Ped Committee is currently planning for this.	Short Term (2013)
9	Develop Walking Maps and plan Weekend Walkabouts	Regional Bicycle, Pedestrian, and Trails Coordinator	County, City, and Town Staff; Friends of Blueways and Greenways Group; WMPO Bike/Ped Committee	Begin March, 2013: four-month planning process to develop walking routes and map; ongoing distribution and promotion. Update every five years. Begin Weekend Walkabouts planning in July 2013: three-month planning process to develop Weekend Walkabout routes, themes, and promotional materials.	Medium Term (2013 - 2015)
10	Establish Campus Commuter Programs	UNC Wilmington and Cape Fear Community College Staff	Regional Bicycle, Pedestrian, and Trails Coordinator	Begin April 2013: four-month planning process to develop commuter program scope and promotional strategy. Launch at start of Fall 2013 semester.	Medium Term (2013 -2015)
11	Schedule Open Street Events	Regional Bicycle, Pedestrian, and Trails Coordinator	County, City, and Town Staff; Friends of Blueways and Greenways Group	Begin November 2013: four-month planning process to develop scope of activities to take place within the "open street" and create promotional materials. Schedule monthly during spring initially. Expand to spring and fall in the future.	Medium Term (2013 -2015)
12	Establish Regional Bicycle Tourism Strategy	WMPO	County, City, and Town Staff; Bicycle & Pedestrian Advisory Committee	Begin November 2013: six-month planning process to develop bicycle tourism regional strategy, establish partnerships, and create marketing materials. Launch as part of Bike Month 2014.	Medium Term (2013 -2015)
13	Generate Greenways Report Card	Regional Bicycle, Pedestrian, and Trails Coordinator	Greenways Advisory Committee; Friends of Blueways and Greenways Group	Begin 2013: three-month process to develop 2013 report card and to plan presentation to the media.	Medium Term (2013 -2015)
14	Establish a bicycle and pedestrian wayfinding system for trails and other points of interest throughout the region	Greenways Advisory Committee Subgroup	Friends of Blueways and Greenways Group	A wayfinding system is recommended to increase awareness of walking and biking distances to destinations around the area, including-but not exclusively-greenways. Distances should be provided in mileage and minutes. The system should be designed so that it is flexible enough to be updated as new projects are completed. See Chapter 5 Design Guidelines for more information about signage and wayfinding.	Medium Term (2013 -2015)

INFRASTRUCTURE ACTION STEPS

#	Task	Lead Agency	Support	Details	Phase
1	Identify and secure specific funding sources for priority trail corridors	WMPO	Greenways Advisory Committee; County, City, and Town Staff	Federal and state grants should be pursued along with local funds to pay for trail ROW acquisition, trail design, construction, and maintenance expenses. "Shovel-ready" designed projects should be prepared in the event that future federal stimulus funds become available. Recommended funding sources may be found in Appendix E.	Short Term (2013 -2014)
2	Establish an Adopt-a-Greenway Program and an Adopt-a-Blueway Program	City and County Parks & Recreation Staff	Greenways Advisory Committee	The City of Wilmington currently has a draft of this program that could leverage both private donations and volunteers for maintaining the greenways system. The program should be coordinated with the County and Towns. This effort should include a website for easy donating.	Short Term (2013 -2014)
3	Use consistent trail design standards and guidelines	County, City, and Town Staff	WMPO	Using the Design Guidelines of Chapter 5 of this plan, implementing agencies should seek to build the highest quality trails possible. Certain trail design standards may be required depending on sources of funding (state, federal, local or private).	Ongoing
4	Begin priority trail and blueway projects	WMPO, County, City, and Town Staff	Greenways Advisory Committee	Immediate attention to the higher priorities will have a large impact on bicycling and walking conditions in the region. First phase work should include critical trail connections and projects identified in the prioritization process. See Map 3.3 for top blueway recommendations.	Short Term (2013 -2014)
5	Develop a long term funding strategy	WMPO, County, City, and Town Staff	Greenways Advisory Committee; WMPO	To allow continued development of the overall system, local government capital funds for trail construction should be set aside every year, even if only a small amount; small amounts of local funding can be matched to outside funding sources. Funding for an ongoing maintenance program should also be included in the local operating budgets. Cross-jurisdictional trail projects lend themselves well to collaboration on funding as coordinated multi-jurisdictional projects are looked upon more favorably by outside funding sources than single-jurisdiction applications.	Short Term (2013)
6	Maintain greenway and blueway facilities	County, City, and Town Staff	WMPO	Local agencies that are responsible for trail and water access maintenance should make immediate repairs to trails and sites that are damaged or have hazardous conditions. For some trails, such as off-road footpaths, maintenance responsibilities can be supplemented with volunteer labor.	Ongoing
7	Develop a phase 2 project list and complete phase 2 projects	Greenways Advisory Committee	County, City, and Town Staff ; WMPO	In 2015, reevaluate near-term priorities based on what has been completed and confirm the agenda of "Phase 2" projects. Consider including earlier projects that were not completed and consider new trail opportunities that may have arisen since 2012.	Medium Term (2015 -2017)
8	Develop phase 3 project list and complete phase 3 projects	Greenways Advisory Committee	County, City, and Town Staff ; WMPO	In 2018, reassess projects and reevaluate priorities and phases. Consider a full plan update.	Long Term (2018 -2020)

DESIGN GUIDELINES

Chapter Contents:

Introduction

Multi-Use Paths

Path/Roadway Crossings

Crossing Beacons and Signals

Bikeway Signing

Design Needs of Bicyclists

Bicycle Facility Typologies

Shared Roadways

Bicycle Boulevards

Separated Bikeways

Cycle Tracks

Separated Bikeways
at Intersections

Bicycle Support Facilities

Design Needs of Paddlers

Paddle Trail Access Sites

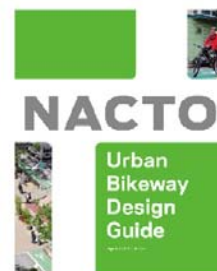
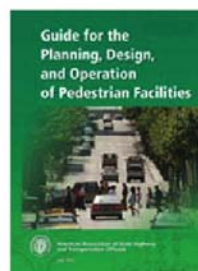
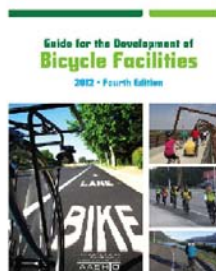
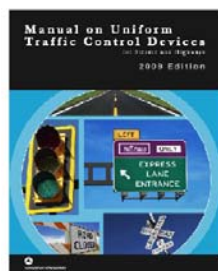
Blueway Signage

INTRODUCTION

This technical handbook is intended to assist the Wilmington Urban Area MPO and member jurisdictions in the selection and design of facilities. The following chapter pulls together best practices by facility type from public agencies and municipalities nationwide. Within the design chapters, treatments are covered within a single sheet tabular format relaying important design information and discussion, example photos, schematics (if applicable), and existing summary guidance from current or upcoming draft standards. Existing standards are referenced throughout and should be the first source of information when seeking to implement any of the treatments featured here.

These design guidelines are flexible and should be applied using professional judgment.

This document references specific national guidelines for bicycle and pedestrian facility design, as well as a number of design treatments not specifically covered under current guidelines. Statutory and regulatory guidance may change. For this reason, the guidance and recommendations in this document function to complement other resources considered during a design process, and in all cases sound engineering judgment should be used. *For additional guiding principles of this plan, refer to page 1-2.*



NATIONAL STANDARDS

The Federal Highway Administration's **Manual on Uniform Traffic Control Devices** (MUTCD) defines the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public traffic. The MUTCD is the primary source for guidance on lane striping requirements, signal warrants, and recommended signage and pavement markings.

To further clarify the MUTCD, the FHWA created a table of contemporary bicycle facilities that lists various bicycle-related signs, markings, signals, and other treatments and identifies their official status (e.g., can be implemented, currently experimental). See **Bicycle Facilities and the Manual on Uniform Traffic Control Devices**.¹

Treatments not explicitly covered by the MUTCD are often subject to experiments, interpretations and official rulings by the FHWA. The **MUTCD Official Rulings** is a resource that allows website visitors to obtain information about these supplementary materials. Copies of various documents (such as incoming request letters, response letters from the FHWA, progress reports, and final reports) are available on this website.²

¹ *Bicycle Facilities and the Manual on Uniform Traffic Control Devices*. (2011). FHWA. http://www.fhwa.dot.gov/environment/bikeped/mutcd_bike.htm

² *MUTCD Official Rulings*. FHWA. <http://mutcd.fhwa.dot.gov/orsearch.asp>

American Association of State Highway and Transportation Officials (AASHTO) **Guide for the Development of Bicycle Facilities**, updated in June 2012 provides guidance on dimensions, use, and layout of specific bicycle facilities. The standards and guidelines presented by AASHTO provide basic information, such as minimum sidewalk widths, bicycle lane dimensions, detailed striping requirements and recommended signage and pavement markings.

Offering similar guidance for pedestrian design, the 2004 AASHTO **Guide for the Planning, Design and Operation of Pedestrian Facilities** provides comprehensive guidance on planning and designing for people on foot.

The National Association of City Transportation Officials' (NACTO) 2012 **Urban Bikeway Design Guide**³ is the newest publication of nationally recognized bikeway design standards, and offers guidance on the current state of the practice designs. The NACTO Urban Bikeway Design Guide is based on current practices in the best cycling cities in the world. The intent of the guide is to offer substantive guidance for cities seeking to improve bicycle transportation in places where competing demands for the use of the right of way present unique challenges. All of the NACTO Urban Bikeway Design Guide treatments are in use internationally and in many cities around the US.

Meeting the requirements of the Americans with Disabilities Act (ADA) is an important part of any bicycle and pedestrian facility project. The United States Access Board's proposed **Public Rights-of-Way Accessibility Guidelines**⁴ (PROWAG) and the **2010 ADA Standards for Accessible Design**⁵ (2010 Standards) contain standards and guidance for the construction of accessible facilities. This includes requirements for sidewalk curb ramps, slope requirements, and pedestrian railings along stairs.

Some of these treatments are not directly referenced in the current versions of the AASHTO Guide or the MUTCD, although many of the elements of these treatments are found within these documents. In all cases, engineering judgment is recommended to ensure that the application makes sense for the context of each treatment, given the many complexities of urban streets.

STATE STANDARDS

NCDOT. (2012). **North Carolina Complete Streets Planning and Design Guidelines**. NCDOT adopted a "Complete Streets" policy in July 2009. The policy directs the Department to consider and incorporate several modes of transportation when building new projects or making improvements to existing infrastructure. This document provides guidance on how that policy will be implemented in order for NCDOT to collaborate with cities, towns and communities during the planning and design phases of projects. Together, they will decide how to provide the transportation options needed to serve the community and complement the context of the area.

NCDOT. (1994). **North Carolina Bicycle Facilities Planning and Design Guidelines**. The state endorsed resource for the design of bicycle facilities.

ADDITIONAL REFERENCES

In addition to the previously described national standards, the basic bicycle and pedestrian design principals outlined in this chapter are derived from the documents listed below. Many of these documents are available online and provide a wealth of public information and resources.

ADDITIONAL US FEDERAL GUIDELINES

- American Association of State Highway and Transportation Officials. (2001). *AASHTO Policy on Geometric Design of Streets and Highways*. Washington, DC. www.transportation.org
- United States Access Board. (2007). *Public Rights-of-Way Accessibility Guidelines (PROWAG)*. Washington, D.C. <http://www.access-board.gov/PROWAC/alterations/guide.htm>

³ <http://nacto.org/cities-for-cycling/design-guide/>

⁴ <http://www.access-board.gov/prowac/>

⁵ http://www.ada.gov/2010ADASTandards_index.htm

- United States Department of Justice. (2010). *2010 ADA Standards for Accessible Design*. http://www.ada.gov/2010ADAstandards_index.htm

BEST PRACTICE DOCUMENTS

- Alta Planning + Design and the Initiative for Bicycle & Pedestrian Innovation (IBPI). (2009). *Fundamentals of Bicycle Boulevard Planning & Design*. <http://www.ibpi.usp.pdx.edu/media/BicycleBoulevardGuidebook.pdf>
- Alta Planning + Design. (2009). *Cycle Tracks: Lessons Learned*. http://www.altaplanning.com/App_Content/files/pres_stud_docs/Cycle%20Track%20lessons%20learned.pdf
- Association of Pedestrian and Bicycle Professionals (APBP). (2010). *Bicycle Parking Design Guidelines, 2nd Edition*.
- City of Portland Bureau of Transportation. (2010). *Portland Bicycle Master Plan for 2030*. <http://www.portlandonline.com/transportation/index.cfm?c=44597>
- Federal Highway Administration. (2005). *BIKESAFE: Bicycle Countermeasure Selection System*. <http://www.bicyclinginfo.org/bikesafe/index.cfm>
- Federal Highway Administration. (2005). *PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System*. <http://www.walkinginfo.org/pedsafe/>
- Federal Highway Administration. (2005). *Report HRT-04-100, Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations*. <http://www.fhwa.dot.gov/publications/research/safety/04100/>
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- King, Michael, for the Pedestrian and Bicycle Information Center. (2002). *Bicycle Facility Selection: A Comparison of Approaches*. Highway Safety Research Center, University of North Carolina – Chapel Hill. <http://www.hsrc.unc.edu/pdf/2002/BicycleFacilitySelectionMKingetal2002.pdf>
- Oregon Department of Transportation. (2012). *Oregon Bicycle and Pedestrian Design Guide*. <http://www.oregon.gov/ODOT/HWY/BIKEPED/planproc.shtml>
- Rosales, Jennifer. (2006). *Road Diet Handbook: Setting Trends for Livable Streets*.

GLOSSARY

The following list is comprised of common terms, acronyms and concepts used in bicycle transportation planning, design and operation.

AASHTO – American Association of State Highway and Transportation Officials

Accessible route – A continuous route on private property that is accessible to persons with disabilities. There must be at least one accessible route linking the public sidewalk to each accessible building.

Actuated signal – A signal where the length of the phases for different traffic movements is adjusted for demand by a signal controller using information from detectors.

ADA – Americans with Disabilities Act of 1990; broad legislation mandating provision of access to employment, services, and the built environment to those with disabilities.

At-grade crossing – A junction where bicycle path or sidewalk users cross a roadway over the same surface as motor vehicle traffic, as opposed to a grade-separated crossing where users cross over or under the roadway using a bridge or tunnel.

Audible pedestrian signals – Pedestrian signal indicators that provide an audible signal to assist visually impaired pedestrians in crossing the street.

Bicycle boulevard - Streets designed to give bicyclists priority by reducing motor vehicle volumes and speeds using barriers or other design elements, in order to enhance bicycle safety and enjoyment.

Bicycle facilities - A general term used to describe all types of bicycle-related infrastructure including linear bikeways and other provisions to accommodate or encourage bicycling, including bike racks and lockers, bikeways, and showers at employment destinations.

Bike lane - A striped lane for one-way bike travel on a street or highway.

Bicycle level of service (BLOS) – Indication of bicyclist comfort level for specific roadway geometries and traffic conditions. Roadways with a better (lower) score are more attractive (and usually safer) for bicyclists.

Bike path – A paved pathway separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent alignment. Bike paths may be used by pedestrians, bicyclists, skaters, wheelchair users, runners, and other non-motorized users.

Bike route - A shared roadway specifically identified for use by bicyclists, providing a superior route based on traffic volumes and speeds, street width, directness, and/or cross-street priority; designated by signs only.

Bikeway – A generic term for any road, street, path or way that in some manner is specifically designed 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.

Bollard – Post used to restrict motor vehicle use of space dedicated to bicyclists and/or pedestrians.

Clearance interval – The length of time that the DON'T WALK indication is flashing on a pedestrian signal indication.

Clearance, lateral – Width required for safe passage of people riding bicycles as measured on a horizontal plane.

Clearance, vertical – Height required for safe passage of people riding bicycles as measured on a vertical plane.

Crosswalk – Any portion of a roadway at an intersection or elsewhere that is distinctly indicated for pedestrian crossing. Where there are no pavement markings, there is a crosswalk at each leg of every intersection, defined by law as the prolongation or connection of the lateral lines of the sidewalks.

Curb extension – An area where the sidewalk and curb are extended into the parking lane, usually in order to shorten pedestrian crossing distance. Also called “bulb-out” or “curb bulb.”

Curb ramp – A combined ramp and landing to accomplish a change of level at a curb in order to provide access to pedestrians using wheelchairs.

Directional signs – Signs typically placed at road and bikeway junctions (decision points) to guide people riding bicycles toward a destination or experience.

Geometry - The vertical and horizontal characteristics of a transportation facility, typically defined in terms of gradient, radius, and superelevation.

Grade separation - Vertical separation of travelways through use of a bridge or tunnel so that traffic conflicts are minimized.

Grade-separated crossing – A bridge or tunnel allowing pedestrians and bicyclists to cross a major roadway without conflict.

HCM - Highway Capacity Manual

HDM – Highway Design Manual

Level of service (LOS) - Term for the measurement of how well traffic “flows” on a roadway system or how well an intersection functions.

Loop detector - A device placed under the pavement at intersections to detect a vehicle or bicycle and subsequently trigger a signal to turn green.

Medians – Area in the center of the roadway that separates directional traffic; may provide a striped crossing and halfway point for pedestrians (also can be effective traffic calming design). Medians may be level with the surrounding roadway or “raised” using curb and/or gutter. Medians may include landscaping, concrete, paint/stripping or any combination thereof.

MUTCD – Manual on Uniform Traffic Control Devices

Paved shoulder – The edge of the roadway beyond the outer stripe edge that provides a place for people riding bicycles. It only functions well for bicyclists if it is wide enough (4-5 feet), free of debris, and does not contain rumble strips or other obstructions.

Pavement marking – An assortment of markings on the surface of the pavement that provide directions to motorists and other road users as to the proper use of the road (the MUTCD determines these standard markings).

Pedestrian – a person afoot; a person operating a pushcart; a person riding on, or pulling a coaster wagon, sled, scooter, tricycle, bicycle with wheels less than 14 inches in diameter, or a similar conveyance; a person on roller skates, skateboard, wheelchair or a baby in a carriage.

Pedestrian signal indication – the lighted WALK/DON’T WALK (or walking man/hand) signal that indicates the pedestrian phase.

Refuge islands – Corner raised triangles or medians, used by pedestrians and bicyclists at intersections or mid-block crossings for assistance with crossing wide streets, especially where motor vehicle right turn lanes exist.

Right-of-way (ROW) - The right of one vehicle, bicycle or pedestrian to proceed in a lawful manner in preference to another vehicle, bicycle, or pedestrian. Also the strip of property in which a transportation facility or other facility is built.

Shared Lane Marking (SLM) or Sharrow – A pavement marking that designates roadway space to be shared between drivers and people riding bicycles.

Shared roadway - A roadway where bicyclists and motor vehicles share the same space with no striped bike lane. Any roadway where bicycles are not prohibited by law (i.e. interstate highways or freeways) is a shared roadway.

Shared use path – A paved right-of-way that permits more than one type of user, such as a trail designated for use by both pedestrians and bicyclists.

Sidewalk – An improved facility intended to provide for pedestrian movement; usually, but not always, located in the public right-of-way adjacent to a roadway. Typically constructed of concrete.

Sight distance - The distance a person can see along an unobstructed line of sight.

Traffic calming - Changes in street alignment, installation of barrier, and other physical measures to reduce traffic speeds and/or cut-through traffic volume in the interest of street safety, livability, and other public purposes.

Traffic control devices - Signs, signals or other fixtures, whether permanent or temporary, placed on or adjacent to a travelway by authority of a public body having jurisdiction to regulate, warn, or guide traffic.

Traffic volume - The number of vehicles that pass a specific point in a specific amount of time (hour, day, year).

Wide curb lane – A 14 foot (or greater) wide outside lane adjacent to the curb of a roadway that provides space for bicyclists to ride to the right of motor vehicles. Also referred to as a “wide outside lane”. If adjacent to parking, 22 foot wide pavement may also be considered a wide curb lane.

Multi-Use Paths

A multi-use path (also known as a greenway or shared-use path) allows for two-way, off-street bicycle use and also may be used by pedestrians, skaters, wheelchair users, joggers and other non-motorized users. These facilities are frequently found in parks, along rivers, beaches, and in greenbelts or utility corridors where there are few conflicts with motorized vehicles. Path facilities can also include amenities such as lighting, signage, and fencing (where appropriate).

Key features of multi-use paths include:

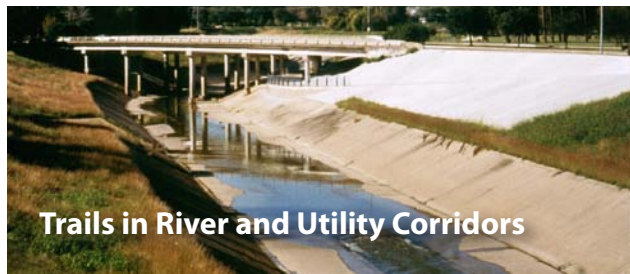
- Frequent access points from the local road network.
- Directional signs to direct users to and from the path.
- A limited number of at-grade crossings with streets or driveways.
- Terminating the path where it is easily accessible to and from the street system.
- Separate treads for pedestrians and bicyclists when heavy use is expected.

This Section Includes:

- General Design Practices
- Trails in River and Utility Corridors
- Trails in Abandoned Rail Corridors
- Trails in Existing Active Rail Corridors
- Shared Use Paths Along Roadways
- Natural Surface Trails
- Boardwalks
- Trail Bridges
- Local Neighborhood Accessways



General Design Practices



Trails in River and Utility Corridors



Trails in Abandoned Rail Corridors



Shared Use Paths along Roadways



Natural Surface Trails



Local Neighborhood Accessways

Multi-Use Paths

General Design Practices

Description

Multi-use paths can provide a desirable facility, particularly for recreation, and users of all skill levels preferring separation from traffic. Bicycle paths should generally provide directional travel opportunities not provided by existing roadways.

Guidance

Width

- 8 feet is the minimum allowed for a two-way path and is only recommended for low traffic situations or under certain design constraints.
- 10 feet is recommended in most situations and will be adequate for moderate to heavy use.
- 12 feet is recommended for heavy use situations with high concentrations of multiple users. A separate track (5' minimum) can be provided for pedestrian use.

Lateral Clearance

- A 2 foot or greater shoulder on both sides of the path should be provided. An additional foot of lateral clearance (total of 3') is required by the MUTCD for the installation of signage or other furnishings.
- Where there is not enough shoulder to meet off-sets at the top of a slope, consider the use of dense shrubbery (see image at right).

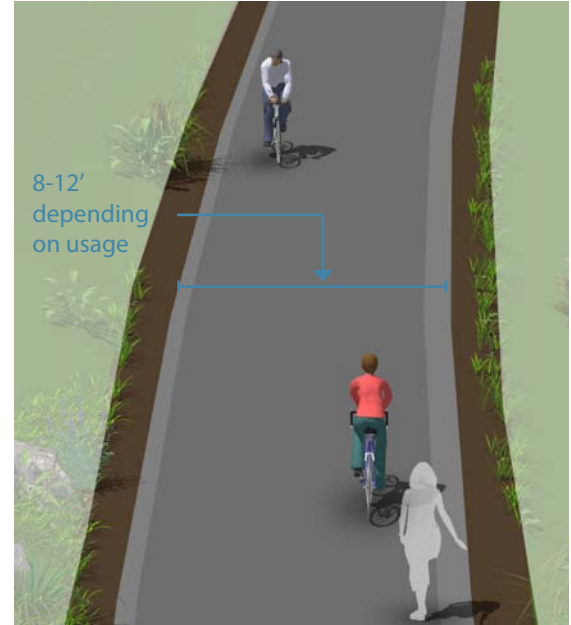
Overhead Clearance

- Clearance to overhead obstructions should be 8 feet minimum, with 10 feet recommended.

Striping

- When striping is required, use a 4 inch dashed yellow centerline stripe with 4 inch solid white edge lines.
- Solid centerlines can be provided on tight or blind corners, and on the approaches to roadway crossings.

Terminate the path where it is easily accessible to and from the street system, preferably at a controlled intersection or at the beginning of a dead-end street.



Discussion

The AASHTO Guide for the Development of Bicycle Facilities generally recommends against the development of shared use paths along roadways. Also known as “sidepaths”, these facilities create a situation where a portion of the bicycle traffic rides against the normal flow of motor vehicle traffic and can result in wrong-way riding when either entering or exiting the path.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
 FHWA. (2009). Manual on Uniform Traffic Control Devices.
 Flink, C. (1993). Greenways: A Guide To Planning Design And Development.

Materials and Maintenance

Asphalt is the most common surface for bicycle paths. The use of concrete for paths has proven to be more durable over the long term. Saw cut concrete joints rather than troweled improve the experience of path users.

Multi-Use Paths

Paths in River and Utility Corridors

Guidance

Multi-use paths in utility corridors should meet or exceed **general design practices**. If additional width allows, wider paths, and landscaping are desirable.

Access Points

Any access point to the path should be well-defined with appropriate signage designating the pathway as a bicycle facility and prohibiting motor vehicles.

Path Closure

Public access to the path may be prohibited during the following events:

- Canal/flood control channel or other utility maintenance activities
- Inclement weather or the prediction of storm conditions

Duke Energy/Progress Energy Transmission ROWs

In 2012, Duke Energy/Progress Energy held a special workshop to address trails in transmission ROWs. A copy of the current Duke Energy Electric Transmission Rights-of-Way Guidelines/Restrictions for North Carolina is available at www.duke-energy.com/safety/right-of-way-management/transmission-restrictions.asp. A summary of the workshop findings may be obtained from Mecklenburg County (who hosted the workshop): Mecklenburg County Park and Recreation, 5841 Brookshire Boulevard, Charlotte, NC 28216; (704) 432-1570; Gwen.Cook@MecklenburgCountyNC.gov.

Description

Utility and waterway corridors often offer excellent path development and bikeway gap closure opportunities. Utility corridors typically include powerline and sewer corridors, while waterway corridors include canals, drainage ditches, rivers, and beaches. These corridors offer excellent transportation and recreation opportunities for bicyclists of all ages and skills.



Discussion

Similar to railroads, public access to flood control channels or canals is undesirable by all parties. Hazardous materials, deep water or swift current, steep, slippery slopes, and debris all constitute risks for public access. Appropriate fencing may be required to keep path users within the designated travel way. Creative design of fencing is encouraged to make the path facility feel welcoming to the user.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
FHWA. (2009). Manual on Uniform Traffic Control Devices.
Flink, C. (1993). Greenways: A Guide To Planning Design And Development.

Materials and Maintenance

Asphalt is the most common surface for bicycle paths. The use of concrete for paths has proven to be more durable over the long term. Saw cut concrete joints rather than troweled improve the experience of path users.

Multi-Use Paths

Paths in Abandoned Rail Corridors

Guidance

Multi-use paths in abandoned rail corridors should meet or exceed **general design practices**. If additional width allows, wider paths, and landscaping are desirable.

In full conversions of abandoned rail corridors, the sub-base, superstructure, drainage, bridges, and crossings are already established. Design becomes a matter of working with the existing infrastructure to meet the needs of a rail-trail.

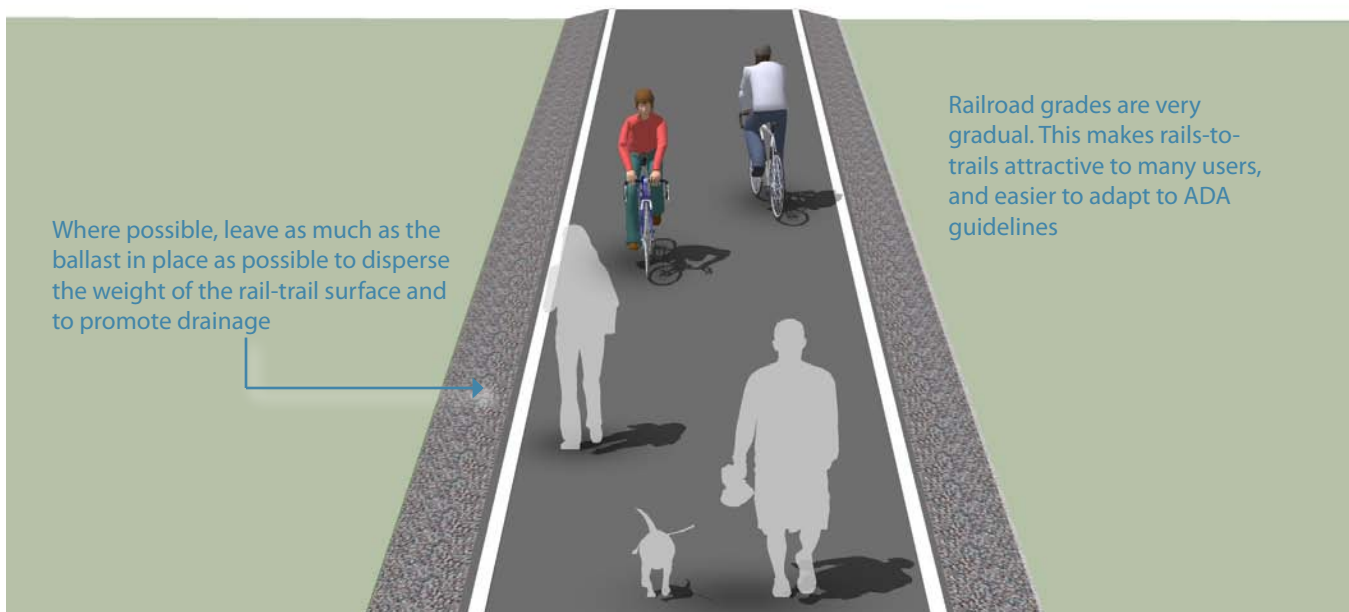
If converting a rail bed adjacent to an active rail line, see **Paths in Existing Active Rail Corridors**.

