RICHMOND
Bicycle Master Plan

2015

ACKNOWLEDGEMENTS

City Of Richmond

Jakob Helmboldt
Travis Bridewell
Thomas Flynn

Special Thanks To

Max Hepp-Buchanan, Sports Backers

Consultant Team

alta PLANNING + DESIGN

Melissa Miklus, ASLA
Charlie Denney
Fionnuala Quinn
Jay Decker
Nick Falbo
Katie Perumbeti

Michael Baker INTERNATIONAL

Scudder Wagg
Jacob Thornton

TABLE OF CONTENTS

RICHMOND
Bicycle Master Plan

1 Introduction

OVERVIEW

The *City of Richmond Bicycle Master Plan* will guide the city and other local partners in improving the existing bicycle infrastructure, constructing new facilities for bicyclists in the city, and fostering a "bicycling culture" through the development of related programs and policies. This Plan strives to diversify mobility (including transportation and recreation) for residents and visitors by enhancing the network of bicycle infrastructure and improving safety to create an environment suitable for a wide variety of users. Final recommendations are built on recent strides made in implementing bicycling infrastructure as well as the considerable momentum gathering for the world road cycling championships to be held in Richmond in 2015.

The Bicycle Master Plan combines adopted local and regional planning efforts with new research, analysis, and public engagement. The result is an up-to-date framework for moving forward with tangible bicycle-related improvements. Beyond physical improvements, the Plan also recommends further exploration of policies and programs to encourage people to increase bicycle trip frequency, interact safely in a multi-modal environment, and grow as a community with the needs of bicyclists in the forefront of planning and design initiatives.

As a League of American Bicyclists certified community, Richmond possesses a firm foundation of efforts to increase bicycle mode share and provide a safe, comfortable environment for bicyclists of all ages and abilities. Advancing engineering, education, encouragement, enforcement, and evaluation and planning will be key components of planning for the future of the Richmond community. This Plan focuses mainly on the engineering component, with the purpose of refining the network to create a hierarchy of routes and illustrating demonstration projects that will have a high impact on improving the environment. This engineering approach will thereby contribute to encouraging bicycle use by improving the design of existing roadways and facilities.

PURPOSE AND BACKGROUND

A Focus on Implementation

A key focus for this project is to identify specific and readily implementable projects that will reap measurable benefits to users of the city streets and visible improvements to the livability of the city. Therefore, the *Richmond Bicycle Master Plan* has been developed with the twin objectives of:

- Providing the blueprint for a comprehensive system in the city that makes bicycling for all purposes and by all users accessible, safe, and desirable; and
- Providing a strong, strategic funding plan for bicycle facility expansion, improvement, and implementation citywide.

The Bicycle Master Plan will include:

- A vision, goals, and benchmarks
- A comprehensive system of connectivity and route selection criteria
- A classification system and standards for Public Works which conform to AASHTO and NACTO standards that clarifies the nature of recommended improvements
- Connections to other transportation modes
- Project prioritization criteria with facility type, action needed, and time frame identified
- A map representing the future vision of bike facilities for Richmond

CHAPTER CONTENTS

Figure 1-1: Existing Bicycling Conditions in Richmond

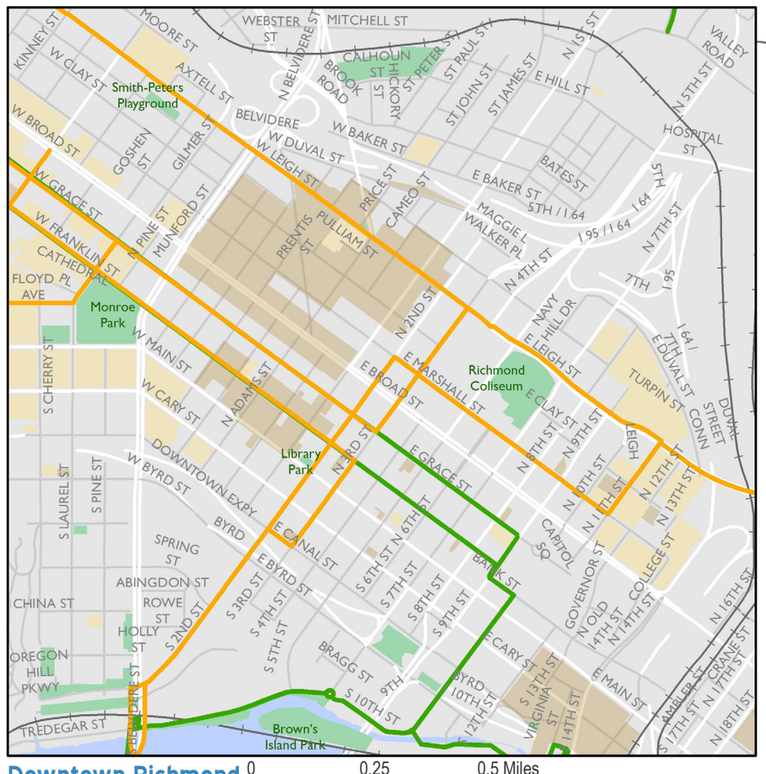
Existing Bicycle Facilities

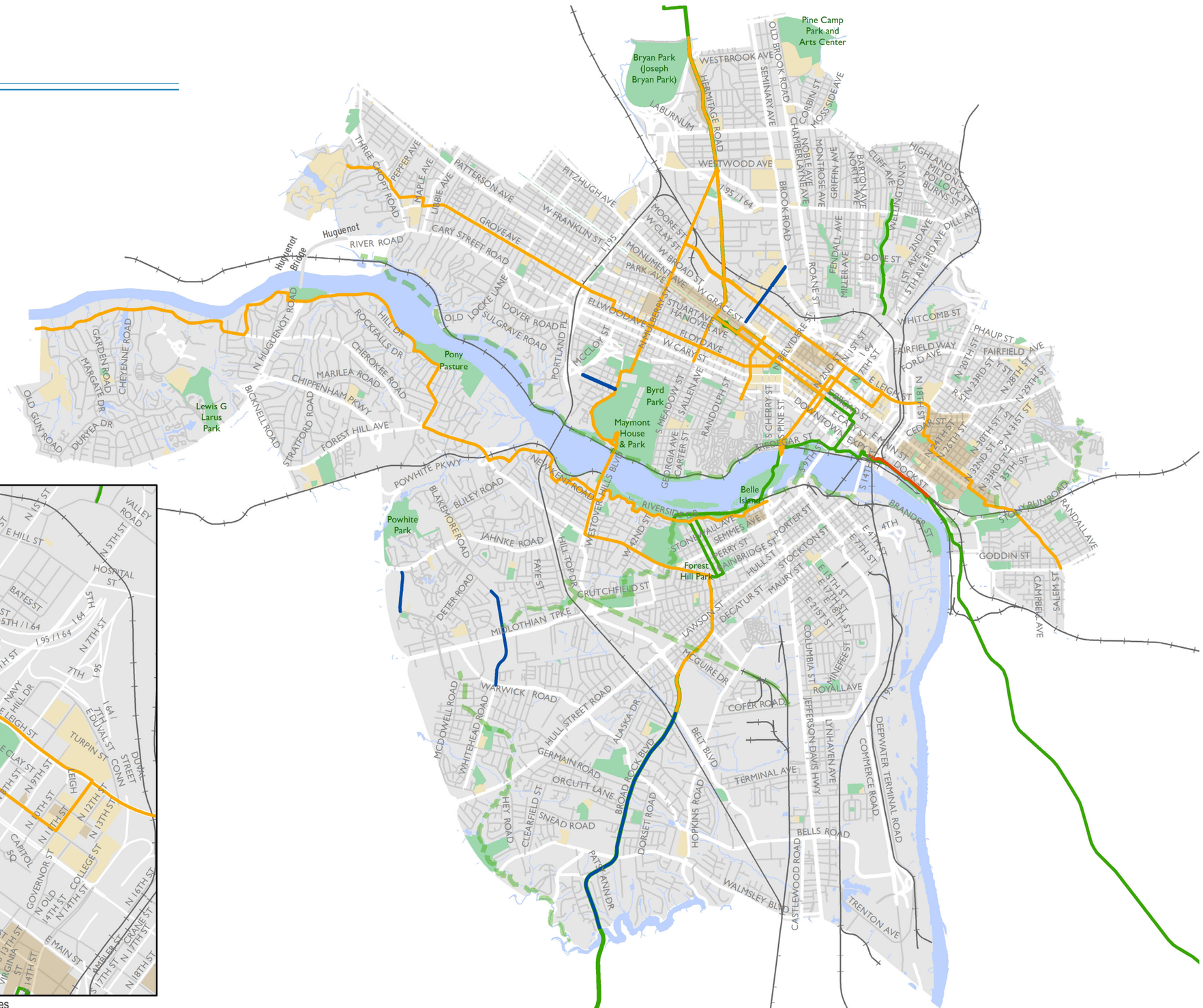
- Bike Lane
- Shared Lane
- Shared Use Path
- Greenway

Areas of Interest

- Parks
- Historic Districts
- Educational Facilities

0 0.5 1 2 Miles



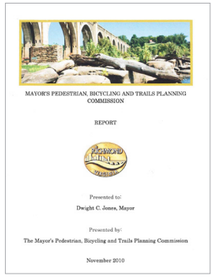


Implementation of the bikeway network consists of discreet steps completed sequentially, from ranking and phasing of each project to application of design standards, development of capital and maintenance costs, funding, and a capital improvement plan. Creation of an implementable bicycling network includes coordination with city staff from Planning and Community Development, Public Works, and Parks and Recreation to formulate an implementation strategy that includes details on cost, responsible department, scheduling, and appropriate funding.

Past and Current Plans

The Bicycle Master Plan connects with past and current planning efforts conducted at the city, regional, and Commonwealth levels including the following studies and reports.

Richmond Regional Bicycle and Pedestrian Plan **(2004)**: This study provided a detailed plan for enhancing bicycle and pedestrian options in the Richmond region, including the city. The completed plan was accepted by the Metropolitan Planning Organization (MPO) as a study, leaving it up to area localities to adopt the plan or to incorporate its elements into their comprehensive plans. Elements of the plan have been incorporated into the Bicycle and Pedestrian element of the MPO 2031 Long-Range Transportation Plan (LRTP).



Mayor's Pedestrian, Bicycling and Trails Planning Commission Report **(2010)**: This report was generated based on the work of the Pedestrian and Bicycling Commission, appointed by Mayor Dwight C. Jones in 2010, to give his administration advice on ways to incorporate walking and bicycling as viable methods of transportation in the city of Richmond and to support pedestrian and bicycle travel by becoming a community where walking and bicycling are integral parts of the city's transportation system. The Bicycle, Pedestrian and Trails Coordinator position, established in 2011, was a key recommendation that grew out of the Commission report produced in 2010.

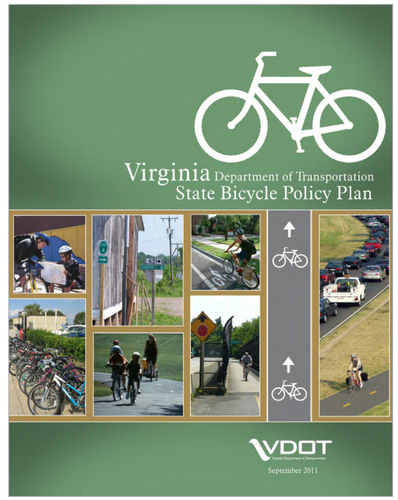
Richmond Strategic Multimodal Transportation Plan (*Richmond Connects*, **2013):** This Plan, known as *Richmond Connects*, focused on projects and programs that would help to transform Richmond's transportation network to provide residents with alternatives to single occupancy vehicle travel. Recommendations included in the plan were a citywide bicycle network, a prioritized list of pedestrian and bicycle improvement projects, design guidance for the implementation of Complete Streets, and implementation of programs to encourage Richmond's citizens to try walking, biking, and transit. The project also had extensive public outreach including the use of social media.

State of Cycling Report @ Virginia Commonwealth University **(2010):** As part of Virginia Commonwealth University's efforts to create a sustainable campus environment, this report was prepared looking at bicycling as a key element of transportation planning. While the university drafted its first Climate Action Plan, the administration had already begun to move toward a more sustainable campus and increase the mode share of bicycling through a variety of initiatives, including adding more bicycle racks on campus. The Report described the current state of cycling on campus and provided recommendations for policies, programs, and infrastructure improvements to increase the bicycling rates.

City of Richmond Master Plan **(2000-2010):** The Master Plan is a key policy document determining the pattern of new development and redevelopment, including where road improvements should occur. The Master Plan sets policy and direction for public and private investment in the city. All jurisdictions within the Commonwealth of Virginia are required to prepare and adopt such a plan and update it regularly. In addition to the Master Plan, the city has adopted a Downtown Plan as well as numerous detailed neighborhood plans.

State Bicycling Policy Plan **(2011)**: The Virginia Department of Transportation (VDOT) developed the State Bicycle Policy Plan to ensure that bicyclists are considered as an integral component of Virginia's multimodal transportation system, and to provide bicycle policy recommendations guiding the planning, design, construction, operation, and maintenance of bicycle accommodations. The plan identifies strategies and opportunities for improving bicycling and integrating bicycling into the transportation network and increasing the rate of bicycling throughout Virginia. The Plan contains four main recommendations:

- Clarifying bicycle accommodation policies
- Providing staff with resources to integrate the requirements of bicyclists in projects and programs
- Improving outreach and coordination on this transportation alternative
- Evaluating the established bicycle plan performance measures



VISION

VISION FOR THE STATE OF BICYCLING IN RICHMOND

The City of Richmond envisions a future where bicycling is an integral component of daily life. A well connected network of bicycle infrastructure coupled with a shift in culture will create an environment that is safe and comfortable for people of all ages and abilities.

The city's vision for bicycling transcends the mission of this Plan. While this Plan focuses on creating a well-defined network of bicycle infrastructure, the overall future for increased and safer bicycling in Richmond should be a layered approach of innovative and appropriate infrastructure (Engineering), programming that evolves with the needs and desires of the community (Education and Encouragement), well-informed law enforcement officers who uphold appropriate laws and regulations (Enforcement), and metrics by which to measure progress (Evaluation). These five "E's" will combine to provide the shift in culture highlighted in the vision statement. While infrastructure can serve as an encouragement tactic, additional programs and efforts by the city, advocacy groups, schools, and employers will fuse together to shift the culture of residents and visitors. The following goals illustrate these shifts, and the city's commitment to creating an environment where bicycling is a viable transportation option and recreational resource for all riders, including the 60% "Interested but Concerned" group[1]. As with all plans, the following goals are aspirational and are constrained by available resources. A combination of resources such as staffing, funding, and public support will guide the implementation of the following strategies as they are needed and/or appropriate.

GOALS

GOAL ONE
Ridership

Increase the amount and mode share of bicycle riding in Richmond for all trip purposes.

Metric: Increase the bicycle commute mode share (based on the American Community Survey) to four percent (4%) by 2016, six percent (6%) by 2020, and ten percent (10%) by 2025. As bicycling rates increase and counting methods, data quality, and information analysis improve, plan for a rate adjustment mechanism which will better account for all types of bicycling trips in mode share.

STRATEGY 1: ENCOURAGE INCREASED BICYCLING RATES

- Draft and adopt a marketing and programs component for the city's bicycling efforts.
- Increase media reporting, promotions, and positive stories profiling a range of riders and useful information.
- Collaborate and work with advocacy groups to organize encouragement strategies and campaigns.

STRATEGY 2: ESTABLISH A COUNTING, MEASURING, AND DATA ANALYSIS ENVIRONMENT TO ALLOW TRACKING OF MODE SHARE RATES

- Develop counting methods to determine overall biking rates and mode shares.
- Conduct routine counts and collect comprehensive data on biking rates and participation.
- Conduct data analysis and reporting for performance measures, targets, and trends annually.
- Conduct annual rate evaluation and analysis to monitor the effectiveness of programs aimed at increasing mode share.
- Enlist local advocacy groups to assist with collecting ridership information and in assessing effectiveness of efforts to increase ridership.
- Establish measures to document rates of bicycling by groups with traditionally lower rates of participation (e.g., females, youth, older adults, people of color).
- Identify and pursue grant funding for improved counting equipment and programs including automated counting and counting protocol best practices.
- Identify and pursue grant funding for installation of digital bicycle traffic counters on two priority routes. Include online tracker for public use.
- Update count data collection and technology as new bicycle detection allows for counting as well as detection of bicycle riders.
- Coordinate between city staff on data collection and integrate bicycling data collection into existing data collection programs.

GOAL TWO
Safety

Improve safety for all bicycle riders.

Metric: Reduce the rate and severity of (reported) citywide bicycle injury crashes by twenty percent (20%) by 2017, thirty-five percent (35%) by 2020, and fifty percent (50%) by 2025.

STRATEGY 1: DEVELOP MEANS OF EVALUATING SAFETY RELATIVE TO INFRASTRUCTURE IMPROVEMENTS

- Select street design measures and treatments with improving bicycling safety and calming vehicle speeds in mind – bike lanes, cycle tracks, bicycle boulevards, road diets, and traffic-calming measures.
- Employ design toolkit guidance to select designs and treatments for new projects.
- Track bicycle-involved collisions by bicycle facility type. Review and compare collision rates across facility types over time to determine whether new facilities are having the intended safety impact. Create processes to identify trends, behaviors, engineering solutions, and policy/institutional issues.

1 Four Types of Cyclists, by Roger Geller: http://www.portlandoregon.gov/transportation/44597?a=237507

- Include pre- and post-evaluations of safety after bicycling changes for repaving and other maintenance projects.
- Develop a method to determine the level of exposure of bicyclists in the environment to determine the relative risk of crashes. Develop Richmond Commuter Cycling Risk Indicator value to allow determination of trends in the crash rate while accounting for the change in bicycling rate over time (see NYC indictor value).
- Improve law enforcement information reporting for serious injury crashes.

STRATEGY 2: IMPROVE USER SAFETY BEHAVIOR

- Collaborate and work with advocacy groups to organize safety strategies and campaigns.
- Seek Department of Motor Vehicles grants to improve targeted enforcement strategies and campaigns as well as bicyclist and driver education.
- Develop coordinated local safety campaigns (e.g., "Street Smart" safety campaign).
- Team with Virginia Commonwealth University (VCU) RamBikes on bicyclist safety education programs and campaigns.
- Add a range of local programs to encourage safer bicycling and driver behavior. Bicycle-related education programs should be targeted at the following groups:
  - Young bicyclists;
  - Adult bicyclists;
  - VCU bicyclists;
  - Drivers;
  - Large-vehicle driver training (city transit system, VCU buses); and
  - Law Enforcement Officials, including post-training classes.
- Prepare crash comparison with peer cities biannually to monitor progress.

Create a bicycle network that connects to places that people want to go and provides a time-efficient travel option.

Metric: Build 20 miles of new "all ages and abilities" priority bikeways by the end of 2015; build out a connected network of bikeways that reaches sixty percent (60%) of the population within a quarter-mile of a bikeway or paved trail and ninety percent (90%) of the population within one mile of a dedicated bicycle facility by 2025.

STRATEGY 1: INTEGRATE BICYCLE PLANNING GOALS, STRATEGIES, AND TACTICS INTO THE CITY'S PLANNING, DESIGN, OPERATION, AND MAINTENANCE ACTIVITIES, SCHEDULES, AND BUDGETS

- Improve coordination and communication across departments and agencies regarding Plan implementation goals and projects.
- Include a review of bicycle planning recommendations when establishing maintenance schedules and plans. Add bicycling improvements to planned repaving and restriping projects.
- Integrate bicycling improvements into the city budget, including a dedicated line amount in the Public Works budget.
- Integrate review of the Bicycle Master Plan during other planning reviews (e.g., developments, parks and recreation, etc.).
- Integrate Plan goals into transit projects, route changes, and other improvements.

STRATEGY 2: ENSURE THE BICYCLING NETWORK IS OPERATED AND MAINTAINED SO THAT IT IS ATTRACTIVE, COMFORTABLE, AND USABLE

- Identify funding sources for implementation and maintenance, particularly for bikeways outside of the traditional street right-of-way (ROW) such as greenways, trails, and other off-street paths.
- Seek shared costs when applicable for street implementation and maintenance.
- Integrate funding requirements and grant applications into yearly schedules for appropriate City Staff.
- Establish new maintenance schedules and practices to maintain bicycle mobility (e.g., street sweeping, leaf collection, snow removal, etc.).
- Create a reporting procedure for biking facility maintenance issues.

STRATEGY 3: IDENTIFY NETWORK BARRIERS, FRAGMENTATION, AND HIGH-VALUE OPPORTUNITIES

- Identify specific single point barriers, short missing links in network, and internal missing connections.
- Review the above list annually to add potential opportunities by expanding the network.
- Coordinate the list with maintenance schedules, development plans, parks plans, grant programs, and other potential opportunities.

Provide equal bicycling access for all through public engagement, program delivery, and capital investment.

Metric: Increase the percentage of females, older adults, youth, low income residents, and people of color who ride regularly (a few times a month or more) and participate in bicycling events.

STRATEGY 1: PREPARE MATERIALS AND METHODS TO PROMOTE AND REACH ADDITIONAL SECTORS OF THE POPULATION

- Prepare culturally appropriate messages and information that addresses issues and concerns of population groups.
- Create new local safety and encouragement materials in additional languages using existing Virginia materials available through Street Smarts and Northern Virginia Regional Commission.
- Ensure broad equitable access to any future bike share program and address barriers to participation.

STRATEGY 2: TARGET MESSAGES AND REACH OUT TO SPECIFICALLY IDENTIFIED GROUPS

- Create targeted programing to encourage increased participation in bicycling by a broader range of the population.
- Create education and encouragement programs targeting specific populations with lower rates of bicycling through such programs as:
  - Adult learn to bike programs;
  - Encouragement in underserved communities (e.g. East of the River program in Washington, DC);
  - Women biking programs (e.g. Black Women Bike DC); and
  - Immigrant outreach and encouragement.
- Add targeted outreach to existing bicycling events and programs and address barriers to participation.
- Promote transit connectivity as part of bicycling encouragement and outreach.
- Create new health outreach programs through coalitions with health providers and foundations.

Build vibrant and healthy communities by creating a welcoming environment for bicycle riding.

Metric: Achieve Silver Level Bicycle Friendly Community (BFC) Status by 2015, Gold Level status by 2020, and Platinum Status by 2025.

STRATEGY 1: DEVELOP COMPLETE STREETS (CS) POLICY REQUIRING ALL CITY TRANSPORTATION PROJECTS TO ACCOMMODATE ALL MODES OF TRANSPORTATION WHERE CONTEXTUALLY APPROPRIATE

- Adopt a Complete Streets policy and ordinance.
- Create Complete Streets implementation strategy for city project scoping and development. Prepare exception policy with documentation requirement.
- Fully integrate bicycling design, operation, and maintenance support into a wide range of city agency tasks.
- Provide on-going in-house staff education on design concepts and integration issues.
- Conduct annual on-bike tour of local facilities for City Staff.
- Conduct site visits by bike/foot as part of the routine design process.