Description

Commonly referred to as Rails-to-Trails or Rail-Trails, these projects convert vacated rail corridors into off-street paths. Rail corridors offer several advantages, including relatively direct routes between major destinations and generally flat terrain.

In some cases, rail owners may rail-bank their corridors as an alternative to a complete abandonment of the line, thus preserving the rail corridor for possible future use.

The railroad may form an agreement with any person, public or private, who would like to use the banked rail line as a trail or linear park until it is again needed for rail use. Municipalities should acquire abandoned rail rights-of-way whenever possible to preserve the opportunity for trail development.



Discussion

It is often impractical and costly to add material to existing railroad bed fill slopes. This results in trails that meet minimum path widths, but often lack preferred shoulder and lateral clearance widths.

Rail-to-trails can involve many challenges including the acquisition of the right of way, cleanup and removal of toxic substances, and rehabilitation of tunnels, trestles and culverts. A structural engineer should evaluate existing railroad bridges for structural integrity to ensure they are capable of carrying the appropriate design loads.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
FHWA. (2009). Manual on Uniform Traffic Control Devices.
Flink, C. (1993). Greenways: A Guide To Planning Design And Development.

Materials and Maintenance

Asphalt is the most common surface for bicycle paths. The use of concrete for paths has proven to be more durable over the long term. Saw cut concrete joints rather than troweled improve the experience of path users.

Multi-Use Paths

Paths in Existing Active Rail Corridors

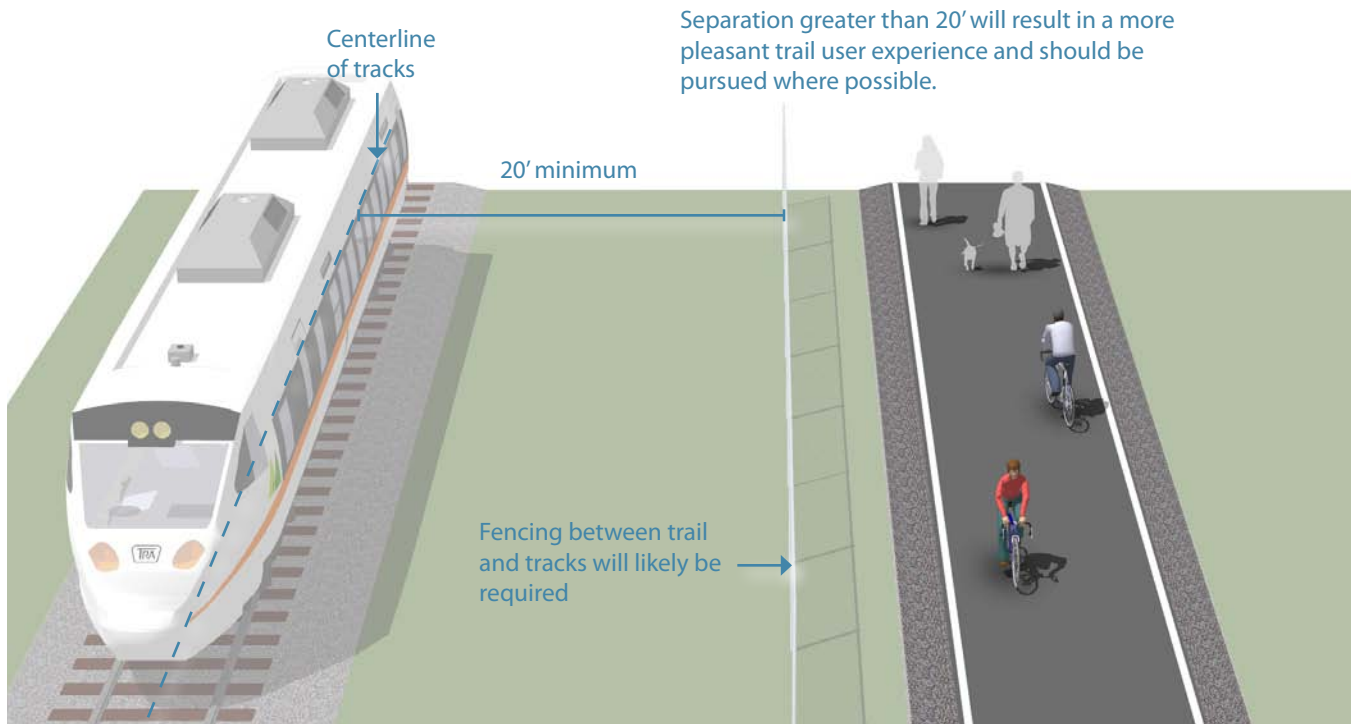
Guidance

Multi-use paths in utility corridors should meet or exceed **General Design Practices**. If additional width allows, wider paths, and landscaping are desirable.

If required, fencing should be a minimum of 5 feet in height with higher fencing usual next to sensitive areas such as switching yards. Setbacks from the active rail line will vary depending on the speed and frequency of trains, and available right-of-way.

Description

Rails-with-Trails projects typically consist of paths adjacent to active railroads. It should be noted that some constraints could impact the feasibility of rail-with-trail projects. In some cases, space needs to be preserved for future planned freight, transit or commuter rail service. In other cases, limited right-of-way width, inadequate setbacks, concerns about safety/trespassing, and numerous mid-block crossings may affect a project's feasibility.



Discussion

Railroads typically require fencing with all rail-with-trail projects. Concerns with trespassing and security can vary with the amount of train traffic on the adjacent rail line and the setting of the bicycle path, i.e. whether the section of track is in an urban or rural setting.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
FHWA. (2009). Manual on Uniform Traffic Control Devices.
FHWA. (2002). Rails-with-Trails: Lessons Learned.

Materials and Maintenance

Asphalt is the most common surface for bicycle paths. The use of concrete for paths has proven to be more durable over the long term. Saw cut concrete joints rather than troweled improve the experience of path users.

Multi-Use Paths

Shared Use Paths Along Roadways

Description

A shared use path allows for two-way, off-street bicycle use and also may be used by pedestrians, skaters, wheelchair users, joggers and other non-motorized users. These facilities are frequently found in parks, along rivers, beaches, and in greenbelts or utility corridors where there are few conflicts with motorized vehicles.

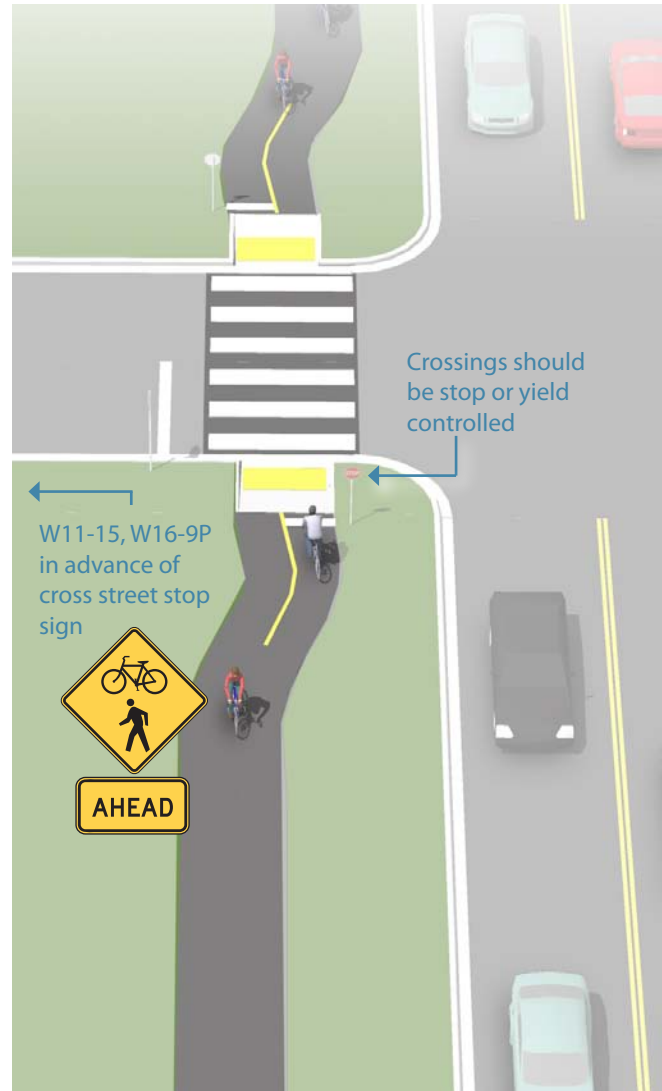
Along roadways, these facilities create a situation where a portion of the bicycle traffic rides against the normal flow of motor vehicle traffic and can result in wrong-way riding where bicyclists enter or leave the path.

The AASHTO Guide for the Development of Bicycle Facilities generally recommends against the development of shared-use paths directly adjacent to roadways.

Guidance

- 8 feet is the minimum allowed for a two-way bicycle path and is only recommended for low traffic situations or under certain design constraints.
- 10 feet is recommended in most situations and will be adequate for moderate to heavy use.
- 12 feet is recommended for heavy use situations with high concentrations of multiple users such as joggers, bicyclists, rollerbladers and pedestrians. A separate track (5' minimum) can be provided for pedestrian use.
- Bicycle lanes should be provided as an alternate (more transportation-oriented) facility whenever possible.

Pay special attention to the entrance/exit of the path as bicyclists may continue to travel on the wrong side of the street.



Discussion

When designing a bikeway network, the presence of a nearby or parallel path should not be used as a reason to not provide adequate shoulder or bicycle lane width on the roadway, as the on-street bicycle facility will generally be superior to the "sidepath" for experienced bicyclists and those who are cycling for transportation purposes.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
NACTO. (2012). Urban Bikeway Design Guide. See entry on Raised Cycle Tracks.

Materials and Maintenance

Asphalt is the most common surface for bicycle paths. The use of concrete for paths has proven to be more durable over the long term. Saw cut concrete joints rather than troweled improve the experience of path users.

Multi-Use Paths

Natural Surface Trails

Guidance

Trails can vary in width from 18 inches to 6 feet or greater; vertical clearance should be maintained at nine-feet above grade.

Base preparation varies from machine-worked surfaces to those worn only by usage.

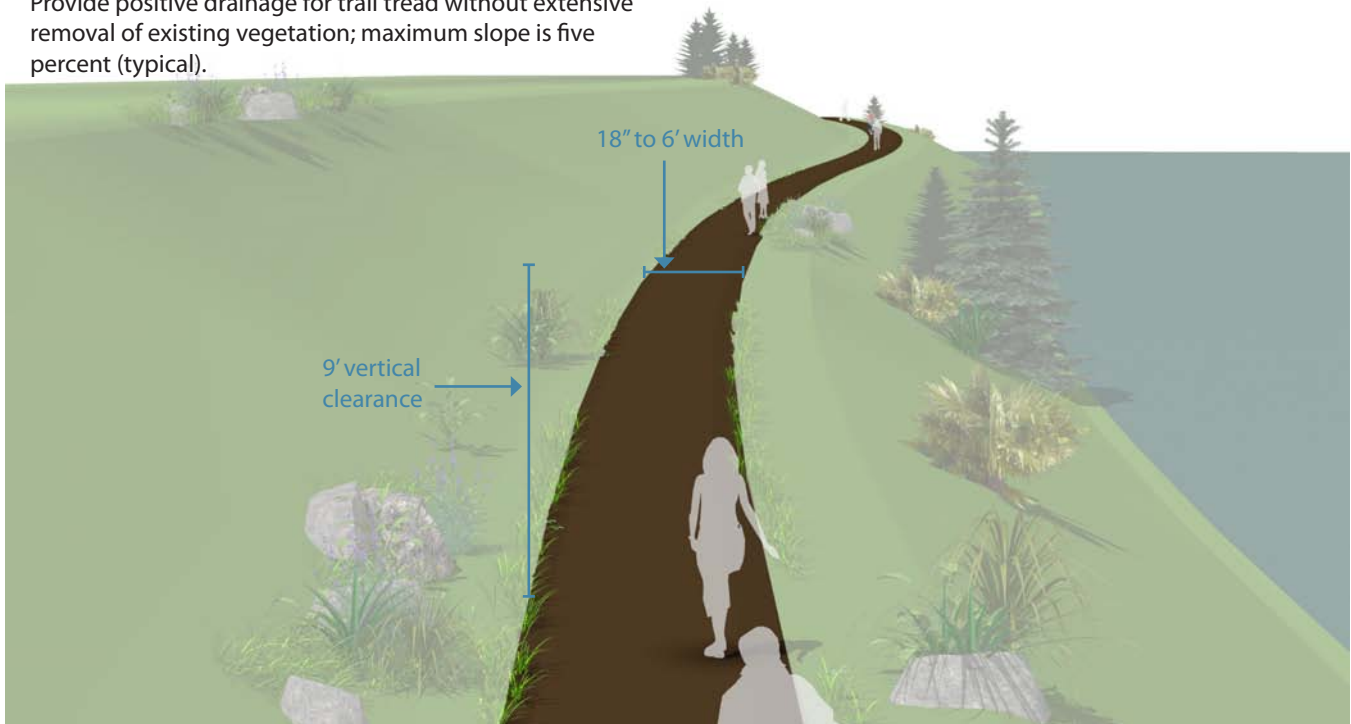
Trail surface can be made of dirt, rock, soil, forest litter, or other native materials. Some trails use crushed stone (a.k.a. "crush and run") that contains about 4% fines by weight, and compacts with use.

Provide positive drainage for trail tread without extensive removal of existing vegetation; maximum slope is five percent (typical).

Description

Sometimes referred to as footpaths or hiking trails, the natural surface trail is used along corridors that are environmentally-sensitive but can support bare earth, wood chip, or boardwalk trails. Natural surface trails are a low-impact solution and found in areas with limited development or where a more primitive experience is desired.

Guidance presented in this section does not include considerations for bicycles. Natural surface trails designed for bicycles are typically known as single track trails.



Discussion

Trail erosion control measures include edging along the low side of the trail, steps and terraces to contain surface material, and water bars to direct surface water off the trail; use bedrock surface where possible to reduce erosion.

Additional References and Guidelines

Flink, C. (1993). Greenways: A Guide To Planning Design And Development.

Materials and Maintenance

Consider implications for accessibility when weighing options for surface treatments.

Multi-Use Paths

Boardwalks

Guidance

- Boardwalk width should be a minimum of 10 feet when no rail is used. A 12 foot width is preferred in areas with average anticipated use and whenever rails are used.
- When the height of a boardwalk exceeds 30", railings are required.
- If access by vehicles is desired, boardwalks should be designed to structurally support the weight of a small truck or a light-weight vehicle.

Description

Boardwalks are typically required when crossing wetlands or other poorly drained areas. They are usually constructed of wooden planks or recycled material planks that form the top layer of the boardwalk. The recycled material has gained popularity in recent years since it lasts much longer than wood, especially in wet conditions. A number of low-impact support systems are also available that reduce the disturbance within wetland areas to the greatest extent possible.



Discussion

In general, building in wetlands is subject to regulations and should be avoided.

The foundation normally consists of wooden posts or auger piers (screw anchors). Screw anchors provide greater support and last much longer.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
FHWA. (2001). Wetland Trail Design and Construction.

Materials and Maintenance

Decking should be either non-toxic treated wood or recycled plastic. Cable rails are attractive and more visually transparent but may require maintenance to tighten the cables if the trail has snow storage requirements.

Multi-Use Paths

Trail Bridges

Guidance

- The clear width of the bridge should allow for 2 ft of clearance on each end of the pathway.
- Bridge deck height should match that of the path surface to provide a smooth transition.
- Bicycle and shared-use paths should include a 54" guard rail where hazardous conditions exist.
- A minimum vertical clearance of 10 ft is desirable for motor vehicle access. Minimum height is 42 inches.
- Maximum opening between railing posts is 6 inches.
- A trail bridge should support 6.25 tons if motor vehicle access is permitted. (AASHTO 2002)

Description

Multi-Use Trail bridges (also 'bicycle/pedestrian bridges' or 'footbridges') are most often used to provide trail access over natural features such as streams and rivers, where a culvert is not an option. The type and size of bridges can vary widely depending on the trail type and specific site requirements. Some bridges often used for multi-use trails include suspension bridges, prefabricated span bridges and simple log bridges. When determining a bridge design for multi-use trails, it is important to consider emergency and maintenance vehicle access.



Discussion

If a corridor already contains a bridge such as an abandoned rail bridge, an engineer should be consulted to assess the structural integrity before deciding to remove or reuse it.

All abutment design should be sealed by a qualified structural engineer and all relevant permits should be filed.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
 AASHTO. (2012). Bridge Design Specifications.
 AASHTO. (2009). Guide Specifications for Design of Pedestrian Bridges.
 AASHTO. (2002). Standard Specifications for Highway Bridges.

Materials and Maintenance

High quality prefabricated pedestrian bridges available.

Multi-Use Paths

Local Neighborhood Accessways

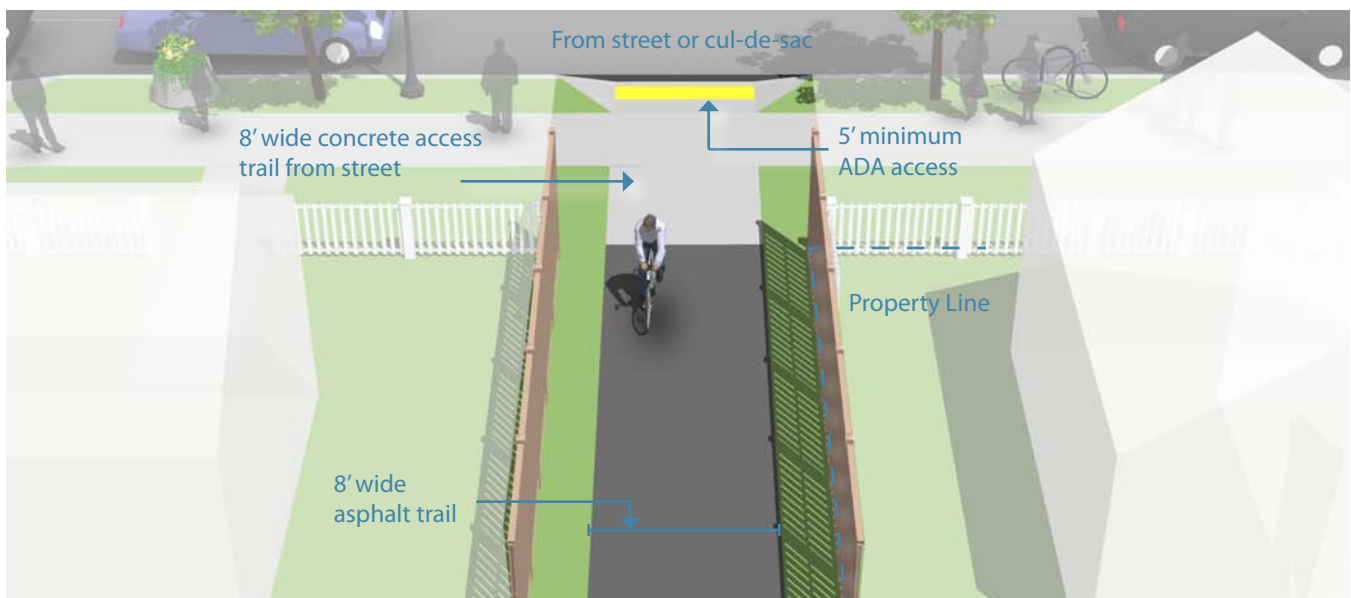
Guidance

- Neighborhood accessways should remain open to the public.
- Trail pavement shall be at least 8' wide to accommodate emergency and maintenance vehicles, meet ADA requirements and be considered suitable for multi-use.
- Trail widths should be designed to be less than 8' wide only when necessary to protect large mature native trees over 18" in caliper, wetlands or other ecologically sensitive areas.
- Access trails should slightly meander whenever possible.

Description

Neighborhood accessways provide residential areas with direct bicycle and pedestrian access to parks, trails, greenspaces, and other recreational areas. They most often serve as small trail connections to and from the larger trail network, typically having their own rights-of-way and easements.

Additionally, these smaller trails can be used to provide bicycle and pedestrian connections between dead-end streets, cul-de-sacs, and access to nearby destinations not provided by the street network.



Discussion

Neighborhood accessways should be designed into new subdivisions at every opportunity and should be required by City/County subdivision regulations.

For existing subdivisions, Neighborhood and homeowner association groups are encouraged to identify locations where such connects would be desirable. Nearby residents and adjacent property owners should be invited to provide landscape design input.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
 FHWA. (2009). Manual on Uniform Traffic Control Devices.
 FHWA. (2006). Federal Highway Administration University Course on Bicycle and Pedestrian Transportation. Lesson 19: Greenways and Shared Use Paths.

Materials and Maintenance

Asphalt is the most common surface for bicycle paths. The use of concrete for paths has proven to be more durable over the long term. Saw cut concrete joints rather than troweled improve the experience of path users.

Path/Roadway Crossings

At-grade roadway crossings can create potential conflicts between path users and motorists, however, well-designed crossings can mitigate many operational issues and provide a higher degree of safety and comfort for path users. This is evidenced by the thousands of successful facilities around the United States with at-grade crossings. In most cases, at-grade path crossings can be properly designed to provide a reasonable degree of safety and can meet existing traffic and safety standards. Path facilities that cater to bicyclists can require additional considerations due to the higher travel speed of bicyclists versus pedestrians.

Consideration must be given to adequate warning distance based on vehicle speeds and line of sight, with the visibility of any signs absolutely critical. Directing the active attention of motorists to roadway signs may require additional alerting devices such as a flashing beacon, roadway striping or changes in pavement texture. Signing for path users may include a standard "STOP" or "YIELD" sign and pavement markings, possibly combined with other features such as bollards or a bend in the pathway to slow bicyclists. Care must be taken not to place too many signs at crossings lest they begin to lose their visual impact.

A number of striping patterns have emerged over the years to delineate path crossings. A median stripe on the path approach will help to organize and warn path users. Crosswalk striping is typically a matter of local and State preference, and may be accompanied by pavement treatments to help warn and slow motorists. In areas where motorists do not typically yield to crosswalk users, additional measures may be required to increase compliance.



Marked/Unsignalized Crossings



Route Users to Existing Signals



Signalized/Controlled Crossings



Overcrossings



Bollard Alternatives

This section includes:

- Marked/Unsignalized Crossings
- Route Users to Existing Signalized Intersections
- Signalized/Controlled Crossings
- Overcrossings
- Bollard Alternatives

Path/Roadway Crossings

Marked/Unsignalized Crossings

Guidance

Maximum traffic volumes

- ≤9,000-12,000 Average Daily Traffic (ADT) volume
- Up to 15,000 ADT on two-lane roads, preferably with a median
- Up to 12,000 ADT on four-lane roads with median

Maximum travel speed

- 35 MPH

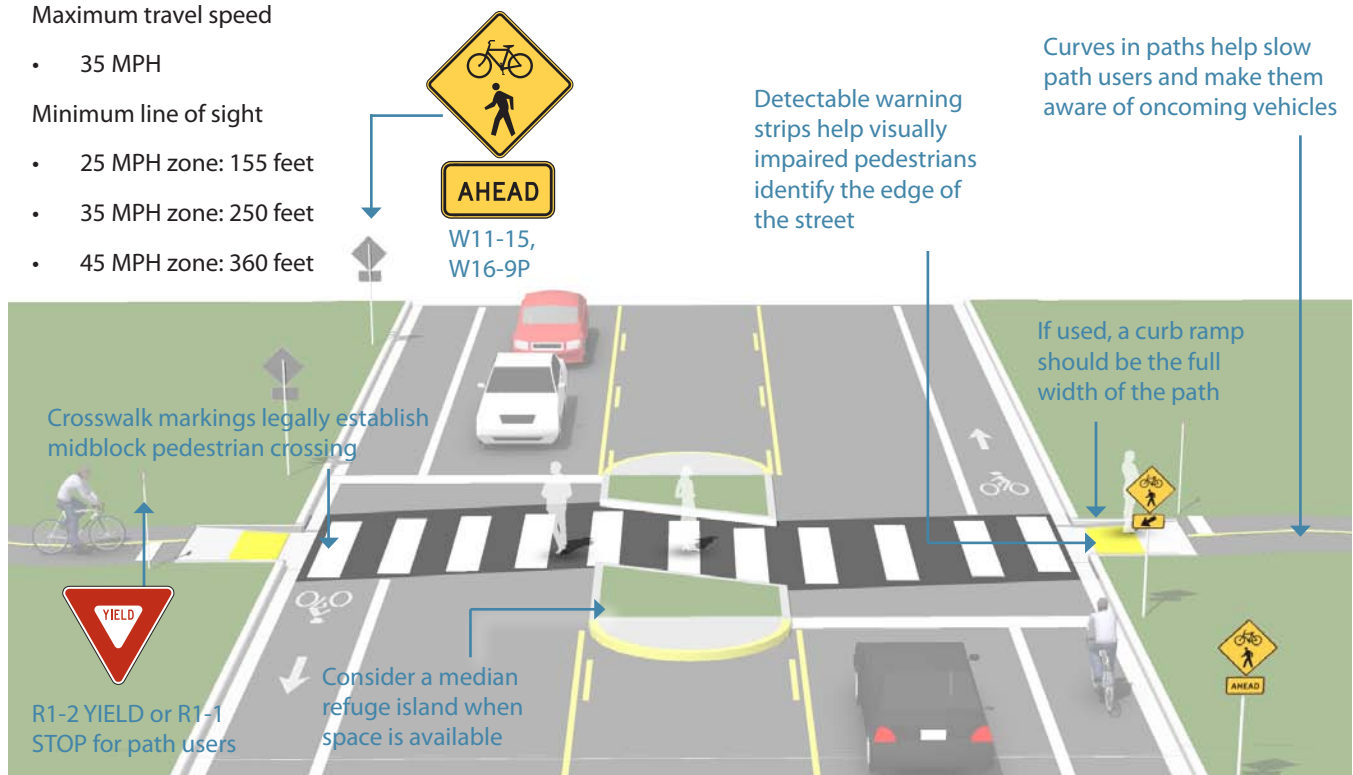
Minimum line of sight

- 25 MPH zone: 155 feet
- 35 MPH zone: 250 feet
- 45 MPH zone: 360 feet

Description

A marked/unsignalized crossing typically consists of a marked crossing area, signage and other markings to slow or stop traffic. The approach to designing crossings at mid-block locations depends on an evaluation of vehicular traffic, line of sight, pathway traffic, use patterns, vehicle speed, road type, road width, and other safety issues such as proximity to major attractions.

When space is available, using a median refuge island can improve user safety by providing pedestrians and bicyclists space to perform the safe crossing of one side of the street at a time.



Discussion

Unsignalized crossings of multi-lane arterials over 15,000 ADT may be possible with features such as sufficient crossing gaps (more than 60 per hour), median refuges, and/or active warning devices like rectangular rapid flash beacons or in-pavement flashers, and excellent sight distance. For more information see the discussion of [active warning beacons](#).

On roadways with low to moderate traffic volumes (<12,000 ADT) and a need to control traffic speeds, a raised crosswalk may be the most appropriate crossing design to improve pedestrian visibility and safety.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
FHWA. (2009). Manual on Uniform Traffic Control Devices.

Materials and Maintenance

Locate markings out of wheel tread when possible to minimize wear and maintenance costs.

Path/Roadway Crossings

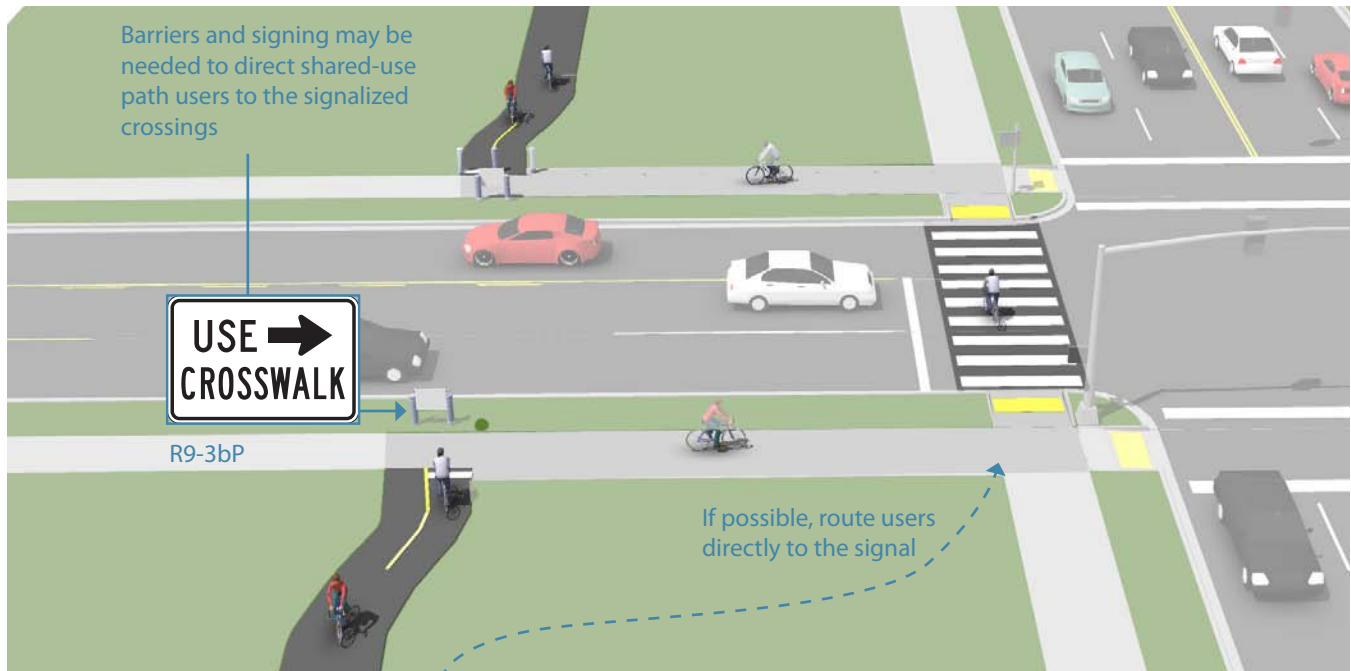
Route Users to Signalized Crossings

Guidance

Path crossings should not be provided within approximately 400 feet of an existing signalized intersection. If possible, route path directly to the signal.