STRATEGY 2: PREPARE AN ANNUAL RICHMOND BICYCLE REPORT CARD TO DOCUMENT PROGRESS. THIS REPORT CARD WOULD BENCHMARK NEW CONSTRUCTION, BICYCLING MODE SHARE, AND PARTICIPATION RATES BY DIFFERENT USER GROUPS, BICYCLE CRASHES, BICYCLING EVENTS, AND PUBLIC PERCEPTIONS ABOUT CYCLING IN THE CITY

- Report annual count results and national mode share data collected.
- Report crash and injury rates.
- Identify progress, trends, and key annual findings.
- Describe infrastructure installed (including on-street, off-street, and parking).
- Report transit links and bicycling usage.
- Report economic measures of success and value of bicycling improvements to city (e.g., growth in retail activity along corridors).
- Describe encouragement initiatives, programs, and local biking events including bike-to-work day.
- Describe educational initiatives, populations served, and measures of success.
- Include local community survey input.
- Describe key recommendations and next steps for upcoming year.
- Include a glossary with terms and explanations.
- Include additional elements required as part of the League of American Bicyclist Bicycle Friendly Community application.

STRATEGY 3: CREATE A MULTI-DISCIPLINARY BICYCLE REPORT CARD AND BICYCLE FRIENDLY COMMUNITY APPLICATION TEAM TO ORGANIZE AND EVALUATE ON-GOING CITY INFORMATION REPORTING AND PREPARATION

- Meet biannually to strategize for Report Card and Bicycle Friendly Community application preparation.
- Review Report Card data collection and new reporting opportunities.

- Review previous League of American Bicyclists (LAB) evaluation report and consult with LAB Bicycle Friendly Community staff about strategy and next steps.
- Review winning applications from comparable Silver and Gold Bicycle Friendly Communities.
- Create and maintain central database for Bicycle Friendly Community application and Report Card information.
- Create and maintain bicycling photo library for use in report card and applications (e.g., everyday users all ages and abilities, all new facilities, installation shots).

THE PLANNING PROCESS AND PUBLIC INVOLVEMENT

This Plan is implementation focused and builds upon the discoveries and recommendations from the *Richmond Connects Plan*. After reviewing data from all existing relevant plans, the bicycle network defined in *Richmond Connects* was used as a base for exploration. A Live, Work, Play, and Access to Transit GIS model with an overlay of Bicycle Suitability Analysis further identified corridors that connect key destinations and origins within Richmond. Field exploration led to a more refined understanding of the current conditions of select routes, including street geometry, parking needs, and adjacent land use. A new recommended network was then produced and vetted through a second round of public input to prepare for prioritization and implementation strategies.

Richmond Connects Baseline

The *Richmond Strategic Multimodal Transportation Plan,* known as *Richmond Connects*, described actions and plans that Richmond will take over the next 20 years to improve transportation within the city. In addition to the concept of transforming streets within Richmond from a primary focus on the movement of cars into more complete streets, the Plan identified an increasing demand for bicycle facilities throughout the city.

Some of the key findings of *Richmond Connects* related to bicycling included:

- Complete streets or near complete streets already existed in many areas of Richmond. Downtown, the Fan, Carytown, and other older parts of the city were developed prior to the dominance of the automobile and include a grid pattern of relatively narrow streets.
- Neighborhoods to the west and south of the James River have developed more recently and have a more suburban development pattern and lack street connectivity, posing problems for connecting bicycle networks across jurisdictions.
- The city had designated certain roadways in its GIS system that are most conducive to supporting bicycle traffic, but the majority of the streets in this system are unsigned and lack markings (they do not have bike lane markings, shared lane markings [commonly referred to as sharrows], or even bike route signs).
- At the time of the *Richmond Connects Plan*:
  - Eight city streets had existing bike lanes (4.0 miles total)
  - There were 12.9 miles of sharrow-marked bike routes in the city
  - None of the James River bridges had dedicated bicycle facilities
  - The Lee Bridge is designated as a route with a shoulder
  - There existed some shared use paths along the river, including the Virginia Capital Trail
  - United States Bike Route 1 crossed through the city and had updated route signs
  - Greater Richmond Transit Company (GRTC) provided bicycle racks on all its buses, with space for two bicycles per bus
  - VCU provided substantial bicycle parking in many areas around its Monroe Park and MCV campuses
  - The city had expanded the availability of on-street bicycle racks to 120 racks

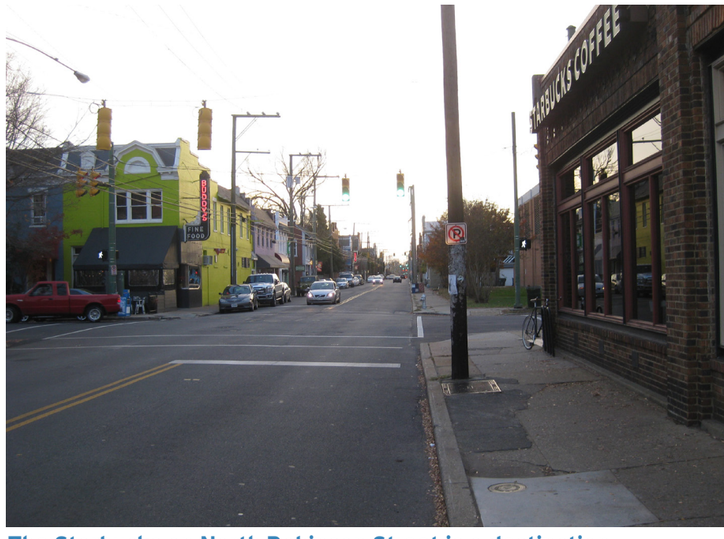
The Plan reported that according to the 2010 American Community Survey estimates, 2.2 percent of commuters in the city biked to work. The percentage of bike commuters had increased from around 1 percent in 2007. By comparison, a national average of 0.5 percent of commuters biked as their primary mode of transportation to work in 2010. According to summaries of DMV reported crash data within the city, there were 532 bicycle/vehicle crashes and 947 pedestrian/vehicle crashes on Richmond streets between 2004 and 2010.

The final *Richmond Connects Plan* did not provide the detailed engineering, funding mechanisms, and specific planning and analysis ultimately required for full implementation of bicycle facilities. However, it did include recommendations necessary for implementation including corridor and project-specific environmental impact studies, modifications to land use plans and ordinances, and inter-jurisdictional cooperation and program development. This Bicycle Master Plan builds upon the research and recommendations within *Richmond Connects* to further refine the bicycling network.

Data Collection and Analysis

Data was collected from various sources to provide input for this Plan and guide the network options and decisions. Field analyses were conducted at many sites around the city. The team visited a variety of corridors based on the Richmond Connects recommended network and the Bicycle Suitability Analysis to examine existing conditions and infrastructure, measure widths, and examine the current operating conditions. The following corridors were assessed in the field:

- Brook Road
- Hermitage Road
- North Avenue
- Brookland Park Boulevard
- Grove Avenue
- Meadow Street



The Starbucks on North Robinson Street is a destination for bicyclists.

Education boards and maps were provided to initiate discussions about which facilities are appropriate for Richmond roads.

- Harrison Street/Colorado Avenue
- Robinson Street/Spottswood Road/Park Drive
- 1st and 2nd Streets
- Broad, Marshall & Mosby Streets (Church Hill)
- Westover Hills Boulevard
- Forrest Hill Avenue
- Broad Rock Boulevard
- Semmens Avenue
- West 15th Street
- Riverside Drive

Public Involvement

Public participation and input is a key component of the bicycle planning process. Through public input, the needs of current and future bicyclists are understood and can be accounted for while developing recommendations. This Plan reflects the input of numerous members of the public who contributed through several forums and mediums. city residents assisted in determining needs for bicycle infrastructure improvements by participating in the following:

- The City of Richmond created and distributed an online survey to solicit public input to determine priority streets and corridors for bicycle improvements, as well as collect information about which types of infrastructure improvements are most desired by the public. Over 2,700 responses were recorded.
- An information table was present at the Sports Backers Anthem Moonlight Ride on Saturday, August 17, 2013. The table was staffed with project team members as well as the City Bike Coordinator and featured informational posters to learn more about the Bike Master Plan and maps to record comments on route issues and opportunities.
- The Partnership for Smarter Growth and Bike Walk RVA held an event at the Science Museum of Virginia entitled *Richmond Region's Bike Future* on Thursday, September 26, 2013. The evening also included an open house about this Plan including informational posters and maps to receive comments from the public.
- A presentation and public open house was held at the Carillon on May 14, 2014. The open house gathered information regarding the network recommendations.

BENEFITS OF A BICYCLE FRIENDLY COMMUNITY

Health and Physical Activity Benefits

A growing number of studies show that the design of our communities—including neighborhoods, towns, transportation systems, parks, trails, and other public recreational facilities—affects our level of physical activity. Regular physical activity is recognized as an important contributor to good health; the Centers for Disease Control and Prevention (CDC) recommend 30 minutes of moderate physical activity each day for adults and 60 minutes each day for children.[2] Unfortunately, many people do not meet these recommendations because they lack environments where they can be physically active. The CDC reports that "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".[3] Having accessible bicycle facilities available, such as bike lanes and paths, can help people more easily incorporate physical activity into their daily lives. Regular physical activity, such as bicycling, is shown to have numerous health benefits:[4]

- Reduces the risk and severity of heart disease and diabetes
- Reduces the risk of some types of cancer
- Improves mood
- Controls weight
- Reduces the risk of premature death

The National Health Costs of…	$$ (Billions)	Estimate Includes	Source
Obesity and overweight	$142	• Healthcare costs • Lost wages due to illness & disability • Future earnings lost by premature death	National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. Statistics Related to Overweight and Obesity: The Economic Costs. Available at: http://win.niddk.nih.gov/statistics/index.htm
Air pollution from traffic	$50-80	• Health care costs • Premature death	Federal Highway Administration. 2000. Addendum to the 1997 Federal Highway Cost Allocation Study Final Report, May 2000. Available at: www.fhwa.dot.gov/policy/hcas/addendum.htm
Traffic crashes	$180	• Healthcare costs • Lost wages • Property damage • Travel delay • Legal/administrative costs • Pain & suffering • Lost quality of life	AAA. Crashes vs. Congestion? What's the Cost to Society? Cambridge, MD: Cambridge Systematics, Inc.; 2008. Available at: www.aaanewsroom.net/assets/files/20083591910.crashesVscongestionfullreport2.28.08.pdf

All cost estimates adjusted to 2008 dollars.

Source: The American Public Health Association, 2010, The Hidden Health Costs of Transportation.

2 Centers for Disease Control and Prevention. http://www.cdc.gov/physicalactivity/everyone/guidelines/index.html

3 U.S. Department of Health and Human Services. Centers for Disease Control and Prevention (1996). Physical Activity and Health: A Report of the Surgeon General

4 National Prevention Council (2011). National Prevention Strategy: America's plan for better health and wellness. Retrieved from http://www.healthcare.gov/prevention/nphpphc/strategy/report.pdf

THE VALUE OF TRANSPORTATION RELATED HEALTH OUTCOMES

The American Public Health Association also recognizes the health benefits of walk- and bike-friendly communities. According to its 2010 report, "Investments in transit, walking and bicycling facilities support transit use, walking and bicycling directly; they also support the formation of compact, walkable, transit-oriented neighborhoods that in turn support more walking, bicycling and transit and less driving. These built environments have repeatedly been associated with more walking, bicycling and transit use, more overall physical activity, and lower body weights; lower rates of traffic injuries and fatalities, particularly for pedestrians; lower rates of air pollution and greenhouse gas emissions; and better mobility for non-driving populations".[5]

The CDC determined that creating and improving places to be active could result in a 25 percent increase in the number of people who exercise at least three times a week.[6] This is significant considering that for people who are inactive, even small increases in physical activity can bring measurable health benefits. The establishment of a safe and reliable network of bikeways and trails can have a positive impact on the health of nearby residents. The Rails-to-Trails Conservancy puts it simply: "Individuals must choose to exercise, but communities can make that choice easier."[7]

An increasingly growing concern of community leaders and planners alike is how healthy our communities will be in the future. Education, infrastructure, health, and public safety needs are critical challenges at the local level. Transportation and mobility are also key elements of the livability index. Open space and recreational opportunities are other important elements. Bicycle facilities are consistently recognized as effective strategies to create more healthy communities, improve safety, and better the quality of life in localities that have embraced them.

Suburban settings also strike a balance between utilitarian (transportation) and recreational bicycling. It is often in these settings, through recreational opportunities, that we teach our children the "rules of the road" and bicycle safety.

Annual Cost Per Mile

costs		yearly totals
operating costs		
gas per mile		
total miles driven	×	
total gas	=	
maintenance	+	
tires	+	
total operating costs	+ =	
ownership costs		
depreciation		
insurance	+	
taxes	+	
license and registration	+	
finance charges	+	
total ownership costs	+ =	
other costs (washing, accessories, etc.)	+	
total driving costs	=	
total miles driven	÷	
cost per mile	=	

Driving Costs Worksheet. American Automobile Association, Your Driving Costs Report: 2013 Edition.

5 American Public Health Association (2010). The Hidden Health Costs of Transportation.

6 U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. (2002). Guide to Community Preventive Services.

7 Rails-to-Trails Conservancy. (2006) Health and Wellness Benefits.

Economic Benefits

TRANSPORTATION SAVINGS

When it comes to transportation costs, bicycling is one of the most affordable forms of transportation available, second only to walking. According to the American Automobile Association, the cost of owning and operating a medium-sized sedan for one year, assuming one drives 10,000 miles per year, is approximately $7,804. [8] Owning and operating a bicycle costs just $120 per year, according to the League of American Bicyclists.[9] The Pedestrian and Bicycle Information Center explains how these lower costs help individuals and communities as a whole: "When safe facilities are provided for pedestrians and bicyclists, more people are able to be productive, active members of society. Car ownership is expensive, and consumes a major portion of many Americans' income".

Bicycling becomes even more attractive from an economic standpoint when the unstable price of gasoline is factored into the equation. Oil prices more than quadrupled between 2000 and 2008, when gasoline prices topped $4 a gallon.[10] The unreliable cost of fuel reinforces the idea that local communities should be built to accommodate people-powered transportation, such as walking and biking. Many areas of the city already have traditional mixed-use and generally compact land development patterns; when combined with new strategies for improving bicycle transportation, many such communities could foster local reductions in auto- and oil-dependency.

PROPERTY VALUES

Bicycle facilities such as bike lanes, paths, and greenway trails are popular community amenities that add value to properties nearby. According to a 2002 survey by the National Association of Realtors and the National Association of Homebuilders, homebuyers rank trails as the second-most important community amenity out of 18 choices, above golf courses, ball fields, parks, security, and others.[11] A study of home values along the Little Miami Scenic Trail in Ohio found that single-family home values increased by $7.05 for every foot closer a home is to the trail.[12] These higher prices reflect how trails and greenways add to the desirability of a community, attracting homebuyers and visitors alike.

Environmental Benefits

AIR QUALITY

Providing the option of bicycling as an alternative to driving can reduce the volume of gasoline consumed and resulting car-related emissions, which in turn improves air quality. Cleaner air reduces the risk and complications of asthma, particularly for children, the elderly, and people with heart conditions or respiratory illnesses.[13] Lower automobile traffic volumes also help to reduce neighborhood noise levels and improve local water quality by reducing automobile-related discharges that are washed into local rivers, streams, and lakes. Furthermore, every car trip replaced with a bicycle trip reduces U.S.

8 American Automobile Association. (2013). Your Driving Costs: How Much are You Really Paying to Drive? 2013 Edition.

9 The League of American Bicyclists. www.bikeleague.org.

10 King, Neil. The Wall Street Journal: Another Peek at the Plateau. (2/27/08).

11 National Association of Homebuilders. (2008). www.nahb.com.

12 Rails to Trails Conservancy. (2005). Economic Benefits of Trails and Greenways.

13 Health Effects Institute (2010). Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects. Special Report 17.

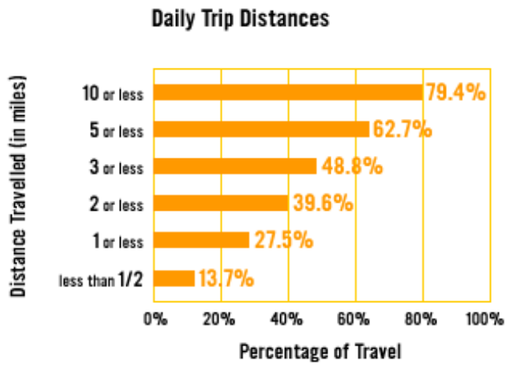
dependency on fossil fuels, which is a national goal. According to a survey by the National Association of Realtors and Transportation for America, 89 percent of Americans agree that transportation investments should support the goal of reducing energy use.[14]

Environmental Services of Greenways, Trails, and Paths

Greenways and trails are a key component of any bicycle network and carry environmental benefits as well. Greenways protect and link fragmented habitat and provide opportunities for protecting plant and animal species. By conserving plant cover, greenways also preserve the natural air filtration processes provided by plants, filtering out harmful pollutants, such as ozone, sulfur dioxide, carbon monoxide, and airborne heavy metal particles. Finally, 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. Greenways also act as a line of defense against natural hazards, such as flooding.

Transportation Benefits

Many city residents do not have access to a motor vehicle or are unable to drive. According to the 2001 National Household Travel Survey, 12 percent of persons age 15 or older do not drive, and 8 percent of U.S. households do not own an automobile. The rates for the City of Richmond are considerably higher with 17.9 percent of households without automobiles in 2000.[15]



Almost 50 percent of all trips in the U.S. are 3 miles or less, or less than a 15-minute bike ride. Source: Pedestrian and Bicycle Information Center, www.pedbikeinfo.org

Providing a well-connected bicycle network provides a safe transportation option for those who are unable or unwilling to drive or who do not have access to an automobile. Bicycle improvements can increase access to important destinations for the young, the elderly, low-income families, and others who may be unable to drive or do not have a motor vehicle. They can also free up time for those who may otherwise have to provide rides to other household members.

Investing in bicycle facilities can also help to reduce congestion and the pollution, gas costs, wasted time, and stress that comes with it. Each person who makes a trip by bicycle is one less car on the road or in the parking lot. A network of wide shoulders, bike lanes, and paths gives people the option of making a trip by bike, which helps to alleviate congestion for everyone. Bicycle facilities can also help to substantially reduce transportation costs by providing a way of getting around without a car for some trips. About half of all trips taken by car are three miles or less, equivalent to a 15-minute bike ride.[16] With a safe, convenient bicycle network, some of these shorter trips could be comfortably made by bike, saving money on gas, parking costs, and vehicle wear and tear over time.

14 National Association of Realtors and Transportation for America. (2009). 2009 Growth and Transportation Survey. www.t4america.org/docs/011609_pr_nart4poll.pdf.

15 http://en.wikipedia.org/wiki/List_of_U.S._cities_with_most_households_without_a_car#cite_note-bikesatwork-1.

16 U.S. Department of Transportation and Federal Highway Administration (2009). National Household Travel Survey.

Quality of Life

Many factors go into determining quality of life for community residents: the local education system, prevalence of quality employment opportunities, and affordability of housing are all items that are commonly cited. Increasingly though, citizens are demanding a cleaner, safer, more enjoyable community that provides amenities for adults and children alike. Communities with quality bike lanes, trails, and bicycle routes attract new residents as well as new businesses and industries. Getting outdoors and being physically active also helps to relieve stress, improve mood, and foster social connections between residents.

Transportation and recreation options will be especially important for older Americans in the coming years. According to the Brookings Institution, the number of older Americans is expected to double between 2000 and 2025.[17] Seniors who find themselves unable to drive or who become uncomfortable with driving will find that their mobility is severely limited if other transportation options are not available. Trails and paths will provide seniors with a place to take a low-intensity bike ride or a stroll around the neighborhood or a way to get to nearby shops and services. Paths and trails are also valuable transportation connections for the elderly because they accommodate motorized wheelchairs, which can provide many seniors with the independent mobility that they would not have otherwise.

Children under 16 are another important subset of our society who merit access to safe mobility options and a higher quality of life. In recent years, increased traffic and a lack of pedestrian and bicycle facilities have made it less safe for children to travel to school or to a friend's house. In 1969, 48 percent of students walked or biked to school, but by 2009, less than 13 percent of students walked or biked to or from school.[18]

In a 2004 Centers for Disease Control and Prevention survey, 1,588 adults answered questions about barriers to walking to school for their youngest child aged 5 to 18 years.[19] The main reasons cited by parents included distance to school, at 62%, and traffic-related danger, at 30%. Strategic additions to the bicycle and pedestrian network could shorten the distance from homes to schools, and overall pedestrian and bicycle improvements can improve the safety of our roadways so that children within Richmond could once again safely bike in their communities. According to the National Center for Safe Routes to School, "Walking or biking to school gives children time for physical activity and a sense of responsibility and independence; allows them to enjoy being outside; and provides them with time to socialize with their parents and friends and to get to know their neighborhoods".[20] Ensuring that children have safe connections to their schools and throughout their neighborhoods can encourage them to spend time outdoors, get the physical activity they need for good health, and enjoy a higher quality of life.

Understanding the many benefits of creating a more bicycle friendly Richmond will help staff planners, city engineers, and key decision makers present bicycle infrastructure as an element that improves the overall quality of life for residents, and provides an attractive, comfortable environment for visitors.

17 Brookings Institution (2003.) The Mobility Needs of Older Americans: Implications for Transportation Reauthorization.

18 National Center for Safe Routes to School (2011). How Children Get to School: School Travel Patterns From 1969 to 2009.

19 Centers for Disease Control and Prevention. The Importance of Regular Physical Activity for Children. Accessed in 2005 from www.cdc.gov/nccdphp/dnpao/index.html.

20 National Center for Safe Routes to School (2006). National Center for Safe Routes to School Talking Points.

This page intentionally left blank.

RICHMOND
Bicycle Master Plan

2 Existing Conditions

OVERVIEW

The City of Richmond, capital of the Commonwealth of Virginia, surrounded by Henrico and Chesterfield Counties, is located at the fall line of the James River approximately 100 miles south of Washington, DC. The city is home to approximately 214,114 people according to the 2013 US Census. The rich cultural and political history of the city makes Richmond a popular destination for visitors, government officials, state-wide conventions, and schools field trips. Richmond's economy is primarily driven by law, finance, and government with federal and local governmental agencies located in the downtown area. The city is also home to the Virginia Commonwealth University (VCU), with a total undergraduate enrollment of 23,951 students in 2013. Richmond lies at the fall line, separating the hilly Piedmont from the Coastal Plain making it a natural center for commerce and a hub for transportation (air, water, and land). This distinction, in addition to being intersected by two major highways (Interstates 95 and 64), puts pressure on local traffic conditions, making multimodal transportation options a crucial component of making the city livable and friendly to all users.

This chapter describes the existing bicycling environment in Richmond, the city's network strengths and weaknesses, existing bicycle planning and implementation efforts, public comments about existing conditions, and field observations of key corridors that can provide critical bicycle connections in the City of Richmond.

EXISTING BIKEWAYS

Richmond's topography and climate conditions provide many opportunities for bicycling activities. Despite the hot and humid summers, Richmond enjoys moderate temperatures the rest of the year. Sections of the urban core have considerable topographic relief, including short steep hills; however much of the urbanized area features flat terrain ideal for utilitarian and commuter cycling. Furthermore, the compact density of the downtown and surrounding neighborhoods along with the grid-like network create an ideal environment for short (two miles or less) bicycling trips.

Geographic Information Systems (GIS) data obtained from the City of Richmond was used to asses the existing bicycle conditions. Figure 2-1 presents existing conditions in Richmond and serves as the foundation for analyzing the current bicycling environment. The analysis included evaluating the roadway network and locations of bicycle-related accidents as well as the identification of popular destinations, bicycling routes, and previously planned facilities.