Description

Path crossings within approximately 400 feet of an existing signalized intersection with pedestrian crosswalks are typically diverted to the signalized intersection to avoid traffic operation problems when located so close to an existing signal. For this restriction to be effective, barriers and signing may be needed to direct path users to the signalized crossing. If no pedestrian crossing exists at the signal, modifications should be made.



Discussion

In the US, the minimum distance a marked crossing can be from an existing signalized intersection varies from approximately 250 to 660 feet. Engineering judgement and the context of the location should be taken into account when choosing the appropriate allowable setback. Pedestrians are particularly sensitive to out of direction travel and jaywalking may become prevalent if the distance is too great.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
AASHTO. (2004). Guide for the Planning, Design, and Operation of Pedestrian Facilities.

Materials and Maintenance

If a sidewalk is used for crossing access, it should be kept clear of snow and debris and the surface should be level for wheeled users.

Path/Roadway Crossings

Signalized/Controlled Crossings

Guidance

Hybrid beacons (illustrated here) may be installed without meeting traffic signal control warrants if roadway speed and volumes are excessive for comfortable path crossings.

Full traffic signal installations must meet MUTCD pedestrian, school or modified warrants. Additional guidance for signalized crossings:

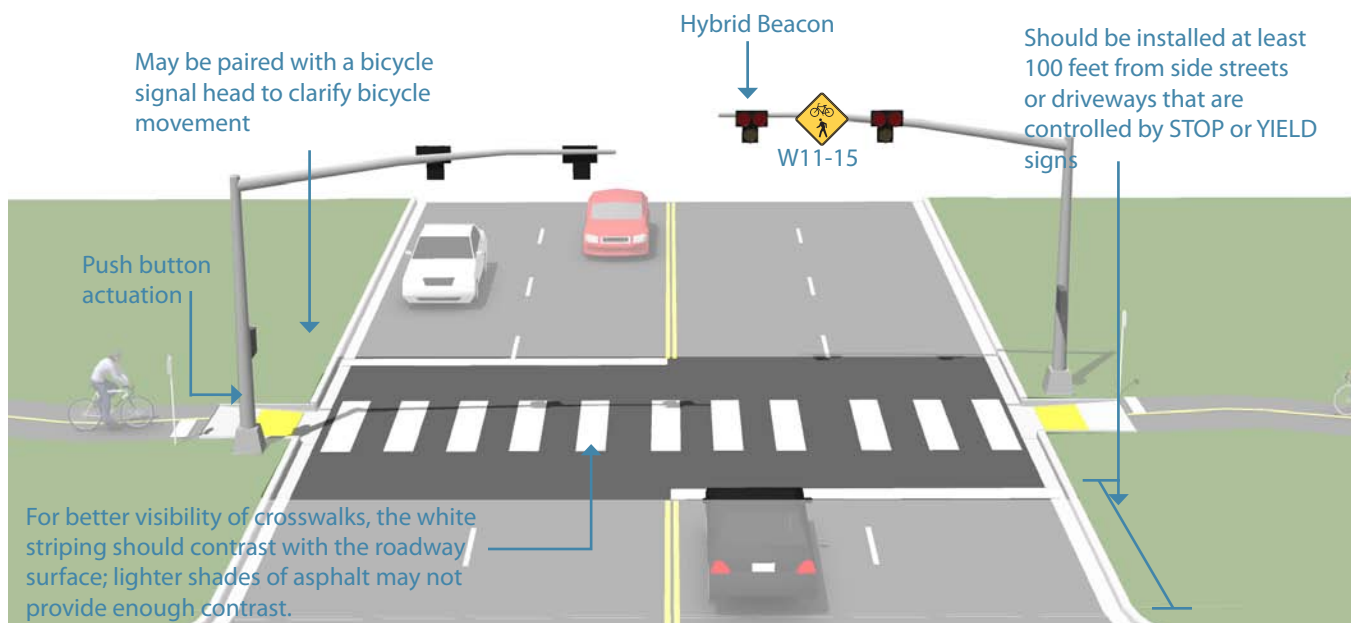
- Located more than 300 feet from an existing signalized intersection
- Roadway travel speeds of 40 MPH and above
- Roadway ADT exceeds 15,000 vehicles

Description

Signalized crossings provide the most protection for crossing path users through the use of a red-signal indication to stop conflicting motor vehicle traffic. The two types of path signalization are full traffic signal control and hybrid signals.

A full traffic signal installation treats the path crossing as a conventional 4-way intersection and provides standard red-yellow-green traffic signal heads for all legs of the intersection.

Hybrid beacon installation (shown below) faces only cross motor vehicle traffic, stays dark when inactive, and uses a unique 'wig-wag' signal phase to indicate activation. Vehicles have the option to proceed after stopping during the final flashing red phase, which can reduce motor vehicle delay when compared to a full signal installation.



Discussion

Shared-use path signals are normally activated by push buttons but may also be triggered by embedded loop, infrared, microwave or video detectors. The maximum delay for activation of the signal should be two minutes, with minimum crossing times determined by the width of the street.

Each crossing, regardless of traffic speed or volume, requires additional review by a registered engineer to identify sight lines, potential impacts on traffic progression, timing with adjacent signals, capacity and safety.

Additional References and Guidelines

FHWA. (2009). Manual on Uniform Traffic Control Devices.
NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

Hybrid beacons are subject to the same maintenance needs and requirements as standard traffic signals. Signing and striping need to be maintained to help users understand any unfamiliar traffic control.

Path/Roadway Crossings

Bollard Alternatives

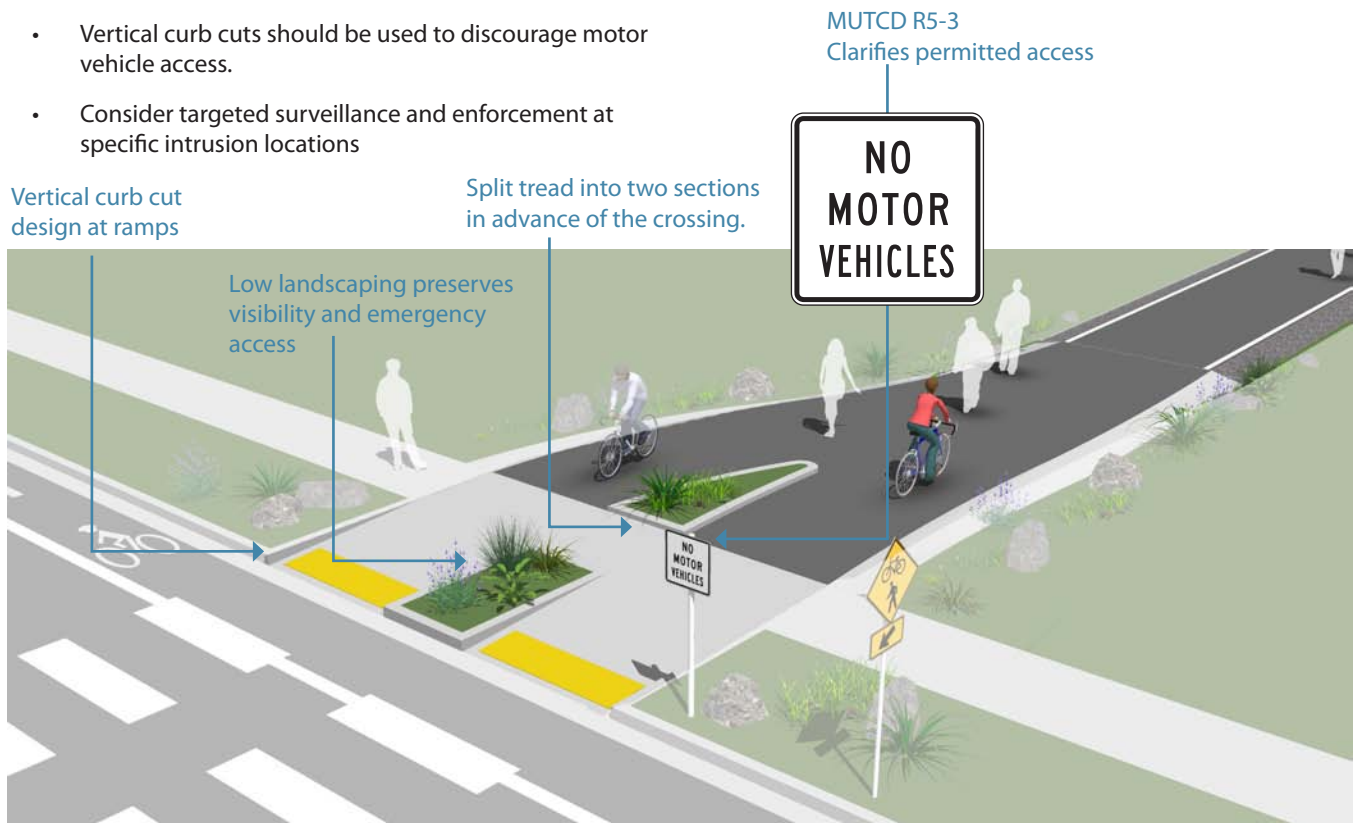
Guidance

- Bollards or other barriers should not continue to be used unless there is a documented history of unauthorized intrusion by motor vehicles.
- “No Motor Vehicles” signage (MUTCD R5-3) may be used to reinforce access rules.
- At intersections, split the path tread into two sections separated by low landscaping.
- Vertical curb cuts should be used to discourage motor vehicle access.
- Consider targeted surveillance and enforcement at specific intrusion locations

Description

Bollards are physical barriers designed to restrict motor vehicle access to the multi-use path. Unfortunately, physical barriers are often ineffective at preventing access, and create obstacles to legitimate trail users.

Alternative design strategies use signage, landscaping and curb cut design to reduce the likelihood of motor vehicle access.



Discussion

Bollards or other barriers should not be used unless there is a documented history of unauthorized intrusion by motor vehicles. If unauthorized use persists, assess whether the problems posed by unauthorized access exceed the risks and issues posed by bollards and other barriers.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.

Materials and Maintenance

Landscaping separation between treads should be maintained to a height easily straddled by emergency vehicles.

Path/Roadway Crossings

Overcrossings

Guidance

8 foot minimum width, 14 feet preferred. If overcrossing has any scenic vistas additional width should be provided to allow for stopping. A separate 5 foot pedestrian area may be provided for facilities with high bicycle and pedestrian use.

10 foot headroom on overcrossing; clearance below will vary depending on feature being crossed.

Roadway:	17 feet
Freeway:	18.5 feet
Heavy Rail Line:	23 feet

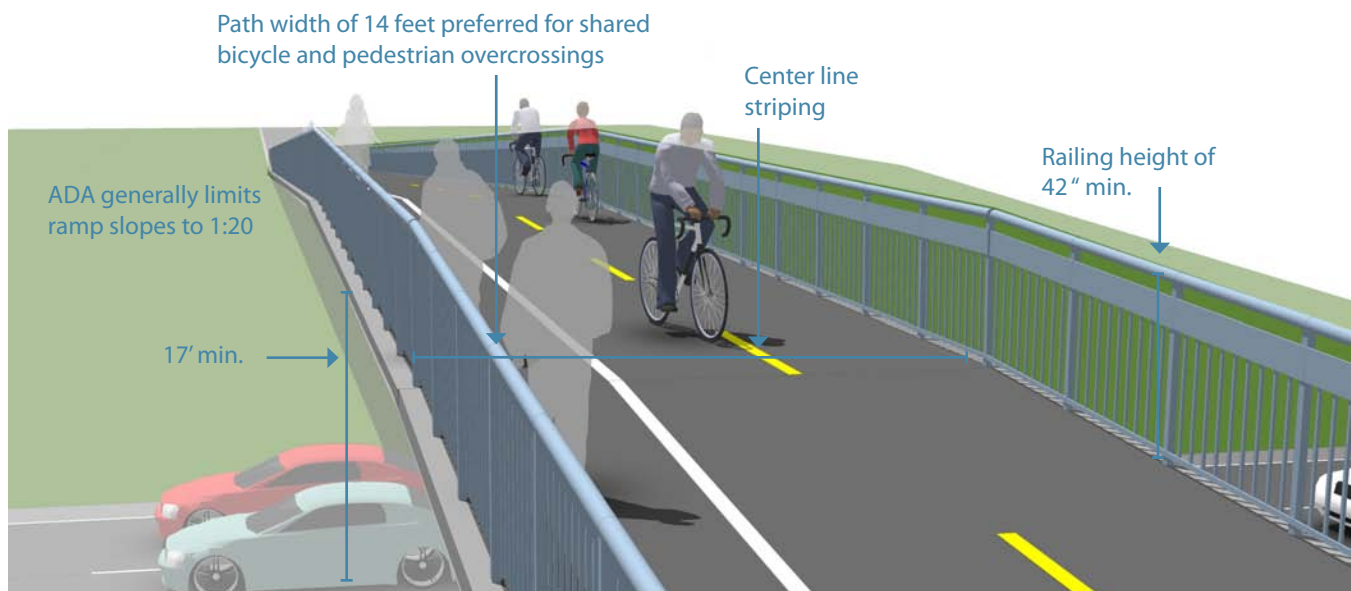
The overcrossing should have a centerline stripe even if the rest of the path does not have one.

Description

Bicycle/pedestrian overcrossings provide critical non-motorized system links by joining areas separated by barriers such as deep canyons, waterways or major transportation corridors. In most cases, these structures are built in response to user demand for safe crossings where they previously did not exist.

Grade-separated crossings may be needed where existing bicycle/pedestrian crossings do not exist, where ADT exceeds 25,000 vehicles, and where 85th percentile speeds exceed 45 miles per hour.

Overcrossings require a minimum of 17 feet of vertical clearance to the roadway below versus a minimum elevation differential of around 12 feet for an undercrossing. This results in potentially greater elevation differences and much longer ramps for bicycles and pedestrians to negotiate.



Discussion

Overcrossings for bicycles and pedestrians typically fall under the Americans with Disabilities Act (ADA), which strictly limits ramp slopes to 5% (1:20) with landings at 400 foot intervals, or 8.33% (1:12) with landings every 30 feet.

Overcrossings pose potential concerns about visual impact and functional appeal, as well as space requirements necessary to meet ADA guidelines for slope.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
AASHTO. (2004). Guide for the Planning, Design, and Operation of Pedestrian Facilities.

Materials and Maintenance

Potential issues with vandalism.

Overcrossings can be more difficult to clear of snow than undercrossings.

Path/Roadway Crossings

Undercrossings

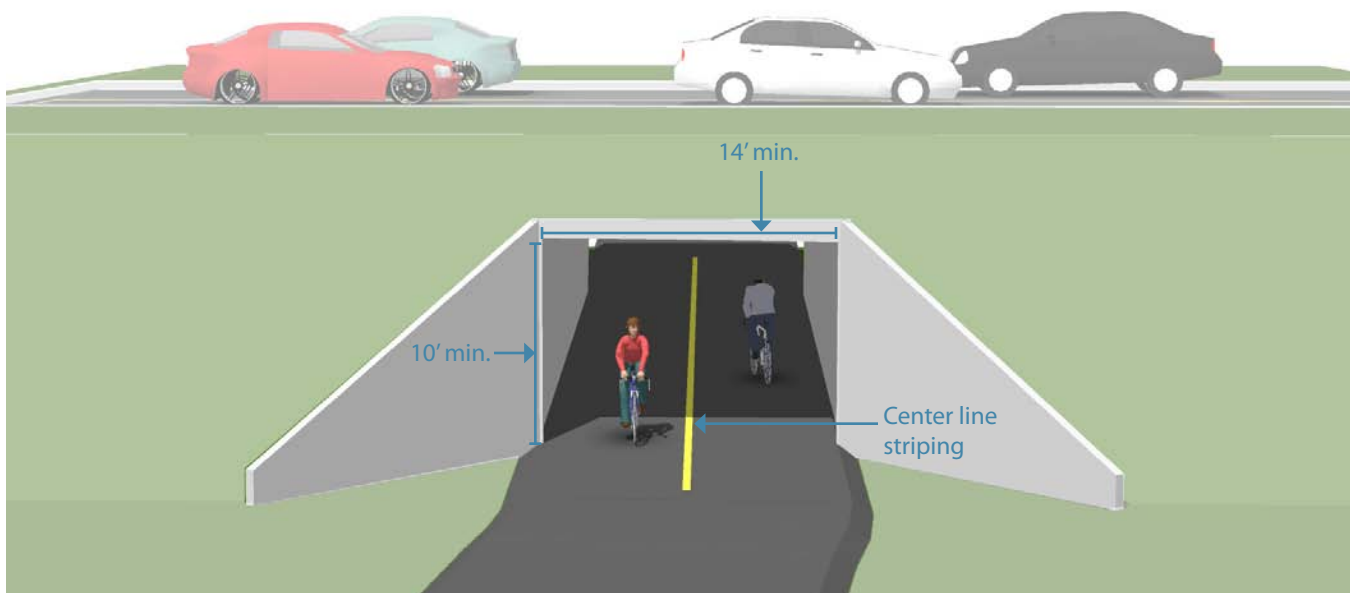
Guidance

- 14 foot minimum width, greater widths preferred for lengths over 60 feet.
- 10 foot minimum height.
- The undercrossing should have a centerline stripe even if the rest of the path does not have one.
- Lighting should be considered during the design process for any undercrossing with high anticipated use or in culverts and tunnels.

Description

Bicycle/pedestrian undercrossings provide critical non-motorized system links by joining areas separated by barriers such as railroads and highway corridors. In most cases, these structures are built in response to user demand for safe crossings where they previously did not exist.

Grade-separated crossings are advisable where existing bicycle/pedestrian crossings do not exist, where ADT exceeds 25,000 vehicles and where 85th percentile speeds exceed 45 miles per hour.



Discussion

Safety is a major concern with undercrossings. Shared-use path users may be temporarily out of sight from public view and may experience poor visibility themselves. To mitigate safety concerns, an undercrossing should be designed to be spacious, well-lit, equipped with emergency cell phones at each end and completely visible for its entire length from end to end.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
AASHTO. (2004). Guide for the Planning, Design, and Operation of Pedestrian Facilities.

Materials and Maintenance

14 foot width allows for maintenance vehicle access.

Potential problems include conflicts with utilities, drainage, flood control and vandalism.

Crossing Beacons and Signals

Signalization

Bicycle Detection and Actuation

Description

Push Button Actuation

User-activated button mounted on a pole facing the street.

Loop Detectors

Bicycle-activated loop detectors are installed within the roadway to allow the presence of a bicycle to trigger a change in the traffic signal. This allows the bicyclist to stay within the lane of travel without having to maneuver to the side of the road to trigger a push button.

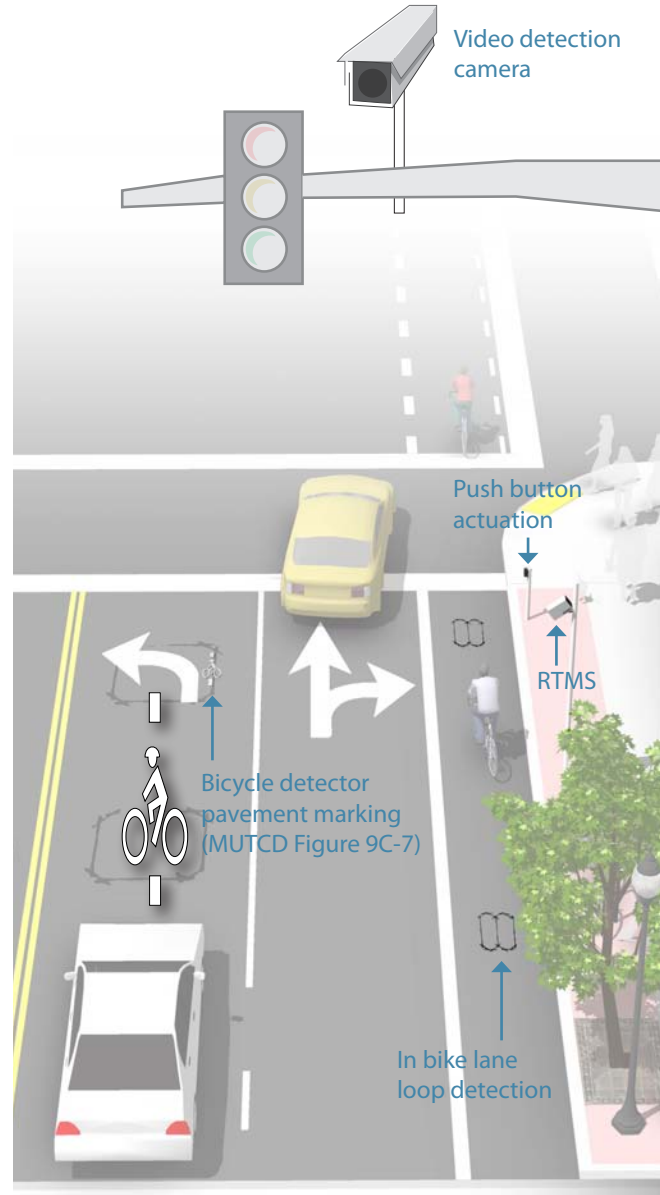
Loops that are sensitive enough to detect bicycles should be supplemented with pavement markings to instruct bicyclists how to trip them.

Video Detection Cameras

Video detection systems use digital image processing to detect a change in the image at a location. These systems can be calibrated to detect bicycles. Video camera system costs range from \$20,000 to \$25,000 per intersection.

Remote Traffic Microwave Sensor Detection (RTMS)

RTMS is a system which uses frequency modulated continuous wave radio signals to detect objects in the roadway. This method marks the detected object with a time code to determine its distance from the sensor. The RTMS system is unaffected by temperature and lighting, which can affect standard video detection.



Discussion

Proper bicycle detection should meet two primary criteria: 1) accurately detects bicyclists and 2) provides clear guidance to bicyclists on how to actuate detection (e.g., what button to push, where to stand).

Bicycle loops and other detection mechanisms can also provide bicyclists with an extended green time before the light turns yellow so that bicyclists of all abilities can reach the far side of the intersection.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
FHWA. (2009). Manual on Uniform Traffic Control Devices.
NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

Signal detection and actuation for bicyclists should be maintained with other traffic signal detection and roadway pavement markings.

Signalization

Active Warning Beacons

Guidance

- Warning beacons shall not be used at crosswalks controlled by YIELD signs, STOP signs or traffic signals.
- Warning beacons shall initiate operation based on pedestrian or bicyclist actuation and shall cease operation at a predetermined time after actuation or, with passive detection, after the pedestrian or bicyclist clears the crosswalk.

Description

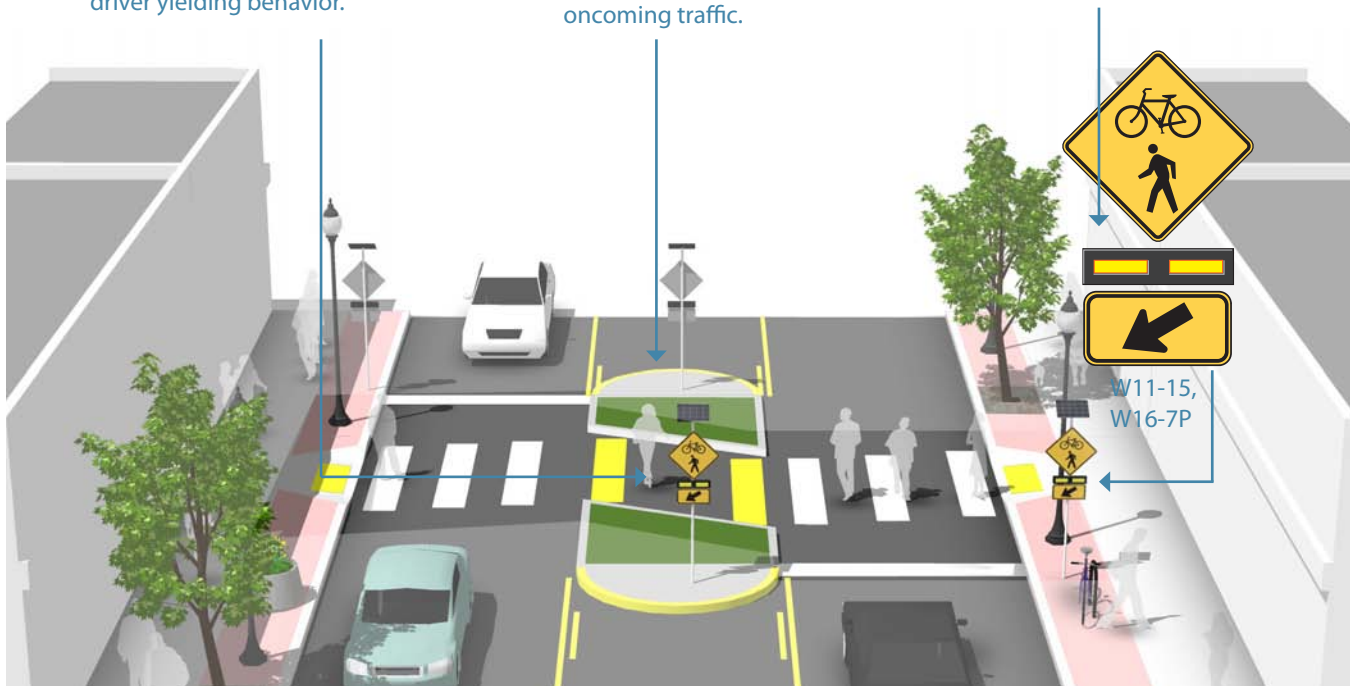
Active warning beacons are user actuated illuminated devices designed to increase motor vehicle yielding compliance at crossings of multi lane or high volume roadways.

Types of active warning beacons include conventional circular yellow flashing beacons, in-roadway warning lights, or rectangular rapid flash beacons (RRFB).

Rectangular Rapid Flash Beacons (RRFB) dramatically increase compliance over conventional warning beacons.

Providing secondary installations of RRFBs on median islands improves driver yielding behavior.

Median refuge islands provide added comfort and should be angled to direct users to face oncoming traffic.



Discussion

Rectangular rapid flash beacons have the highest compliance of all the warning beacon enhancement options.

A study of the effectiveness of going from a no-beacon arrangement to a two-beacon RRFB installation increased yielding from 18 percent to 81 percent. A four-beacon arrangement raised compliance to 88 percent. Additional studies over long term installations show little to no decrease in yielding behavior over time.

Additional References and Guidelines

NACTO. (2012). Urban Bikeway Design Guide.
 FHWA. (2009). Manual on Uniform Traffic Control Devices.
 FHWA. (2008). MUTCD - Interim Approval for Optional Use of Rectangular Rapid Flashing Beacons (IA-11)

Materials and Maintenance

Depending on power supply, maintenance can be minimal. If solar power is used, RRFBs can run for years without issue.

Signalization

Hybrid Beacon for Mid-Block Crossing

Guidance

Hybrid beacons may be installed without meeting traffic signal control warrants if roadway speed and volumes are excessive for pedestrian crossings. See MUTCD Ch 4F.

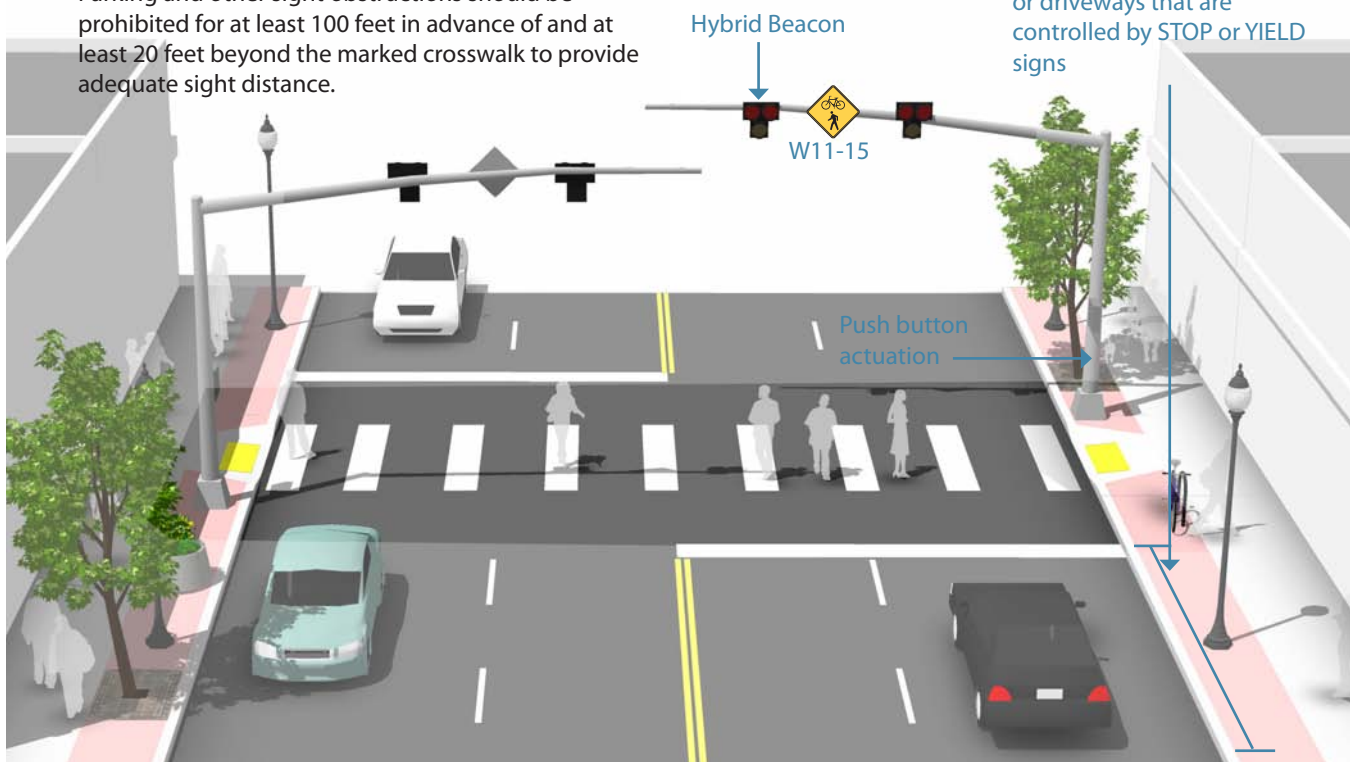
- If installed within a signal system, signal engineers should evaluate the need for the hybrid signal to be coordinated with other signals.
- Parking and other sight obstructions should be prohibited for at least 100 feet in advance of and at least 20 feet beyond the marked crosswalk to provide adequate sight distance.

Description

A hybrid beacon consists of a signal-head with two red lenses over a single yellow lens on the major street, and pedestrian and/or **bicycle signal heads** for the minor street.

Hybrid beacons are used to improve non-motorized crossings of major streets. A hybrid beacon consists of a signal-head with two red lenses over a single yellow lens on the major street, and a pedestrian signal head for the crosswalk

Should be installed at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs



Discussion

Hybrid beacon signals are normally activated by push buttons, but may also be triggered by infrared, microwave or video detectors. The maximum delay for activation of the signal should be two minutes, with minimum crossing times determined by the width of the street.

Each crossing, regardless of traffic speed or volume, requires additional review by a registered engineer to identify sight lines, potential impacts on traffic progression, timing with adjacent signals, capacity, and safety.

Additional References and Guidelines

FHWA. (2009). Manual on Uniform Traffic Control Devices.
NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

Hybrid beacons are subject to the same maintenance needs and requirements as standard traffic signals. Signing and striping need to be maintained to help users understand any unfamiliar traffic control.

Signalization

Hybrid Beacon for Bicycle Route Crossing

Guidance

Hybrid beacons may be installed without meeting traffic signal control warrants if roadway speed and volumes are excessive for pedestrian crossings. See MUTCD Ch 4F.

- If installed within a signal system, signal engineers should evaluate the need for the hybrid signal to be coordinated with other signals.

Description

A hybrid beacon consists of a signal-head with two red lenses over a single yellow lens on the major street, and pedestrian and/or **bicycle signal heads** for the minor street. There are no signal indications for motor vehicles on the minor street approaches.

Hybrid beacons are used to improve non-motorized crossings of major streets in locations where side-street volumes do not support installation of a conventional traffic signal or where there are concerns that a conventional signal will encourage additional motor vehicle traffic on the minor street. Hybrid beacons may also be used at mid-block crossing locations.



Discussion

The hybrid beacon can significantly improve the operation of a bicycle route, particularly along **Bicycle Boulevard** corridors. Because of the low traffic volumes on these facilities, intersections with major roadways are often unsignalized, creating difficult and potentially unsafe crossing conditions for bicyclists.

Each crossing, regardless of traffic speed or volume, requires additional review by a registered engineer to identify sight lines, potential impacts on traffic progression, timing with adjacent signals, capacity and safety.

Additional References and Guidelines

FHWA. (2009). Manual on Uniform Traffic Control Devices.
NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

Hybrid beacons are subject to the same maintenance needs and requirements as standard traffic signals. Signing and striping need to be maintained to help users understand any unfamiliar traffic control.

Bikeway Signing

The ability to navigate through a city is informed by landmarks, natural features and other visual cues. Signs throughout the city should indicate to bicyclists:

- Direction of travel
- Location of destinations
- Travel time/distance to those destinations

These signs will increase users' comfort and accessibility to the bicycle systems.

Signage can serve both wayfinding and safety purposes including:

- Helping to familiarize users with the bicycle network
- Helping users identify the best routes to destinations
- Helping to address misperceptions about time and distance
- Helping overcome a "barrier to entry" for people who are not frequent bicyclists (e.g., "interested but concerned" bicyclists)

A community-wide bicycle wayfinding signage plan would identify:

- Sign locations
- Sign type – what information should be included and design features
- Destinations to be highlighted on each sign – key destinations for bicyclists
- Approximate distance and travel time to each destination

Bicycle wayfinding signs also visually cue motorists that they are driving along a bicycle route and should use caution. Signs are typically placed at key locations leading to and along bicycle routes, including the intersection of multiple routes. Too many road signs tend to clutter the right-of-way, and it is recommended that these signs be posted at a level most visible to bicyclists rather than per vehicle signage standards.

This section includes:

- Wayfinding Sign Types
- Wayfinding Sign Placement



Wayfinding Signage

Wayfinding Sign Types

Description

A bicycle wayfinding system consists of comprehensive signing and/or pavement markings to guide bicyclists to their destinations along preferred bicycle routes. There are three general types of wayfinding signs:

Confirmation Signs

Indicate to bicyclists that they are on a designated bikeway. Make motorists aware of the bicycle route.

Can include destinations and distance/time. Do not include arrows.

Turn Signs

Indicate where a bikeway turns from one street onto another street. Can be used with pavement markings.

Include destinations and arrows.

Decisions Signs

Mark the junction of two or more bikeways.

Inform bicyclists of the designated bike route to access key destinations.

Destinations and arrows, distances and travel times are optional but recommended.

Alternative Designs

A customized alternative design may be used to include pedestrian-oriented travel times and local logos (design at right is an example only).



Discussion

There is no standard color for bicycle wayfinding signage. Section 1A.12 of the MUTCD establishes the general meaning for signage colors. Green is the color used for directional guidance and is the most common color of bicycle wayfinding signage in the US, including those in the MUTCD.

Additional References and Guidelines

FHWA. (2009). Manual on Uniform Traffic Control Devices.
 NACTO. (2012). Urban Bikeway Design Guide.
 AASHTO. (2012). Guide for the Development of Bicycle Facilities.

Materials and Maintenance

Maintenance needs for bicycle wayfinding signs are similar to other signs and will need periodic replacement due to wear.

Wayfinding Signage

Wayfinding Sign Placement

Guidance

Signs are typically placed at decision points along bicycle routes – typically at the intersection of two or more bikeways and at other key locations leading to and along bicycle routes.

Decisions Signs

Near-side of intersections in advance of a junction with another bicycle route.

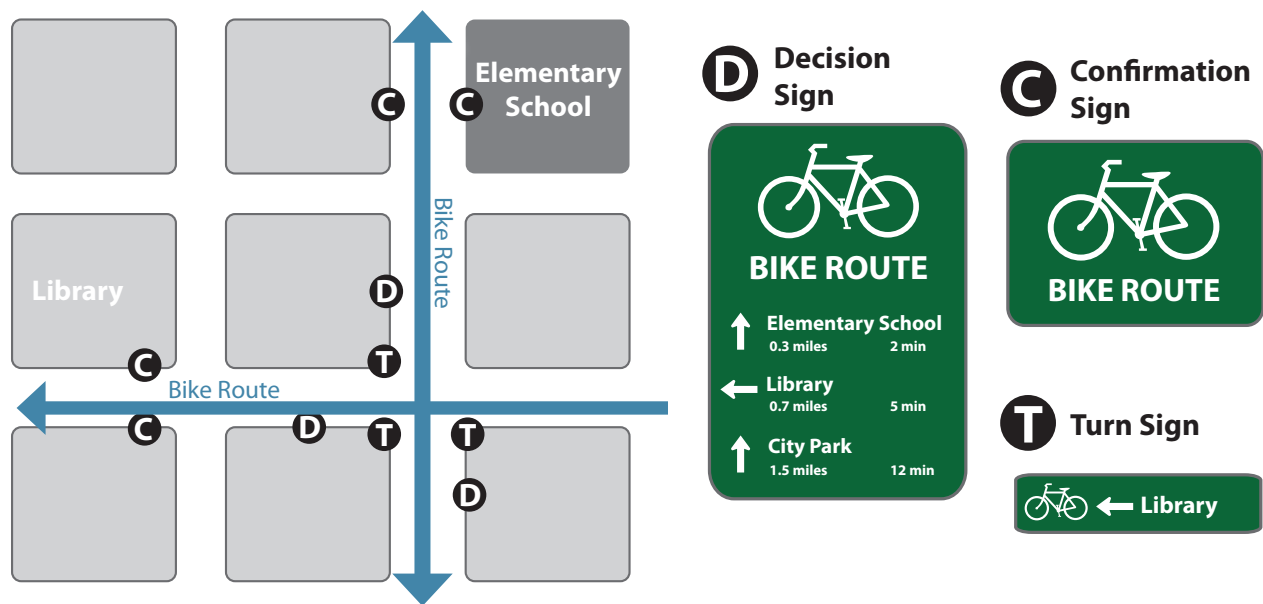
Along a route to indicate a nearby destination.

Confirmation Signs

Every ¼ to ½ mile on off-street facilities and every 2 to 3 blocks along on-street bicycle facilities, unless another type of sign is used (e.g., within 150 ft of a turn or decision sign). Should be placed soon after turns to confirm destination(s). Pavement markings can also act as confirmation that a bicyclist is on a preferred route.

Turn Signs

Near-side of intersections where bike routes turn (e.g., where the street ceases to be a bicycle route or does not go through). Pavement markings can also indicate the need to turn to the bicyclist.



Discussion

It can be useful to classify a list of destinations for inclusion on the signs based on their relative importance to users throughout the area. A particular destination's ranking in the hierarchy can be used to determine the physical distance from which the locations are signed. For example, primary destinations (such as the downtown area) may be included on signage up to five miles away. Secondary destinations (such as a transit station) may be included on signage up to two miles away. Tertiary destinations (such as a park) may be included on signage up to one mile away.

Additional References and Guidelines

FHWA. (2009). Manual on Uniform Traffic Control Devices.
 NACTO. (2012). Urban Bikeway Design Guide.
 AASHTO. (2012). Guide for the Development of Bicycle Facilities.

Materials and Maintenance

Maintenance needs for bicycle wayfinding signs are similar to other signs and will need periodic replacement due to wear.

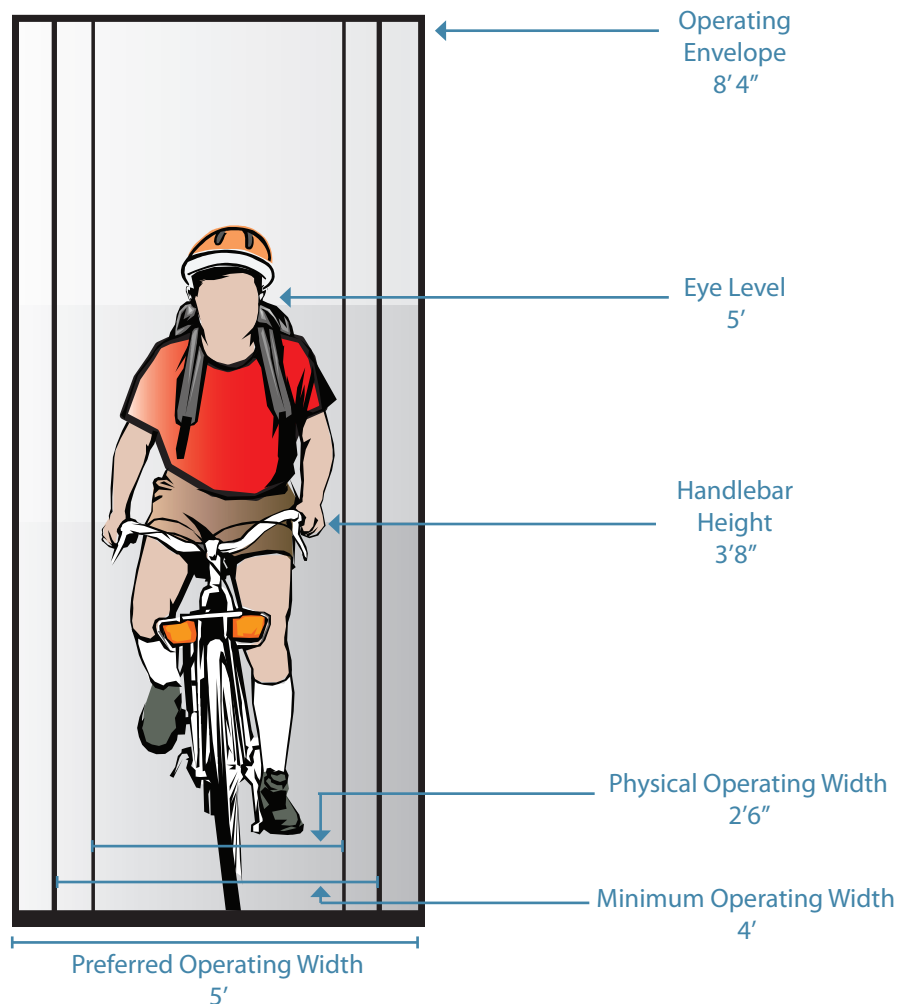
Design Needs of Bicyclists

The purpose of this section is to provide the facility designer with an understanding of how bicyclists operate and how their bicycle influences that operation. Bicyclists, by nature, are much more affected by poor facility design, construction and maintenance practices than motor vehicle drivers. Bicyclists lack the protection from the elements and roadway hazards provided by an automobile's structure and safety features. By understanding the unique characteristics and needs of bicyclists, a facility designer can provide quality facilities and minimize user risk.

Bicycle as a Design Vehicle

Similar to motor vehicles, bicyclists and their bicycles exist in a variety of sizes and configurations. These variations occur in the types of vehicle (such as a conventional bicycle, a recumbent bicycle or a tricycle), and behavioral characteristics (such as the comfort level of the bicyclist). The design of a bikeway should consider reasonably expected bicycle types on the facility and utilize the appropriate dimensions.

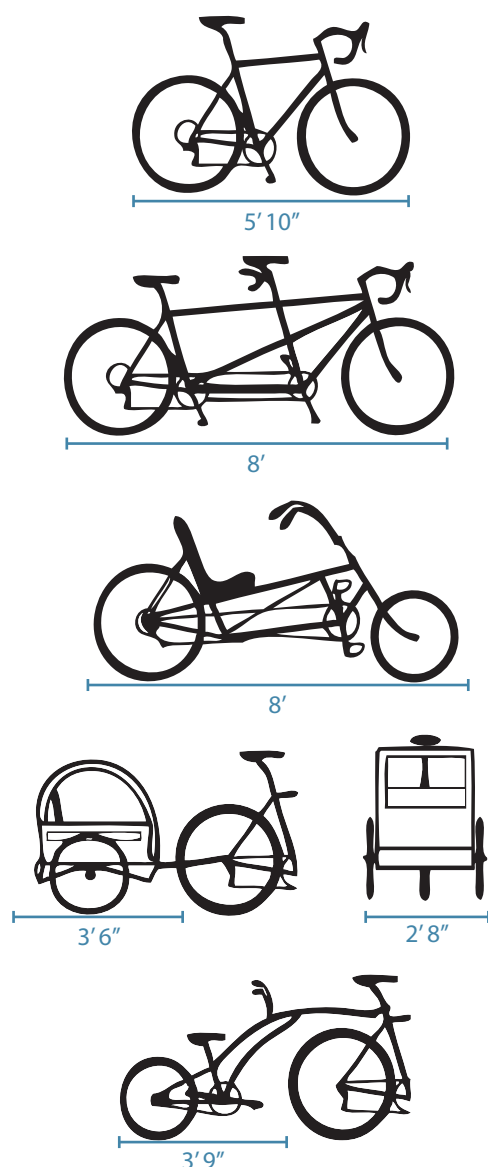
The figure below illustrates the operating space and physical dimensions of a typical adult bicyclist, which are the basis for typical facility design. Bicyclists require clear space to operate within a facility. This is why the minimum operating width is greater than the physical dimensions of the bicyclist. Bicyclists prefer five feet or more operating width, although four feet may be minimally acceptable.



Standard Bicycle Rider Dimensions

Source: AASHTO Guide for the Development of Bicycle Facilities, 3rd Edition

In addition to the design dimensions of a typical bicycle, there are many other commonly used pedal-driven cycles and accessories to consider when planning and designing bicycle facilities. The most common types include tandem bicycles, recumbent bicycles, and trailer accessories. The figure and table below summarize the typical dimensions for bicycle types.



Bicycle as Design Vehicle - Typical Dimensions

Source: AASHTO Guide for the Development of Bicycle Facilities, 3rd Edition *AASHTO does not provide typical dimensions for tricycles.

Design Speed Expectations

The expected speed that different types of bicyclists can maintain under various conditions also influences the design of facilities such as shared use paths. The table to the right provides typical bicyclist speeds for a variety of conditions.

Bicycle as Design Vehicle - Typical Dimensions

Bicycle Type	Feature	Typical Dimensions
Upright Adult Bicyclist	Physical width	2 ft 6 in
	Operating width (Minimum)	4 ft
	Operating width (Preferred)	5 ft
	Physical length	5 ft 10 in
	Physical height of handlebars	3 ft 8 in
	Operating height	8 ft 4 in
	Eye height	5 ft
	Vertical clearance to obstructions (tunnel height, lighting, etc)	10 ft
Recumbent Bicyclist	Approximate center of gravity	2 ft 9 in - 3 ft 4 in
	Physical length	8 ft
Tandem Bicyclist	Eye height	3 ft 10 in
	Physical length	8 ft
Bicyclist with child trailer	Physical length	10 ft
	Physical width	2 ft 8 in

Bicycle as Design Vehicle - Design Speed Expectations

Bicycle Type	Feature	Typical Speed
Upright Adult Bicyclist	Paved level surfacing	15 mph
	Crossing Intersections	10 mph
	Downhill	30 mph
	Uphill	5 -12 mph
Recumbent Bicyclist	Paved level surfacing	18 mph

*NCDOT Bicycle Facilities Planning and Design Guidelines, page 45, chapter "Design Speed", requires a 20 mph design speed. Utilizing a smaller radius may require a wider pavement width.

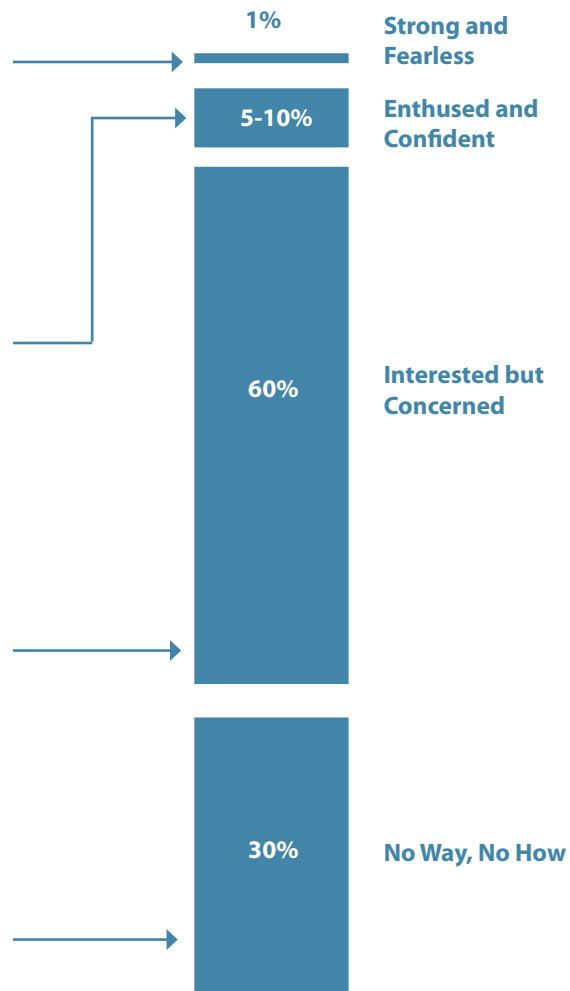
*Tandem bicycles and bicyclists with trailers have typical speeds equal to or less than upright adult bicyclists.

Types of Bicyclists

It is important to consider bicyclists of all skill levels when creating a non-motorized plan or project. Bicyclist skill level greatly influences expected speeds and behavior, both in separated bikeways and on shared roadways. Bicycle infrastructure should accommodate as many user types as possible, with decisions for separate or parallel facilities based on providing a comfortable experience for the greatest number of people.

The bicycle planning and engineering professions currently use several systems to classify the population, which can assist in understanding the characteristics and infrastructure preferences of different bicyclists. The most conventional framework classifies the “design cyclist” as *Advanced*, *Basic*, or *Child*¹. A more detailed understanding of the US population as a whole is illustrated in the figure below. Developed by planners in Portland, OR² and supported by data collected nationally since 2005, this classification provides the following alternative categories to address varying attitudes towards bicycling in the US:

- **Strong and Fearless** (approximately 1% of population) – Characterized by bicyclists that will typically ride anywhere regardless of roadway conditions or weather. These bicyclists can ride faster than other user types, prefer direct routes and will typically choose roadway connections -- even if shared with vehicles -- over separate bicycle facilities such as shared use paths.
- **Enthusied and Confident** (5-10% of population) - This user group encompasses bicyclists who are fairly comfortable riding on all types of bikeways but usually choose low traffic streets or multi-use paths when available. These bicyclists may deviate from a more direct route in favor of a preferred facility type. This group includes all kinds of bicyclists such as commuters, recreationalists, racers and utilitarian bicyclists.
- **Interested but Concerned** (approximately 60% of population) – This user type comprises the bulk of the cycling population and represents bicyclists who typically only ride a bicycle on low traffic streets or multi-use trails under favorable weather conditions. These bicyclists perceive significant barriers to their increased use of cycling, specifically traffic and other safety issues. These people may become “Enthusied & Confident” with encouragement, education and experience.
- **No Way, No How** (approximately 30% of population) – Persons in this category are not bicyclists, and perceive severe safety issues with riding in traffic. Some people in this group may eventually become more regular cyclists with time and education. A significant portion of these people will not ride a bicycle under any circumstances.



Typical Distribution of Bicyclist Types

¹ *Selecting Roadway Design Treatments to Accommodate Bicycles. (1994). Publication No. FHWA-RD-92-073*

² *Four Types of Cyclists. (2009). Roger Geller, City of Portland Bureau of Transportation. <http://www.portlandonline.com/transportation/index.cfm?&a=237507>*

Bicycle Facility Typologies

This section summarizes the bicycle facility typology developed for the Wilmington Urban Area MPO. The specific facility type that should be provided depends on the surrounding environment (e.g. auto speed and volume, topography, and adjacent land use) and expected bicyclist needs (e.g. bicyclists commuting on a highway versus students riding to school on residential streets).

Facility Selection Guidelines

There are no 'hard and fast' rules for determining the most appropriate type of bicycle facility for a particular location – roadway speeds, volumes, right-of-way width, presence of parking, adjacent land uses, and expected bicycle user types are all critical elements of this decision. Studies find that the most significant factors influencing bicycle use are motor vehicle traffic volumes and speeds. Additionally, most bicyclists prefer facilities separated from motor vehicle traffic or located on local roads with low motor vehicle traffic speeds and volumes. Because off-street pathways are physically separated from the roadway, they are perceived as safe and attractive routes for bicyclists who prefer to avoid motor vehicle traffic. Consistent use of treatments and application of bikeway facilities allow users to anticipate whether they would feel comfortable riding on a particular facility, and plan their trips accordingly. This section provides guidance on various factors that affect the type of facilities that should be provided.



This section includes:

- Facility Classification
- Facility Continua

Bicycle Facility Selection Guidelines

Facility Classification

Description

Consistent with bicycle facility classifications throughout the nation, these Bicycle Facility Design Guidelines identify the following classes of facilities by degree of separation from motor vehicle traffic.

Shared Roadways are bikeways where bicyclists and cars operate within the same travel lane, either side by side or in single file depending on roadway configuration. The most basic type of bikeway is a signed shared roadway. This facility provides continuity with other bicycle facilities (usually bike lanes), or designates preferred routes through high-demand corridors.



Shared Roadways may also be designated by pavement markings, signage and other treatments including directional signage, traffic diverters, chicanes, chokers and /or other traffic calming devices to reduce vehicle speeds or volumes. Such treatments often are associated with **Bicycle Boulevards**.



Separated Bikeways, such as bike lanes, use signage and striping to delineate the right-of-way assigned to bicyclists and motorists. Bike lanes encourage predictable movements by both bicyclists and motorists.



Cycle Tracks are exclusive bike facilities that combine the user experience of a separated path with the on-street infrastructure of conventional bike lanes.



Multi Use Paths are facilities separated from roadways for use by bicyclists and pedestrians.



Bicycle Facility Selection Guidelines

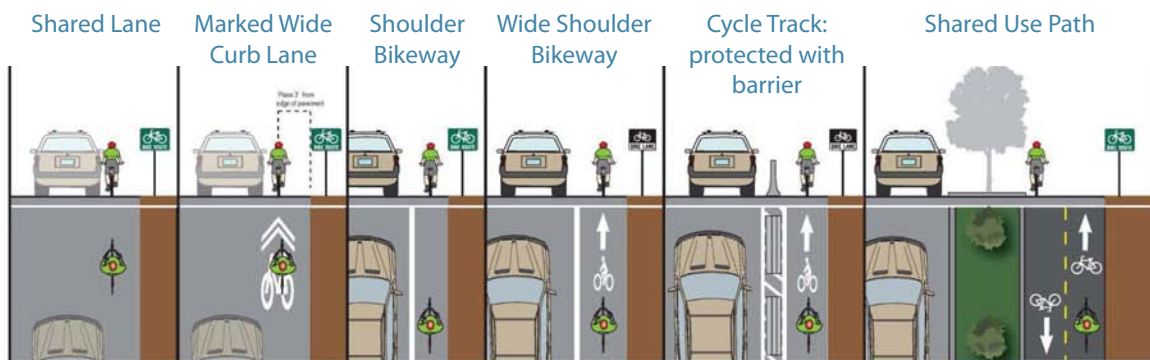
Facility Continua

The following continua illustrate the range of bicycle facilities applicable to various roadway environments, based on the roadway type and desired degree of separation. Engineering judgment, traffic studies, previous municipal planning efforts, community input and local context should be used to refine criteria when developing bicycle facility recommendations for a particular street. In some corridors, it may be desirable to construct facilities to a higher level of treatment than those recommended in relevant planning documents in order to enhance user safety and comfort. In other cases, existing and/or future motor vehicle speeds and volumes may not justify the recommended level of separation, and a less intensive treatment may be acceptable. For state roadways, NCDOT's Complete Streets Planning and Design Guidelines offer further information on bicycle facilities, including signed routes, shared lanes, shoulders, bicycle lanes, and multi-use paths.

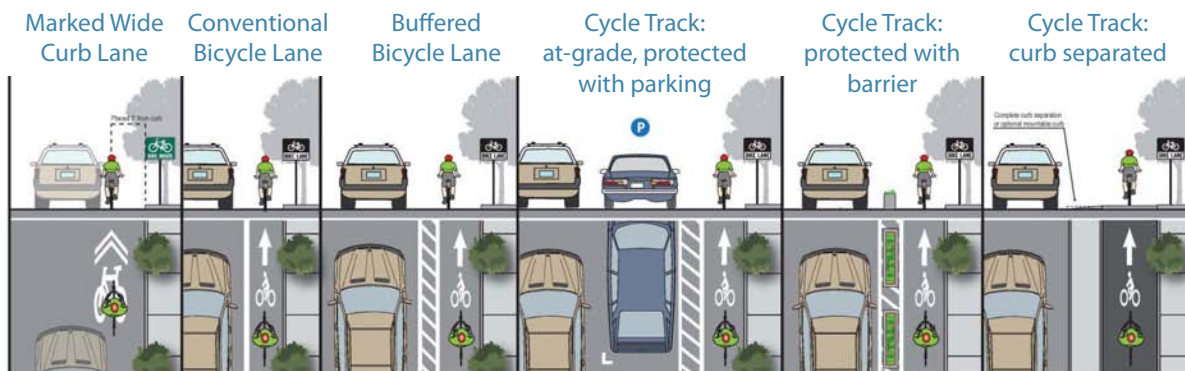
Least Protected

Most Protected

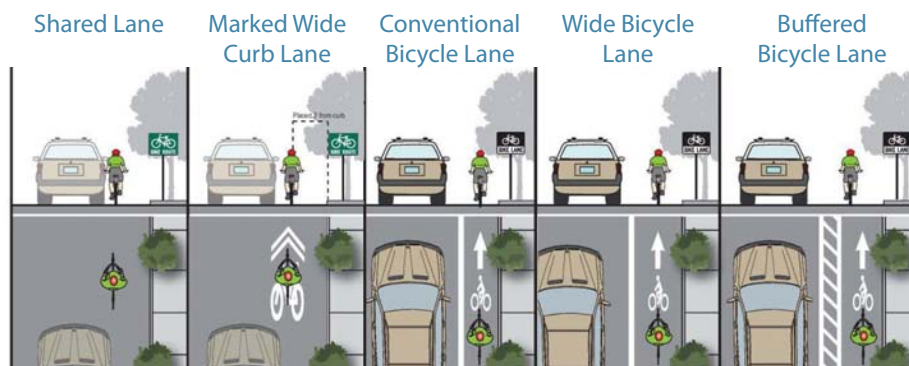
Arterial/Highway Bikeway Continuum (without curb and gutter)



Arterial/Highway Bikeway Continuum (with curb and gutter)



Collector Bikeway Continuum



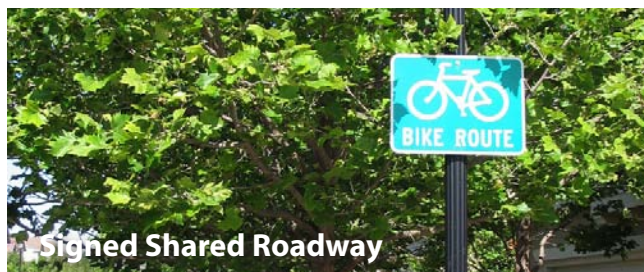
Shared Roadways

On shared roadways, bicyclists and motor vehicles use the same roadway space. These facilities are typically used on roads with low speeds and traffic volumes, however they can be used on higher volume roads with wide outside lanes or shoulders. A motor vehicle driver will usually have to cross over into the adjacent travel lane to pass a bicyclist, unless a wide outside lane or shoulder is provided.