CHAPTER CONTENTS

RICHMOND
Bicycle Master Plan

Figure 2-1: Existing Bicycle Facilities in Richmond, Virginia

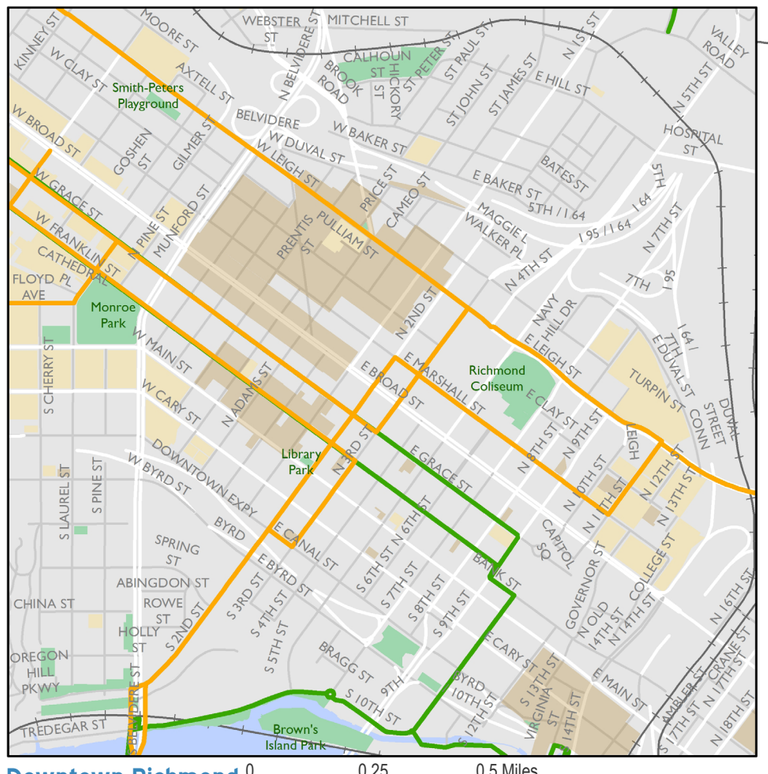
Existing Bicycle Facilities

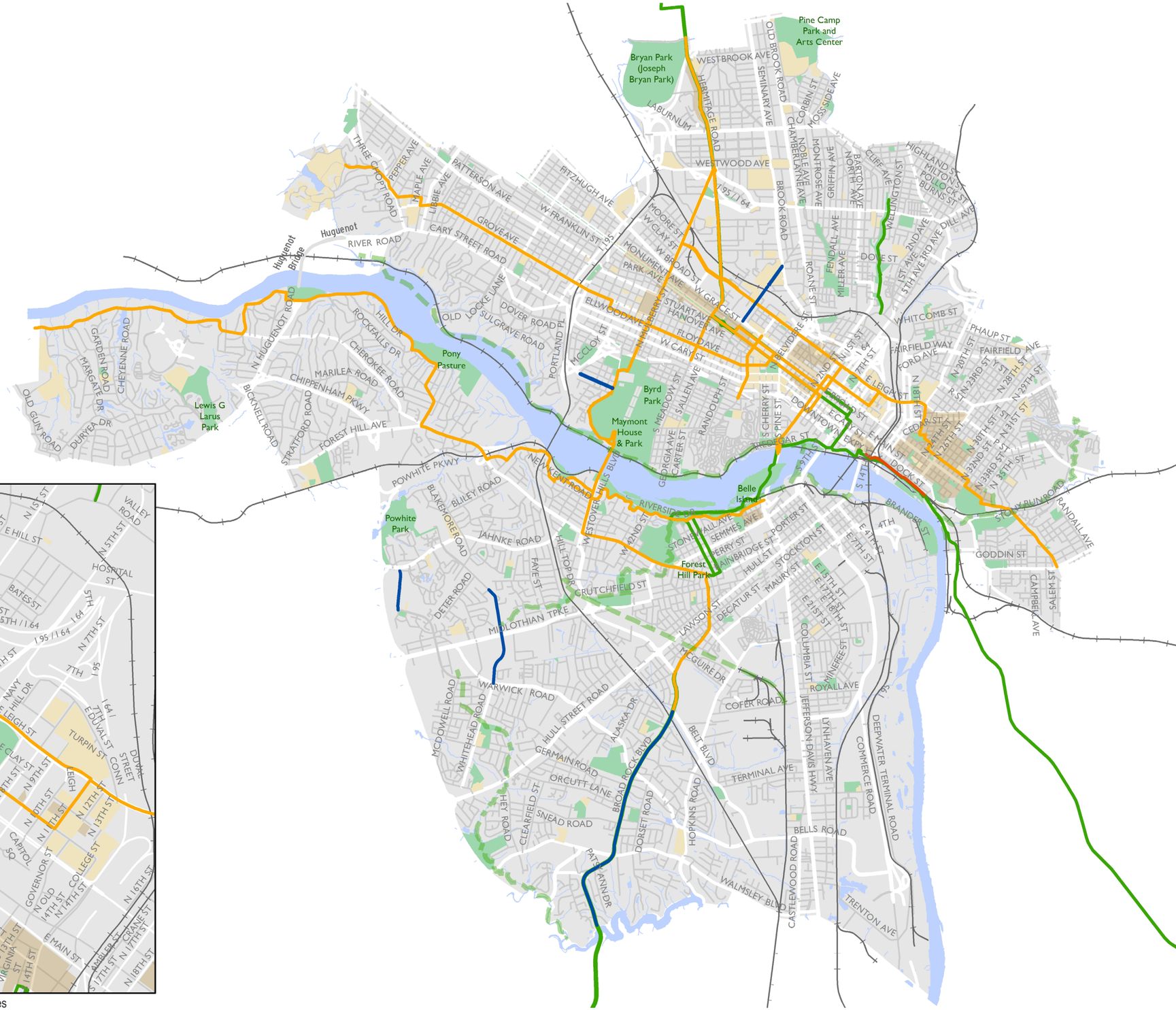
- Bike Lane
- Shared Lane
- Shared Use Path
- Greenway

0 0.5 1 2 Miles

Areas of Interest

- Parks
- Historic Districts
- Educational Facilities





EXISTING PLAN REVIEW

Since a thorough plan review was a major component of the 2013 *Richmond Connects Plan,* it can be assumed that all pertinent historic, current, and relevant bicycle related policies and recommendations were vetted to craft a network and action steps for improving bicycling in Richmond (short descriptions can be found in the Introduction Chapter). Therefore, this Plan will focus on the findings and outcomes from *Richmond Connects* as the baseline for crafting recommendations for this implementation focused Bicycle Master Plan.

Richmond Strategic Multimodal Transportation Plan (Richmond Connects, 2013)

Richmond Connects is a 20-year multimodal transportation plan for the City of Richmond. The plan describes the strategic actions the city will focus on over the next 20 years to improve transportation for city residents and visitors. The plan addresses the following guidelines, goals, and strategies related to on-road bicycle facilities and off-road greenway trails.

VISION FROM RICHMOND CONNECTS

"In the 21st Century, Transportation in Richmond will support the City's unique role and history as the capital of Virginia through the efficient movement of people and goods. A truly multimodal transportation system will support economic development, tourism, and sustainability goals, will include all modes of travel, will improve livability by operating safely and offering travel choices for all ages and abilities of users."

GUIDING PRINCIPLES

- Operationally, every roadway and travel mode will be safe for all users.
- Neighborhoods and communities throughout the city will be linked by a balanced system of multimodal bikeable, walkable, and transit-friendly transportation connections.
- Streets will be more complete and well designed.
- Reduce Vehicle Miles of Travel (VMT) within the city by encouraging alternatives to the single occupant vehicle trips, and increase the use of bicycles, pedestrians, and transit facilities.
- Richmond will have more multimodal centers, corridors, and adopt land use and parking policies that support alternative modes of transportation, walking, and biking.

EXISTING PEDESTRIAN AND BICYCLE CONDITIONS

Traditional street grid patterns with narrow lanes and sidewalks dominate the older parts of the city such as Downtown, the Fan, and Carytown. More recently, developed neighborhoods to the west and south of the James River have a more suburban development pattern lacking bicycle and pedestrian friendly accommodations. Existing bicycle facilities in the city include shared roadways (12.9 miles marked with sharrows as of 2012), bike lanes (in a few streets), and multi-use paths along the James River and in Forest Hill Park. The map on the previous page (2-2) provides an overview of the existing bicycle facilities in the city.

GRTC provides bicycle racks (two) on all buses, and bicycle parking facilities are sporadic around downtown but substantial around VCU campuses.

According to the crash analysis conducted in the Richmond Connects Plan, the following corridors had relatively high numbers of pedestrian and bicycle crashes compared to other corridors in the city. This analysis determined crash rates throughout the city by using crash data from 2008-2010 and calculating the number of crashes per million vehicle miles travelled (VMT):

- Broad Street
- W. Cary Street
- Midlothian Turnpike
- Grove Avenue
- Hull Street

BICYCLE AND PEDESTRIAN INVESTMENTS

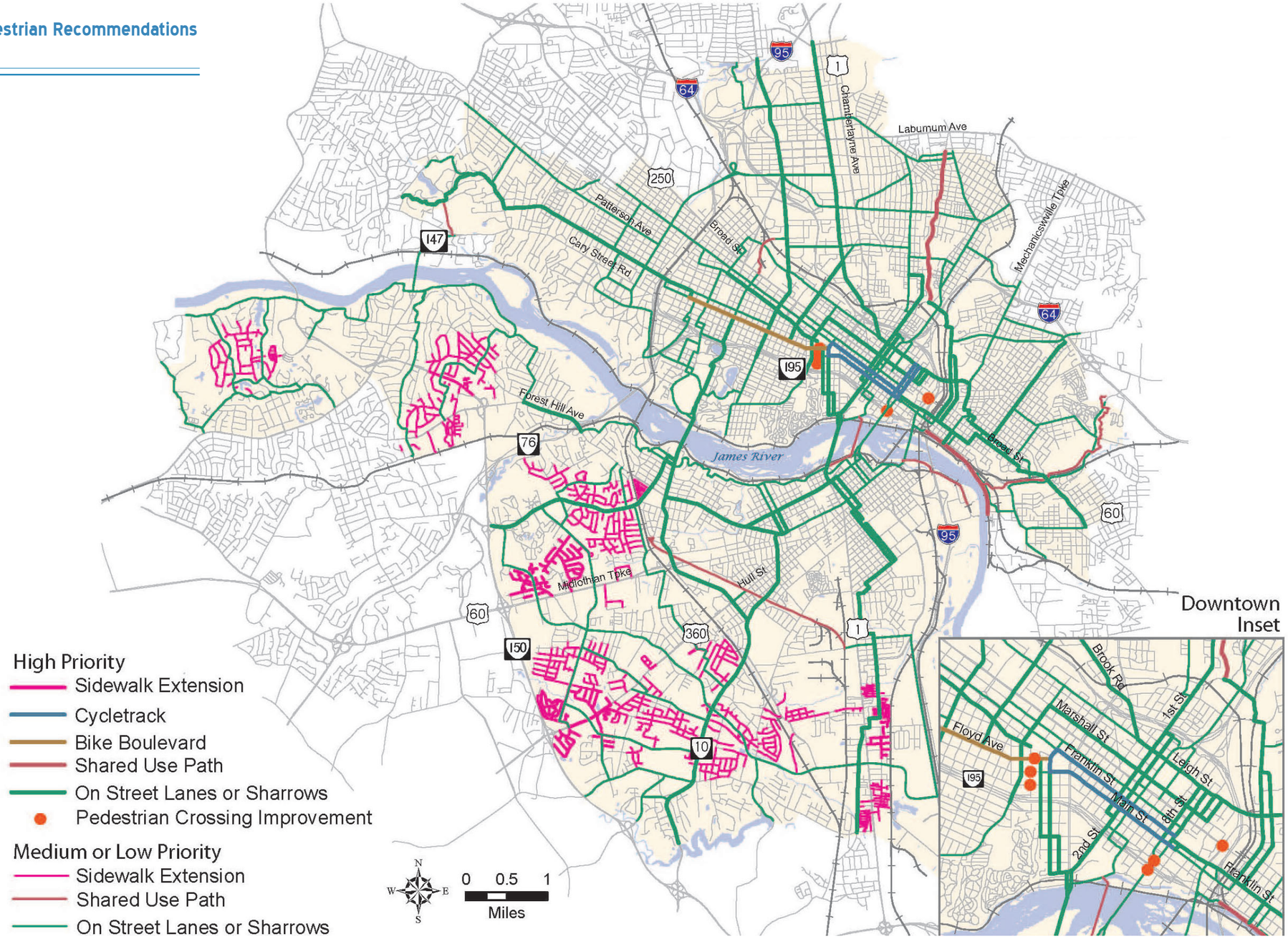
The proposed bicycle and pedestrian investments are shown in the map on the next page. The Plan outlines the following bicycle recommendation improvements:

- Develop a city-wide bicycling network that includes dedicated lanes, sharrows, cycle tracks, and bicycle boulevards.
- Develop major North/South and East/West bicycle routes with a focus on major destinations such as downtown and VCU.
- A cycle track is recommended along Franklin and Main Streets in downtown.
- A bicycle boulevard is recommended on Floyd Avenue.
- Support bicycling education and infrastructure in low income communities.
- Require bicycle parking in new development and encourage bicycle access in existing buildings.
- Coordinate with various partners to develop a bike share system within the city.

IMPLEMENTATION ACTION STEPS

Within *Richmond Connects* is a table including projects, plans, and policies with an implementation time frame assigned to each. The table is the result of comparing the strategies and guiding principles. This Plan further refines or supports the bicycle mode category action steps. *Note:* As of the date of writing this Plan, the Frankling/Main Street cycle track and the Floyd Avenue Bicycle Boulevard projects are being further studied for short term implementation.

Figure 2-2: Bicycle and Pedestrian Recommendations from *Richmond Connects*



BICYCLE DEMAND ANALYSIS

Bicycle Suitability Index

The Bicycle Suitability Index (BSI) provides a general understanding of expected activity in the bicycling environment by combining categories representative of where people live, work, play, access public transit, and go to school into a composite sketch of regional demand. Area specific land use and transportation factors, such as the GRTC service, local cultural destinations, schools, and trails are considered in addition to various demographic factors.

A bicycle network is likely to attract a large portion of the population if its fundamental attribute is low stress connectivity. In other words, a network should provide direct routes between origins and destinations that do not include links that exceed one's tolerance for traffic stress. The Bicycle Suitability Index (BSI) is an objective, data-driven evaluation model which identifies high traffic stress links, bicycle network gaps and gaps between "low stress" links, and a score assessing the relative user comfort or level of stress a user may experience on each link. Each user is different and will tolerate different levels of stress in their journey, so these maps should be used as a general guide rather than an absolute truth. Also, the data sets used provide a high-level view of regional conditions.

BSI also combines a variety of roadway characteristic categories to provide a general understanding of the quality of the travel environment. Appendix B of this Plan describes the use of GIS data for this model, which in the end develops a composite sketch for both demand and supply.

This type of analysis has also been conducted by local and regional planning agencies, as well as universities across the United States. Relating where people live, work, play, access public transit, and go to school through a geographic medium (GIS) is consistent with research emerging from Portland State University and the Mineta Transportation Institute.

ROADWAY CHARACTERISTICS

An analysis of roadway quality refines the BSI demand analysis. This "supply" analysis identifies the quality of a roadway to and from other factors used in this analysis. Factors in this analysis include roadway connectivity, speed limit, street classification, block length, and existing/planned on- and off-street bicycle facilities. Features were assigned scores based on their perceived suitability for supporting bicycle activity; essentially high scores were assigned to short, local roads with low speeds and proximity to bicycle facilities.

Figure 2-3 provides an overview of the steps involved in the BSI analysis. Overall, the purpose of the demand analysis is to identify areas where bicyclists are likely to be able to justify improvement projects, if warranted by the relative quality of the supply. Figures 2-5 through 2-11 illustrate and describe how the weighted features contribute to the variation in overall demand and supply.

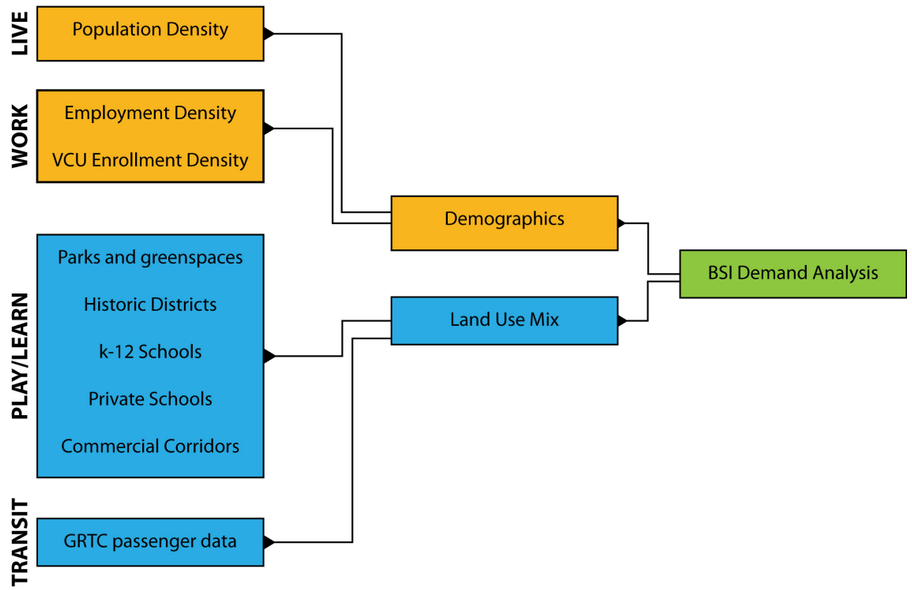


Figure 2-3: BSI Model Flow Chart

WHERE PEOPLE LIVE

This map illustrates 2007-2011 American Community Survey (ACS) block level census data including population density, percent of walk and bicycle commuters, and percent of households with zero vehicle ownership. These locations represent potential trip origin locations. More trips can be made in areas with higher population density if conditions are suitable.

For all maps, the areas shaded more deeply in red represent higher demand areas relative to other colors on the map.

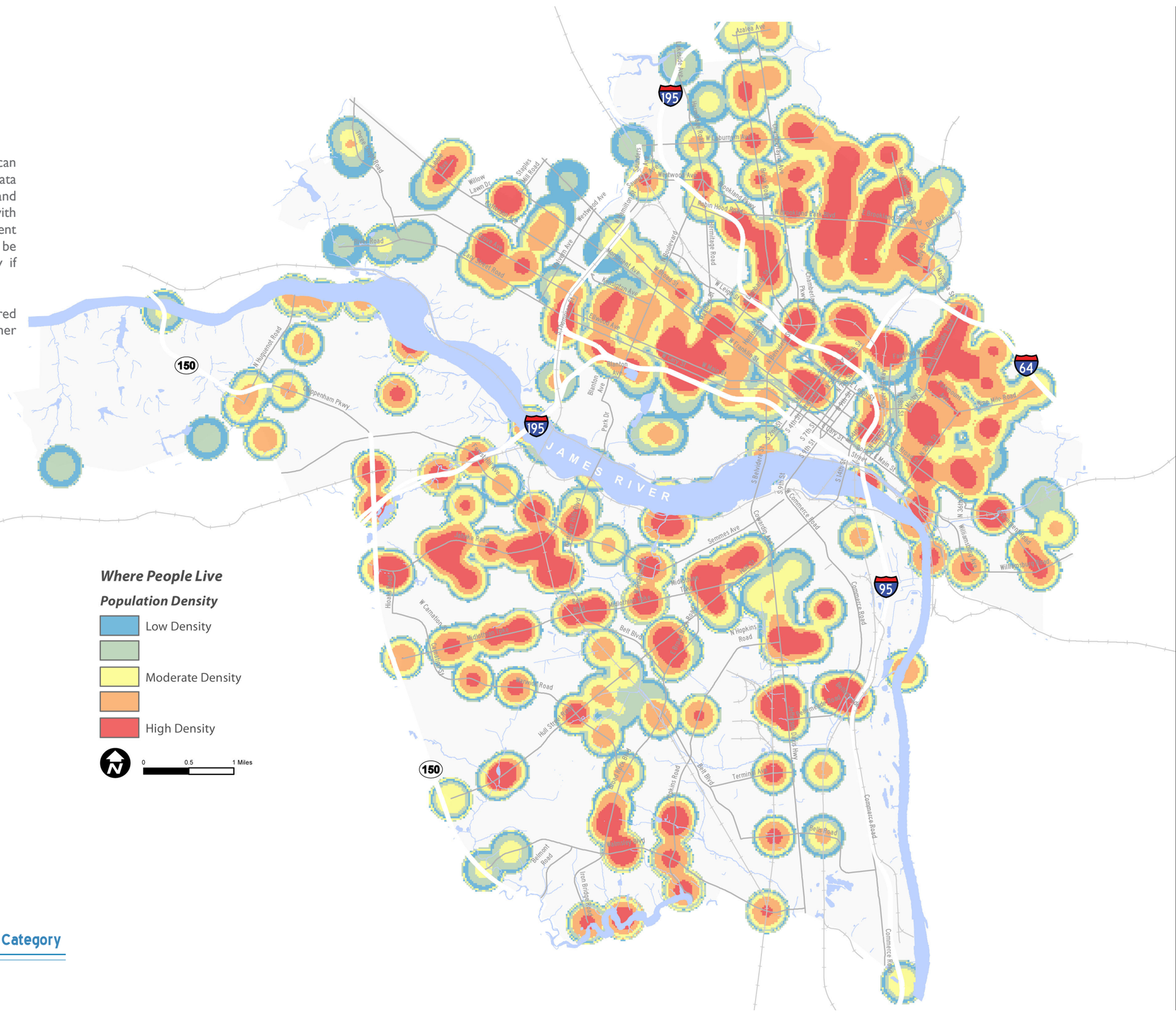


Figure 2-4: BSI Results Live Category

WHERE PEOPLE WORK

Trip end data is displayed for people working or going to college in the City of Richmond regardless of residency. Its basis is 2010 total employment by census block and 2013 total student enrollment at VCU. The highest concentrations are clearly defined in the core of downtown and near campus.