Shared roadways employ a large variety of treatments from simple signage and shared lane markings to more complex treatments including directional signage, traffic diverters, chicanes, chokers, and/or other traffic calming devices to reduce vehicle speeds or volumes.

Bicycle Boulevards

Bicycle boulevards are a special class of shared roadways designed for a broad spectrum of bicyclists. They are low-volume local streets where motorists and bicyclists share the same travel lane. Treatments for bicycle boulevards are selected as necessary to create appropriate automobile volumes and speeds, and to provide safe crossing opportunities of busy streets.



Signed Shared Roadway



Marked Shared Roadway

This section includes:

- Signed Shared Roadway
- Marked Shared Roadway

Shared Roadways

Signed Shared Roadway

Guidance

Lane width varies depending on roadway configuration.

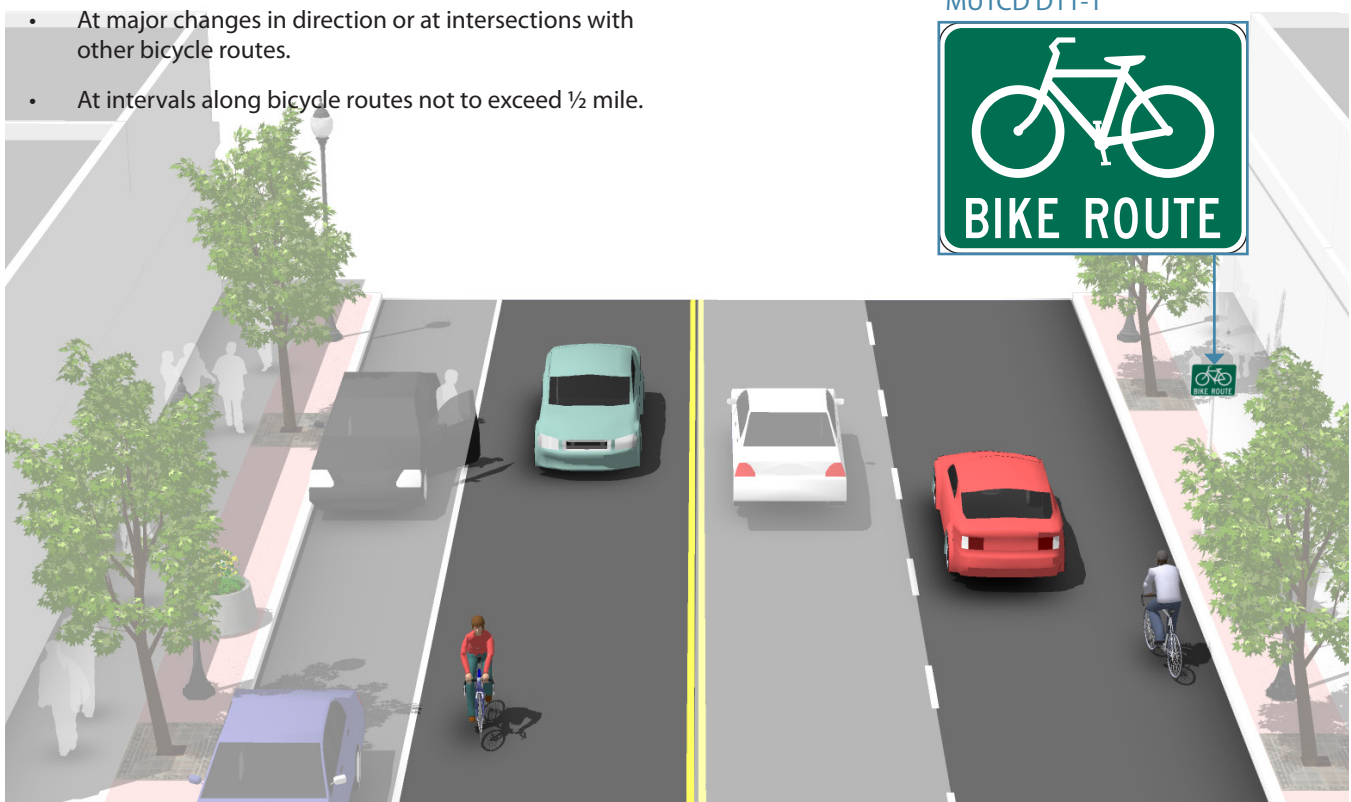
Bicycle Route signage (D11-1) should be applied at intervals frequent enough to keep bicyclists informed of changes in route direction and to remind motorists of the presence of bicyclists. Commonly, this includes placement at:

- Beginning or end of Bicycle Route.
- At major changes in direction or at intersections with other bicycle routes.
- At intervals along bicycle routes not to exceed ½ mile.

Description

Signed Shared Roadways are facilities shared with motor vehicles. They are typically used on roads with low speeds and traffic volumes, however can be used on higher volume roads with wide outside lanes or shoulders. A motor vehicle driver will usually have to cross over into the adjacent travel lane to pass a bicyclist, unless a wide outside lane or shoulder is provided.

MUTCD D11-1



Discussion

Signed Shared Roadways serve either to provide continuity with other bicycle facilities (usually bike lanes) or to designate preferred routes through high-demand corridors.

This configuration differs from a **Bicycle Boulevard** due to a lack of traffic calming, wayfinding, pavement markings and other enhancements designed to provide a higher level of comfort for a broad spectrum of users.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
FHWA. (2009). Manual on Uniform Traffic Control Devices.
NCDOT. (1994). North Carolina Bicycle Facilities Planning and Design Guidelines.

Materials and Maintenance

Maintenance needs for bicycle wayfinding signs are similar to other signs, and will need periodic replacement due to wear.

Shared Roadways

Marked Shared Roadway

Guidance

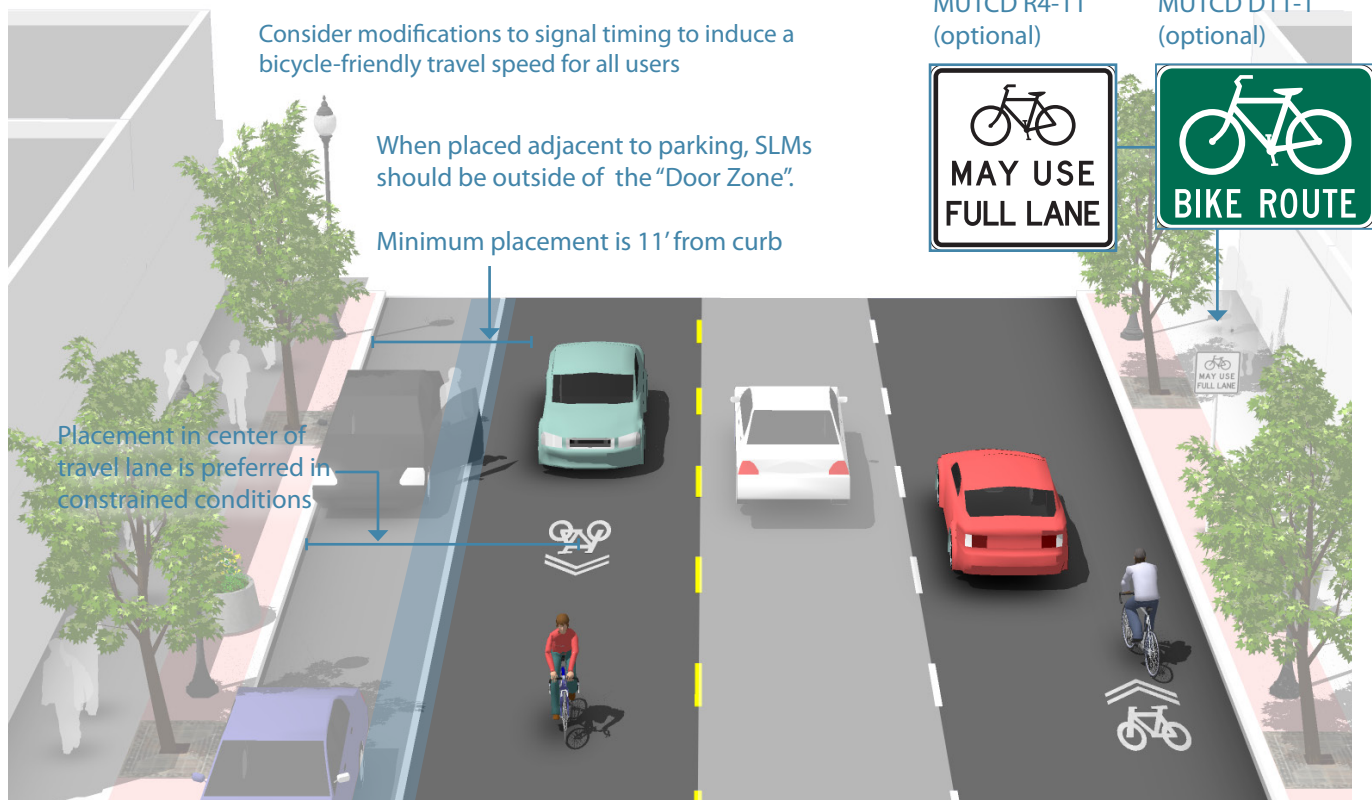
- In constrained conditions, preferred placement is in the center of the travel lane to minimize wear and promote single file travel.
- Minimum placement of SLM marking centerline is 11 feet from edge of curb where on-street parking is present, 4 feet from edge of curb with no parking. If parking lane is wider than 7.5 feet, the SLM should be moved further out accordingly.

Description

A marked shared roadway is a general purpose travel lane marked with shared lane markings (SLM) used to encourage bicycle travel and proper positioning within the lane.

In constrained conditions, the SLMs are placed in the middle of the lane to discourage unsafe passing by motor vehicles. On a wide outside lane, the SLMs can be used to promote bicycle travel to the right of motor vehicles.

In all conditions, SLMs should be placed outside of the door zone of parked cars.



Discussion

Bike Lanes should be considered on roadways with outside travel lanes wider than 15 feet, or where other lane narrowing or removal strategies may provide adequate road space. SLMs shall not be used on shoulders, in designated **Bike Lanes**, or to designate **Bicycle Detection** at signalized intersections. (MUTCD 9C.07)

This configuration differs from a **Bicycle Boulevard** due to a lack of traffic calming, wayfinding, and other enhancements designed to provide a higher level of comfort for a broad spectrum of users.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
FHWA. (2009). Manual on Uniform Traffic Control Devices.
NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

Placing SLMs between vehicle tire tracks will increase the life of the markings and minimize the long-term cost of the treatment.

Bicycle Boulevards

Bicycle boulevards are low-volume, low-speed streets modified to enhance bicyclist by using treatments such as signage, pavement markings, traffic calming and/or traffic reduction, and intersection modifications. These treatments allow through movements of bicyclists while discouraging similar through-trips by non-local motorized traffic.

Jurisdictions throughout the country use a wide variety of strategies to determine where specific treatments are applied. While no federal guidelines exist, several best practices have emerged for the development of bicycle boulevards. At a minimum, bicycle boulevards should include distinctive pavement markings and wayfinding signs. They can also use combinations of traffic calming, traffic diversion, and intersection treatments to improve the bicycling environment. The appropriate level of treatment to apply is dependent on roadway conditions, particularly motor vehicle speeds and volumes.

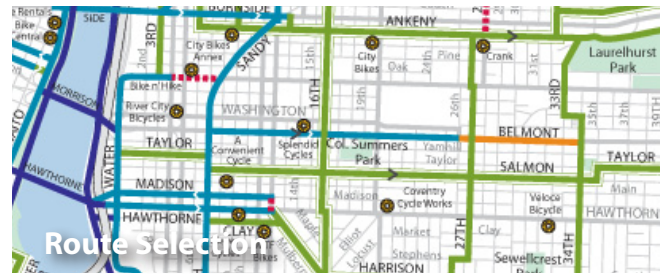
Traffic conditions on bicycle boulevards should be monitored to provide guidance on when and where treatments should be implemented. When motor vehicle speeds and volumes or bicyclist delay exceed the preferred limits, additional treatments should be considered for the bicycle boulevard.

The Ann Street Bicycle Boulevard in Wilmington, NC

The Ann Street Bicycle Boulevard completes the River to the Sea Bikeway from downtown Wilmington to Wrightsville Beach, therefore making the bicycle boulevard accessible to most of Wilmington's population. According to Census 2000 data, there are about 16,000 who live in close proximity to the Ann Street Bicycle Boulevard.



The first Ann Street Bicycle Boulevard Group Ride from S 15th St to the Riverfront Farmers' Market drew about 30 people.



This section includes:

- Route Selection
- Basic Treatments
- Minor Intersection Treatments
- Major Intersection Treatments
- Offset Intersection Treatments

Bicycle Boulevards

Route Selection

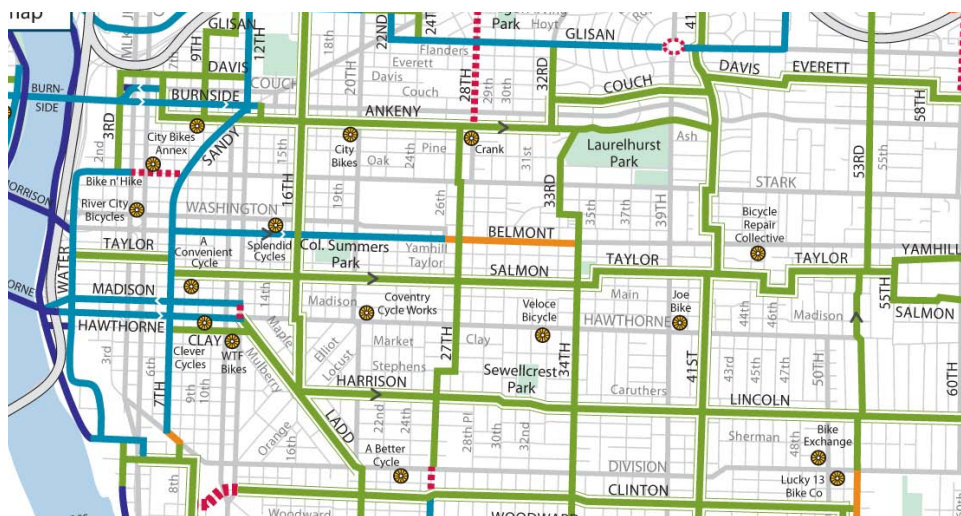
Guidance

- Streets are signed at 25 mph or less to improve the bicycling environment and decrease the risk and severity of crashes.
- Traffic volumes are limited to 3,000 vehicles per day (ideally less than 1,500) to minimize passing events and potential conflicts with motor vehicles.
- Use of streets that parallel major streets can discourage non-local motor vehicle traffic without significantly impacting motorists.
- Use of streets where a relatively continuous route for bicyclists exists and/or where treatments can provide wayfinding and improve crossing opportunities at offset intersections.
- Use of streets where bicyclists have right-of-way at intersections or where right-of-way is possible to assign to bicyclists.

Description

Bicycle boulevards should be developed on streets that improve connectivity to key destinations and provide a direct route for bicyclists. Local streets with existing traffic calming, traffic diversions, or signalized crossings of major streets are good candidates, as they tend to be existing bicycle routes and have low motor vehicle speeds and volumes. Other streets where residents have expressed a desire for traffic calming are also good options.

Bicycle boulevards parallel to commercial streets improve access for “interested but concerned” bicyclists and complement bike lanes on major roadways.



In Portland, OR, the bicycle network includes a high density of bicycle boulevards parallel to streets with bike lanes.

- MULTI-USE PATH
Closed to motor vehicles
- MULTI-USE PATH (unpaved)
- BIKE BOULEVARDS /
NEIGHBORHOOD GREEN STREETS
pavement markings & directional
signs to guide cyclists
- SHARED ROADWAY
on lower traffic street
- BIKE LANE
or wide shoulder, usually on
higher traffic streets
- SHARED ROADWAY WITH WIDER
OUTSIDE LANE
on moderate and higher traffic
street

Discussion

Bicycle boulevards should form a continuous network of streets or off-street facilities that accommodate bicyclists who are less willing to ride on streets with motorized traffic. Most bicycle boulevards are located on residential streets, though they can also be on commercial or industrial streets. Due to the presence of trucks and commercial vehicles, as well as the need to maintain good traffic flow and retain motor vehicle parking, bicycle boulevards on commercial or industrial streets can tolerate higher automobile speeds and volumes than would be desired on neighborhood streets. Vertical traffic calming can minimize impacts to large vehicles and parking.

Additional References and Guidelines

Alta Planning + Design and IBPI. (2009). Bicycle Boulevard Planning and Design Handbook.
City of Berkeley. (2000). Bicycle Boulevard Design Tools and Guidelines.
City of Emeryville. (2011). Bicycle Boulevard Treatments.

Materials and Maintenance

Repaving, street sweeping and other maintenance should occur with higher frequency than on other local streets.

Bicycle Boulevards

Basic Treatments

Description

Signs and pavement markings are the minimum treatments necessary to designate a street as a bicycle boulevard. Together, they visibly designate a roadway to both bicyclists and motorists. Signs, and in some cases pavement markings, provide wayfinding to help bicyclists remain on the designated route.

Guidance

Pavement Markings

Place symbols every 250-800 feet along a linear corridor, as well as after every intersection.

On narrow streets where a motor vehicle cannot pass a bicyclist within one lane of traffic, place stencils in the center of the travel lane.

See [Marked Shared Roadway](#) guidance for additional information on the use of shared lane markings.

A bicycle symbol can be placed on a standard road sign, along with distinctive coloration.

Signs

See [Bikeway Signing](#) for guidance on developing bicycle wayfinding signage. Some cities have developed unique logos or colors for wayfinding signs that help brand their bicycle boulevards.

Be consistent in content, design, and intent; colors reserved by the Manual on Uniform Traffic Devices (MUTCD) for regulatory and warning road signs are not recommended.

Signs can include information about intersecting bikeways and distance/time information to key destinations.



Discussion

Wayfinding signs displaying destinations, distances, and "riding time" can dispel common misperceptions about time and distance while increasing users' comfort and accessibility to the bicycle boulevard network. Bicycle boulevards frequently include offset intersections or 'jog' onto another street. Signs and pavement markings can help bicyclists remain on the route. In addition, fewer businesses or services are located along local streets, and signs inform bicyclists of the direction to key destinations, including commercial districts, transit hubs, schools and universities, and other bikeways.

Additional References and Guidelines

City of Milwaukee. (2009). Milwaukee Bicycle Wayfinding Signage Plan
 City of Oakland (2009). Design Guidelines for Bicycle Wayfinding Signage
 NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

Pavement markings should be repainted and signs replaced as needed. Wayfinding signs should be regularly updated with new major destinations and bikeways.

Bicycle Boulevards

Minor Intersection Treatments

Description

Treatments at minor roadway intersections are designed to improve the visibility of a bicycle boulevard, raise awareness of motorists on the cross-street that they are likely to encounter bicyclists, and enhance safety for all road users.

Guidance

- On the bicycle boulevard, the majority of intersections with minor roadways should stop-control cross traffic to minimize bicyclist delay. This will maximize bicycling efficiency.
- Traffic circles are a type of **Horizontal Traffic Calming** that can be used at minor street intersections. Traffic circles reduce conflict potential and severity while providing traffic calming to the corridor.
- If a stop sign is present on the bicycle boulevard, a second stop bar for bicyclists can be placed closer to the centerline of the cross street than the motorists' stop bar to increase the visibility of bicyclists waiting to cross the street.
- Curb extensions can be used to move bicyclists closer to the centerline to improve visibility and encourage motorists to let them cross.



Stop Signs on Cross-Street



Traffic Circles



Bicycle Forward Stop Bar



Curb Extension

Discussion

Stop signs increase bicycling time and energy expenditure, frequently leading to non-compliance by bicyclists and motorists, and/or use of other less desirable routes. Bicycle boulevards should have fewer stops or delays than other local streets. A typical bicycle trip of 30 minutes can increase to 40 minutes if there is a STOP sign at every block (*Berkeley Bicycle Boulevard Design Tools and Guidelines*). If several stop signs are turned along a corridor, speeds should be monitored and traffic-calming treatments used to reduce excessive vehicle speeds on the bicycle boulevard.

Additional References and Guidelines

City of Berkeley. (2000). *Bicycle Boulevard Design Tools and Guidelines*.
City of London Transport for London. Advanced stop lines (ASLS) background and research studies.
Transportation Research Board. (2006). *Improving Pedestrian Safety at Unsignalized Crossings*. NCHRP Report # 562.

Materials and Maintenance

Vegetation in traffic circles and curb extensions should be regularly trimmed to maintain visibility and attractiveness. Repaint bicycle stop bars as needed.

Bicycle Boulevards

Major Intersection Treatments

Description

The quality of treatments at major street crossings can significantly affect a bicyclist's choice to use a bicycle boulevard, as opposed to another road that provides a crossing treatment.

Guidance

- **Bike boxes** increase bicyclist visibility to motorists and reduce the danger of right "hooks" by providing a space for bicyclists to wait at signalized intersections.
- Median islands provided at uncontrolled intersections of bicycle boulevards and major streets allow bicyclists to cross one direction of traffic at a time as gaps in traffic occur.
- **Hybrid Beacons, active warning beacons** and **bicycle signals** can facilitate bicyclists crossing a busy street on which cross-traffic does not stop.
- Select treatments based on engineering judgment; see National Cooperative Highway Research Program (NCHRP) Report # 562 *Improving Pedestrian Safety at Unsignalized Crossings* (2006) for guidance on appropriate use of crossing treatments. Treatments are designed to improve visibility and encourage motorists to stop for pedestrians; with engineering judgement many of the same treatments are appropriate for use along bicycle boulevards.



Bike Box



Median Island



Hybrid Beacon (HAWK)



Rectangular Rapid Flash Beacon (RRFB)

Discussion

Bicycle boulevard retrofits to local streets are typically located on streets without existing signalized accommodation at crossings of collector and arterial roadways. Without treatments for bicyclists, these intersections can become major barriers along the bicycle boulevard and compromise safety.

Additional References and Guidelines

NACTO. (2012). *Urban Bikeway Design Guide*.
 Transportation Research Board. (2006). *Improving Pedestrian Safety at Unsignalized Crossings*. NCHRP Report # 562.
 Federal Highway Administration. (2004). *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations*. FHWA-RD-04-100

Materials and Maintenance

Maintain signs, markings, and other treatments and replace as needed. Monitor intersections for bicyclist delay to determine if additional treatments are warranted.

Bicycle Boulevards

Offset Intersection Treatments

Description

Offset intersections can be challenging for bicyclists who are required to briefly travel along the busier cross street in order to continue along the bicycle boulevard.

Guidance

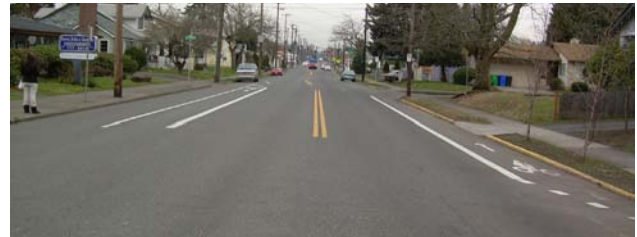
- Appropriate treatments depend on volume of traffic including turning volumes, traffic speeds and the type of bicyclist using the crossing.
- **Contraflow Bike Lanes** allow bicyclists to travel against the flow of traffic on a one-way street and can improve bicycle boulevard connectivity.
- Bicycle left-turn lanes can be painted where a bicycle boulevard is offset to the right on a street that has sufficient traffic gaps. Bicyclists cross one direction of traffic and wait in a protected space for a gap in the other direction. The bike turn pockets should be at least 4 feet wide, with a total of 11 feet for both turn pockets and center striping.
- Short **Bike Lanes** on the cross street assist with accessing a bicycle boulevard that jogs to the left. Crossing treatments should be provided on both sides to minimize wrong-way riding.
- A **Cycle Track** can be provided on one side of a busy street. Bicyclists enter the cycle track from the bicycle boulevard to reach the connecting segment of the bicycle boulevard. This maneuver may be signaled on one side.



Contraflow Bike Lane



Left Turn Bike Lanes



Short Bike Lanes on the Cross Street



Cycle Track Connection

Discussion

Because bicycle boulevards are located on local streets, the route is often discontinuous. Wayfinding and pavement markings assist bicyclists with remaining on the route.

Additional References and Guidelines

NACTO. (2012). *Urban Bikeway Design Guide*.
Hendrix, Michael. (2007). *Responding to the Challenges of Bicycle Crossings at Offset Intersections*. Third Urban Street Symposium.

Materials and Maintenance

Paint can wear more quickly in high traffic areas or in winter climates. Facilities should be cleared of snow through routine snow removal operations.

Separated Bikeways

Designated exclusively for bicycle travel, separated bikeways are segregated from vehicle travel lanes by striping, and can include pavement stencils and other treatments. Separated bikeways are most appropriate on arterial and collector streets where higher traffic volumes and speeds warrant greater separation.

Separated bikeways can increase safety and promote proper riding by:

- Defining road space for bicyclists and motorists, reducing the possibility that motorists will stray into the bicyclists' path.
- Discouraging bicyclists from riding on the sidewalk.
- Reducing the incidence of wrong way riding.
- Reminding motorists that bicyclists have a right to the road.



Shoulder Bikeway



Bike Lane with No On-Street Parking



Bike Lane with On-Street Parking



Buffered Bike Lane

This section includes:

- Shoulder Bikeway
- Bike Lane with No On-Street Parking
- Bike Lane Adjacent to On-Street Parking
- Buffered Bike Lane

Separated Bikeways

Shoulder Bikeways

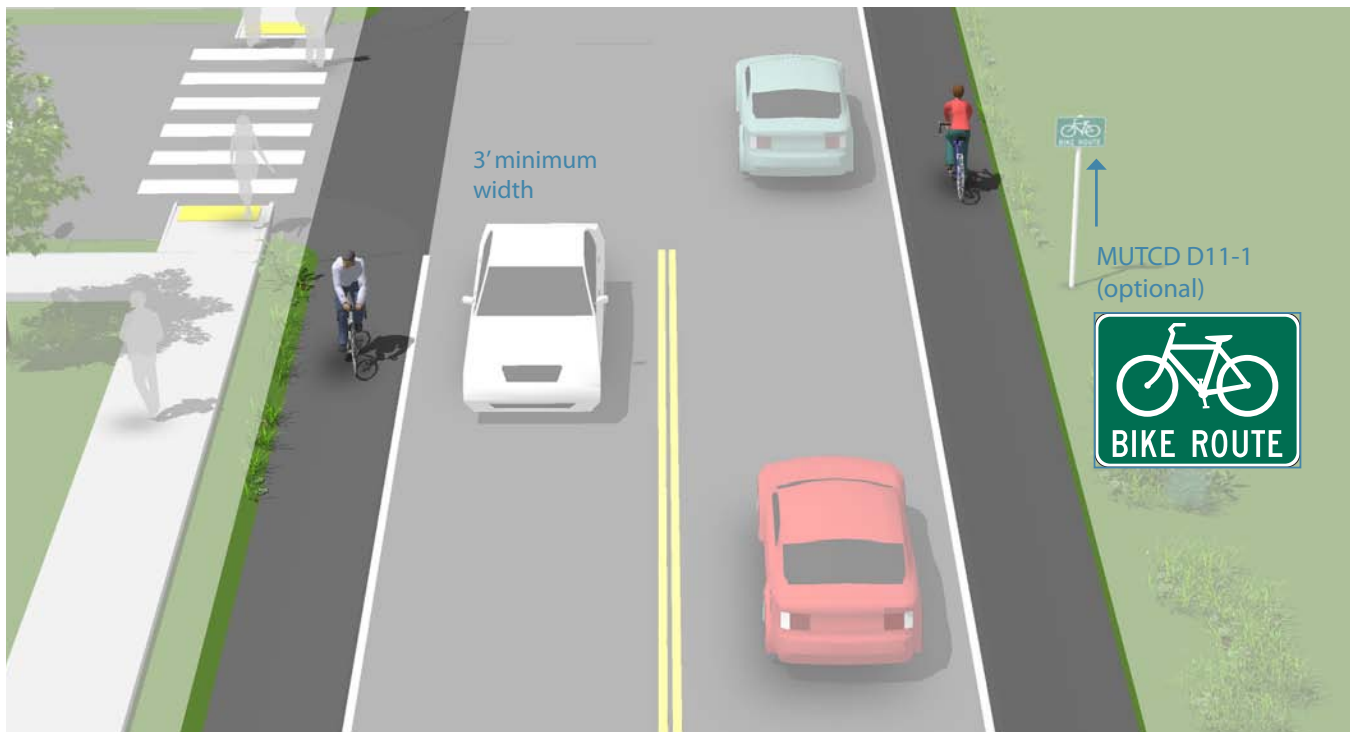
Guidance

- If 4 feet or more is available for bicycle travel, the full bike lane treatment of signs, legends, and an 8" bike lane line would be provided.
- If it is not possible to meet minimum bicycle lane dimensions, a reduced width paved shoulder can still improve conditions for bicyclists on constrained roadways. In these situations, a minimum of 3 feet of operating space should be provided.