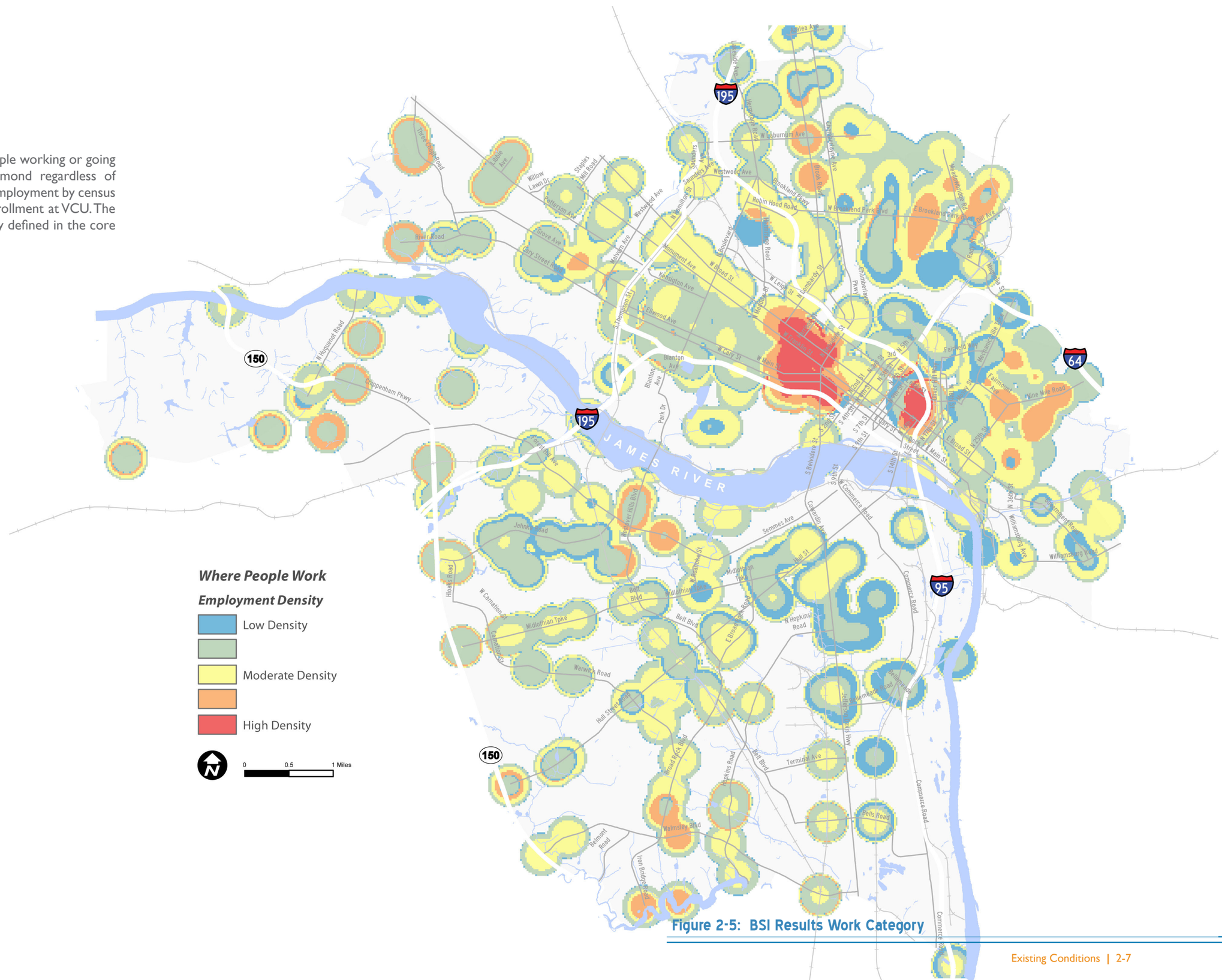


Figure 2-5: BSI Results Work Category

WHERE PEOPLE PLAY

Locations indicating play are a combination of varied land use types and destinations. Overlays such as retail destinations, parks, and historic destinations as well as K-12 schools throughout the city are assembled to depict choice-based places and youth education centers.

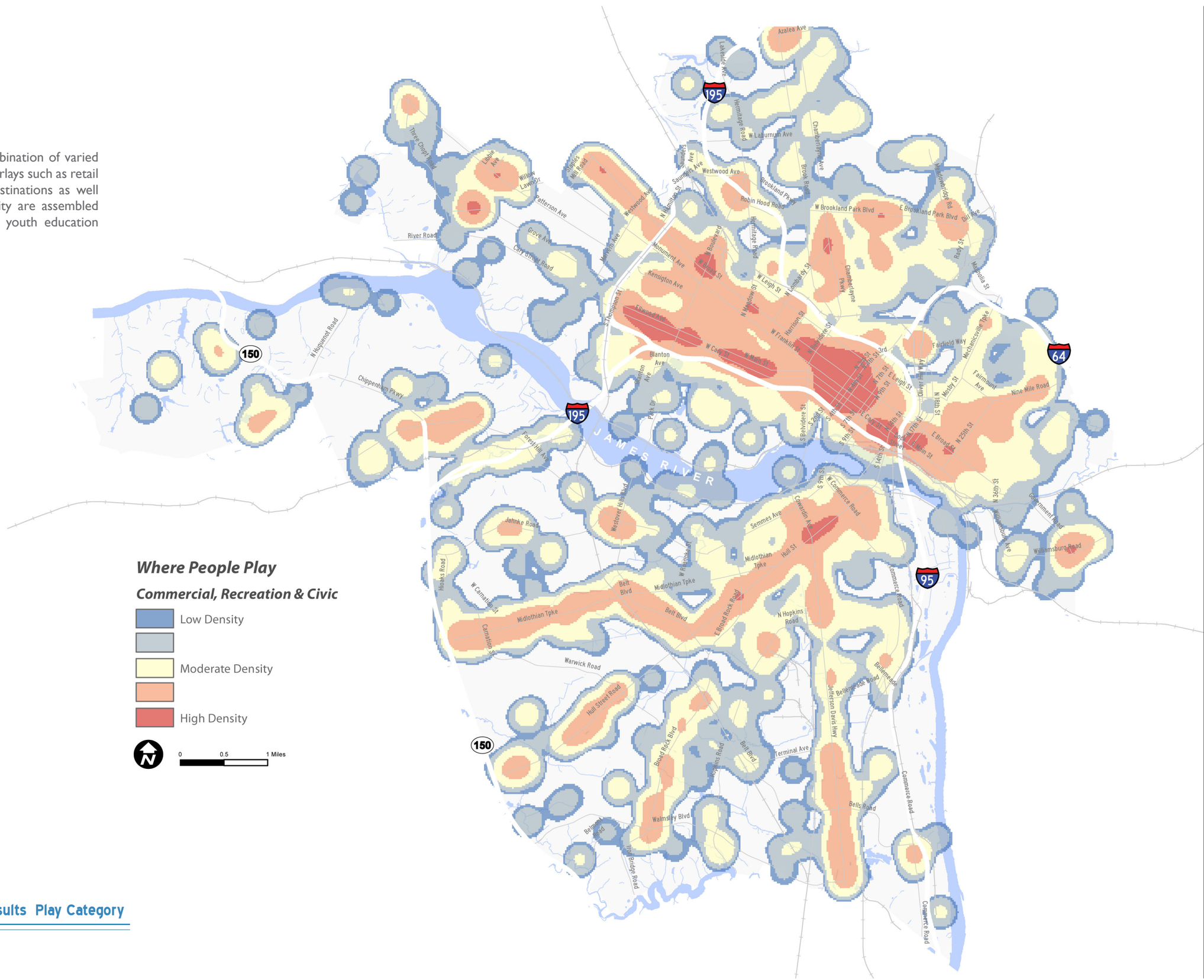


Figure 2-6: BSI Results Play Category

WHERE PEOPLE ACCESS TRANSIT

This heat map is created by assessing the location of GRTC bus stops in the City of Richmond. This category accounts for the total number of "on" and "off" boardings per stop.

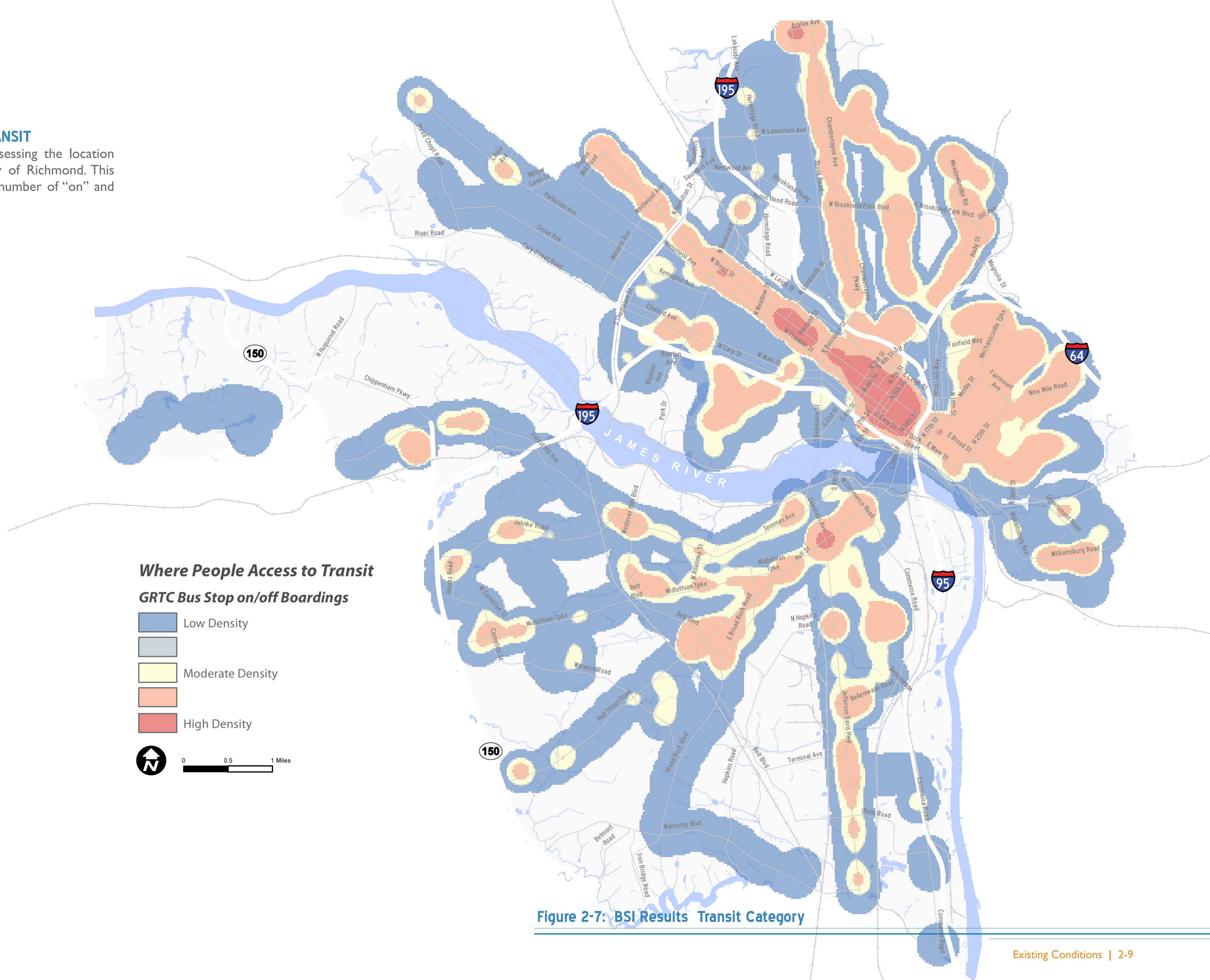


Figure 2-7: BSI Results Transit Category

BSI DEMAND RESULTS

After independently processing each of the features described in the previous maps, the composite model is created and grouped into five demand classes using breaks in the data values. Estimated demand is highest throughout Richmond's North and East sides. Areas that yield highest demand include the VCU campus, downtown, and numerous historic districts and popular parks in the city. The South side of Richmond is dominated by single family homes and represents potential trip generators. The results indicate some pockets of high demand in this area.

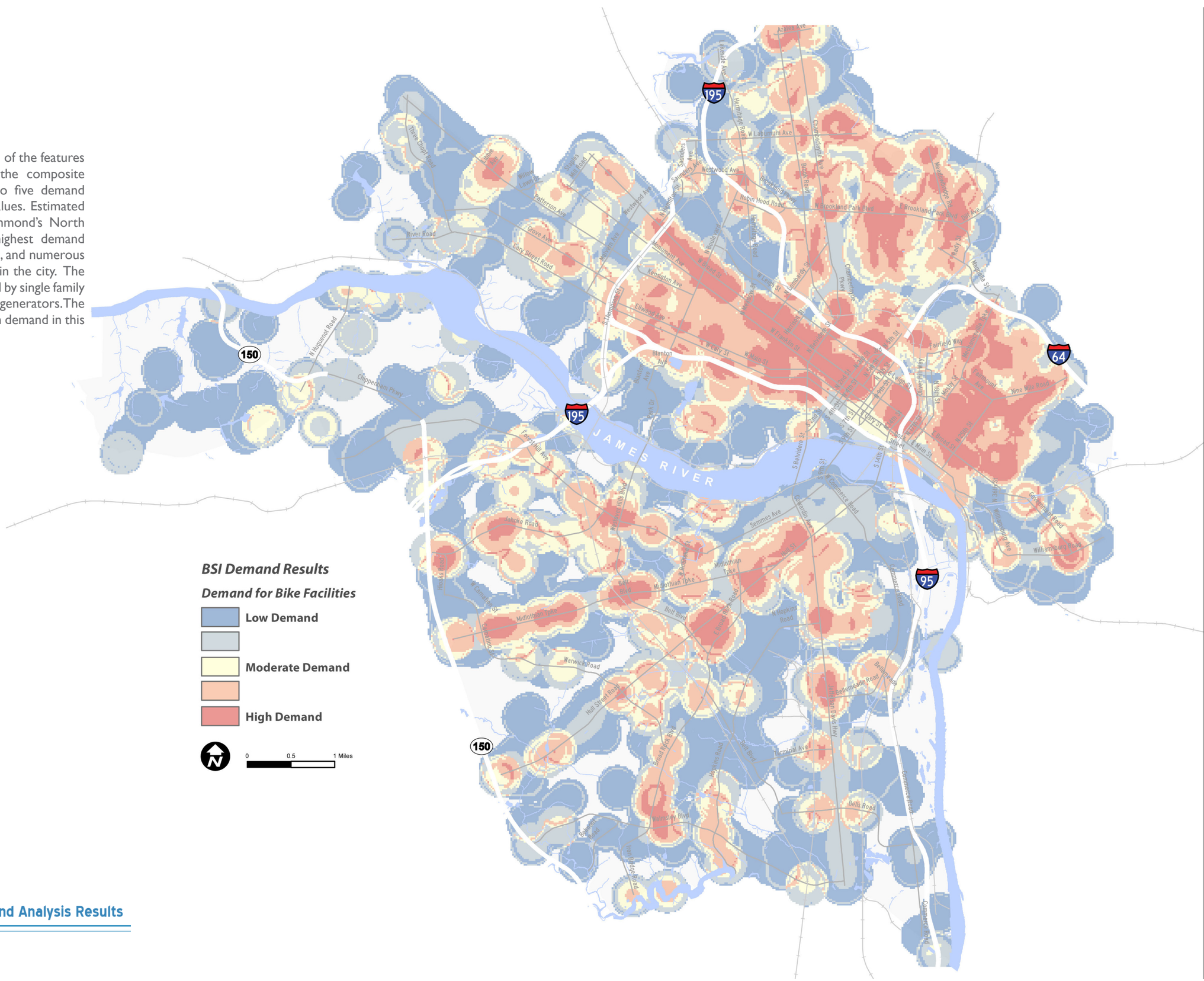


Figure 2-8: BSI Demand Analysis Results

ROADWAY QUALITY (BSI SUPPLY RESULTS)

Scores in BSI Supply analysis are based on roadway characteristics that are perceived to have an impact on bicycle safety, comfort, and ease of movement. The purpose of the supply analysis is to determine if infrastructure improvements are warranted given the existing conditions.

Using available data for the entire city, roadways were classified according to Feature Class, posted speed limit, and 2011 AADT values. Roadways were assigned a score based on the level of stress a bicyclist is likely to experience when traveling along the roadway. In addition, the roadways scored points based on proximity to existing bicycle facilities.

It is important to note that the analysis depends on quantitative data and may not reflect the actual comfort of a bicyclists on a particular road. The analysis portrays roadway quality based on a characterization of data, but safety, comfort, and ease of movement are influenced by many factors that can not be quantified accurately. The analysis should be treated as a baseline to show the potential quality of each roadway. Further analysis is required to more accurately verify the characterization of each roadway.

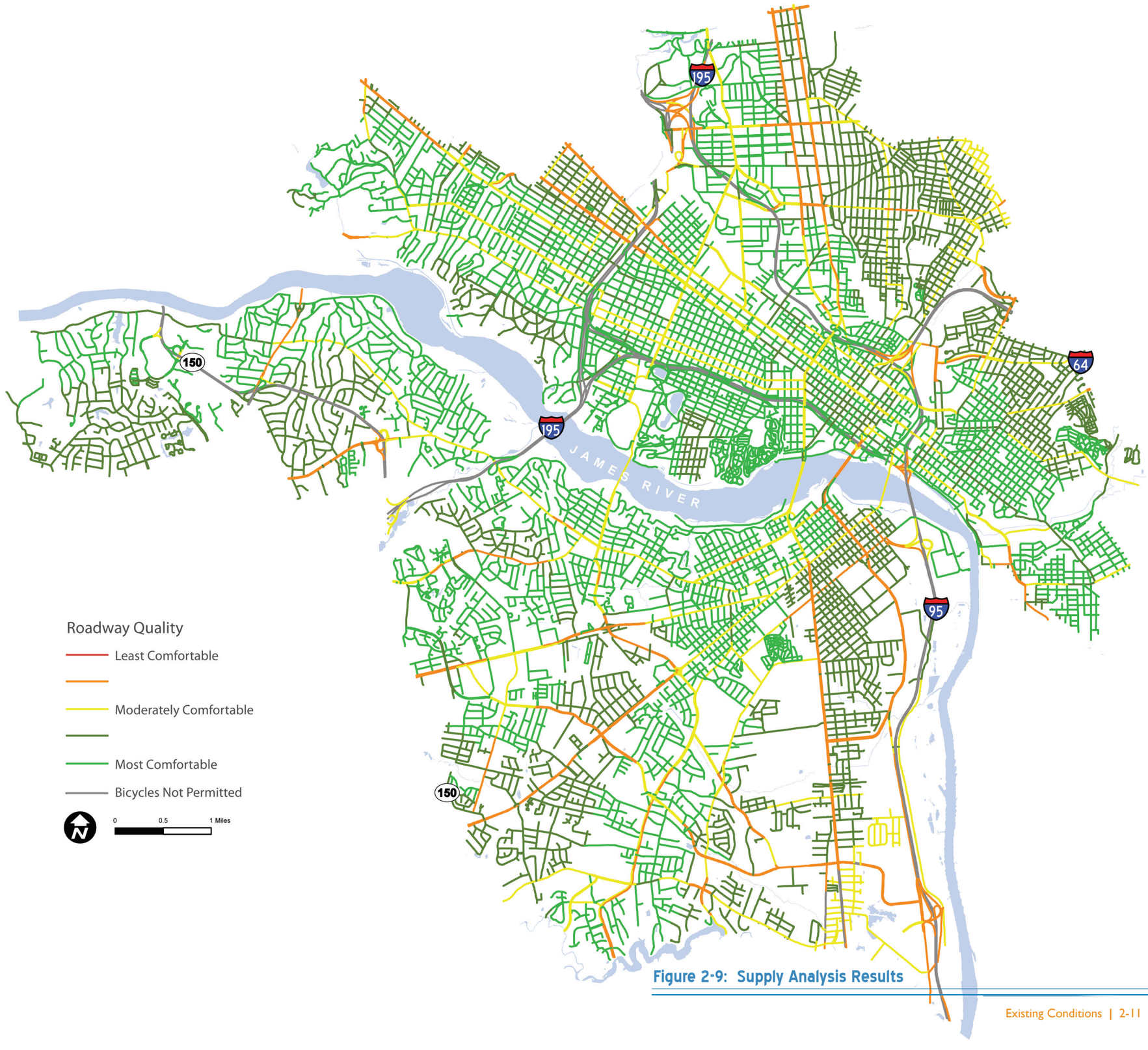


Figure 2-9: Supply Analysis Results

BICYCLE SUITABILITY ANALYSIS CONCLUSIONS

Variation in demand and supply are combined into the Composite BSI model. Possible bicycle improvement options are summarized below.

Areas with **high demand** for bicycling and **most comfortable** infrastructure can benefit from innovative programs and capital projects that further support walking, closure of key gaps, and should be considered showcase areas where best practices can be modeled for the city. These areas provide opportunities for improvements and should be a high priority for investment.

Areas with **high demand** and **least comfortable** infrastructure can benefit from infrastructure improvements to improve bicycling conditions. These areas may require sidewalks, bicycle facilities, or intersection improvements to accommodate high level of demand. They should also be a high priority for investment.

Areas with **low demand** for bicycling and **most comfortable** infrastructure can benefit from programs to encourage bicycling, and land use changes or development to increase the density of attractors and generators. These areas should be a medium priority for investment.

Areas with **low demand** for bicycling and **least comfortable** infrastructure can benefit from basic infrastructure improvements. These areas should be a low-priority for investment. Please refer to Appendix B for the full methodology of the analysis.

LIST OF HIGH DEMAND & LEAST COMFORTABLE CORRIDORS

1. Chamberlayne Ave between Azalea Ave & E Leigh St
2. Brook Road between Azalea Ave & E Leigh St
3. W Broad St between Staples Mill Road & 17 St
4. Monument Ave between Staples Mill Road & Lombardy St
5. N Belvidere St between the James River and Leigh St
6. N Boulevard between Cary St & W Leigh St
7. Jahnke Road between Hioaks Road & Forest Hill Ave
8. Midlothian Tpke between Carnation St & Hull St
9. Westover Hills Blvd between Midlothian Tpke & Riverside Dr

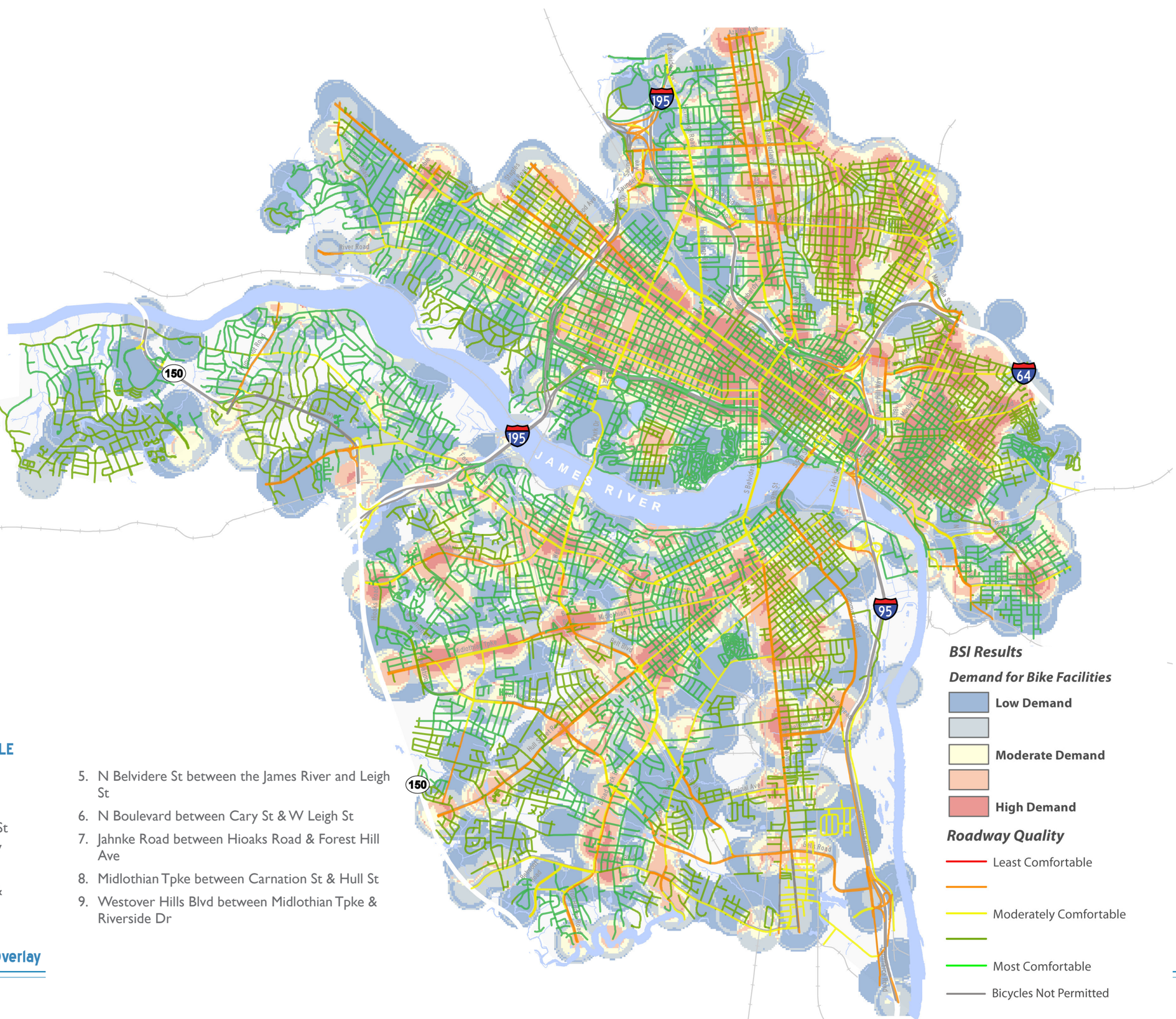


Figure 2-10: BSI Conclusions Supply & Demand Overlay

Bicycle Commuter Estimates

Journey-to-work information collected by the US Census Bureau's American Communities Survey (ACS) is the foundation of this analysis. The ACS "Commuting to Work" data provide an indication of current bicycle system usage. A major objective of any bicycle facility enhancement or encouragement program is to increase the "bicycle mode split", or percentage of people who choose to bike rather than drive alone. The most recent ACS data available for the City of Richmond is the 2007-2011 five-year estimates. Model variables from the ACS for the City of Richmond include: total population (204,214 people), employed population (96,802 people), school enrollment (23,115 students grade K-12; 28,023 college students), and travel-to-work mode split shown in Table 2-1.