MUTCD D11-1
(optional)

Description

Typically found in less-dense areas, shoulder bikeways are paved roadways with striped shoulders (4'+) wide enough for bicycle travel. Shoulder bikeways often, but not always, include signage alerting motorists to expect bicycle travel along the roadway. Shoulder bikeways should be considered a temporary treatment, with full bike lanes planned for construction when the roadway is widened or completed with curb and gutter. This type of treatment is not typical in urban areas and should only be used where constraints exist.



Discussion

A wide outside lane may be sufficient accommodation for bicyclists on streets with insufficient width for bike lanes but which do have space available to provide a wider (14'-16') outside travel lane. Consider configuring as a **marked shared roadway** in these locations.

Where feasible, **roadway widening** should be performed with pavement resurfacing jobs, but not exceeding desirable bike lane widths.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
FHWA. (2009). Manual on Uniform Traffic Control Devices.
NCDOT. (1994). North Carolina Bicycle Facilities Planning and Design Guidelines.

Materials and Maintenance

Paint can wear more quickly in high traffic areas or in winter climates. Shoulder bikeways should be cleared of snow through routine snow removal operations.

Separated Bikeways

Bike Lane with No On-Street Parking

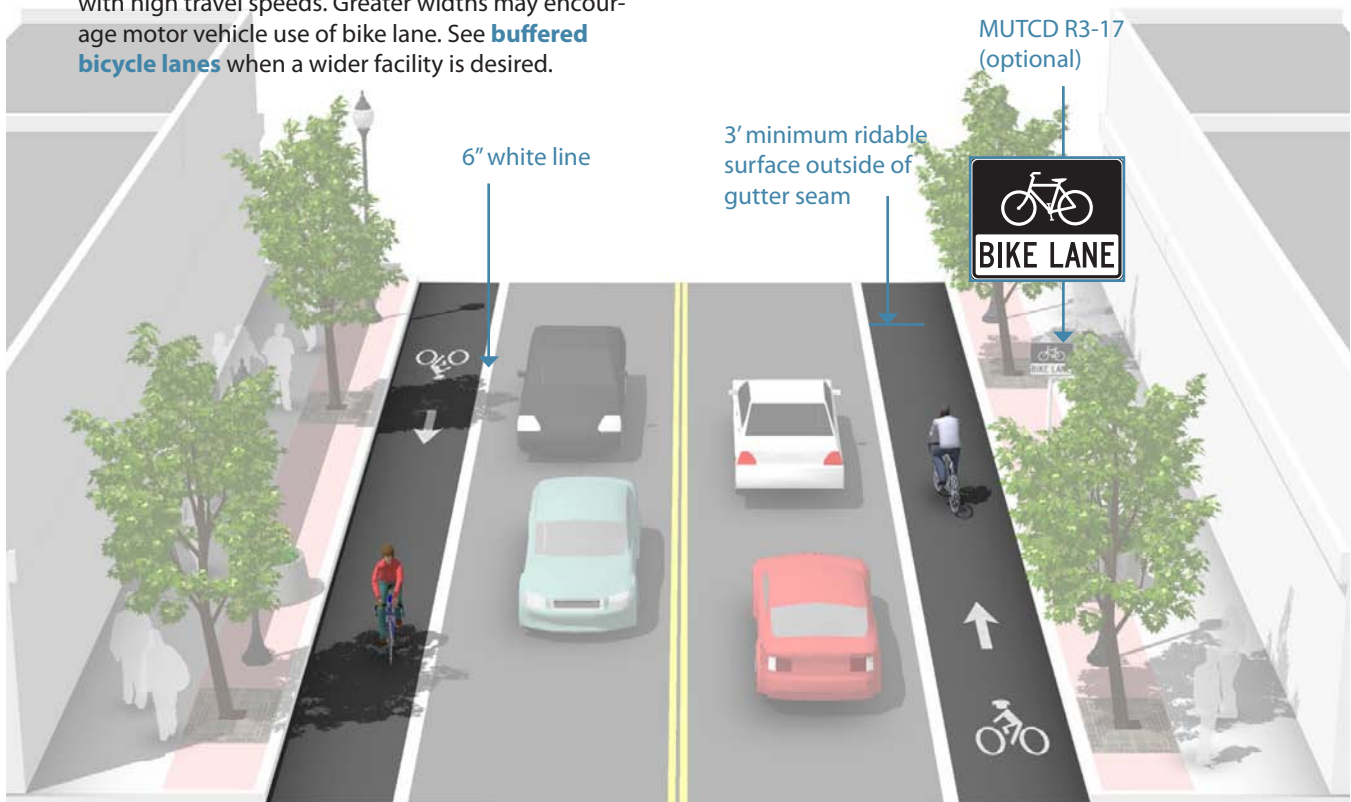
Guidance

- 4 foot minimum when no curb and gutter is present.
- 5 foot minimum when adjacent to curb and gutter or 3 feet more than the gutter pan width if the gutter pan is wider than 2 feet.
- 7 foot maximum width for use adjacent to arterials with high travel speeds. Greater widths may encourage motor vehicle use of bike lane. See **buffered bicycle lanes** when a wider facility is desired.

Description

Bike lanes designate an exclusive space for bicyclists through the use of pavement markings and signage. The bike lane is typically located on the right side of the street, between the adjacent travel lane and curb, and is used in the same direction as motor vehicle traffic.

A bike lane width of 7 feet makes it possible for bicyclists to ride side-by-side or pass each other without leaving the bike lane, thereby increasing the capacity of the lane.



Discussion

Wider bicycle lanes are desirable in certain situations such as on higher speed arterials (45 mph+) where use of a wider bicycle lane would increase separation between passing vehicles and bicyclists. Appropriate signing and stenciling is important with wide bicycle lanes to ensure motorists do not mistake the lane for a vehicle lane or parking lane. Consider **Buffered Bicycle Lanes** when further separation is desired.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
 FHWA. (2009). Manual on Uniform Traffic Control Devices.
 NACTO. (2012). Urban Bikeway Design Guide.
 NCDOT. (1994). North Carolina Bicycle Facilities Planning and Design Guidelines.

Materials and Maintenance

Paint can wear more quickly in high traffic areas or in winter climates. Bicycle lanes should be cleared of snow through routine snow removal operations.

Separated Bikeways

Bike Lane Adjacent to On-Street Parallel Parking

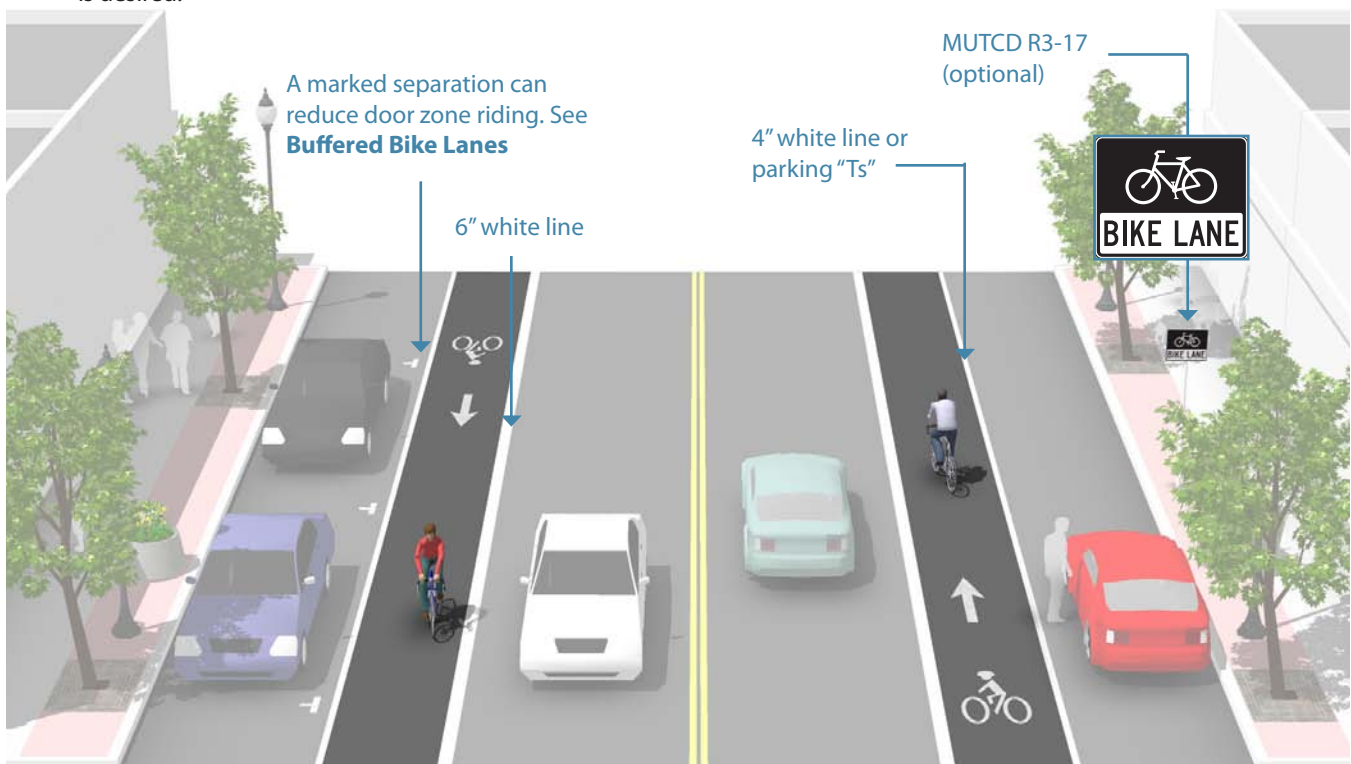
Guidance

- 12 foot minimum from curb face to edge of bike lane.
- 14.5 foot preferred from curb face to edge of bike lane.
- 7 foot maximum for marked width of bike lane. Greater widths may encourage vehicle loading in bike lane. See [buffered bicycle lanes](#) when a wider facility is desired.

Description

Bike lanes designate an exclusive space for bicyclists through the use of pavement markings and signage. The bike lane is located adjacent to motor vehicle travel lanes and is used in the same direction as motor vehicle traffic. Bike lanes are typically on the right side of the street, between the adjacent travel lane and curb, road edge or parking lane.

Many bicyclists, particularly less experienced riders, are more comfortable riding on a busy street if it has a striped and signed bikeway than if they are expected to share a lane with vehicles.



Discussion

Bike lanes adjacent to on-street parallel parking require special treatment in order to avoid crashes caused by an open vehicle door. The bike lane should have sufficient width to allow bicyclists to stay out of the door zone while not encroaching into the adjacent vehicular lane. Parking stall markings, such as parking "Ts" and double white lines create a parking side buffer that encourages bicyclists to ride farther away from the door zone.

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
 FHWA. (2009). Manual on Uniform Traffic Control Devices.
 NACTO. (2012). Urban Bikeway Design Guide.
 NCDOT. (1994). North Carolina Bicycle Facilities Planning and Design Guidelines.

Materials and Maintenance

Paint can wear more quickly in high traffic areas or in winter climates. Bicycle lanes should be cleared of snow through routine snow removal operations.

Separated Bikeways

Buffered Bike Lane

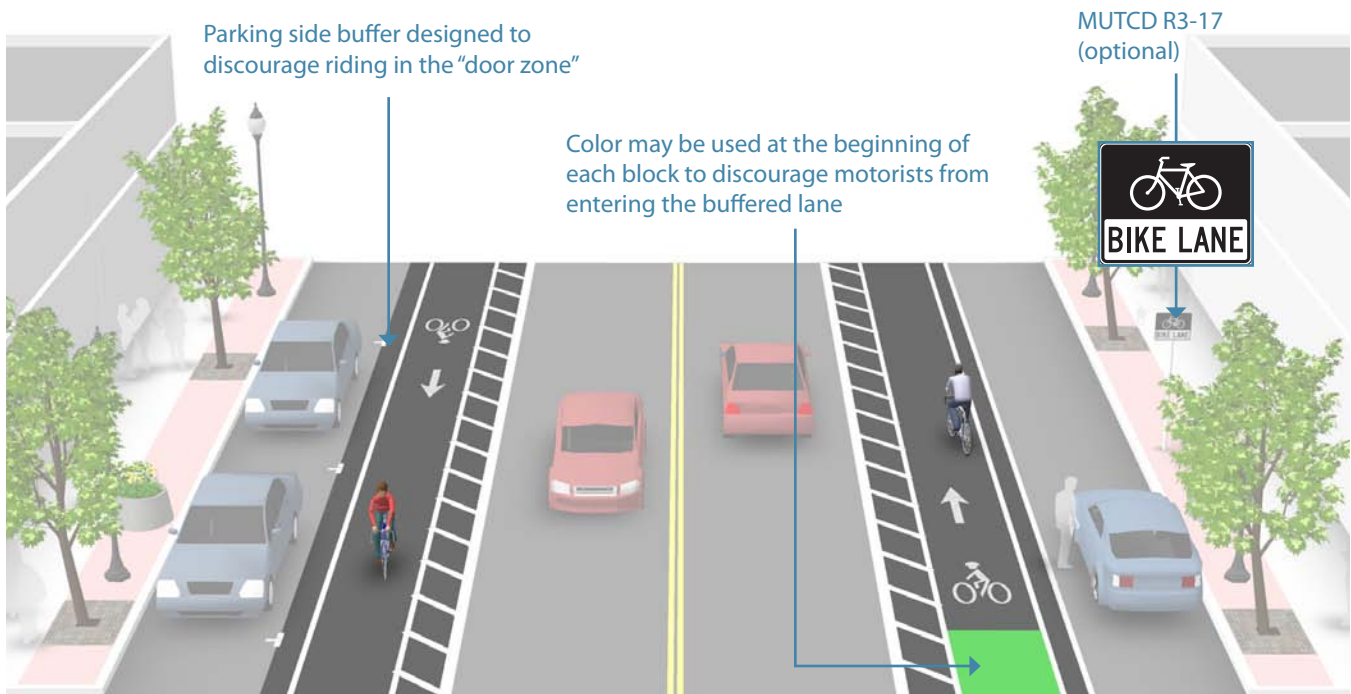
Guidance

- Where bicyclist volumes are high or where bicyclist speed differentials are significant, the desired bicycle travel area width is 7 feet.
- Buffers should be at least 2 feet wide. If 3 feet or wider, mark with diagonal or chevron hatching. For clarity at driveways or minor street crossings, consider a dotted line for the inside buffer boundary where cars are expected to cross.

Description

Buffered bike lanes are conventional bicycle lanes paired with a designated buffer space, separating the bicycle lane from the adjacent motor vehicle travel lane and/or parking lane. Buffered bike lanes are allowed as per MUTCD guidelines for buffered preferential lanes (section 3D-01).

Buffered bike lanes are designed to increase the space between the bike lane and the travel lane or parked cars. This treatment is appropriate for bike lanes on roadways with high motor vehicle traffic volumes and speed, adjacent to parking lanes, or a high volume of truck or oversized vehicle traffic.



Discussion

Frequency of right turns by motor vehicles at major intersections should determine whether continuous or truncated buffer striping should be used approaching the intersection. Commonly configured as a buffer between the bicycle lane and motor vehicle travel lane, a parking side buffer may also be provided to help bicyclists avoid the 'door zone' of parked cars.

Additional References and Guidelines

FHWA. (2009). Manual on Uniform Traffic Control Devices. (3D-01)
 NACTO. (2012). Urban Bikeway Design Guide.
 AASHTO. (2012). Guide for the Development of Bicycle Facilities.

Materials and Maintenance

Paint can wear more quickly in high traffic areas or in winter climates. Bicycle lanes should be cleared of snow through routine snow removal operations.

Cycle Tracks

A cycle track is an exclusive bike facility that combines the user experience of a separated path with the on-street infrastructure of a conventional bike lane. A cycle track is physically separated from motor traffic and distinct from the sidewalk. Cycle tracks have different forms but all share common elements—they provide space that is intended to be exclusively or primarily used by bicycles, and are separated from motor vehicle travel lanes, parking lanes, and sidewalks. In situations where on-street parking is allowed, cycle tracks are located to the curb-side of the parking (in contrast to bike lanes).

Cycle tracks may be one-way or two-way, and may be at street level, sidewalk level or at an intermediate level. If at sidewalk level, a curb or median separates them from motor traffic, while different pavement color/texture separates the cycle track from the sidewalk. If at street level, they can be separated from motor traffic by raised medians, on-street parking or bollards.

A two-way cycle track is desirable when more destinations are on one side of a street (therefore preventing additional crossings), if the facility connects to a path or other bicycle facility on one side of the street, or if there is not enough room for a cycle track on both sides of the road.

By separating bicyclists from motor traffic, cycle tracks can offer a higher level of comfort than bike lanes and are attractive to a wider spectrum of the public.

Intersections and approaches must be carefully designed to promote safety and facilitate left-turns from the right side of the street. See [separated bikeways at intersections](#) for more information.



This section includes:

- Cycle Track Separation and Placement
- One-Way Cycle Tracks
- Two-Way Cycle Tracks
- Driveways and Minor Streets
- Major Street Crossings

Cycle Tracks

Cycle Track Separation and Placement

Guidance

- Cycle tracks should ideally be placed along streets with long blocks and few driveways or mid-block access points for motor vehicles. Cycle tracks located on one-way streets have fewer potential conflict areas than those on two-way streets.
- In situations where on-street parking is allowed, cycle tracks shall be located between the parking lane and the sidewalk (in contrast to bike lanes).

Description

Protection is provided through physical barriers and can include bollards, parking, a planter strip, an extruded curb, or on-street parking. Cycle tracks using these protection elements typically share the same elevation as adjacent travel lanes.

Raised cycle tracks may be at the level of the adjacent sidewalk or set at an intermediate level between the roadway and sidewalk to separate the cycle track from the pedestrian area.



Discussion

Sidewalks or other pedestrian facilities should not be narrowed to accommodate the cycle track as pedestrians will likely walk on the cycle track if sidewalk capacity is reduced. Visual and physical cues (e.g., pavement markings & signage) should be used to make it clear where bicyclists and pedestrians should be travelling. If possible, separate the cycle track and pedestrian zone with a furnishing zone.

Additional References and Guidelines

NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

In cities with winter climates, barrier separated and raised cycle tracks may require special equipment for snow removal.

Cycle Tracks

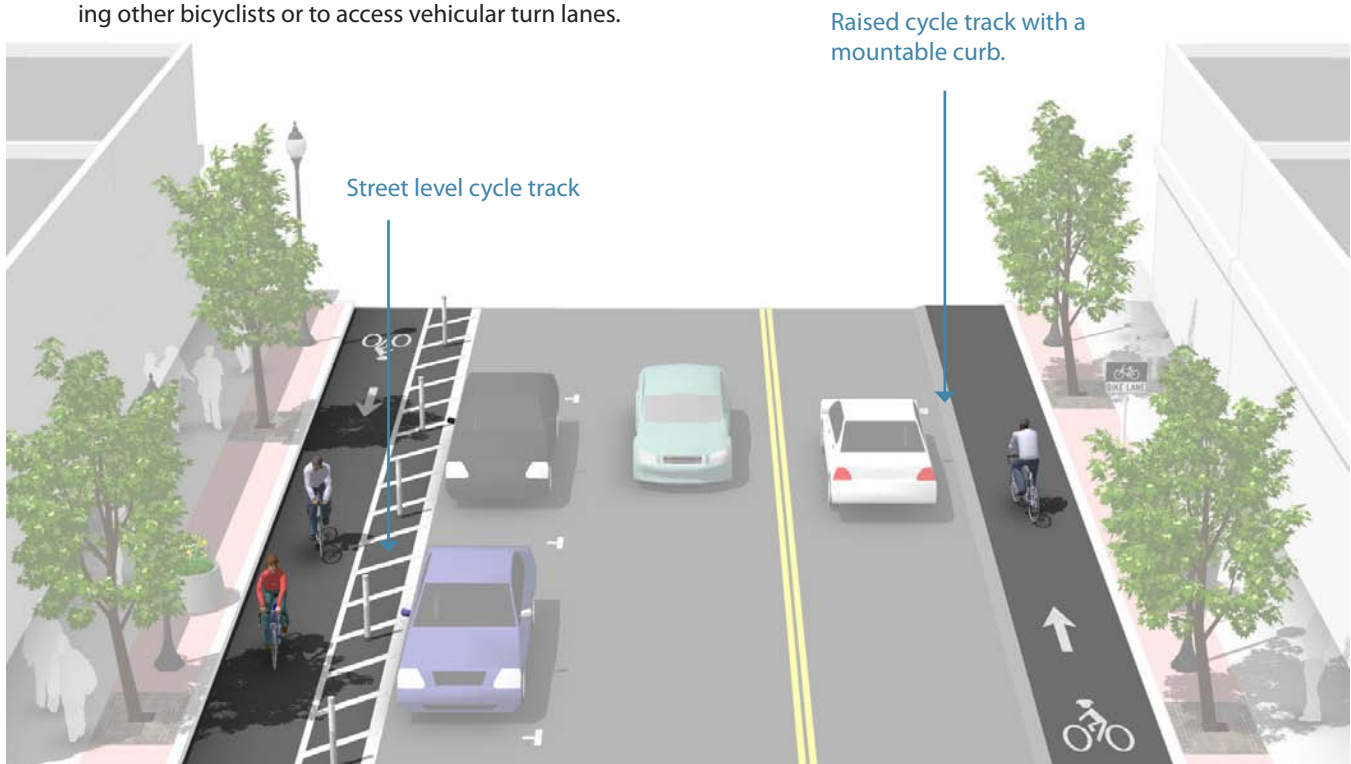
One-Way Cycle Tracks

Guidance

- 7 foot recommended minimum to allow passing.
- 5 foot minimum width in constrained locations.
- When placed adjacent to parking, the parking buffer should be three feet wide to allow for passenger loading and to prevent door collisions.
- When placed adjacent to a travel lane, one-way raised cycle tracks may be configured with a mountable curb to allow entry and exit from the bicycle lane for passing other bicyclists or to access vehicular turn lanes.

Description

One-way cycle tracks are physically separated from motor traffic and distinct from the sidewalk. Cycle tracks are either raised or at street level and use a variety of elements for physical protection from passing traffic.



Discussion

Special consideration should be given at transit stops to manage bicycle and pedestrian interactions. Driveways and minor street crossings are unique challenges to cycle track design. Parking should be prohibited within 30 feet of the intersection to improve visibility. Color, yield markings and "Yield to Bikes" signage should be used to identify the conflict area and make it clear that the cycle track has priority over entering and exiting traffic. If configured as a raised cycle track, the crossing should be raised so that the sidewalk and cycle track maintain their elevation through the crossing.

Additional References and Guidelines

NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

In cities with winter climates, barrier separated and raised cycle tracks may require special equipment for snow removal.

Cycle Tracks

Two-Way Cycle Tracks

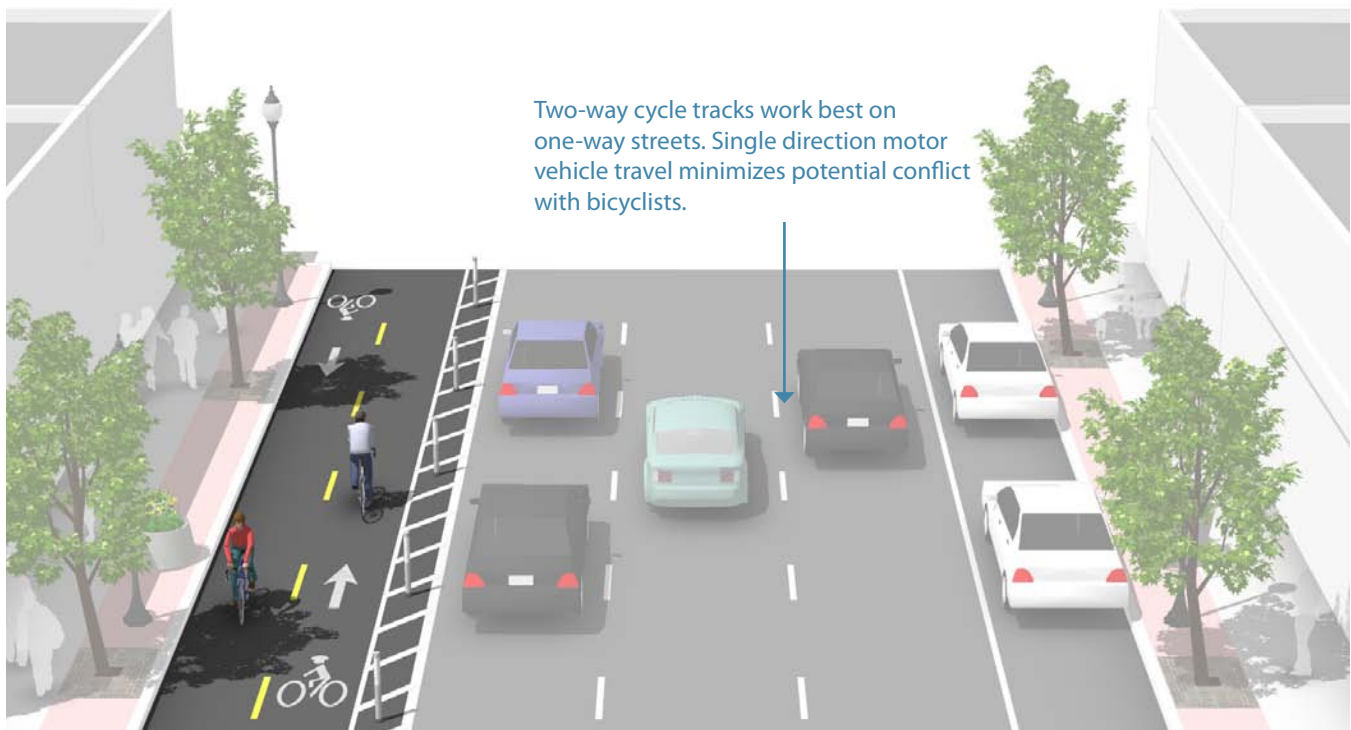
Guidance

- 12 foot recommended minimum for two-way facility
- 8 foot minimum in constrained locations
- When placed adjacent to parking, the parking buffer should be three feet wide to allow for passenger loading and to prevent door collisions.

Description

Two-way cycle tracks are physically separated cycle tracks that allow bicycle movement in both directions on one side of the road. Two-way cycle tracks share some of the same design characteristics as **one-way cycle tracks**, but may require additional considerations at driveway and side-street crossings.

A two-way cycle track may be configured as a protected cycle track at street level with a parking lane or other barrier between the cycle track and the motor vehicle travel lane and/or as a raised cycle track to provide vertical separation from the adjacent motor vehicle lane.



Discussion

Two-way cycle tracks require a higher level of control at intersections to allow for a variety of turning movements. These movements should be guided by separated signals for bicycles and motor vehicles. Transitions into and out of two-way cycle tracks should be simple and easy to use to deter bicyclists from continuing to ride against the flow of traffic.

At driveways and minor intersections, bicyclists riding against roadway traffic in two-way cycle tracks may surprise pedestrians and drivers not expecting bidirectional travel. Appropriate signage is recommended.

Additional References and Guidelines

NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

In cities with winter climates barrier, separated and raised cycle tracks may require special equipment for snow removal.

Cycle Tracks

Driveways and Minor Street Crossings

Guidance

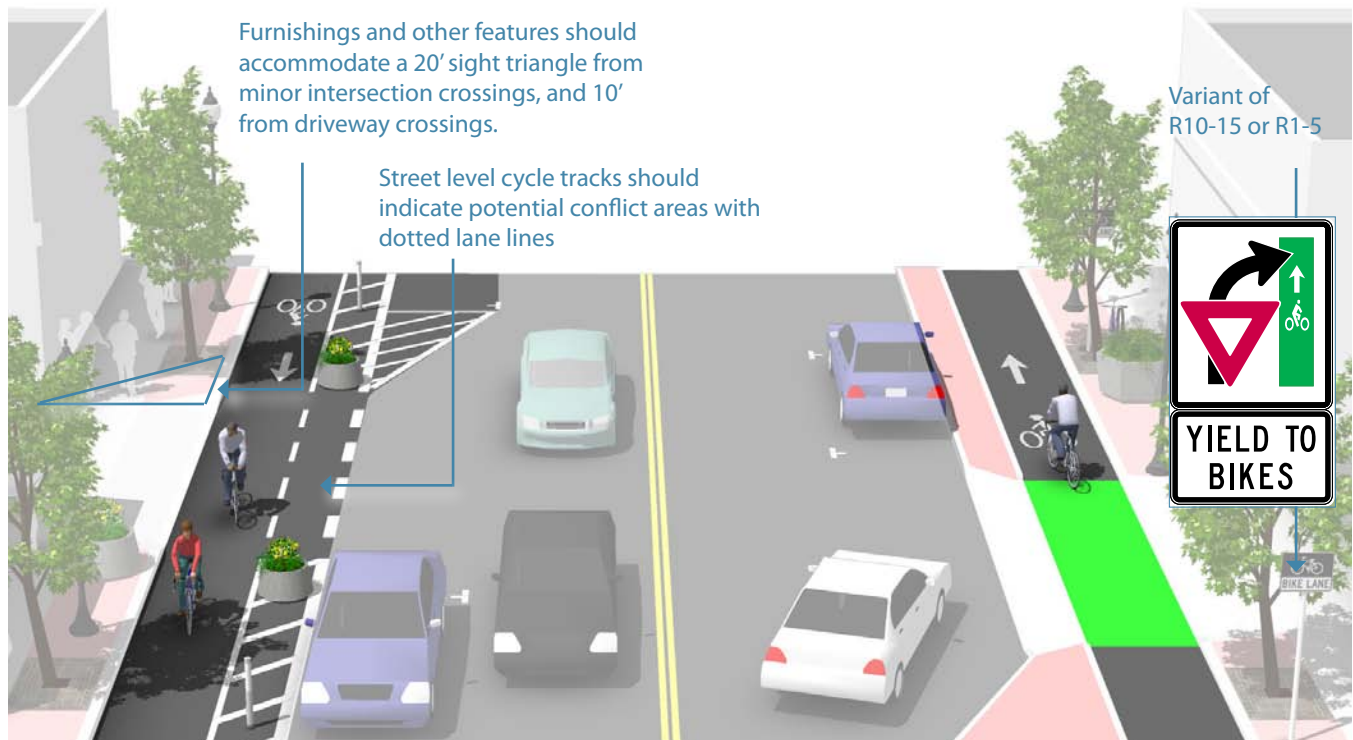
- If raised, maintain the height of the cycle track through the crossing, requiring automobiles to cross over.
- Remove parking 30 feet prior the intersection.
- Use colored pavement markings and/or shared lane markings through the conflict area.
- Place warning signage to identify the crossing.