Table 2-1: Commute Modeshare in Richmond

	Bicycling	Walking	Source
Employed	1.67%	4.42%	ACS, 2007-2011
K-12	0.67%	10.57%	NHTS 2009
College	1.67%	4.42%	ACS, 2007-2011

The 2009 National Household Travel Survey (NHTS) provides a substantial national dataset of travel characteristics, particularly for trip characteristics of bicycling and walking trips. Data used from this survey include:

- Student mode split, grades K-12
- Trip distance by mode by trip purpose
- Ratio of walking/bicycling work trips to utilitarian trips
- Ratio of work trips to social/recreational trips
- Average trip length by trip purpose and mode

Several of these variables are trip type multipliers that provide an indirect method of estimating the number of walking and bicycling trips made for other reasons, such as shopping and running errands. NHTS 2009 data indicates that for every bicycle work trip, there are slightly more than two utilitarian bicycle trips made. Although these trips cannot be directly attached to a certain group of people (not all of the utilitarian bicycling trips are made by people who bicycle to work) these multipliers allow a high percentage of the community's walking and bicycling activity to be captured in an annual estimate.

The Safe Routes to School Baseline Data Report (2010) was used to determine the percent of students who walk or bicycle by the parents' estimate of distance as well as the frequently of carpooling for trip replacement.

NOTE:
As with any modeling projection, the accuracy of the result is dependent on the accuracy of the input data and other assumptions. Effort was made to collect the best data possible for input to the model, but in many cases, national data was used where local data points were unavailable. Examples of information that could improve the accuracy of this exercise include the detailed results of local Safe Routes to Schools parent and student surveys, a regional household travel survey, and a student travel survey of college students.

Hermitage Road is an example of an existing facility marked with sharrows.

EXISTING WALKING AND BICYCLING TRIPS

Table 2-2 shows the results of the model, which estimates that about 11,000 bicycle trips and almost 55,000 walking trips occur in Richmond each day. Based on the model assumptions, the majority of trips are non-work utilitarian trips, which include medical/dental services, shopping/errands, family personal business, obligations, transporting someone, meals, and other trips.

Table 2-2: Current Walking and Bicycling Trips

	Bicycling	Walking	Source
Commute Trips			
Bicycle/ walking commuters	1,619	4,278	Employed population multiplied by mode split
Weekday bicycle/ walking trips	3,237	8,557	Number of commuters multiplied by two for return trips
School Trips			
K-12 bicycle/ walking commuters	155	2,444	School children population multiplied by mode split
Weekday K-12 bicycle/ walking trips	311	4,888	Number of student bicyclists multiplied by two for return trips
College Trips			
College bicycle/ walking commuters	469	1,239	College Students multiplied by mode split
Weekday bicycle/ walking college trips	937	2,477	Number of college student bicyclists multiplied by two for return trips
Utilitarian Trips			
Daily adult bicycle/walking commute trips	4,174	11,034	Number of bicycle/walking trips plus number of bicycle/walking college trips
Daily bicycle/walking utilitarian trips	6,538	38,787	Utilitarian bicycle/walking trips multiplied by ratio of utilitarian to work trips (NHTS). Distributes weekly trips over entire week (vs. commute trips over 5 days)
Total Current Daily Trips	**11,023**	**54,708**	

TRIP REPLACEMENT

To estimate the total distance Richmond residents travel to work or school by walking and bicycling, the model isolates different walking and bicycling user groups and applies trip distance information for walking or bicycling trips by mode based on NHTS 2009.

Shown in Table 2-3, the model estimates that the estimated 21 million bicycling and walking trips each year replace over six million vehicle trips, equal to almost 8 million miles of trips.

Table 2-3: Estimated Current Vehicle Trips Replaced by Walking and Bicycling Trips

	Bicycling	Walking	Source
Commute Trips			
Weekday vehicle trips replaced	2,285	6,040	Trips multiplied by drive alone trips to determine automobile trips replaced by bicycle trips
Weekday miles replaced (bicycled/walked)	8,089	4,047	Number of vehicle trips reduced multiplied by average bicycle/walking work trip length (NHTS 2009)
School Trips			
Weekday vehicle trips reduced	90	1,415	Trips multiplied by drive alone trips to determine automobile trips replaced by bicycle/walking trips
Weekday miles replaced (bicycled/walked)	69	1,087	Number of vehicle trips reduced multiplied by average trip length to/ from school (SRTS 2010)
College Trips			
Weekday vehicle trips reduced	661	1,748	Trips multiplied by drive alone trips to determine automobile trips replaced by bicycle/walking trips
Weekday miles replaced (bicycled/walked)	979	979	Number of vehicle trips reduced multiplied by average bicycle school/ daycare/religious trip length (NHTS 2009)
Utilitarian Trips			
Daily vehicle trips reduced	2,947	7,788	Number of daily utilitarian trips multiplied by drive alone trips
Daily miles replaced (bicycled/ walked)	5,579	5,192	Number of vehicle trips reduced multiplied by average utilitarian trip length (NHTS 2009; does not include work or home trips)
Yearly Results	**Bicycling**	**Walking**	**Total**
Yearly bicycle/walking trips	3,476,803	17,840,291	**21,317,094**
Yearly vehicle trips reduced	1,223,256	5,039,423	**6,262,680**
Yearly miles Replaced (bicycled/walked)	4,353,078	3,356,426	**7,709,503**

CURRENT BENEFITS

To the extent that bicycling and walking trips replace single-occupancy vehicle trips, they reduce emissions and have tangible economic impacts by reducing traffic congestion, crashes, and maintenance costs. In addition, the reduced need to own and operate a vehicle saves families money. These benefits are shown in Table 2-4.

Table 2-4: Environmental and Economic Benefits

	Bicycling	Walking	Source
Yearly vehicle miles replaced	4,353,078	3,356,426	
Air Quality Benefits			
Reduced Hydrocarbons (pounds/year)	13,052	10,064	EPA, 2005[1]
Reduced Particulate Matter (pounds/year)	97	75	EPA, 2005
Reduced Nitrous Oxides (pounds/year)	9,117	7,030	EPA, 2005
Reduced Carbon Monoxide (pounds/year)	119,001	91,756	EPA, 2005
Reduced Carbon Dioxide (pounds/year)	3,541,254	2,730,471	EPA, 2005
Economic Benefits of Air Quality			
Particulate Matter	$8,142	$6,278	NHTSA, 2011[2]
Nitrous Oxides	$18,234	$14,059	NHTSA, 2011
Carbon Dioxide	$60,716	$46,815	NHTSA,2011
Reduced External Costs of Vehicle Travel	5,579	5,192	Number of vehicle trips reduced multiplied by average utilitarian trip length (NHTS 2009; does not include work or home trips)
Crashes/Traffic Congestion	$1,784,762	$1,376,134	AAA, 2008[3]
Roadway Maintenance Costs	$609,431	$469,900	Kitamura, R., Zhao, H., and Gubby, A. R., 1989[4]
Household Transportation Savings			
Reduction in HH transportation spending	$2,176,539	$1,678,213	IRS operational standard mileage rates for 2010[5]
Total	**$4,657,823**	**$3,591,399**	

[1] From EPA report 420-F-05-022 "Emission Facts: Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks." 2005.

[2] NHTSA Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks, Table VIII-5 (http://www.nhtsa.dot.gov/ portal/site/nhtsa/menuitem.d0b5a45b55bfbe582f57529 cdba046a0/).

[3] "Crashes vs. Congestion – What's the Cost to Society?"

http://newsroom.aaa.com/wp-content/uploads/2011/11/2011_AAA_CrashvCongUpd.pdf

[4] Kitamura, R., Zhao, H., and Gubby, A. R. (1989). Development of a Pavement Maintenance Cost Allocation Model. Institute of Transportation Studies – University of California, Davis (http://pubs.its.ucdavis.edu/publication_detail.php?id=19). $0.08/mile (1989), adjusted to 2010 dollars using the Bureau of Labor Statistics Inflation Calculator (http://www.bls.gov/data/inflation_calculator.htm).

[5] http://www.irs.gov/newsroom/article/0,,id=216048,00.html

PUBLIC COMMENTS

The Richmond Bicycle Master Plan citizen survey was made available to the public via the city website, Sports Backers, and at public events. The survey was widely publicized, reaching out to a high number of respondents. A total of 2,737 responses were received, a large majority were people with access to a bike. General results are discussed below and some of the specific questions are illustrated through graphs. Raw responses are recorded in Appendix D - Public Input.

Respondent Characteristics

Of the 2,737 survey respondents, 57 percent were males and 43 percent of respondents were females. The highest percentage of respondents was between the ages of 25-45 years old, and a relatively low percentage of seniors and youth participated in the survey. Over three quarters of respondents live in the City of Richmond.

As shown in Figure 2-11, approximately 55 percent of respondents describe themselves as "enthused and confident" riders, and 30 percent are "interested but concerned" about bicycling. This presents a tremendous opportunity for increasing bicycle commute mode share, as the 30 percent "interested but concerned" individuals will presumably become enthused and confident as more infrastructure improvements are built. Figure 2-12 reveals that 37 percent of respondents currently commute to work by bicycle. This percent is remarkable, considering that the Richmond's existing commute mode share according to the American Community Survey 5 year (2007-2011) estimate is 1.7 percent. Over 40 percent of respondents ride a few times per week, and 24 percent of respondents ride daily. Figure 2-12 shows respondents' reasons for bicycling. Almost all respondents noted that they ride for recreational purposes and almost half of respondents said they ride for socializing and visiting friends.

Figure 2-11: Which of the following best describes your bicycling habits and comfort level?

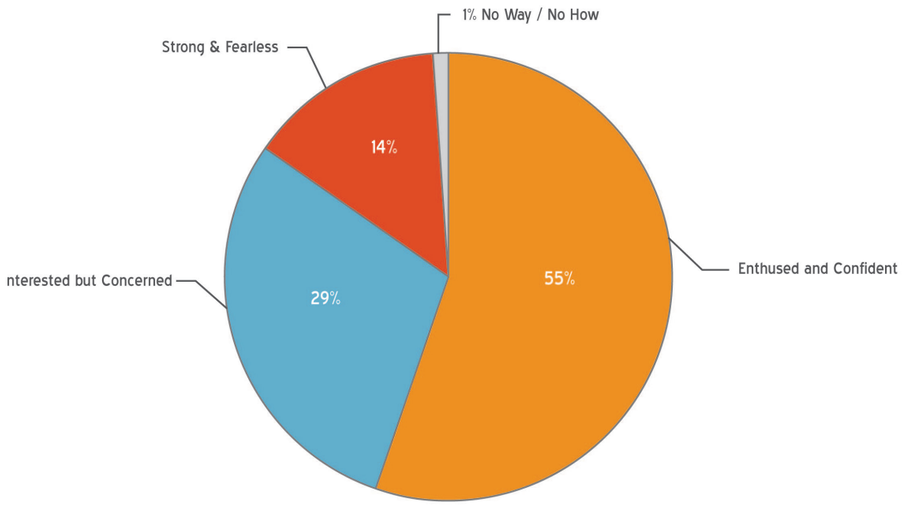
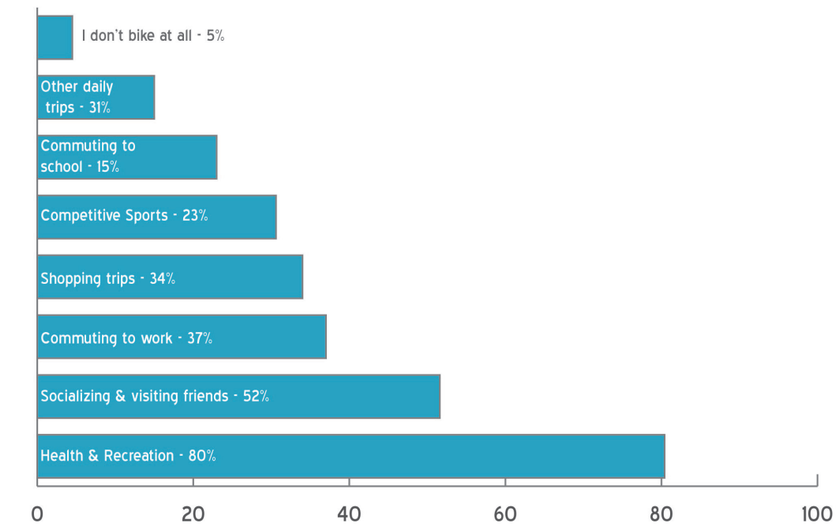


Figure 2-12: What type of bicycling do you currently do?



Bicycling Preferences

Overall bicycling is perceived as a safe activity by respondents; Figure 2-13 shows how this and other statements regarding bicycling are perceived by the public. Speed and traffic volumes along with lack of facilities are the main reasons that discourage people from riding more often in Richmond. The survey asked respondents to rank their preference for infrastructure currently in place and planned for the city, including sharrows, bike lanes, buffer bike lanes, and cycle tracks. Figure 2-14 shows a comparison of the respondent's preferences for bike infrastructure. Bike lanes are preferred 50 percent more than sharrows in general; likewise, buffered bike lanes and cycle tracks have higher preferability rankings overall compared to bike lanes.

Bicycle Facilities

Respondents indicated that the City of Richmond should create a safer and easier environment for cycling and provide bike infrastructure within the existing roadway network where feasible. Figure 2-15 displays the most popular suggestions for future bikeway facilities based on the survey. The size of the font reflects the number of respondents that selected the location for improvements.

Figure 2-13: What is your perception of bicycling in Richmond?

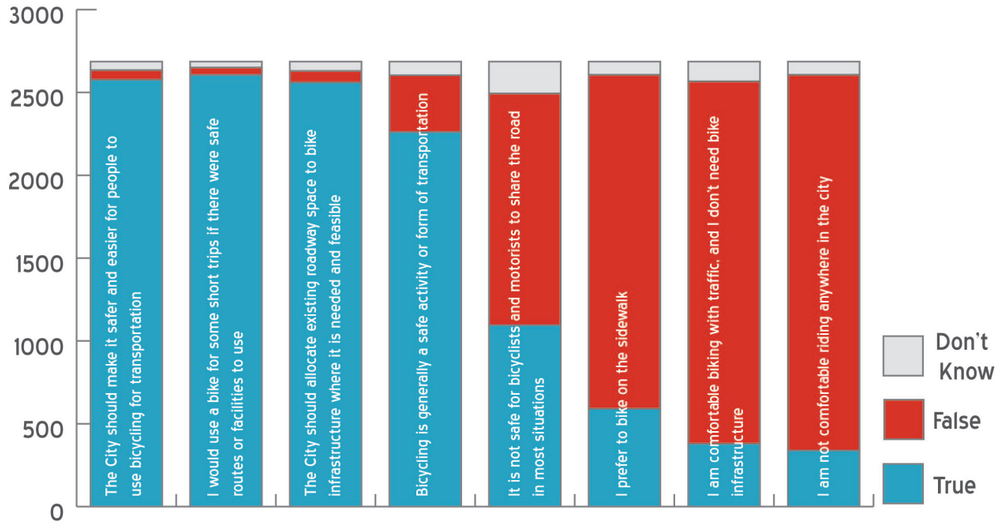
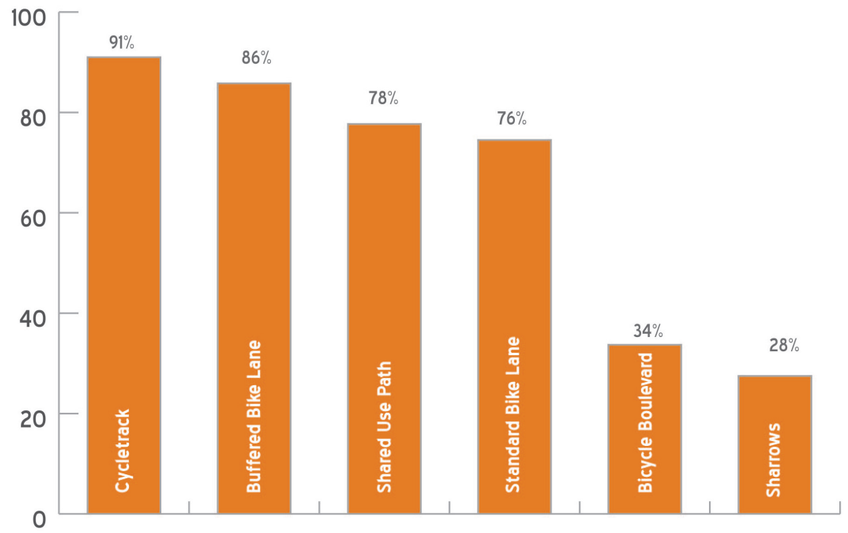


Figure 2-14: Which of these bikeway facilities do you prefer?



End-of-Trip Facilities

Appropriately-sited, high quality bicycle parking is a necessary addition to a bicycle network since it provides a place for bicyclists to park their bicycles once they have arrived at their destinations. Incidentally, 82 percent of survey respondents indicated that having access to bike parking will make them more likely to visit a business.

Popular Destinations

According to the survey results the following are the top destinations for people to bike to currently in Richmond:

1. Park
2. Carytown
3. VCU
4. Downtown
5. The Fan

Bike Corrals offer businesses an opportunity to increase the amount of parking available to customers as well as improve the streetscape environment.

Figure 2-15: What are the top destinations that you think need improved bike access?

Example of a road diet. Road diets have been successful in changing fast, auto-oriented roadways into multimodal corridors.

PROGRAMS AND POLICIES

Meeting the goals of this Plan will not only require new facilities, it will also require implementation of bicycle related programs and policies. A comprehensive approach is necessary to create a bicycle-friendly community, and thus the approach must focus on overall livability and bikeability in all planning decisions involving land use, growth, and transportation. This section discusses existing and/or planned programs and policies intended to increase mode shift to active transportation for the City of Richmond.

Existing Programs

It is critical to the success and growth of biking in Richmond to couple infrastructure improvements with a robust variety of programs to encourage use, educate drivers and bicyclists, and create awareness of the city's dedication to enhancing the on- and off-street network.

Statewide initiatives are a key component to promoting safe, comfortable, biking environments throughout Virginia. Programming descriptions and ideas can be found in the *Virginia Bicycle Facility Resource Guide* and include:

- Bike Smart! Virginia (education)
- Bicycle Safety Rodeos (education)
- Helmet programs (education)
- Community youth bicycle safety initiatives (education)
- Public service announcements (education)
- Ride-Like-a-Pro safety events (education)
- Adult bicycle programs (education)
- Bicycle maps/brochures (encouragement)
- Web site information (encouragement)
- Bicycle clubs (encouragement)
- Statewide or regional bicycle guides (encouragement)
- Bike to Work Week (encouragement)
- Bicycle tours (encouragement)
- Health benefits (encouragement)
- Bicycle rules of the road (enforcement)
- Bicycle ticketing programs (enforcement)
- Bicycle crash reporting (enforcement)

Complete Streets Policy

Richmond Connects recommends adopting a Complete Streets Policy to encourage more walking and bicycling activity. Complete Streets resolutions have been adopted across the state by several jurisdictions. It is imperative that these policies include strong language that requires inclusion of all modes in the design of all new transportation projects. Other recommendations to make this policy effective include:

- Use street typologies to guide street design by considering both the function of the street as well as its context.
- Reduce speed and increase safety through road diets and other lane modifications, as appropriate.
- Convert select one-way streets to two-way streets corridors in downtown to encourage more pedestrian activity and reduce vehicular traffic.
- Support temporary use of streets for recreational activities such as "Ciclovia-type" events.

Richmond Connects lists a number of priority projects recommended for Complete Streets improvements. The high priority complete street projects recommended include:

- Malvern Avenue road diet, with bike lanes and roundabouts
- Brookland Parkway road diet, with bike lanes and roundabouts
- Grove Avenue road diet, with possible roundabouts
- Hermitage Corridor road diet, with possible roundabouts

Furthermore, three corridors, Cary Street Road, Three Chop Road, and Brook Road are recommended for Context Sensitive redesign. Undergoing full studies of these corridors is recommended to determine the most appropriate improvements given the existing conditions.

This page intentionally left blank.

RICHMOND
Bicycle Master Plan

3 Network Recommendations

OVERVIEW

Many factors in American cities are contributing to a movement where bicycling is becoming a more popular choice for transportation, not just recreation. As a more environmentally and fiscally friendly choice, young adults are choosing to forego purchasing vehicles and are using bicycles to commute to work and recreation destinations. Other members of the community require safe bikeways because they cannot afford a vehicle or may be far from public transportation facilities. To support these cultural changes and provide safe, well-connected avenues of transportation for those without personal vehicles, bikeways, both on- and off-road, are increasingly becoming an integral component of transportation infrastructure.

Incremental changes will create a safe, accessible, and well-connected bicycle network for residents and visitors of Richmond. Detailed within the recommendations are the methodology for selecting bikeways, types of cyclists, facility types, and the infrastructure network established via a Richmond-specific prioritization process. The result is a system of facilities that has been classified into short, mid, and long-term projects with expansive details and cut sheets (illustrated road layouts) developed for ten priority projects. These projects will serve as demonstration treatments to initiate implementation and foster momentum for completing the network. To serve as a guide for future implementation, Appendix A houses design guidelines for various facility types and treatments to build a safe and comfortable network.