Description

The added separation provided by cycle tracks creates additional considerations at intersections that should be addressed.

At driveways and crossings of minor streets a smaller fraction of automobiles will cross the cycle track. Bicyclists should not be expected to stop at these minor intersections if the major street does not stop.

Openings in the barrier or curb are needed at intersections and driveways or other access points to allow vehicle crossing.



Discussion

At these locations, bicyclist visibility is important, as a buffer of parked cars or vegetation can reduce the visibility of a bicyclist traveling in the cycle track. Markings and signage should be present that make it easy to understand where bicyclists and pedestrians should be travelling. Access management should be used to reduce the number of crossings of driveways on a cycle track. Driveway consolidations and restrictions on motorized traffic movements reduce the potential for conflict.

Additional References and Guidelines

NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

In cities with winter climates, barrier separated and raised cycle tracks may require special equipment for snow removal.

Cycle Tracks

Major Street Crossings

Description

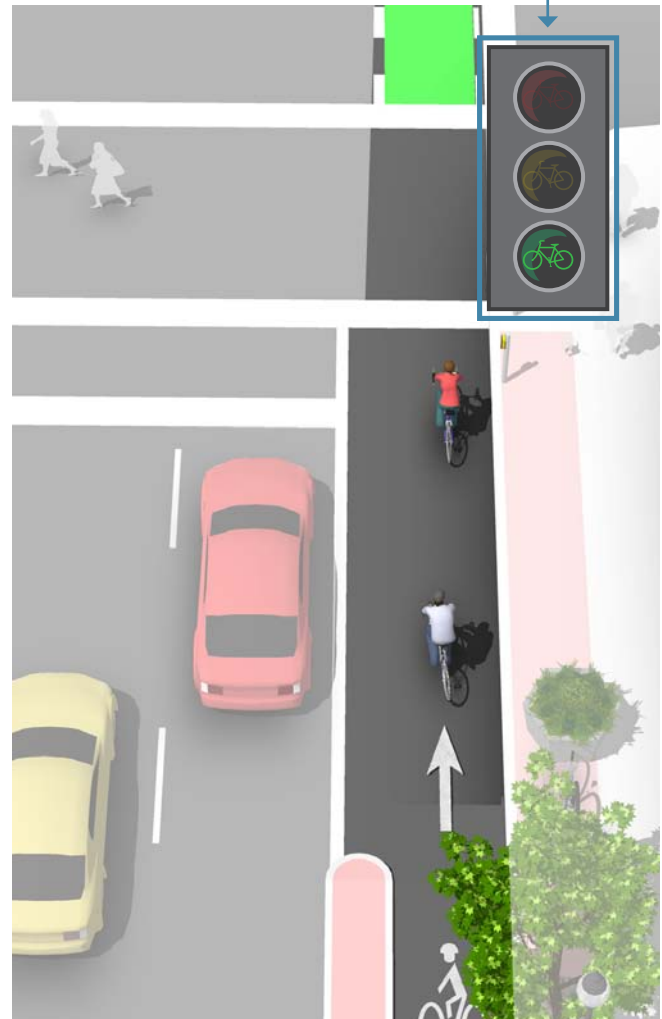
Cycle tracks approaching major intersections must minimize and mitigate potential conflicts and provide connections to intersecting facility types.

Cycle track crossings of signalized intersections can also be accomplished through the use of a bicycle signal phase which reduces conflicts with motor vehicles by separating bicycle movements from any conflicting motor vehicle movements.

Guidance

- Drop cycle track buffer and transition to bike lane 16' in advance of the intersection.
- Remove parking 16' -50' in advance of the buffer termination.
- Use a **bike box** or advanced stop line treatment to place bicyclists in front of traffic.
- Use **colored pavement** markings through the conflict area.
- Provide for left-turning movements with **two-stage turn** boxes.
- Consider using a protected phase **bicycle signal** to isolate conflicts between bicyclists and motor vehicle traffic.
- In constrained conditions with right turn only lanes, consider transitioning to a **shared bike lane/turn lane**.

Demand-only bicycle signals can be implemented to reduce vehicle delay and to prevent an empty signal phase from regularly occurring.



Discussion

Signalization utilizing a bicycle signal head can also be set to provide cycle track users a green phase in advance of vehicle phases. The length of the signal phase will depend on the width of the intersection.

The same conflicts exist at non-signalized intersections. Warning signs, special markings and the removal of on-street parking in advance of the intersection can raise visibility and awareness of bicyclists.

Additional References and Guidelines

AASHTO. (1999). Guide for the Development of Bicycle Facilities.
FHWA. (2009). Manual on Uniform Traffic Control Devices.
NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

In cities with winter climates, barrier separated and raised cycle tracks may require special equipment for snow removal.

Separated Bikeways at Intersections

Intersections are junctions at which different modes of transportation meet and facilities overlap. An intersection facilitates the interchange between bicyclists, motorists, pedestrians and other modes in order to advance traffic flow in a safe and efficient manner. Designs for intersections with bicycle facilities should reduce conflict between bicyclists (and other vulnerable road users) and vehicles by heightening the level of visibility, denoting clear right-of-way and facilitating eye contact and awareness with other modes. Intersection treatments can improve both queuing and merging maneuvers for bicyclists, and are often coordinated with timed or specialized signals.

The configuration of a safe intersection for bicyclists may include elements such as color, signage, medians, signal detection and pavement markings. Intersection design should take into consideration existing and anticipated bicyclist, pedestrian and motorist movements. In all cases, the degree of mixing or separation between bicyclists and other modes is intended to reduce the risk of crashes and increase bicyclist comfort. The level of treatment required for bicyclists at an intersection will depend on the bicycle facility type used, whether bicycle facilities are intersecting, and the adjacent street function and land use.

This section includes:

- Bike Lanes at Right Turn Only Lanes
- Colored Bike Lanes in Conflict Areas
- Shared Bicycle/Right Turn Lanes
- Intersection Crossing Markings
- Bike Lanes at High Speed Interchanges



Bike Lanes at Right Turn Only Lanes



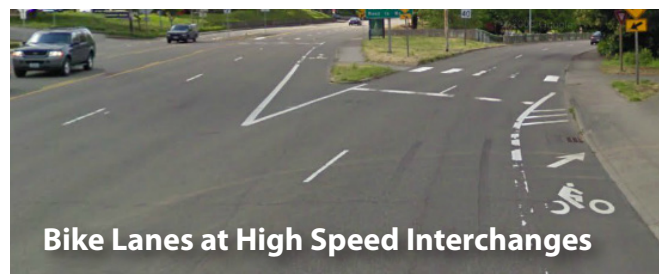
Colored Bike Lanes in Conflict Areas



Combined Bike Lane/Turn Lane



Intersection Crossing Markings



Bike Lanes at High Speed Interchanges

Separated Bikeways at Intersections

Bike Lanes at Right Turn Only Lanes

Description

The appropriate treatment at right-turn lanes is to place the bike lane between the right-turn lane and the right-most through lane or, where right-of-way is insufficient, to use a **shared bike lane/turn lane**.

The design (right) illustrates a bike lane pocket, with signage indicating that motorists should yield to bicyclists through the conflict area.

Guidance

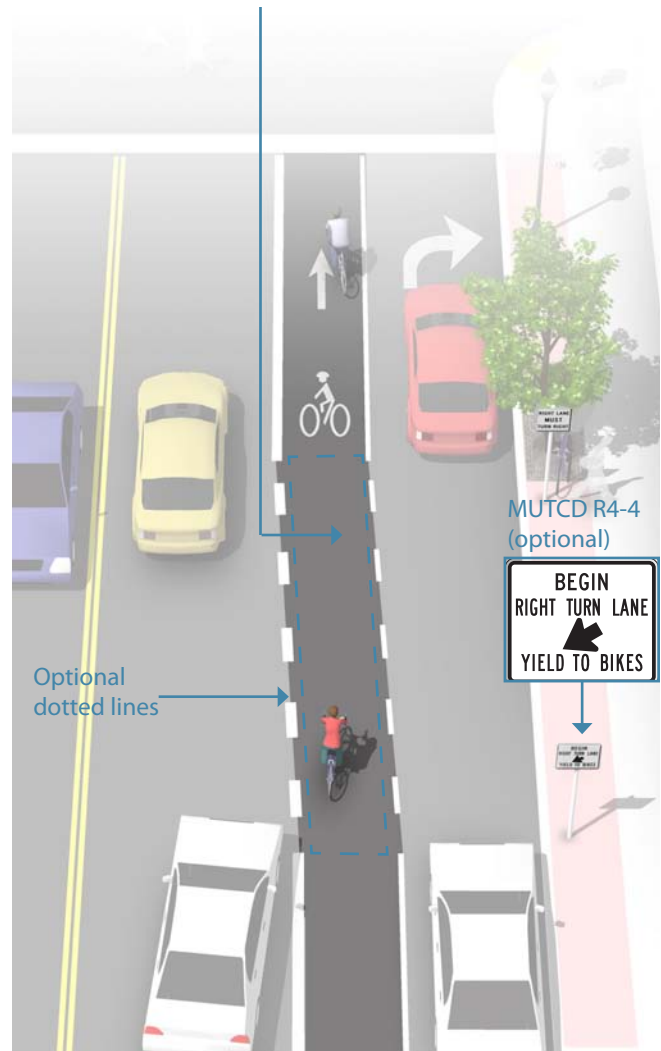
At auxiliary right turn only lanes (add lane):

- Continue existing bike lane width; standard width of 5 to 6 feet or 4 feet in constrained locations.
- Use signage to indicate that motorists should yield to bicyclists through the conflict area.
- Consider using **colored conflict areas** to promote visibility of the mixing zone.

Where a through lane becomes a right turn only lane:

- Do not define a dotted line merging path for bicyclists.
- Drop the bicycle lane in advance of the merge area.
- Use shared lane markings to indicate shared use of the lane in the merging zone.

Colored pavement may be used in the weaving area to increase visibility and awareness of potential conflict



Discussion

For other potential approaches to providing accommodations for bicyclists at intersections with turn lanes, please see [shared bike lane/turn lane](#), [bicycle signals](#), and [colored bike facilities](#).

Additional References and Guidelines

AASHTO. (2012). Guide for the Development of Bicycle Facilities.
FHWA. (2009). Manual on Uniform Traffic Control Devices.
NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

Because the effectiveness of markings depends entirely on their visibility, maintaining markings should be a high priority.

Separated Bikeways at Intersections

Colored Bike Lanes in Conflict Areas

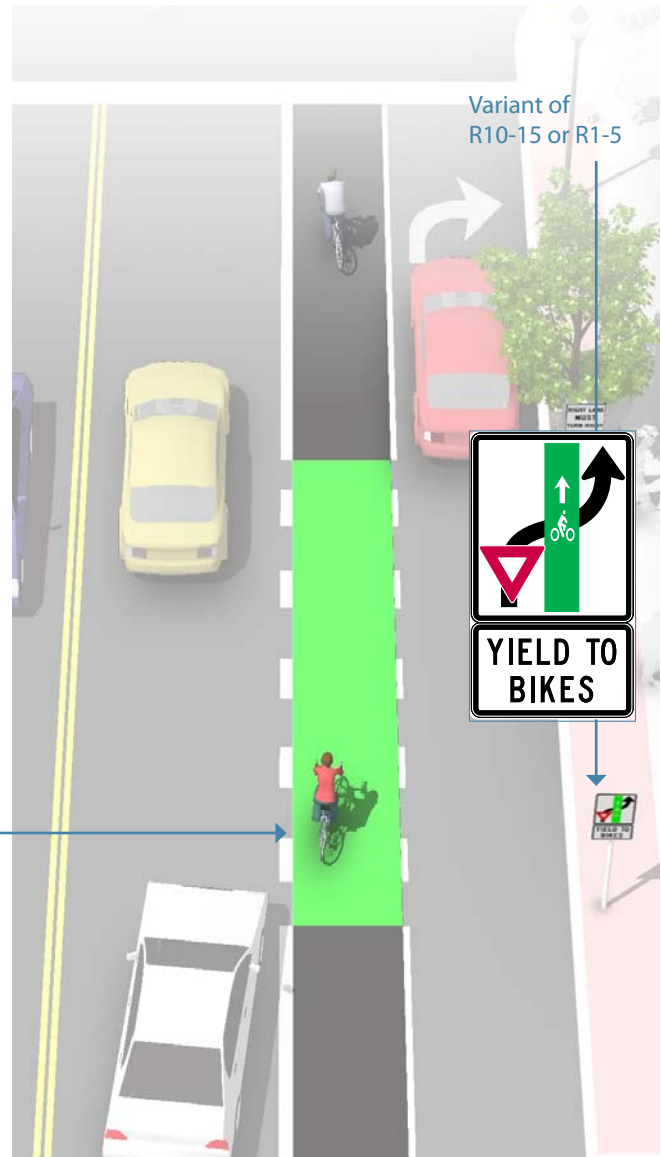
Description

Colored pavement within a bicycle lane increases the visibility of the facility and reinforces priority of bicyclists in conflict areas.

Guidance

- Green colored pavement was given interim approval by the Federal Highways Administration in March 2011. See interim approval for specific color standards.
- The colored surface should be skid resistant and retro-reflective.
- A “Yield to Bikes” sign should be used at intersections or driveway crossings to reinforce that bicyclists have the right-of-way in colored bike lane areas.

Normal white dotted edge lines should define colored space



Discussion

Evaluations performed in Portland, OR, St. Petersburg, FL and Austin, TX found that significantly more motorists yielded to bicyclists and slowed or stopped before entering the conflict area after the application of the colored pavement when compared with an uncolored treatment.

Additional References and Guidelines

FHWA. (2011). Interim Approval (IA-14) has been granted. Requests to use green colored pavement need to comply with the provisions of Paragraphs 14 through 22 of Section 1A.10
NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

Because the effectiveness of markings depends entirely on their visibility, maintaining markings should be a high priority.

Separated Bikeways at Intersections

Combined Bike Lane / Turn Lane

Description

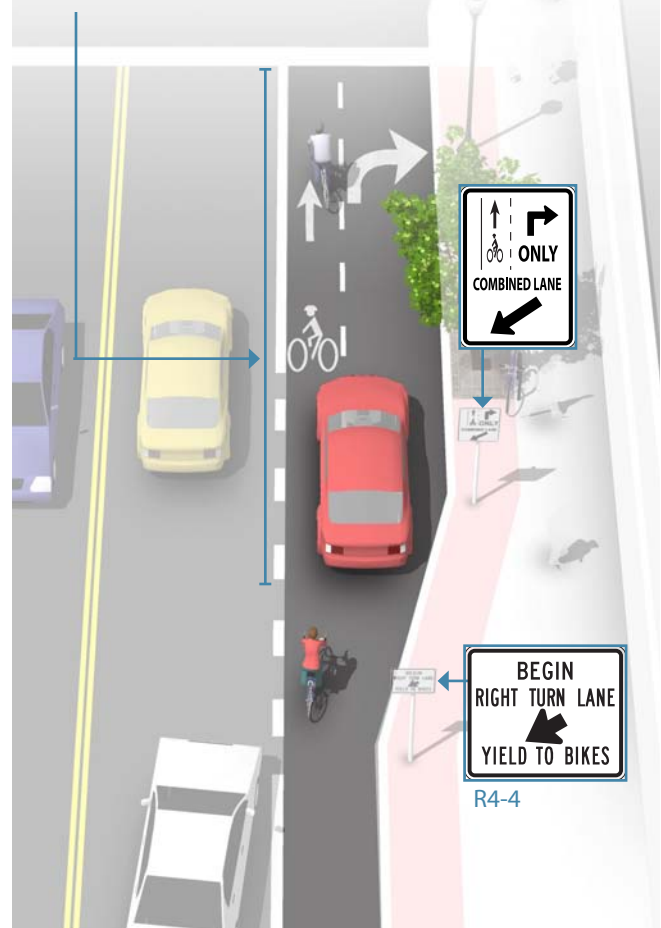
The combined bicycle/right turn lane places a standard-width bike lane on the left side of a dedicated right turn lane. A dotted line delineates the space for bicyclists and motorists within the shared lane. This treatment includes signage advising motorists and bicyclists of proper positioning within the lane.

This treatment is recommended at intersections lacking sufficient space to accommodate both a standard **through bike lane** and right turn lane.

Guidance

- Maximum shared turn lane width is 13 feet; narrower is preferable.
- Bike Lane pocket should have a minimum width of 4 feet with 5 feet preferred.
- A dotted 4 inch line and bicycle lane marking should be used to clarify bicyclist positioning within the combined lane, without excluding cars from the suggested bicycle area.
- A “Right Turn Only” sign with an “Except Bicycles” plaque may be needed to make it legal for through bicyclists to use a right turn lane.

Short length turn pockets encourage slower motor vehicle speeds



Discussion

Case studies cited by the Pedestrian and Bicycle Information Center indicate that this treatment works best on streets with lower posted speeds (30 MPH or less) and with lower traffic volumes (10,000 ADT or less). May not be appropriate for high-speed arterials or intersections with long right turn lanes. May not be appropriate for intersections with large percentages of right-turning heavy vehicles.

Additional References and Guidelines

NACTO. (2012). Urban Bikeway Design Guide.
This treatment is currently slated for inclusion in the next edition of the AASHTO Guide for the Development of Bicycle Facilities

Materials and Maintenance

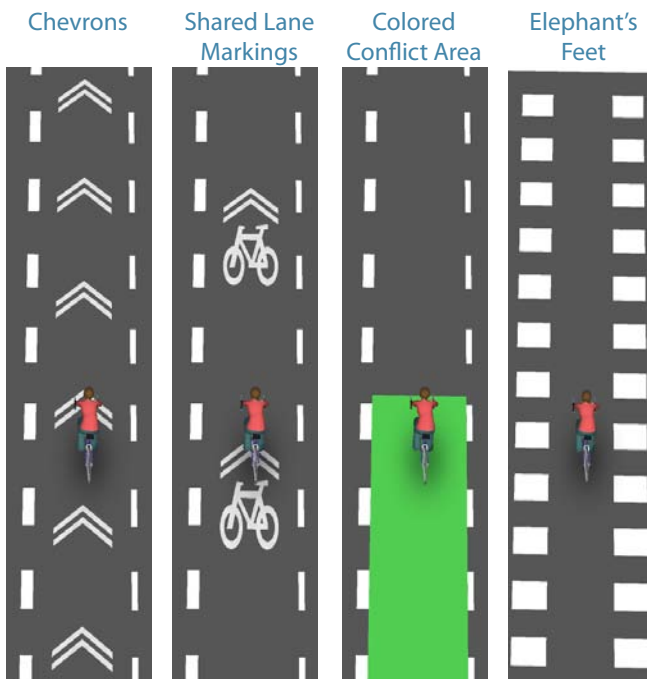
Locate markings out of tire tread to minimize wear. Because the effectiveness of markings depends on their visibility, maintaining markings should be a high priority.

Separated Bikeways at Intersections

Intersection Crossing Markings

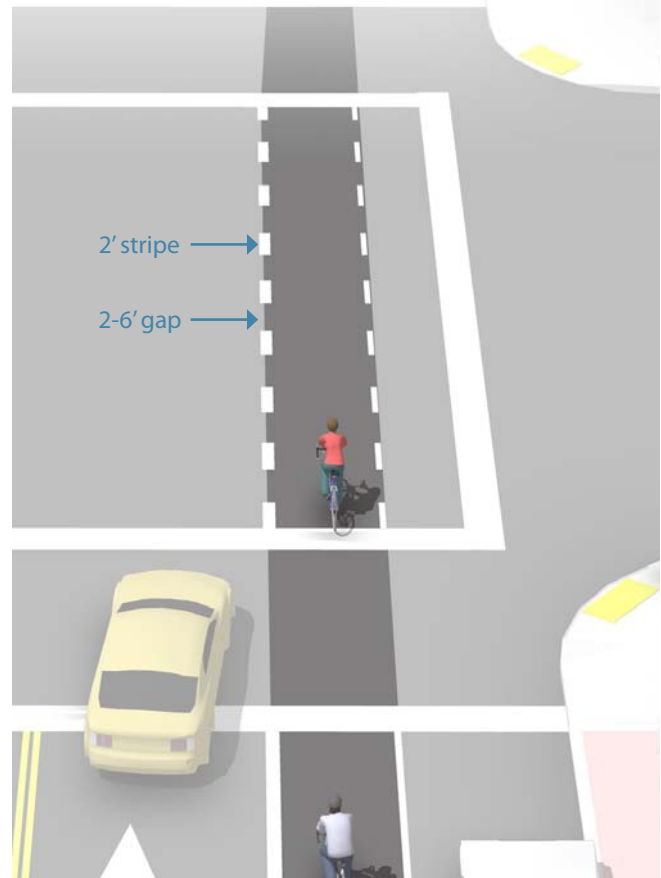
Guidance

- See MUTCD Section 3B.08: “dotted line extensions”
- Crossing striping shall be at least six inches wide when adjacent to motor vehicle travel lanes. Dotted lines should be two-foot lines spaced two to six feet apart.
- Chevrons, shared lane markings, or **colored bike lanes in conflict areas** may be used to increase visibility within conflict areas or across entire intersections. Elephant’s Feet markings are common in Europe and Canada.



Description

Bicycle pavement markings through intersections indicate the intended path of bicyclists through an intersection or across a driveway or ramp. They guide bicyclists on a safe and direct path through the intersection and provide a clear boundary between the paths of through bicyclists and either through or crossing motor vehicles in the adjacent lane.



Discussion

Additional markings such as chevrons, shared lane markings, or **colored bike lanes in conflict areas** are strategies currently in use in the United States and Canada. Cities considering the implementation of markings through intersections should standardize future designs to avoid confusion.

Additional References and Guidelines

FHWA. (2009). Manual on Uniform Traffic Control Devices. (3A.06)
 NACTO. (2012). Urban Bikeway Design Guide.

Materials and Maintenance

Because the effectiveness of marked crossings depends entirely on their visibility, maintaining marked crossings should be a high priority.

Separated Bikeways at Intersections

Bike Lanes at High Speed Interchanges

Guidance

Entrance Ramps:

Angle the bike lane to increase the approach angle with entering traffic. Position crossing before drivers' attention is focused on the upcoming merge.

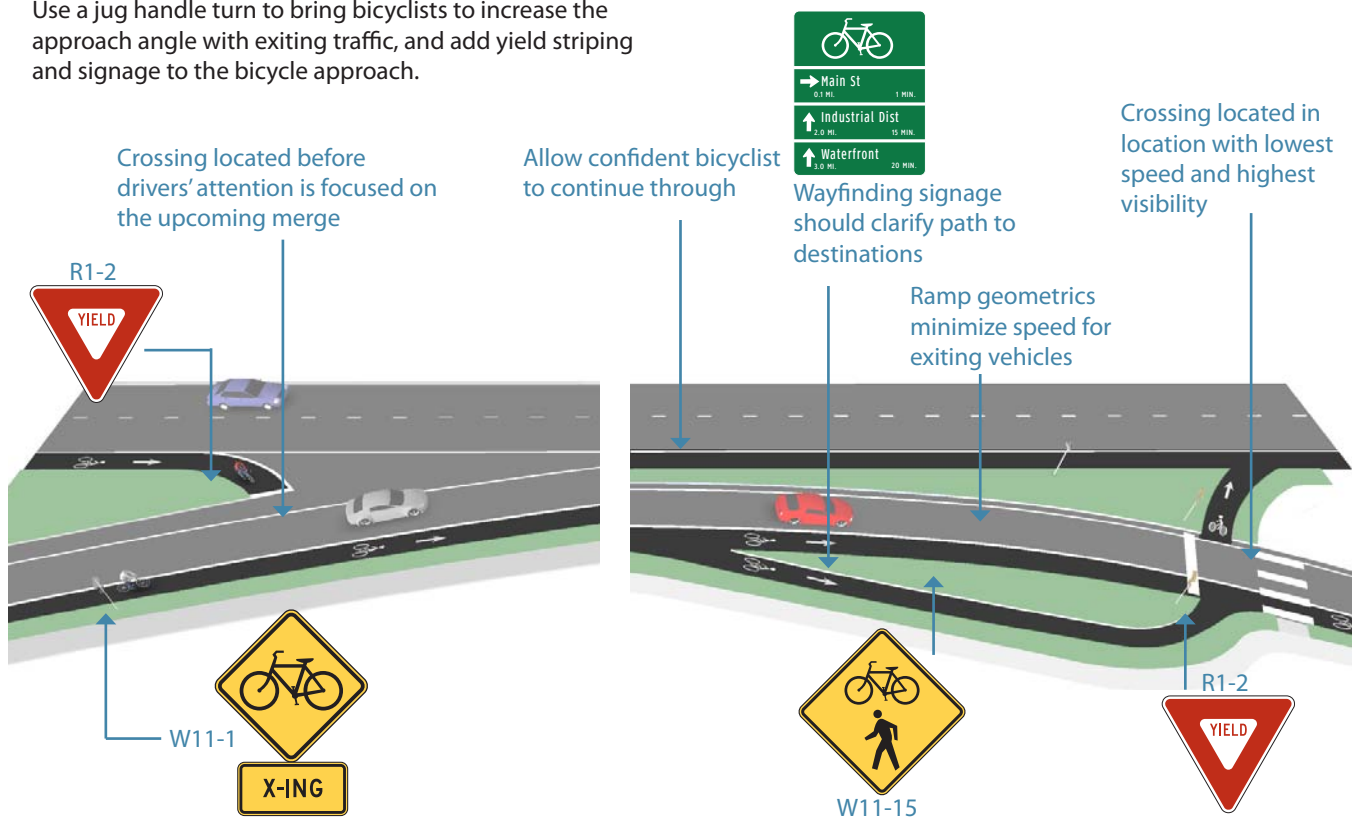
Exit Ramps:

Use a jug handle turn to bring bicyclists to increase the approach angle with exiting traffic, and add yield striping and signage to the bicycle approach.

Description

Some arterials may contain high speed freeway-style designs such as merge lanes and exit ramps, which can create difficulties for bicyclists. The entrance and exit lanes typically have intrinsic visibility problems because of low approach angles and feature high speed differentials between bicyclists and motor vehicles.

Strategies to improve safety focus on increasing sight distances, creating formal crossings, and minimizing crossing distances.



Discussion

While the jug-handle approach is the preferred configuration at exit ramps, provide the option for through bicyclists to perform a vehicular merge and proceed straight through under safe conditions.

Additional References and Guidelines

FHWA. (2009). Manual on Uniform Traffic Control Devices. Bicycle and Pedestrian Transportation. Lesson 15: Bicycle Lanes

Materials and Maintenance

Locate crossing markings out of wheel tread when possible to minimize wear and maintenance costs.

Bicycle Support Facilities

Bicycle Parking

Bicyclists expect a safe, convenient place to secure their bicycle when they reach their destination. This may be short-term parking of 2 hours or less, or long-term parking for employees, students, residents, and commuters.

Access to Transit

Safe and easy access to bicycle parking facilities is necessary to encourage commuters to access transit via bicycle. Providing bicycle access to transit and space for bicycles on buses and rail vehicles can increase the feasibility of transit in lower-density areas, where transit stops are beyond walking distance of many residences. People are often willing to walk only a quarter- to half-mile to a bus stop, while they might bike as much as two or more miles to reach a transit station.

'Fix-it' Stations

The Fix-it Station includes all the tools necessary to perform basic repairs and maintenance, from changing a flat to adjusting brakes and derailleurs. The tools and air pump are securely attached to the stand with stainless steel cables and tamper-proof fasteners. Hanging the bike from the hanger arms allows the pedals and wheels to spin freely while making adjustments. As seen below, these stations can also feature a Quick Read (QR) code for mobile/online instructions on how to repair your bicycle.