METHODOLOGY

Network recommendations are crafted after first developing a baseline of information about the community. This baseline is detailed in the Existing Conditions chapter and includes a review of previously adopted plans, GIS demand and supply modeling, fieldwork, and public needs analysis. The results and outputs of existing conditions tactics are then layered to reveal a framework for:

- WHO should be served by the network?
- WHERE do they live?
- WHERE do they want to go?
- WHICH facility types are appropriate?

The WHO

In Richmond, the vision and goals of the plan emphasize equality. Therefore, this network should serve recreation and transportation users of all ages and abilities across a spectrum of income levels. This requires a "hubs and spokes" method for developing a network that connects people from their homes to key destinations and daily services. Essentially, the hubs are high demand areas (downtown, residential neighborhoods, shopping centers) which need to be served by spokes (cycle tracks, bike lanes, bike/walk streets, etc.). Serving multiple ages and abilities also dictates a level of comfort and safety acceptable for children riding bikes to school, physically challenged individuals recreating and commuting, zero car ownership households commuting to work, and visitors exploring the city.

The WHERE

The Live, Work, Play, analysis tells us where people live and key destinations in the city. The supply analysis reveals which roads may be suitable for bicycle facilities. Public input also helps refine these areas of high demand as well as which routes may be ideal for facilities and which to avoid. Input from City Staff, public comments, and the demand and supply analysis are layered to narrow potential routes to review in field analysis.

CHAPTER CONTENTS

The WHICH

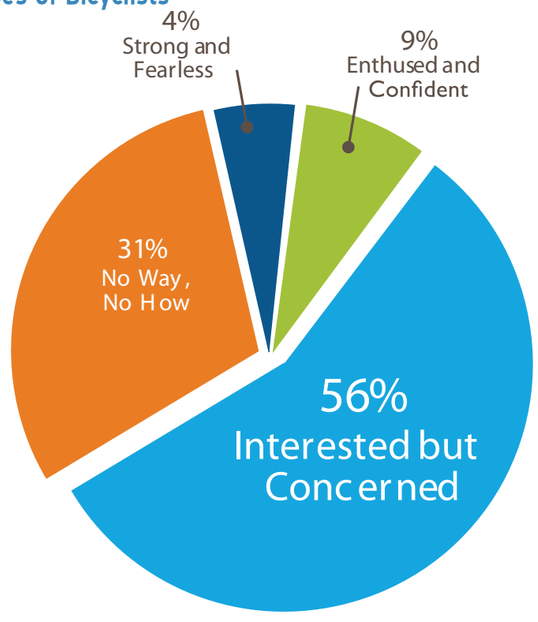
Knowing the WHO and WHERE fuels a more focused field exploration of WHICH routes may become alignments for different types of facilities. With a goal of elevating the protection and comfort as high as possible, the facility selection becomes a delicate balance of what can fit within the existing ROW or roadway (curb-to-curb), and where it is critical that the city invests in larger capital projects to implement facilities with protection and organization that enable all levels of cyclists to circulate. Both qualitative and quantitative factors guide the facility selection process.

THE WHO: TYPES OF BICYCLISTS

Bicyclists can be categorized into four distinct groups based on comfort level and riding skills. Bicyclists' skill levels greatly influence expected speeds and behavior, both in separated bikeways and on shared roadways. Each of these groups have different bicycle facility needs, so it is important to consider how a bicycle network will accommodate each type of cyclist when creating a non-motorized plan or project. The 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. Since this Plan focuses on many user types, it is critical to consider in the hubs and spokes method WHO you are connecting to WHERE and what facility type may be key to their comfort and safety. According to modern research, people are generally categorized into one of four bicyclist types. The characteristics, attitudes, and infrastructure preferences of each type are described below[1].

Please note that this data and characterizations represent the findings of the referenced study and not the Richmond region. It is used as a research tool to generalize Richmond area riders for the purposes of planning.

Figure 3-1: Types of Bicyclists



[1] J. Dill., N. Mcneil. 2012. Four Types of Cyclists? http://web.pdx.edu/~jdill/Types_of_Cyclists_PSUWorkingPaper.pdf

Strong and Fearless

(Approximately 4 percent of the population)
This bicyclist type is characterized by the 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 multi-use paths.

Enthused and Confident

(9 percent of the population)
This user group includes 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, recreational riders, racers, and utilitarian bicyclists.

Interested but Concerned

(Approximately 56 percent of the 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 "Enthused & Confident" with encouragement, education, and experience.

No Way, No How

(Approximately 31 percent of the 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 never ride a bicycle other than on rare occasions or under special circumstances (e.g., in a park or with a child).

For the purposes of bicycle network planning and design, VDOT has adopted the Federal Highway Administration's (FHWA) classification of bicyclists into A, B, and C groups. The definitions of these groups are listed on the following page.

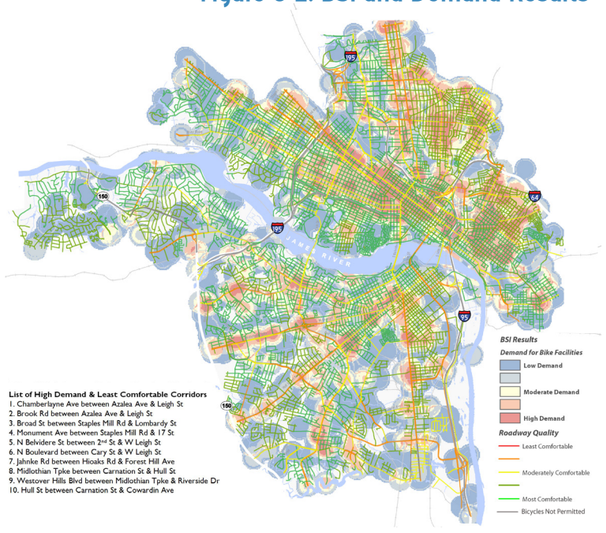
VDOT - Types of Bicycle Riders

Type	Description
A	Advanced or experienced riders generally using their bicycles as they would a motor vehicle. They are riding for convenience and speed and want direct access to destinations with a minimum of detour or delay. They are comfortable riding with motor vehicle traffic; however, they need sufficient operating space on the traveled way or shoulder to eliminate the need for either themselves or a passing motor vehicle to shift position.
B	Basic or less confident adult riders using their bicycles for transportation, but prefer to avoid roads with fast and busy motor vehicle traffic unless there is ample roadway width to allow easy overtaking by faster motor vehicles. Thus, basic riders are comfortable riding on neighborhood streets and shared used paths and prefer designated on-road facilities such as bike lanes or wide shoulders.
C	Children, riding on their own or with their parents, may not travel as fast as their adult counterparts but still require access to key destinations in the community, such as schools, libraries, parks, and recreational facilities. Residential streets with low motor vehicle speeds, linked with shared used paths and busier streets with well-defined pavement markings between bicycles and motor vehicles, can accommodate children without encouraging them to ride in the travel lane of major arterials.

THE WHERE: DEMAND AND SUPPLY

The "hubs" of the network were derived from the demand model, online input map, and public survey. Top priorities for bicycle network connections are downtown, points along Broad and Monument, areas along Brookland Park Blvd, neighborhoods off Nine Mile Road and N 25th Ave, and a few patches stretching along major roads south of the James River. With the hubs and spokes method, downtown is one of the major cores which will need connective "spokes" reaching out to the hot spots throughout the city to connect people with key destinations.

Figure 3-2: BSI and Demand Results

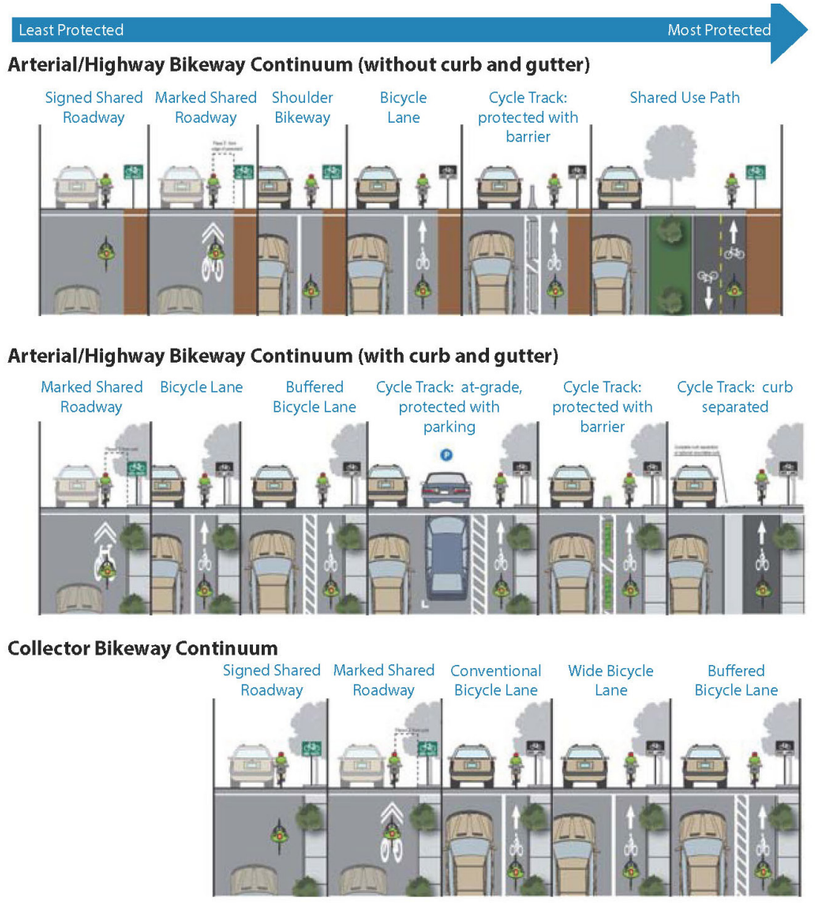


After layering the BSI (full size map and methodology found on page 2-12) with the demand analysis there are several roadways that need to be considered for bicycle improvements, but currently are not "comfortable" as indicated by the BSI analysis. In these cases, fieldwork is imperative to understanding the current geometry of the roadway and determining if changes can be made to reconfigure the environment to support multiple modes in a safe, organized manner.

THE WHICH: FACILITY TYPE

When choosing facility types to generate a well-connected network for the population of Richmond, it is essential to understand the different types of facilities and in what conditions they should be implemented. The below continuum (also found in Appendix A) summarizes multiple bicycle facilities by level of protection. Appendix A provides details for each of the below facilities and how they should be implemented according to national and local standards.

Figure 3-3: Bicycle Facility Continuum



Specific design recommendations must account for various factors when determining the best possible solution for bikeways. Types of bicyclists, facilities types, traffic characteristics, motor vehicle volumes, parking, existing land widths, land use, safety, comfort, destinations, origins, topography, land ownership, and available ROW all factor into crafting an appropriate solution. No single chart can encapsulate the myriad of factors related to making a context sensitive solution. The process is two-fold with considerations for standards and guidelines coupled with cultural and environmental variables. A roadway with low AADT's and two fourteen-foot lanes may seem like a simple candidate to be considered a wide outside lane, but steep topography may dictate the use of at least one bike lane to accommodate climbing bicyclists.

The below criteria provide a guide for considerations but should not serve as a scientific method for selecting the appropriate design.

1. **Bicyclists' Behavior and Destinations**
   a. Is this a current bike route?
   b. Is this route used by many bicyclists but does not have a facility?
   c. Does this route connect destinations and origins?
   d. Would more people use this route if there was a more safe and comfortable facility?
   e. Would a facility on this roadway encourage the 56 percent of interested but concerned riders to use this route?
   f. Could crash rates be reduced by making bikeway facility improvements?
2. **Vehicle Characteristics**
   a. What types of vehicles travel along this route? Is it frequented by large trucks?
   b. What is the designed and operating speed of the road? Could it be lowered?
   c. What is the annual average daily traffic (AADT)?
3. **Roadway Characteristics**
   a. What is the existing profile? Curb, gutter, parking type and width, travel lane width, median?
   b. Are there stormwater grates? How large and what orientation?
   c. Is the parking necessary? Could it be reconfigured (angled/parallel/90 degree) or relocated?
   d. Could the number of lanes be reduced (based on AADT)?
   e. Could the lane width be reduced?
4. **Goals For The Corridor**
   a. Could bike facility improvements make this part of the backbone network and encourage new riders?
   b. Could bike facility improvements contribute to economic development (Bicycle Friendly Business District, touring route, connect commercial nodes, etc.)?

By asking these questions, the importance of the facility and room available to integrate a facility can be determined.

QUANTITATIVE FACTORS

Some manuals, including the Federal Highway Administration (FHWA) and the Virginia Department of Transportation (VDOT) Road Design Manual, provide charts that help make the connection between speed, AADT, and bike facilities (below); however, these charts do not account for contextually sensitive elements. They also do not consider the vast range of bicycle facilities available.

Figure 3-4: VDOT Design Guidance (1 of 2)

wc and sl widths represent "usable widths" of outer lanes, measured from lane stripe to edge of gutter pan, rather than to the face of curb. If no gutter pan is provided, add 1 ft. minimum for shy distance from the face of curb.

Table 1: Group A Bicyclists, Urban Section, No Parking

average motor vehicle operating speed	average annual daily traffic (AADT) volume											
	less than 2,000				2,000–10,000				over 10,000			
	adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance	
		truck, bus, rv				truck, bus, rv				truck, bus, rv		
less than 30mph	sl 12	sl 12	wc 14	wc 14	sl 12	wc 14	wc 14	wc 14	wc 14	wc 14	wc 14	wc 14
30-40 mph	wc 14	wc 14	wc 15	wc 15	wc 14	wc 15	wc 15	wc 15	wc 14	wc 15	wc 15	wc 15
41-50 mph	wc 15	wc 15	wc 15	wc 15	wc 15	wc 15	sh 6	sh 6	wc 15	wc 15	sh 6	sh 6
over 50 mph	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6

wc widths represent "usable widths" of outer travel lanes, measured from the left edge of the parking space (8 to 10 ft. minimum from the curb face) to the left stripe of the travel lane.

Table 2: Group A Bicyclists, Urban Section, With Parking

average motor vehicle operating speed	average annual daily traffic (AADT) volume											
	less than 2,000				2,000–10,000				over 10,000			
	adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance	
		truck, bus, rv				truck, bus, rv				truck, bus, rv		
less than 30mph	wc 14	wc 14	wc 14	wc 14	wc 14	wc 14	wc 14	wc 14	wc 14	wc 15	wc 15	wc 14
30-40 mph	wc 14	wc 14	wc 15	wc 15	wc 14	wc 15	wc 15	wc 15	wc 14	wc 15	wc 15	wc 15
41-50 mph	wc 15	wc 15	wc 15	wc 15	wc 15	wc 16	sh 16	sh 16	wc 15	wc 15	sh 16	sh 16
over 50 mph	na	na	na	na	na	na	na	na	na	na	na	na

wc and sl widths represent "usable widths" of outer lanes, measured from lane stripe to edge of the pavement if a smooth, firm, level shoulder is adjacent. If rough or dropped pavement edges or a soft shoulder exists, add 1 ft. minimum for shy distance from the edge of the pavement.

Table 3: Group A Bicyclists, Rural Section

average motor vehicle operating speed	average annual daily traffic (AADT) volume											
	less than 2,000				2,000–10,000				over 10,000			
	adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance	
		truck, bus, rv				truck, bus, rv				truck, bus, rv		
less than 30mph	sl 12	sl 12	wc 14	wc 14	sl 12	wc 14	wc 14	wc 14	wc 14	wc 14	sh 4	sh 4
30-40 mph	wc 14	wc 14	sh 4	sh 4	wc 14	wc 15	sh 4	sh 4	sh 4	sh 4	sh 4	sh 4
41-50 mph	sh 4	sh 4	sh 4	sh 4	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6
over 50 mph	sh 4	sh 6	sh 6	sh 4	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6

K E Y
widths are in feet
wc = wide curb lane
sh = shoulder
sl = shared lane
bl = bike lane
na = not applicable

VDOT | Virginia Department of Transportation 2-16

Figure 3-5: VDOT Design Guidance (2 of 2)

wc widths represent "usable widths" of outer lanes, measured from lane stripe to edge of gutter pan, rather than to the face of curb. If no gutter pan is provided, add 1 ft. minimum for shy distance from the face of curb. bl widths represent the minimum width from the curb face. For VDOT projects, the bike lane stripe will lie 4 feet minimum from the edge of the gutter pan. The bike lane stripe will lie 5 feet minimum from the face of curb.

wc and sl widths represent "usable widths" of outer lanes, measured from the left edge of the parking space (8 to 10 ft. minimum from the curb face) to the left stripe of the travel lane.

K E Y
widths are in feet
wc = wide curb lane
sh = shoulder
sl = shared lane
bl = bike lane
na = not applicable

Table 4: Group B/C Bicyclists, Urban Section, No Parking

average motor vehicle operating speed	average annual daily traffic (AADT) volume											
	less than 2,000				2,000–10,000				over 10,000			
	adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance	
		truck, bus, rv				truck, bus, rv				truck, bus, rv		
less than 30mph	wc 14	wc 14	wc 14	wc 14	wc 14	wc 14	wc 14	wc 14	bl 5	bl 5	bl 5	bl 5
30–40 mph	bl 5	bl 5	bl 5	bl 5	bl 5	bl 6	bl 6	bl 5	bl 5	bl 6	bl 6	bl 5
41–50 mph	bl 5	bl 5	bl 5	bl 5	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6
over 50 mph	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6

Table 5: Group B/C Bicyclists, Urban Section, With Parking

average motor vehicle operating speed	average annual daily traffic (AADT) volume											
	less than 2,000				2,000–10,000				over 10,000			
	adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance	
		truck, bus, rv				truck, bus, rv				truck, bus, rv		
less than 30mph	wc 14	wc 14	wc 14	wc 14	wc 14	wc 14	wc 14	wc 14	bl 5	bl 5	bl 5	bl 5
30–40 mph	bl 5	bl 5	bl 5	bl 5	bl 5	bl 6	bl 6	bl 5	bl 6	bl 6	bl 6	bl 6
41–50 mph	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6	bl 6
over 50 mph	na	na	na	na	na	na	na	na	na	na	na	na

Table 6: Group B/C Bicyclists, Rural Section

average motor vehicle operating speed	average annual daily traffic (AADT) volume											
	less than 2,000				2,000–10,000				over 10,000			
	adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance		adequate sight distance		inadequate sight distance	
		truck, bus, rv				truck, bus, rv				truck, bus, rv		
less than 30mph	sh 4	sh 4	sh 4	sh 4	sh 4	sh 4	sh 4	sh 4	sh 4	sh 4	sh 4	sh 4
30–40 mph	sh 4	sh 4	sh 4	sh 4	sh 4	sh 6	sh 6	sh 4	sh 6	sh 6	sh 6	sh 6
41–50 mph	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6	sh 6
over 50 mph	sh 6	sh 6	sh 6	sh 6	sh 8	sh 8	sh 8	sh 8	sh 8	sh 8	sh 8	sh 8

Other charts are helpful in distilling the appropriate conditions for facility types, such as this chart from the 2013 Seattle Bicycle Master Plan. While this provides an easy guide, not all factors are present to make a final decision (e.g., does the route connect people with places?).

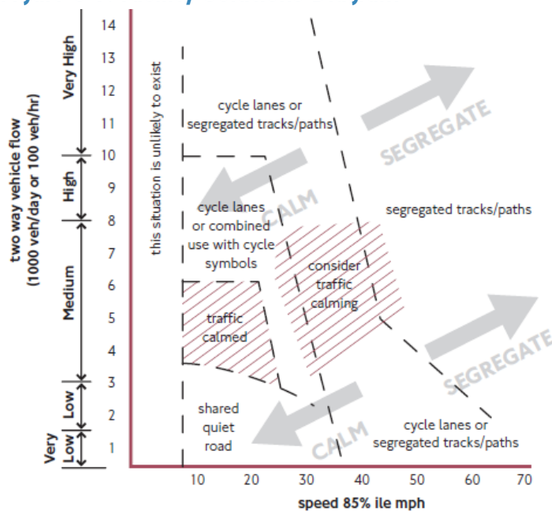
Figure 3-6: A Guidance Example - 2013 *Seattle Bicycle Master Plan* Facility Guidance

Generalized Bicycle Facility Designation	Bicycle Facility Types	Posted Speed Limit (mph)	Average Daily Traffic (ADT) per day	Street Classification
Neighborhood Greenway	Neighborhood Greenway	20	1,500 or less	Non-arterial
Shared Street	Shared lane pavement marking (sharrow)	25 - 30	To be used due to ROW constraints or topography	Non-arterial and Collector/Minor arterials
In street, minor separation	Bicycle lane; Climbing Lane	30	8,000 or less	Collector arterial
	Buffered bicycle lane	30	15,000 or less	Collector/Minor arterials
Cycle Tracks (protected bicycle lanes)	Physically separated (raised or with barrier on-street facility)	30 and greater	15,000 and above	Minor/Principal arterials
Off-street*	Multi-use trail	N/A	N/A	N/A

This chart illustrates a process to determine bicycle facility designations based on street designations as well as safety aspects. Other factors that affect bicycle facility selection beyond posted speed limit, street classification and volume include: topography, traffic mix of transit and freight vehicles, presence of on-street parking, intersection and driveway density, surrounding land use, and roadway width. These factors are not included in the facility designation chart above, but should always be a consideration in the project development and design process. Facilities may be designed to provide a higher level of safety and comfort than the minimums recommended here.

*Off-Street Trails may be developed opportunistically on corridors where there is available adjacent land, or on corridors with a special transportation function (e.g., sections of Alaskan Way)

Figure 3-7: Facility Solutions Diagram



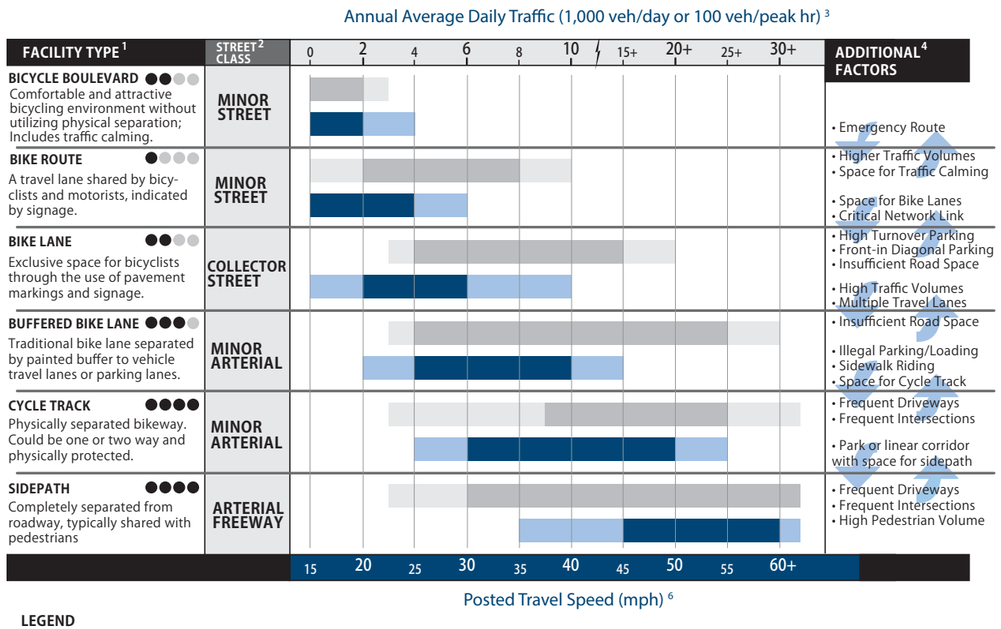
Some pictorial graphs, such as the one to the left, are as seen as too aggressive for American facilities.