More info on 'Fix-it' Stations:
www.dero.com/products/fixit/



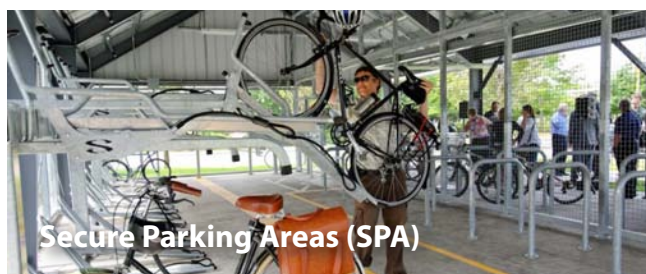
Bicycle Racks



On-Street Bike Corral



Bicycle Lockers



Secure Parking Areas (SPA)



Bicycle Access to Transit



Fix-it Stations

Bicycle Support Facilities

Bicycle Racks

Guidance

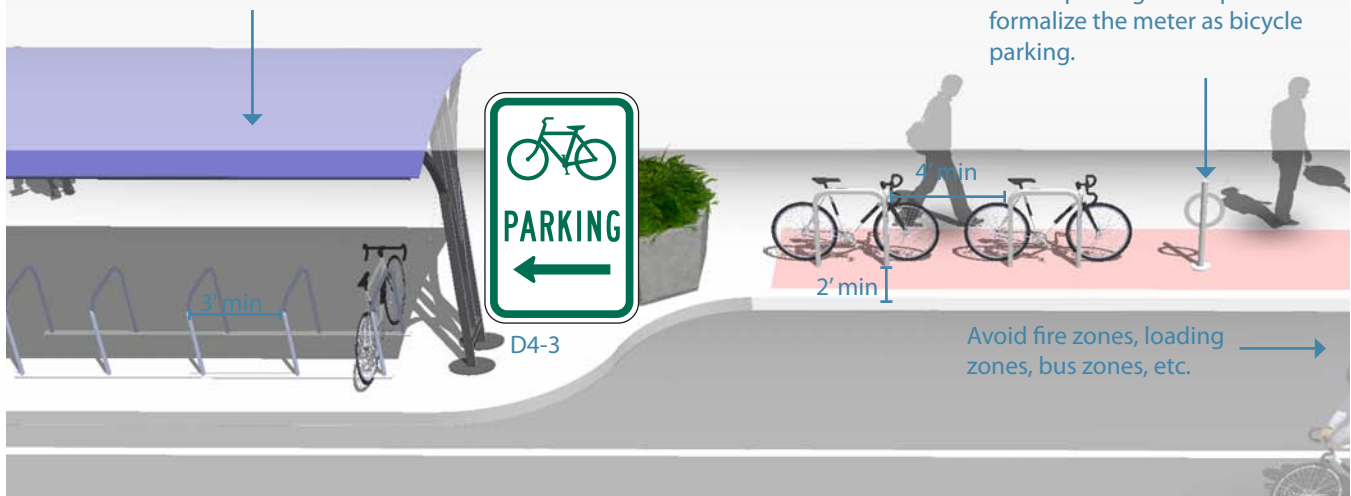
- 2' minimum from the curb face to avoid 'dooring.'
- Close to destinations; 50' maximum distance from main building entrance.
- Minimum clear distance of 6' should be provided between the bicycle rack and the property line.
- Should be highly visible from adjacent bicycle routes and pedestrian traffic.
- Locate racks in areas that cyclists are most likely to travel.

Description

Short-term bicycle parking is meant to accommodate visitors, customers, and others expected to depart within two hours. It should have an approved standard rack, appropriate location and placement, and weather protection. The Association for Pedestrian and Bicycle Professionals (APBP) recommends selecting a bicycle rack that:

- Supports the bicycle in at least two places, preventing it from falling over.
- Allows locking of the frame and one or both wheels with a U-lock.
- Is securely anchored to ground.
- Resists cutting, rusting and bending or deformation.

Bicycle shelters consist of bicycle racks grouped together within structures with a roof that provides weather protection.



Discussion

Where the placement of racks on sidewalks is not possible (due to narrow sidewalk width, sidewalk obstructions, street trees, etc.), bicycle parking can be provided in the street where on-street vehicle parking is allowed in the form of **on-street bicycle corrals**.

Some types of bicycle racks may meet design criteria, but are discouraged except in limited situations. This includes undulating "wave" racks, schoolyard "wheel bender" racks, and spiral racks.

Additional References and Guidelines

APBP. (2010). Bicycle Parking Guide 2nd Edition.
AASHTO. (2012). Guide for the Development of Bicycle Facilities.

Materials and Maintenance

Use of proper anchors will prevent vandalism and theft. Racks and anchors should be regularly inspected for damage. Educate snow removal crews to avoid burying racks during winter months.

Bicycle Support Facilities

On-Street Bicycle Corral

Guidance

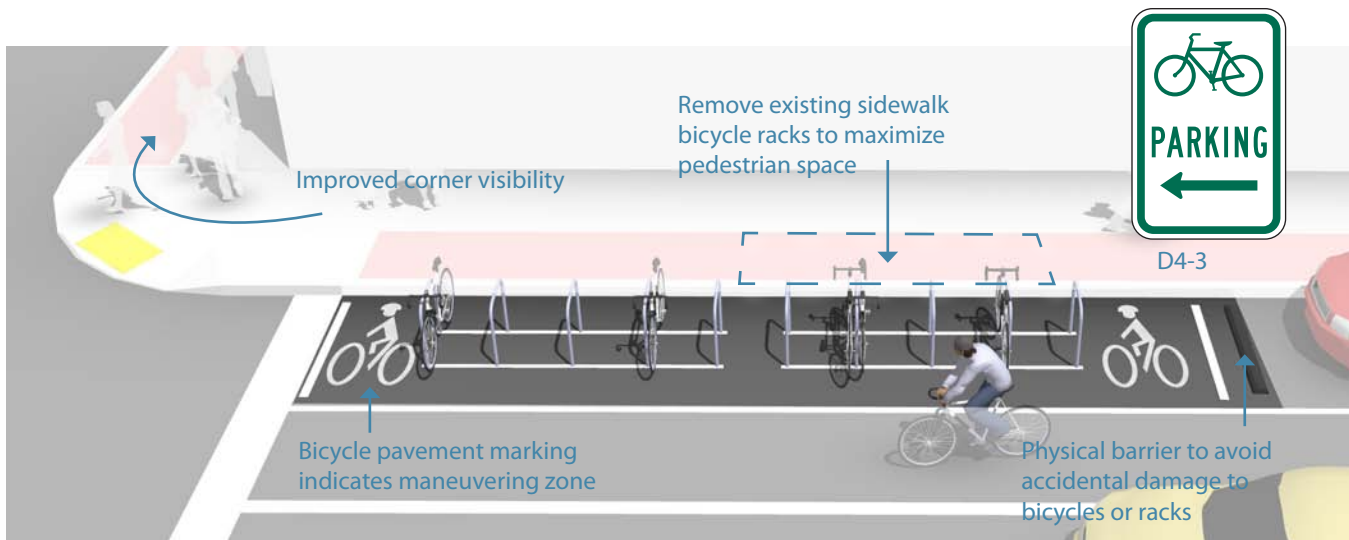
See guidelines for sidewalk **Bicycle Rack** placement and clear zones.

- Bicyclists should have an entrance width from the roadway of 5' – 6'.
- Can be used with parallel or angled parking.
- Parking stalls adjacent to curb extensions are good candidates for bicycle corrals since the concrete extension serves as delimitation on one side.

Description

Bicycle corrals (also known as on-street bicycle parking) consist of bicycle racks grouped together in a common area within the street traditionally used for automobile parking. Bicycle corrals are reserved exclusively for bicycle parking and provide a relatively inexpensive solution to providing high-volume bicycle parking. Bicycle corrals can be implemented by converting one or two on-street motor vehicle parking spaces into on-street bicycle parking. Each motor vehicle parking space can be replaced with approximately 6-10 bicycle parking spaces.

Bicycle corrals move bicycles off the sidewalks, leaving more space for pedestrians, sidewalk café tables, etc. Because bicycle parking does not block sightlines (as large motor vehicles would do), it may be possible to locate bicycle parking in 'no-parking' zones near intersections and crosswalks.



Discussion

In many communities, the installation of bicycle corrals is driven by requests from adjacent businesses, and is not a city-driven initiative. In such cases, the city does not remove motor vehicle parking unless it is explicitly requested. In other areas, the city provides the facility and business associations take responsibility for the maintenance of the facility. Communities can establish maintenance agreements with the requesting business. Bicycle corrals can be especially effective in areas with high bicycle parking demand or along street frontages with narrow sidewalks where parked bicycles would be detrimental to the pedestrian environment.

Additional References and Guidelines

APBP. (2010). Bicycle Parking Guide 2nd Edition.

Materials and Maintenance

Physical barriers may obstruct drainage and collect debris. Establish a maintenance agreement with neighboring businesses. In snowy climates the bicycle corral may need to be removed during the winter months.

Bicycle Support Facilities

Bicycle Lockers

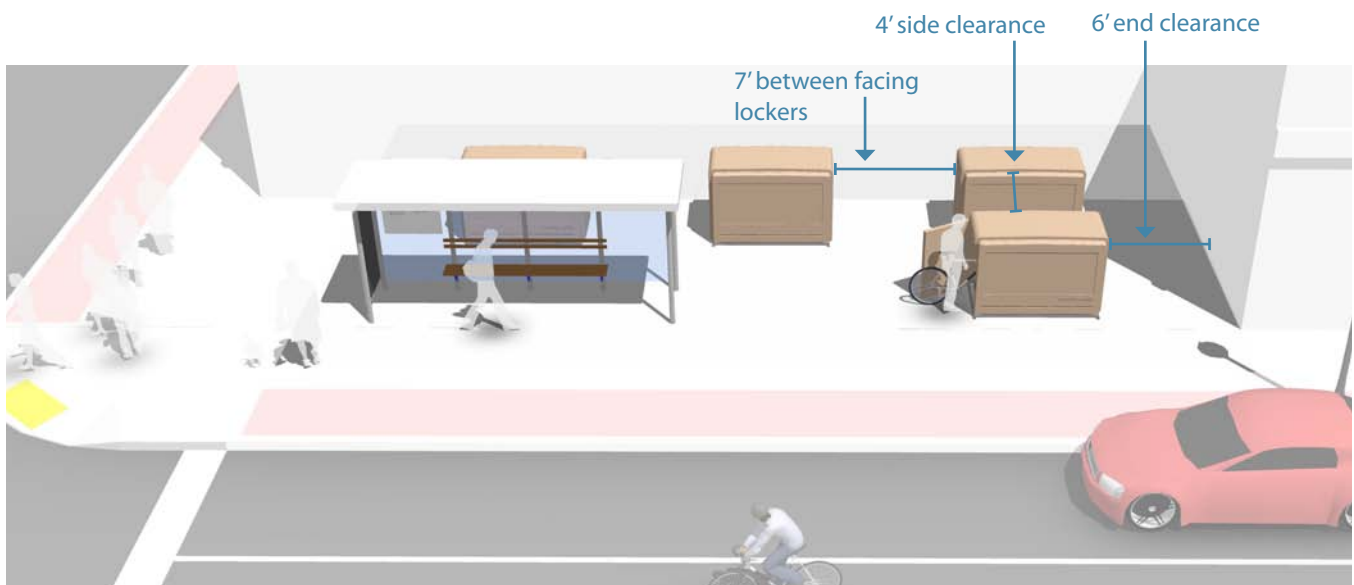
Guidance

- Minimum dimensions: width (opening) 2.5'; height 4'; depth 6'.
- 4 foot side clearance and 6 foot end clearance.
- 7 foot minimum distance between facing lockers.
- Locker designs that allow visibility and inspection of contents are recommended for increased security.
- Access is controlled by a key or access code.

Description

Bicycle lockers are intended to provide long-term bicycle storage for employees, students, residents, commuters, and others expected to park more than two hours. Long-term facilities protect the entire bicycle, its components and accessories against theft and against inclement weather, including snow and wind-driven rain.

Bicycle lockers provide space to store a few accessories or rain gear in addition to containing the bicycle. Some lockers allow access to two users - a partition separating the two bicycles can help users feel their bike is secure. Lockers can also be stacked, reducing the footprint of the area, although that makes them more difficult to use.



Discussion

Long-term parking facilities are more expensive to provide than short-term facilities, but are also significantly more secure. Although many bicycle commuters would be willing to pay a nominal fee to guarantee the safety of their bicycle, long-term bicycle parking should be free wherever automobile parking is free. Potential locations for long-term bicycle parking include transit stations, large employers, and institutions where people use their bikes for commuting and not consistently throughout the day.

Additional References and Guidelines

APBP. (2010). Bicycle Parking Guide 2nd Edition.
AASHTO. (2012). Guide for the Development of Bicycle Facilities.

Materials and Maintenance

Regularly inspect the functioning of moving parts and enclosures. Change keys and access codes periodically to prevent access to unapproved users.

Bicycle Support Facilities

Secure Parking Areas (SPA)

Guidance

Key features may include:

- Closed-circuit television monitoring.
- Double high racks & cargo bike spaces.
- Bike repair station with bench.
- Bike tube and maintenance item vending machine.
- Bike lock “hitching post” – allows people to leave bike locks.
- Secure access for users.

Double-height racks help take advantage of the vertical space, further maximizing the parking capacity.

Description

A Secure Parking Area for bicycles, also known as a BikeSPA or Bike & Ride (when located at transit stations), is a semi-enclosed space that offers a higher level of security than ordinary bike racks. Accessible via key-card, combination locks, or keys, BikeSPAs provide high-capacity parking for 10 to 100 or more bicycles. Increased security measures create an additional transportation option for those whose biggest concern is theft and vulnerability.

In the space formerly used for seven cars, a BikeSPA can comfortably park 80 bikes with room for future expansion.



Discussion

Long-term parking facilities are more expensive to provide than short-term facilities, but are also significantly more secure. Although many bicycle commuters would be willing to pay a nominal fee to guarantee the safety of their bicycle, long-term bicycle parking should be free wherever automobile parking is free. BikeSPAs are ideal for transit centers, airports, train stations, or wherever large numbers of people might arrive by bicycle and need a secure place to park while away.

Additional References and Guidelines

APBP. (2010). Bicycle Parking Guide 2nd Edition.
AASHTO. (2012). Guide for the Development of Bicycle Facilities.

Materials and Maintenance

Regularly inspect the functioning of moving parts and enclosures. Change keys and access codes periodically to prevent access to unapproved users.

Bicycle Support Facilities

Bicycle Access to Transit

Description

Safe and easy access to transit stations and secure bicycle parking facilities is necessary to encourage commuters to access transit via bicycle. Bicycling to transit reduces the need to provide expensive and space consuming car parking spaces.

Many people who ride to a transit stop will want to bring their bicycle with them on the transit portion of their trip, so buses and other transit vehicles should be equipped accordingly.

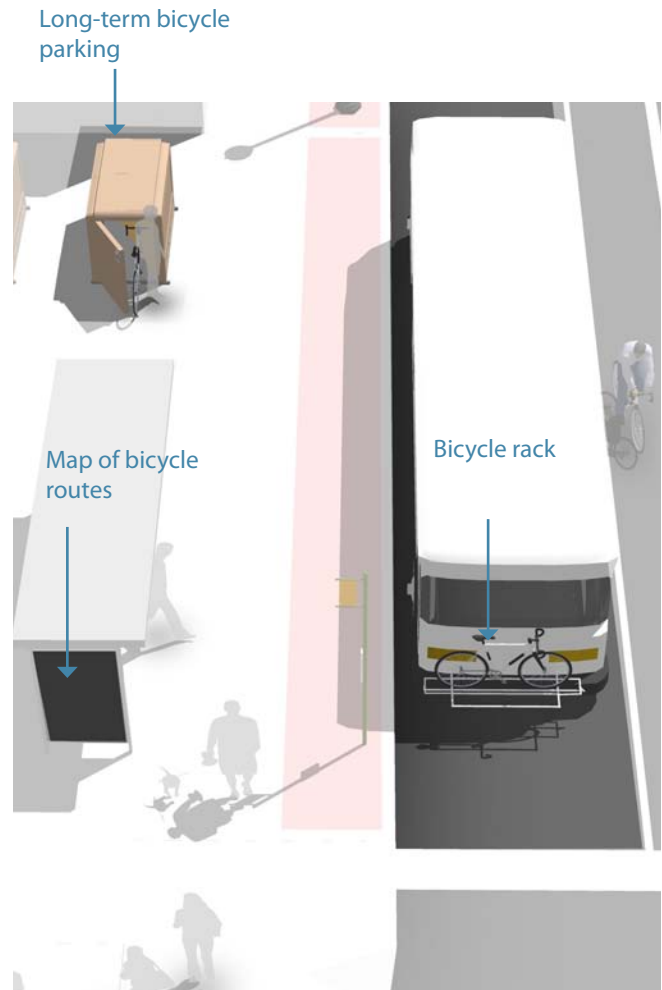
Guidance

Access

- Provide direct and convenient access to transit stations and stops from the bicycle and pedestrian networks.
- Provide maps at major stops and stations showing nearby bicycle routes.
- Provide wayfinding signage and pavement markings from the bicycle network to transit stations.
- Ensure that connecting bikeways offer proper **bicycle actuation and detection**.

Bicycle Parking

- The route from bicycle parking locations to station/stop platforms should be well-lit and visible.
- Signing should note the location of bicycle parking, rules for use, and instructions as needed.
- Provide safe and secure long-term parking such as **bicycle lockers** at transit hubs. Parking should be easy to use and well maintained.



Discussion

Providing bicycle routes to transit helps combine the long-distance coverage of bus and rail travel with the door-to-door service of bicycle riding. Transit use can overcome large obstacles to bicycling, including distance, hills, riding on busy streets, night riding, inclement weather, and breakdowns. High-visibility crosswalks and mid-block crossings are often appropriate treatments to provide safer bicycle and pedestrian access to bus stops, particularly at high-usage transit stops. If a bus stop is located mid-block, adequate crossing treatments should be provided, based on the level of traffic on the roadway. All transit riders will need to cross the street to access or leave the bus stop.

Additional References and Guidelines

APBP. (2010). Bicycle Parking Guide 2nd Edition.
 FHWA. (2006). Federal Highway Administration University Course on Bicycle and Pedestrian Transportation. Lesson 18: Bicycle and Pedestrian Connections to Transit
 AASHTO. (2012). Guide for the Development of Bicycle Facilities.

Materials and Maintenance

Regularly inspect the functioning of long-term parking moving parts and enclosures. Change keys and access codes periodically to prevent access to unapproved users.

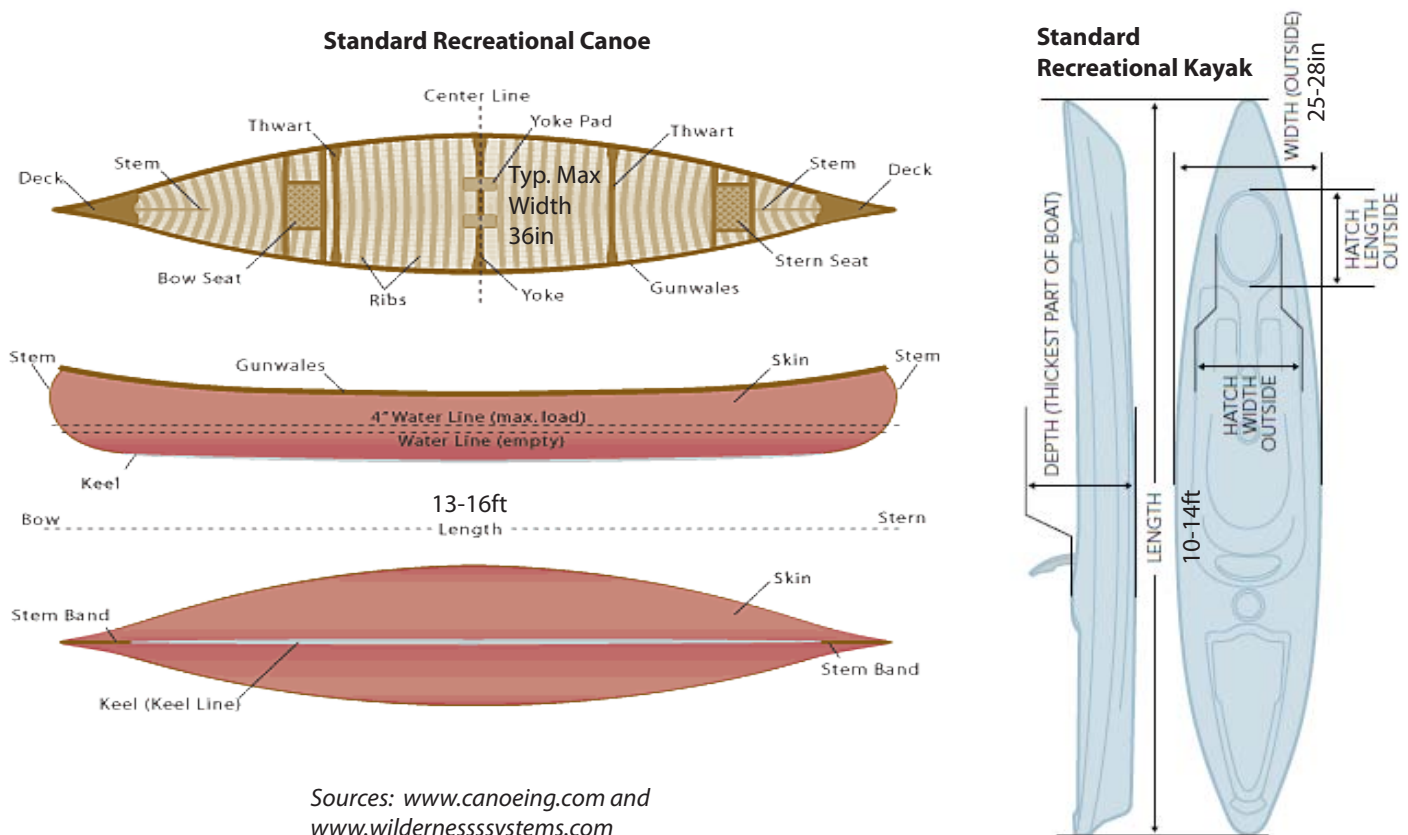
Design Needs of Paddlers

The purpose of this section is to provide the facility designer with an understanding of how paddlers operate and how a canoe or kayak influences that operation. Paddlers can be more acutely affected by poor trail/facility design and other man-made and natural obstacles than motorized boaters. Paddlers generally lack the protection from the elements and other waterway hazards provided by a motorized boat's larger structure and safety features. By understanding the unique characteristics and needs of paddlers, a facility designer can provide quality facilities and minimize user risk.

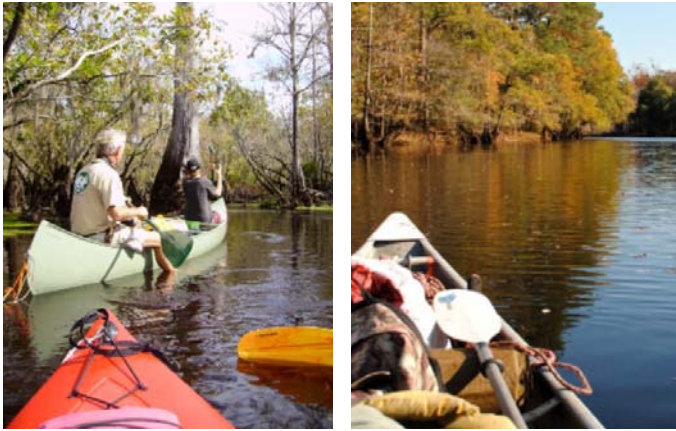
Canoe and Kayak Design Vehicles

Similar to motor boats, canoes and kayaks exist in a variety of sizes and configurations. These variations occur in the types of canoe or kayak (such as expedition, whitewater) and behavioral characteristics (such as the comfort level of the paddler). The design of a blueway should consider reasonably expected canoe/kayak types on the trail and utilize the appropriate design.

The figure below illustrates physical components of a typical recreational canoe and kayak, which are the basis for typical trail selection and design. In addition to the reach of an oar/paddle, paddlers require clear space to operate within a facility. This is why the minimum operating width will be greater than the physical reach of the paddler.



Variations of a typical canoe and kayak also require consideration when planning and designing paddling facilities. Other types of canoes and/or kayaks include expedition/touring, whitewater, and racing. The pictures and tables below summarize these types.



Photos: www.capefearriveradventures.com

Canoe Design Vehicle - Typical Dimensions

Canoe Type	Features	Common Dimensions
Recreational Canoe	Length Max Width	13-16ft 36in+
Expedition/ Touring Canoe	Length Max Width	18-20ft 35-39in
Whitewater Canoe	Length Max Width	12-16ft 25-33in
Racing Canoe	Length Max Width	18-20ft 28-33in

Kayak Design Vehicle - Typical Dimensions

Kayak Type	Features	Common Dimensions
Recreational Kayak	Length Width	10-14ft 25-28in
Expedition/ Touring Kayak	Length Width	13-20ft 20-24in
Whitewater Kayak	Length Width	6-12ft 25-40in

Canoe and Kayak as Design Vehicles - Design Speed Expectations

Type	Typical Speed
Canoe	1-3mph
Kayak	3-5mph

**These numbers are variable; many factors can affect speed including - wind, currents/tides, boat type, paddler ability level, etc.*

Sources: Search and Rescue British Columbia; Coast and Kayak Magazine

Design Speed Expectations

The expected speed that different types of canoes and kayaks can maintain under various conditions also influences the design of facilities such as distances between launch sites. The table to the right provides typical canoe and kayak speeds.

Paddle Trail Access Sites

Non-motorized canoe and kayak access sites should be simple, low maintenance, and inexpensive. A stable riverbank or shoreline is typically adequate as long as there is a path that is flat and hard enough to carry boats. The following dimensions are recommended for access:

- 12' wide at the water line
- Tapered to 9' wide at the top entrance area
- 15' in length
- 3:1 slope at the stream bank*

The availability of parking at a launch site will depend upon the specific site's accessibility. Remote sites will require less parking while sites located in areas with higher use will require more. Launch sites in downtown Wilmington or other areas of high use will need more space and available parking than remote areas along Smith Creek and Island Creek. Canoe and kayak slips can also be provided at trailheads, allowing more convenient access for frequent visitors.

For ecologically sensitive sites such as Masonboro Island Coastal Reserve, low-impact access points (sometimes only requiring a sign or marker) may be explored to reduce erosion and degradation at multiple sites, caused by a lack of designated access.

**Source: Openlands. All About Canoe and Kayak Launches. 2012. Accessed from: <http://openlands.org/greenways/how-to-guides/all-about-canoe-and-kayak-launches.html>.*

NCDENR State Trails Program Standards for Paddle Trail Access Sites

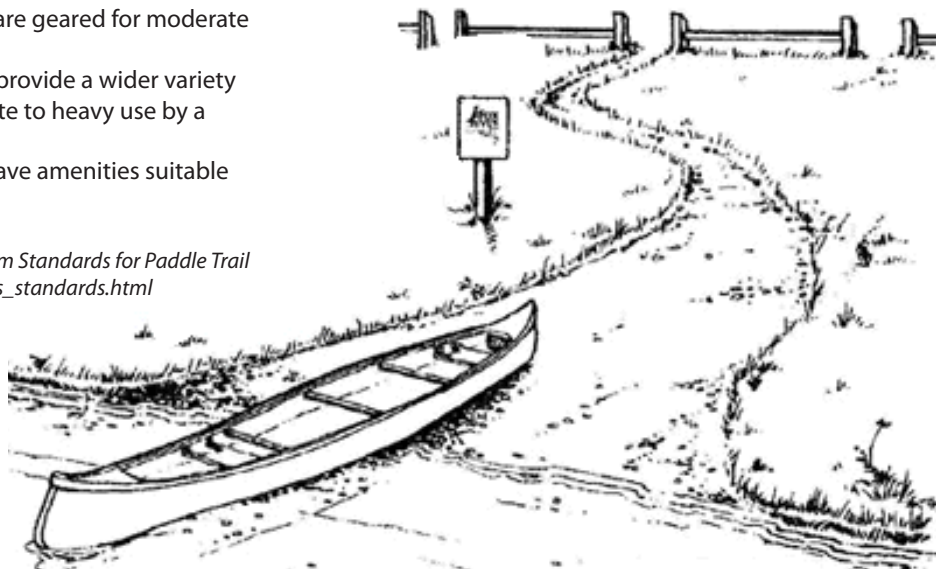
All access sites designated by the NCDENR State Trails Program must follow certain guidelines and standards. Standards for different types of access sites are highlighted below.

- Level I Access Site: A Level I Access site is rustic in nature with little if any infrastructure.
- Level II Access Site: A Level II access site has minimal infrastructure to facilitate use.
- Level III Access Site: Level III Access sites are geared for moderate use and have basic amenities.
- Level IV Access Site: Level IV access sites provide a wider variety of amenities and are suitable for moderate to heavy use by a large user group.
- Level V Access Site: Level V access sites have amenities suitable for large group usage.

For more information on NCDENR State Trails Program Standards for Paddle Trail Access Sites: www.ncsu.edu/ncblueways/ncblueways_standards.html



Top: on-site canoe/kayak storage for rent; Above: canoe/kayak pier for high bank access (examples from Charleston, SC). Below: A typical paddle trail access site.



Blueway Signage

Signage is important in creating a safe, efficient, marketable, and low-impact blueway trail system. Key considerations include:

- Selecting the appropriate amount, size, color, style, location, and material in balancing the need to be visible with the desire to minimize visual intrusion
- Other practical factors include cost and availability, weather resistance, installation, and susceptibility to vandalism and theft

Types of signs include:

- Road signs leading to a launch site - websites, guides, and maps can be useful as well
- Trailhead signs - kiosks, displays, and bulletin boards are strategic locations to post information because most water trail users will spend some amount of time preparing for their trip here. Displaying the following information can be helpful:
 - Blueway map
 - Safety measures and water trail specific warnings
 - Leave No Trace guidelines
 - Parking locations and rules
 - Interpretation
 - Amenities
- Campsites and day-use site signs - can be helpful in directing boaters to the appropriate location; trailhead signs can accomplish this as well
- Signs along the trail, wayfinding - these are helpful, especially around the Wilmington area, in directing boaters to proper channels, streams, around islands as well as nearby hazards
 - Important in identifying distances to other launch sites, points of interest, etc

Positive language should be used in sign wording to encourage appropriate responses from users. For example, say "Camping by written permission only, please" and point users to further information instead of saying "No camping".*



Kayak safety signage and mobile phone wayfinding/educational information in Charleston, SC.



Above: Educational signage on the Beaver Pond Paddling Trail in TX, and directional signage on the Great Calusa Blueway Paddling Trail in PA and the Weedon Island Preserve in FL.

Tidal Information

The ebb and flow of tidal waters play an important role in the experience of a paddler in coastal areas like Wilmington and New Hanover County. Strong tidal currents rushing in and out twice per day can significantly affect the speed and ease in which a paddler crosses water bodies. The following application, 'Tide Prediction', provides local tidal information, and can be accessed here for use on mobile devices: <http://www.appbrain.com/app/tide-prediction/net.muchoviento.android.tide>

*Source: American Rivers. Promote a Blue Trail: Create Blue Trail Signs. Accessed from: www.bluetrailsguide.org/promote