Notes:
1. Each route will need to be judged in the light of its specific situation
2. Cycle lanes or tracks will not normally be required in traffic calmed areas
3. Congested traffic conditions may benefit from cycle lanes or tracks
4. Designs should tend to either calm traffic or segregate cyclists

To summarize best practices and regulations from various sources, the chart below accounts for multiple factors that influence bicycle users' comfort and safety. There is a significant impact on cycling comfort when the speed differential between bicyclists and motor vehicle traffic is high and motor vehicle traffic volumes are high. As a starting point to identify a preferred facility, the chart below can be used to determine the recommended type of bikeway to be provided in particular roadway speed and volume situations. To use this chart, identify the appropriate daily traffic volume and travel speed on an existing or proposed roadway and locate the facility types indicated as appropriate given those key variables.

Other factors beyond speed and volume which affect facility selection include traffic mix of automobiles and heavy vehicles, the presence of on-street parking, intersection density, surrounding land use, and roadway sight distance. See the right column of the chart for other key issues to consider when selecting an appropriate facility type.

Figure 3-8: Facility Type Selection Guidance



Notes:

1. Refers to specific bicycle facilities described in the design guidelines. Many local roads function just fine as they are due to their low traffic volume and speed.

2. The use of functional classes provides some general context for the cases in which bicycle facilities are most likely to be implemented. Land use and additional factors (see 4) should always take precedence in determining which facility type to select.

3. Urban peak hour factors typically range from 8 to 12 percent of AADT. For the purposes of this chart, the peak hour is assumed to be 10 percent of AADT.

4. Noted additional factors include a selection of considerations that may influence the selection of bicycle facility type where roadway speed/volume values overlap over multiple facilities. Many of the factors that suggest increasing separation are common across multiple facility types like bike lanes, buffered bike lanes and cycle tracks.

5. Increased separation of bicycle facilities from motor vehicle traffic typically results in higher levels of user comfort and appeals to wider skill levels of bicyclists.

6. This chart considers posted speed limit only. The 85th percentile speed may vary, and may change with implementation of a bikeway.

The above charts and graphs are great tools to assist in decision making for the placement and type of bicycle facility, but contextually sensitive considerations and cause and effect scenarios for implementing bicycle facilities, parking takes, or lane reductions do not fall into one simple chart. This stresses the importance of the human element in facility design, including input from users, non-users, City Staff (including maintenance departments), engineers, planners, and designers.

QUALITATIVE FACTORS

To address the network as a whole, and how it begins to fit together as a hubs and spokes model, a wider lens much be used to consider the holistic impact of the system. Stepping away from the minutia of facility options within particular roadway segments, the network must function as a whole. A hierarchy should emerge with clear defined spaces for bicyclists connecting major destinations and providing protection, separation, and organization for multiple modes. Reaching out from these routes can be facilities with less protection due to factors including lower traffic volumes. The last branches, or spokes, should be those reaching the last mile into demand areas including residences.

The hierarchy begins to take shape as:

- *A Backbone*: routes reaching across the city, connecting major destinations, and offering separation and comfort including cycle tracks, protected bike lanes, and bike lanes.
- *Neighborhood Networks*: routes reaching out from the backbone to connect neighborhood schools, shopping districts, and residences with varying levels of contextually appropriate facilities including bike lanes, paths, and bicycle boulevards.
- *Green Connectors*: routes providing access to Richmond's parks and open spaces by neighborhood connections and multiuse paths.

The facility recommendations in this Plan compose the backbone of the bicycle system. Future additions to the system will help strengthen the backbone and build out the rest of the hierarchy as demand is needed. It is important to consider the following qualitative factors as future routes and facilities are planned and constructed.

ACCESSIBILITY

Readily accessible connections need to be considered a key component of any bicycle network. Accessibility is measured by the distance a bike facility is located from a specified attraction, the ease by which this distance can be traveled by bicycle, and the extent to which all likely origins and destinations are served. For example, some progressive communities in other states have adopted a criterion of having a bicycle facility within one mile of every residence.

DIRECTNESS

Bicyclists and motorists both desire a direct and quick route to destination points. Studies have shown that most bicyclists will not even use the best bicycle facility if it greatly increases the travel distance or trip time over that provided by less desirable alternatives. Generally speaking, Group A bicyclists prefer directness while Group B/C bicyclists prefer comfort and perceived safety as the key characteristics of the bicycle facility.

CONTINUITY

A proposed bicycle network should be viewed as a transportation system and provide continuous, direct connections to numerous attractions throughout the community. If gaps exist in the network, measures should be taken to provide safe and efficient short-term alternatives and long-term permanent solutions.

CONSISTENCY
Providing consistent bicycle facility types should be a goal when planning and designing bicycle networks. To the extent possible, bicycle facilities should provide bicyclists with a relatively consistent facility type (i.e. shared use path, bicycle lane, or shoulder improvement) within key corridors. Switching between facility types can create conflict points, be confusing, and leave bicyclists with a sense of abandonment within the overall network.

ROUTE ATTRACTIVENESS
Bicycle networks or portions of the network should encompass such factors as separation from motor traffic, proximity to visual aesthetics, connections to employment centers, major passive and active recreation areas, and the real or perceived threat to personal safety along the facility. These factors tend to encourage novice and recreational bicyclists to view the bicycle as a mode of transportation and enhance the overall bicycle network.

LOW CONFLICT
Bicycle networks should consist of routes that minimize conflicts between bicyclists and motorists and between bicyclists and pedestrians. In addition, areas of high crash incidents should be avoided or addressed directly through intersection improvements and/or other safety improvement measures.

EASE OF IMPLEMENTATION/COSTS
Right-of-way, environmental, historical, and funding constraints, as well as the political climate, must all be considered during the planning process to ensure that implementation of the plan is actually feasible. For example, land acquisition costs and historical and environmental impacts need to be carefully considered to determine the feasibility of a project.

MULTIMODAL COORDINATION
The integration of bicycling with other modes of transportation, particularly public transit, benefits the entire transportation network. It has been well demonstrated in many American, European, and Asian communities that with the proper facilities and policies, bicycles can have a significant complementary effect on transit systems, resulting in increased ridership. Bicycles provide the on-demand, door stop service that most bus and rail systems are unable to provide. Buses and trains will usually travel faster and farther than most bicyclists. The combination has a synergistic effect amplifying the market area and effectiveness of each. Park and ride facilities also complement bicycle facilities by providing bicyclists and motorists with mode transfer opportunities. Finally, multimodal connections help reduce traffic congestion by providing alternatives to the single occupant vehicle (SOV).

MULTI-JURISDICTIONAL COORDINATION
Providing and anticipating connections across jurisdictional boundaries are necessary in developing a comprehensive plan. Communities need to look outside their borders to ensure there is a level of regional connectivity associated with the local plan. The regional Planning District Commission or Metropolitan Planning Organization can provide insight and assistance during this process.

SAFETY AND SECURITY OF BICYCLISTS
The design of bicycle facilities needs to be treated as any other transportation project, with personal and traffic safety as key design elements. Safety is an important part of any plan and includes education, enforcement, encouragement, and design of facilities. The concepts of safety, such as safe intersection treatments, must guide the development of all bicycle facilities. In addition, the bicyclist needs to be educated about safe bicycling practices. Finally, personal security issues need to be addressed, especially when dealing with shared use paths. Appropriate landscaping, lighting, safety call boxes, and frequent patrols are common measures to improve bicycling safety and security.

IMPLEMENTATION CONSIDERATIONS OF SELECTING FACILITY TYPES
While some bicyclists or "interested but concerned" bicyclists (p. 3-2) may think it would be ideal to implement cycle tracks throughout Richmond, it is not always feasible to use the most protected facility, with the highest capital costs, across the entire area. There are several considerations that must be applied when finalizing and refining the network. Roadways connecting high demand areas may not be suitable for on-road bike facilities that are easily added with a restriping project. In these cases, alternate routes, road diets, or completely changing the character of the ROW may be considered to link important destinations. Other considerations should be accounted for when weighing the importance of how bicycle facilities communicate with motorists and how they indicate to bicyclist how to behave when mixing with other modes of transportation.

Installing Shared Lane Markings
Already, the City of Richmond has embraced the use of the sharrow. As this is a simple and cost effective method, it can sometimes be overused or used in situations where the cost and effort of a more organized multi-modal corridor would be more effective. Sharrows take the place of traditional bicycle lanes where travel lanes cannot be narrowed, where speeds do not exceed 35 mph, and/or where there is on-street parking. This may not be the best facility in the downtown to encourage new users to bicycle, but it does help riders on downtown streets substantiate their presence within the roadway. In this case, the message a sharrow sends to motorists can be as important as the message it sends to those on bicycles. The intent of the shared lane marking is fivefold:

1. Assist bicyclists with lateral positioning in a shared lane with on-street parallel parking in order to reduce the chance of a bicyclist's impacting the open door of a parked vehicle,
2. Assist bicyclists with lateral positioning in lanes that are too narrow for a motor vehicle and a bicycle to travel side by side within the same traffic lane,
3. Alert road users of the lateral location bicyclists are likely to occupy within the roadway,
4. Encourage safe passing of bicyclists by motorists, and
5. Reduce the incidence of wrong-way bicycling.

While shared-lane markings are not typically recommended or needed on local, residential streets, they are sometimes used along such streets when part of a signed route or bicycle boulevard (walk/bike street). It should be noted that **sharrows are not a replacement for bicycle lanes in their effectiveness or use.**

Signage and Wayfinding Projects
A relatively low-cost, short-term action that the city can pursue immediately is to develop and adopt a signage style policy and procedure to be applied throughout the entire community to make it easier for people to find destinations. Signage programs that include informational, warning, and regulatory signage along specific routes or in an entire community can be updated to include wayfinding to improve

navigation. Bicycle route signs are one example of these wayfinding signs and can be installed along routes independently of other signage projects or as a part of a more comprehensive wayfinding improvement project. Posting signage that includes bicycle travel times to major destinations can help to increase awareness of the ease and efficiency of bicycle travel – improving navigation and serving as an encouragement effort. See Appendix A: Design Guidelines for more detailed guidance on signage and wayfinding improvements.

For a step-by-step guide to help non-professionals participate in the process of developing and designing a signage system, as well as information on the range of signage types, visit the Project for Public Places website: www.pps.org/info/amenities_bb/signage_guide.

Restriping and Road Diets Via Existing Roadway Projects (repaving/resurfacing/widening/new roadways)

Opportunities for restriping and road diets (reconfiguring lane widths) are covered in the Implementation Chapter as an important coordination effort across departments that can easily change the bicycling environment. With any type of roadway project that is currently funded or planned for – the Bicycle and Pedestrian Coordinator should have a chance to comment and review during the design process to determine if adding bicycle facilities could benefit the circulation and transportation efficiency of the city. These efforts require cross department coordination, sharing of information, and the ability of the City Staff to communicate and support the intention to provide a safe and comfortable transportation system for pedestrians, bicyclists, motorists, and public transit riders. In some cases, there is no, or minimal, additional cost incurred to a resurfacing and restriping project to add a bicycle lane. This coordination will, in the long term, save the city the capital costs of retrofitting roadways to include bicycle accommodations.

One-Way to Two-Way or Two-Way to One-Way Conversions

As bicyclists typically do not make use of every road in Richmond, one-way and two-way conversion projects can seriously impact the ability of bicyclists to access their homes, work, or destinations for daily needs. The Bicycle and Pedestrian Coordinator should be present during these planning and design initiatives to represent the bicycling population and provide appropriate circulation options. In some cases, such as in Baltimore City, these conversions have led to parking reconfigurations which created the opportunity to include a bike lane. Several scenarios should be applied to each type of conversion to analyze the impacts on traffic volume and patterns for all modes.

Removing Parking

Some neighborhood collector roadways are wide enough to stripe with bicycle lanes, but they are used by residents for on-street parking, especially in the evening. In such locations, removing parking is likely to create considerable controversy and is not recommended unless there is no other solution (unless the parking is seldom used). In the case that removing parking is being considered, the parking should not be removed unless there is substantial public support for the bike lanes on that particular roadway and a robust public involvement process (involving adjacent residents and businesses) is undertaken prior to removing parking.

If it is not practical to add a bike lane, edgelines and shared lane markings may be considered. On roads where the outside lane and parking area combined are more than 17-feet-wide, 10-foot-wide travel lanes can be striped with an edgeline, leaving the remaining space on either side for parking. The stripe would help slow motor vehicles and provide extra comfort for bicyclists, especially during the daytime when fewer cars would be parked along the curb. On roads with outside lane and parking areas that are narrower than 17-feet-wide, shared lane markings can be provided approximately every 250 feet on the right side of the motor vehicle travel lane to increase the visibility of the bike route.

Significant Barriers and Conflict Points

Bridges, overpasses, underpasses, ramps, bodies of water, large intersections, and high speed roadways present a challenge when closing gaps in the network. In these cases, creating safe connections for bicyclists will require the coordination and support of several departments and agencies. Likely the situation has been addressed in another community and case studies accompanied by discussions with local staff can help Richmond understand challenges, best practices, and lessons learned for accommodating bicyclists in these challenging environments. Many times, the treatments considered for making space for bike facilities or improving visibility are new to residents and visitors. Awareness and education campaigns can be effective in helping all who circulate throughout the city understand how to use these facilities, yield appropriately, and be mindful of appropriate behaviors. Guides like NACTO are a great reference tool when considering treatments for more challenging situations as this guide illustrates some of the most innovative approaches to facility design. Using this as a tool and communicating with VDOT and Public Works to provide guidance and case studies may be required to garner support and approval for implementation. Other projects may require creative funding and engineering solutions to retrofit bridges with bicycle and pedestrian spaces, tunnel under roads, make use of existing culverts for multi-use paths, and construct bicycle and pedestrian bridges. Each challenge should be approached with a collaborative effort, multidisciplinary perspectives, and a creative process to close these critical gaps.

Network Refinement

Refining the network then becomes more of an art than a science. Contextual knowledge, public demand, and historically successful implementation processes are employed to refine route selection and facility type. This process is crucial to providing a network in the plan that can grow with the needs of the community. It is important to note that with each feasibility and design study the recommendations within this Plan may be modified to suit the current culture and environment of Richmond. A recommendation for a buffered bicycle lane may not feasibly fit for the entire length of a corridor and therefore may need to be part buffered bike lane, part bike lane, and short connective segments of sharrows. This is acceptable and expected. In the planning stages, complete surveys are not conducted to examine feasibility in depth enough to refine the treatments. Each project recommended in this Plan should be evaluated and vetted through a process by which the facility can be built with the intention of providing the most appropriate level of separation and comfort for bicyclists of all types.

Figure 3-9: Refined Network Recommendations

Existing Bicycle Facilities

- Bike Lane
- Shared Lane
- Shared Use Path
- Greenway

Areas of Interest

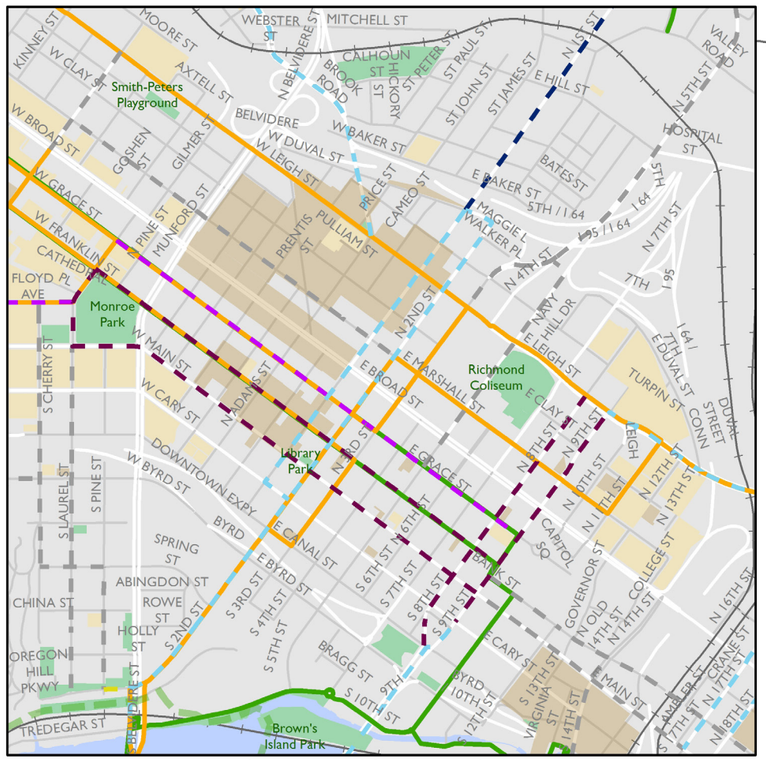
- Parks
- Historic Districts
- Educational Facilities

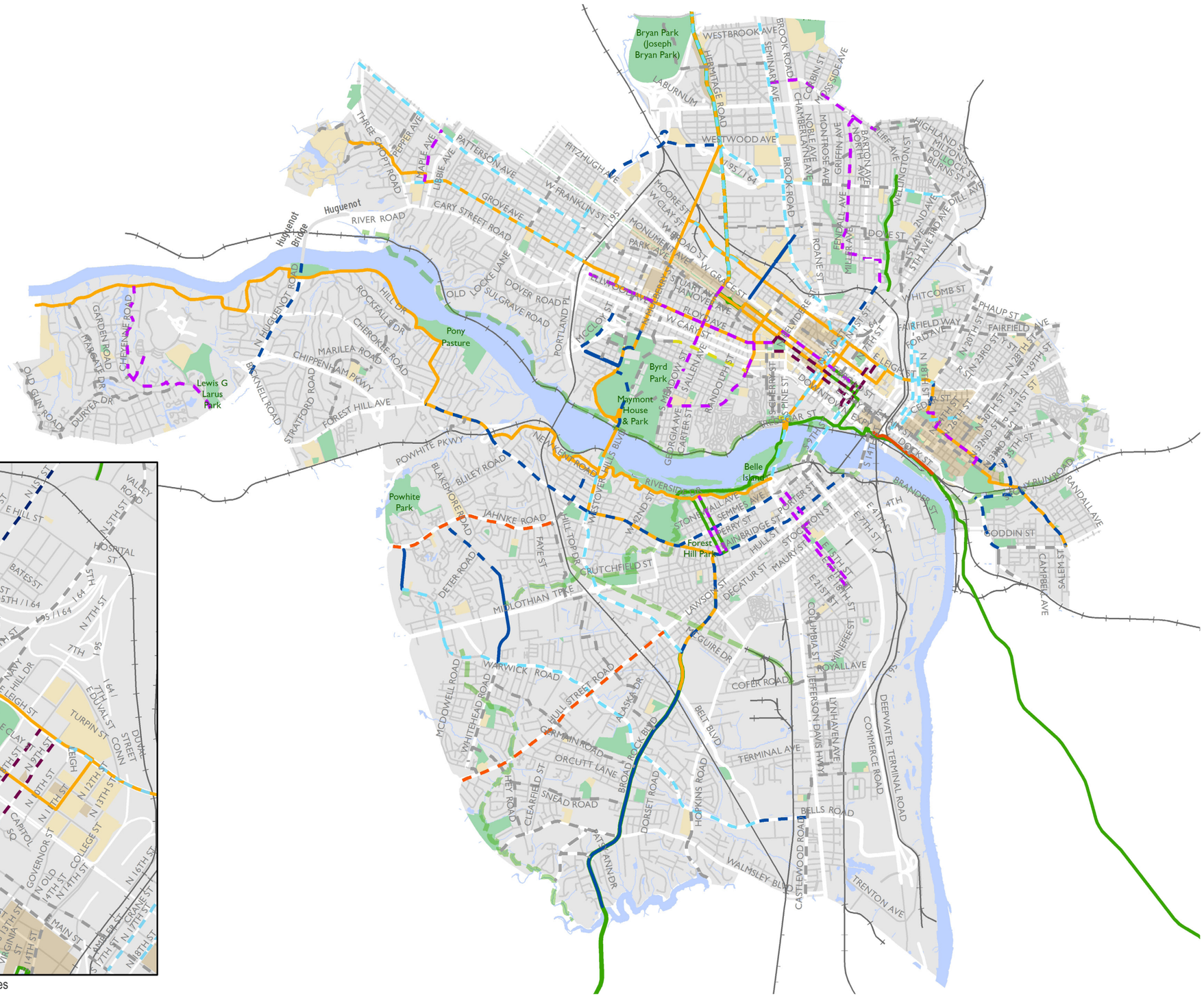
Proposed Network Recommendations

- Future Facility
- Shared Use Path
- Cycle Track
- Buffered Bike Lane
- Bike Lane
- Contra Flow Bike Lane
- Bike-Walk Street
- Greenway*

0 0.5 1 2 Miles

*Greenway recommendations are from previous city planning efforts. The corridors are conceptual and illustrated with a slightly transparent and thicker line to indicate the alignment variance and need for further study.





PROJECT PRIORITIZATION PROCESS

After refining the network based on all of the factors above, a process must be conducted to prioritize which projects should be implemented in the short (2-4 years), mid (4-7 years), and long-term (7-10+ years). To prepare for prioritization, the city developed a list of criteria that was value based. These values, or important criteria, were weighted to indicate the level of importance to the community. Criteria examples include if the facility provides access to a school, or if it closes a gap with an existing facility, and if it was among the top needs and desires of the community via input collected in the survey. After segmenting the network into manageable, buildable, fundable projects with logical end points – each segment is evaluated based on the criteria and scored according to the weight (1-5) applied to the criteria. This process is kept as simple as possible to allow for a quick review of which routes within the network score high according to the city's initial thoughts on which values are critical to creating a livable community.

After the scoring process was completed, the priorities were refined based on which projects were funded, how those projects would affect the adjacent implementation, which projects are most feasible, and other contextual judgments based on the knowledge of the city.

The Values and Weights Table illustrates each of the prioritization criteria and the assigned weights for each. The project tables represent the refined short, mid, and long-term projects that were reorganized after filtering out funded projects and "future facility" projects. These two items were removed to illustrate the importance of implementing a network of facilities that would serve a greater population of bicyclists, including the interested but concerned. Following the tables are three maps illustrating how the city will grow the network over the short, mid, and long-term.

The top ten priority projects are illustrated in further detail with design criteria and section graphics. Each project cut-sheet offers a planning level cost estimate for the priority project. The cost estimates are based on the most recently available per unit cost information obtained from the city and VDOT. Project costs vary over time and by geography. Further evaluation during project design will be needed to determine exact project costs.

It is important to note that this table and mapping serves as a guide for the city in its efforts to create a more bicycle friendly environment. At any time, one of the projects may take higher or lower priority, or be modified to become a different facility type. As the network grows and other improvements are made, changes can also be made to realign recommendations to parallel roads that may provide safer connections. These may be due to traffic volumes, fit, one-way/two-way conversions, or land use.

As the network grows, sharrows will be added incrementally to complete connections where other facility types may not be feasible or as a placeholder for a future facility yet to be determined. The "future facility" line type has been included on the map series without a specific timeline to illustrate the fluidity of closing gaps and refining the network as the culture and environment of Richmond changes. These routes, if not built during previous stages, should be vetted for other facility types when this plan is due to be updated. Planning level cost estimates were used to establish the respective timeline and can be found starting on page 3-14.

Table 3-1: Values and Weights

Criteria	Score	Description
Proximity to Schools	3	The facility provides direct access to a K-12 School
	3	The facility provides direct access to a University
	2	Provides indirect access to a school (within 1/4 mile)
Population and Employment Density	4	Facility is located (provides access) in a high density area
	2	Facility is located (provides access) in a moderate density area
	1	Facility is located in a low density area
Connectivity to Activity Centers	3	Provides direct access to a commercial land use, park or historic attraction
	2	Provides indirect access to a commercial land use, park or historic attraction (1/4 mile)
Connectivity to Existing or Funded Facilities	5	Connects (intersects) an existing facility
	4	Connects (intersects) a funded facility
	3	Provides indirect access to an existing or funded facility (1/4)
Relative Feasibility	5	Project requires only paint
	3	Project requires parking removal or lane reconfiguration (Road Diet)
	2	Project requires construction
	1	Project requires acquisition of rights-of-way
Service to Low Income and Low Vehicle Ownership Areas	2	Facility is located in a low income area
	2	Facility is located in a low car ownership area
Safety Corridor	5	Facility is located at a high crash hotspot
	3	Facility is located at a medium crash hotspot
	1	Facility is located at a low crash hotspot
Public Input	2	Top 1-5 Most Desired Improvements by survey respondents
	1	Top 6-10 Most Desired Improvement by survey respondents

Table 3-2: Short-Term (2-4 years) Network Prioritization Table

Route Name	From	To	Facility Type	Miles	Facility Cost Estimate	Prioritization Score
E Grace Street	Laurel Street	N 9th Street	Bike-Walk Street	1.0	$149,129	30
S 1st Street/W Cary Street	E Duval Street	W Cary Street	Buffered Bike Lane	0.8	$48,892	28
N 2nd Street/E Duval Street	E Duval Street	S Belvidere Street	Buffered Bike Lane	1.4	$89,148	28
Bainbridge Street	Broad Rock	Brander Street	Bike Lane	1.7	$62,391	28
S Meadow Street	W Broad Street	Colorado Ave	Bike-Walk Street	1.5	$212,627	27
Blanton Ave / S Boulevard	Idlewood	Park Drive	Bike Lane	0.6	$21,714	26
Brook Road	W Laburnum Ave	E Leigh Street	Buffered Bike Lane	2.6	$164,412	25
E Broad Rock Road	Forest Hill Ave	Belt Blvd	Bike Lane	1.2	$45,101	25
N 1st Street	Monteiro Street	E Duval Street	Bike Lane	0.6	$21,101	24
W Brookland Park Blvd	Henrico Tpke	3rd Ave	Buffered Bike Lane	0.6	$36,059	24
E Marshall St/Glenwood Ave	Mosby Street	Government Road	Bike-Walk Street	0.9	$131,986	24
Mosby Street & E Marshall/N 35th/Glenwood	E Clay Street/N 32nd Street	O Street/ Government Rd	Bike Lane	1.0	$36,752	24
Westwood Avenue	W Broad Street	Hermatage Road	Bike Lane	1.6	$59,671	24
Grove Avenue	Three Chopt Road	Thompson Street	Buffered Bike Lane	2.2	$137,601	24
Jefferson Avenue	M Street	E Marshall Street	Buffered Bike Lane	0.3	$21,521	23
Maple Avenue	Park Avenue	Grove Ave	Bike-Walk Street	0.7	$95,926	23
Hermitage Road	Brookland Pkwy	W Broad Street	Buffered Bike Lane	1.5	$93,696	21

Table 3-3: Mid-Term (4-7 years) Network Prioritization Table

Route Name	From	To	Facility Type	Miles	Facility Cost Estimate	Prioritization Score
E 15th Street	Semmes Ave	Ingram Ave	Bike-Walk Street	1.2	$178,093	23
W 14th St/E 16th Street	Semmes Ave	Ingram Ave	Bike-Walk Street	1.4	$195,937	23
Hull Road	Chippenham	Belt Blvd	Shared Use Path	2.7	$1,441,264	23
Forest Hill Ave	Riverside Drive	Westover Hill Blvd	Bike Lane	1.3	$49,092	22
N 9th Street	E Leigh Street	E Cary Street	Cycle Track	0.5	$94,110	22
N 8th Street	E Leigh Street	Canal Street	Cycle Track	0.6	$109,661	22
Fendall Ave/ W Home St / Monteiro St	North City limits	E First Street	Bike-Walk Street	2.2	$311,977	21

Table 3-4: Long-Term (7-10+ years) Network Prioritization Table

Route Name	From	To	Facility Type	Miles	Facility Cost Estimate	Prioritization Score
Warwick Road	Brookline Street	Belt Blvd	Buffered Bike Lane	4.2	$270,025	29
Colorado Avenue	Floyd Ave	S Meadow Street	Bike-Walk Street	1.4	$194,654	29
Belt Blvd	Crutchfield Street	Broad Rock Blvd	Buffered Bike Lane	1.3	$80,227	28
Prince Arthur Road	Forest Hill Ave	Evelyn Byrd Road	Bike Lane	0.4	$14,075	24
German School Road	Jahnke Road	Seaman Road	Bike Lane	0.7	$26,456	23
Janke Road	Blakemore Road	City Western Limits	Shared Use Path	0.9	$475,200	22
W 29th Street	Riverside Drive	Bainbridge Street	Bike-Walk Street	0.7	$95,835	21
Patterson Ave	Three Chopt Road	Malvern Avenue	Buffered Bike Lane	3.0	$188,940	21
McCloy Street	Grayland Ave	Douglasdale Road	Bike Lane	0.5	$19,091	20
N Huguenot Road	South end of Huguenot Bridge	Chesterfiled County Line	Bike Lane	1.3	$50,035	20
W Carnation Street	Hioaks Road	Midothian Tpke	Buffered Bike Lane	0.7	$43,901	20
Claremont Ave/ North Ave	Brook Road	E Ladies Mile Road	Bike-Walk Street	1.3	$190,053	20
N Lombardy Street	Overbrook Road	Brook Road	Bike Lane	0.2	$8,533	19
Westover Hills Blvd	Forest Hill	Crutchfield Street	Buffered Bike Lane	0.8	$47,861	19
Goverment Road	Stony Run Road	Williamsburg Road	Bike Lane	0.8	$30,559	19
Stony Run Road	Williamsburg Ave	Goverment Road	Bike Lane	0.5	$18,694	18
Forest Hill Avenue	Hathaway Road	Powhite Pkway	Bike Lane	0.8	$30,766	18
Westover Hills Blvd	Nickel Bridge	Forest Hill	Buffered Bike Lane	0.6	$39,033	17
Park Drive	Blanton Ave	Nickel Bridge	Bike Lane	0.7	$25,329	17
Malvern Avenue	W Broad Street	Grove Ave	Buffered Bike Lane	0.9	$58,981	17
Brook Road	Azalea Ave	W Laburnum Ave	Buffered Bike Lane	1.2	$77,700	17
W 30th Street	Semmes Ave	Bainbride Street	Bike-Walk Street	0.3	$40,705	16
Bells Road	Belt Blvd	Castlewood Road	Bike Lane	0.5	$19,456	15
Cheyenne Rd/Stony Point Rd	Cherokee Road	W Huguenot Road	Bike-Walk Street	2.1	$302,841	15
Williamsburg Ave	Proposed Greenway	Williamsburg Road	Bike Lane	0.6	$23,783	13
Carnation Street	Midothian Tpke	Brookline Street	Buffered Bike Lane	0.2	$12,490	13
Bittersweet Road	Cheyenne Road	Creek Summit Circle	Bike-Walk Street	0.3	$41,671	12
Willow Lawn Drive	Bromley Lane	Patterson Avenue	Buffered Bike Lane	0.3	$18,165	10

Table 3-5: Future Facility Table (No Timeline, Implemented as Needed)

Route Name	From	To	Facility Type	Miles	Facility Cost Estimate	Prioritization Score
W Marshall Street	Harrison St	N 2nd St	Shared Lane	0.8	$13,238	31
Paterson Ave/Park Ave	Malvern Ave	N Hampton St	Shared Lane	2.4	$37,728	29
E Main St	N 9th Sttreet	N 17th Street	Shared Lane	0.5	$8,561	28
N Harrison Street	Leigh Street	Broad Street	Shared Lane	0.3	$4,015	27
Lombardy Street	W Broad St	Floyd Ave	Shared Lane	0.4	$7,109	27
Cherry Street	Floyd Avenue	Spring Street	Shared Lane	0.6	$8,747	27
N Belmont Avenue	Park ave	Grayland Ave	Shared Lane	0.8	$12,281	27
Mechanicsville Tpke	Phaup St	O Street	Shared Lane	1.4	$22,549	27
Overbrook Road	Hermitage Rd	North Ave	Shared Lane	1.5	$23,931	27
S Sheppard St/Grant St	Parkwood Ave	S Belmont Ave	Shared Lane	0.6	$8,746	26
Westmoreland St	Monument Avenue	Grove Avenue	Shared Lane	0.7	$10,475	26
Laurel Street	W Main Street	Oregon Hill Pwy	Shared Lane	0.7	$11,480	26
N Robinson Street	W Broad Ave	Idlewood Ave	Shared Lane	1.0	$15,255	26
N 3rd St/N 5th St/Rowen Av/1st St	Willow St	E Leigh St	Shared Lane	1.5	$24,194	26
Bank St/E Franklin St/E Broad St	N 9th St	Chimborazo Blvd	Shared Lane	1.8	$27,765	26
Boroughbridge Rd/Cullen Rd	Jahnke Rd	Broad Rock Blvd	Shared Lane	3.1	$49,255	26
Idlewood Avenue	S Harrison Street	S Cherry Street	Shared Lane	0.2	$3,837	25
S 21st St	E Marshall St	Dock St	Shared Lane	0.5	$7,594	25
Dove St/Willow St	North Ave	3rd Ave	Shared Lane	0.6	$9,208	25
Idlewood Ave/ Srobinson St	S Shepard St	Shirley Lane	Shared Lane	1.1	$16,797	25
N 28th St	Phaup St	E Broad St	Shared Lane	1.6	$24,816	25
Jehnke Road	CSX	Forest Hill Ave	Shared Lane	0.3	$4,752	25
N 5th Street	N 4th St	E Grace Street	Shared Lane	0.5	$8,495	24
W Ladies Mile Road	Fendall Ave	Brookland Park Blvd	Shared Lane	0.6	$9,860	24
Brookland Park Blvd	Hawthrone Avenue	Henrico Dr	Shared Lane	0.9	$14,347	24
3rd Ave/Dill Ave	City Limits	Rowen Ave	Shared Lane	1.4	$21,895	24
Fairfield Avenue	Oliver Hill Way	Eastern city limits	Shared Lane	1.6	$25,837	24
S Pine Street	Spring Street	Oregon Hill Pwy	Shared Lane	0.3	$4,059	23
S Belmont Ave / Maplewood Ave	Douglasdale Road	S Sheppard St	Shared Lane	0.5	$7,259	23
Magnolia St	3rd Ave	Mechanicsville Tpke	Shared Lane	0.9	$14,162	23
S 22nd St	River Greenway	E Frankling Street	Shared Lane	0.2	$2,851	22
Chimborazo Blvd	Oakwood Avenue	E Broad Street	Shared Lane	0.6	$8,896	22
College Rd/Campus Dr	City Limits	Towana Rd	Shared Lane	0.6	$9,122	22
Semmes Avenue	Cowardin Ave	S 9th St	Shared Lane	0.7	$11,588	22
Phaup St/Kane St	Mechanicsville Tpke	N 28th St	Shared Lane	0.8	$13,457	22
N 14th St/Hull St/Brander St	E Franklin St	Bainbridge St	Shared Lane	0.9	$13,937	22
Meadowbridge Road	City limits	Brookland Park	Shared Lane	0.9	$14,247	22
Belleview Ave/Bryan Park	Bryan Park Ave	Brook Road	Shared Lane	1.6	$25,895	22
Parkwood Avenue	S Belmont Ave	Shepard St	Shared Lane	0.1	$1,468	21
Spring Street	S Cherry Street	S Pine Street	Shared Lane	0.1	$2,116	21
Pepper Ave	Patterson Ave	Three Chopt Rd	Shared Lane	0.1	$9,023	21
Bryce Lane	Hull Street Road	Rock Blvd	Shared Lane	0.2	$16,059	21

Route Name	From	To	Facility Type	Miles	Facility Cost Estimate	Prioritization Score
Walmsley Blvd	Pocosham Park	Iron Bridge Road	Shared Lane	0.4	$22,860	21
Rockfall Dr/Kenmore Road	Forest Hill Ave	Riverside Dr	Shared Lane	0.6	$33,350	21
North Avenue	Overlook Road	Dove Street	Shared Lane	1.2	$1,755	20
M Street	N 28th Street	N 25th Street	Shared Lane	1.8	$2,972	20
Towna Rd	Campus Dr	UofR	Shared Lane	0.2	$6,710	20
W 9th St	Bridge	Bainbridge St	Shared Lane	0.4	$9,183	20
P St/Oakwood Ave/ E Richmond Rd	N 28th St	Stony Run Pkwy	Shared Lane	0.5	$19,260	20
Snead Road	Whitehead Road	Broad Rock Blvd	Shared Lane	0.1	$29,180	20
Grayland Avenue	McCloy Street	Shepard St	Shared Lane	0.2	$3,107	19
Wright Avenue	Cofer Rd	Lynhaven Ave	Shared Lane	0.3	$5,765	19
Ingram Ave	E 15th Street	Mason Street	Shared Lane	0.4	$7,507	19
Joplin Ave	Mason Street	Harwood Street	Shared Lane	0.5	$1,500	18
Rhoadmiller Street	Greenway	Hermitage Rd	Shared Lane	0.5	$2,450	18
Retting Rd/Granite Hall	Forest Hill Avenue	Rail Road (Greenway)	Shared Lane	0.6	$4,036	18
Hunt Ave	Hazelhurst Ave	Meadowbridge Rd	Shared Lane	1.0	$6,949	18
W Clay St/N Shepard St	Altamont Ave	Park Ave	Shared Lane	1.2	$7,279	18
E Ladies Mile Road	Hazelhurst Ave	Meadowbridge Rd	Shared Lane	0.1	$7,376	18
Shirley Ln/Amelia St	Park Dr	S Meadow St	Shared Lane	0.1	$9,623	18
Lynhaven Ave	Royall Avenue	Summer Hill Avenue	Shared Lane	0.2	$16,497	18
Whitehead Road	Warwick Road	Elkhardt Road	Shared Lane	0.3	$18,617	18
Harwood St	Columbia Street	Joplin Avenue	Shared Lane	1.1	$1,055	17
Mason St	Ingram Avenue	Joplin Avenue	Shared Lane	1.2	$1,121	17
Grayland Avenue	S Robinson Street	S Addison Street	Shared Lane	1.3	$3,162	17
W 7th St	Semmes Ave	Bainbridge Street	Shared Lane	0.1	$4,649	17
Taylor Dr/Margate Drive	Cherokee Road	Oldfield Drive	Shared Lane	0.1	$17,321	17
Williamson Rd/Newtown Rd	Government Road	Rail Road	Shared Lane	0.1	$19,152	16
Castlewood Road	Ruffin Road	Southern City Limits	Shared Lane	0.2	$20,995	16
Clearfield Street	Chesterfield Drive	Bryce Lane	Shared Lane	0.3	$834	15
Webber Ave	Columbia Street	Lynhaven Avenue	Shared Lane	0.4	$2,222	15
Chesterfield Drive	Hull Street Road	Clearfield Street	Shared Lane	0.4	$2,344	15
Elkhardt Road	Whitehead Road	Hull Street Road	Shared Lane	0.5	$2,468	15
W Belmont Road	Belmont Road	Iron Bridge Road	Shared Lane	0.8	$5,209	15
Hampton St	Colorado Ave	Kansas Ave	Shared Lane	0.9	$6,911	15
Ruffin Road	Warwick Road	Davee Road	Shared Lane	0.1	$6,996	15
Columbia St	Harwood St	Webber Avenue	Shared Lane	0.1	$7,988	15
Swanson Road	Whitehead Road	Hull Street Road	Shared Lane	0.1	$13,448	15
Hopkins Road	Warwick Road	Southern City Limits	Shared Lane	0.4	$13,935	15
Columbia St	Summer Hill Avenue	Ruffin Road	Shared Lane	0.7	$1,797	13
W Marshall Street	Altamont Ave	N Shepard St	Shared Lane	0.1	$1,530	12
Summer Hill Ave	Columbia Street	Lynhaven Avenue	Shared Lane	0.1	$2,107	12
Hobby Hill Road	Margate Drive	Cheyenne Road	Shared Lane	0.4	$6,801	12
Belmont Road	Walmsley Blvd	Southern City Limits	Shared Lane	0.7	$11,228	12
Old Gun Road E	Western City Limits	Duyee Drive	Shared Lane	1.1	$16,984	12
Duryea Dr/Evansway Ln	Old Gun Rd	Ashdown Rd	Shared Lane	1.5	$23,674	12
Hey Road	Snead Road	Walmsley Blvd	Shared Lane	0.6	$9,087	11

PLANNING LEVEL COST ESTIMATES

The network prioritization timeline is based on planning level cost estimates derived from national standards, industry expertise, and local project costs. These cost estimates should be regarded as preliminary in nature and may vary widely due to the large amount of variation that can occur during the design and construction phases. Variations from actual project costs will result from additional factors such as design exceptions, value engineering, utility relocation, and environmental impacts. As projects move forward in the project development process, emerging details will support the refinement of these costs. Please note that the estimates were developed as 2014 dollars and do not take inflation into account.

The following tables outline the planning level cost estimates of constructing the following bicycle facilities:

- Bike Lane
- Buffered Bike Lane
- Cycle Track
- Bike/Walk Street

The following assumptions were used in the development of the cost estimates:

1. Cost calculations assume that bicycle facility improvements are made on both sides of the street with the exception of shared use paths and sidepaths. This also assumes any pavement costs are independent of bicycle facility.
2. Cost estimates do not include design unless specifically stated in assumptions. Per the City of Richmond, design costs, which include construction planning, public process, facility design, and other background work required to implement the project, can generally be estimated at 25 percent of the facility construction cost. Projects requiring a higher level of public process may incur higher design costs.
3. Per the City of Richmond, cost estimates involving major construction do not include contingency costs, which typically are estimated at 25 percent of the construction costs. This includes 15-20 percent for construction and 5-10 percent for construction administration.
4. Other costs where applicable include landscaping 5 percent, Drainage 10 percent (unless otherwise noted), Traffic control 5 percent and Utility adjustments 10 percent.
5. Thermoplastic may last 3 to 5 years, depending on placement in the roadway.

Bike Lane

Component	Cost	Usage	Cost ($/linear foot)
6" Stripe	$6.00/LF	Continuous	$6.00
Bike Lane Symbol Marking	$250.00	Repeated every 250 ft	$1.00
Signage	$60.00	Repeated every 1000 ft	$0.06
Total costs per Linear Foot			**$7.06**

Buffered Bike Lane

Component	Cost	Usage	Cost ($/linear foot)
6" Stripe hatched	$10.00/LF	Continuous	$11.00
Bike Lane Symbol Marking	$250.00	Repeated every 250 ft	$1.00
Signage	$60.00	Repeated every 1000 ft	$0.06
Total costs per Linear Foot			**$12.06**

Cycle Track

Component	Cost	Usage	Cost ($/linear foot)
6" Stripe hatched	$9.00/LF	Continuous	$11.00
Flex Post	$50.00	Repeated every 10 ft	$5.00
Bike Lane Symbol Marking	$250.00	Repeated every 250 ft	$1.00
Signage	$60.00	Repeated every 1000 ft	$0.06
Traffic Calming Treatments (minimal)	Various	Bulb outs, chicanes, etc.	$6.00
Colored Pavement	$ 12.00/sqft	Bike boxes, colored Lanes, & through intersections	$10.00
Total costs per Linear Foot			**$33.06**

Bike/Walk Street

Component	Cost	Usage	Cost ($/linear foot)
Shared Lane Marking (Sharrow)	$250.00	Repeated every 250 ft	$1.00
Signage	$60.00	Repeated every 1000 ft	$0.06
Traffic Calming Treatments (intensive)	Various	Bulb outs, speed humps, etc.	$16.00
Intersection Treatments	Various	Mini Traffic Circle, Median Refuge, etc.	$10.00
Total costs per Linear Foot			**$27.06**

Figure 3-10: Funded Recommendations

Existing Bicycle Facilities

- Bike Lane
- Shared Lane
- Shared Use Path
- Greenway

Areas of Interest

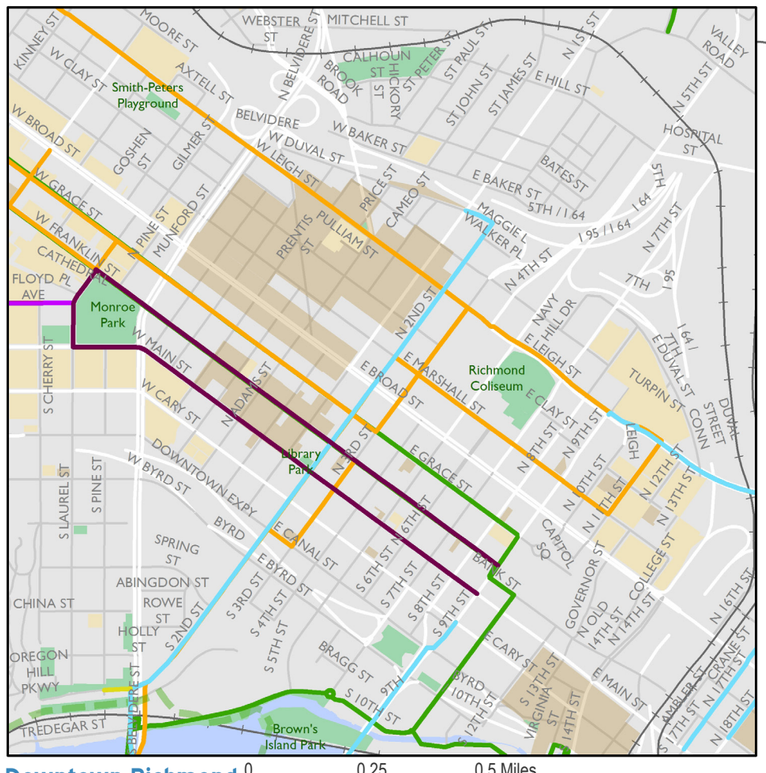
- Parks
- Historic Districts
- Educational Facilities

Proposed Funded Network

- Bike Lane
- Shared Use Path
- Cycle Track
- Buffered Bike Lane
- Contra Flow Bike Lan
- Bike-Walk Street
- Greenway*

0 0.5 1 2 Miles

*Greenway recommendations are from previous city planning efforts. The corridors are conceptual and illustrated with a slightly transparent and thicker line to indicate the alignment variance and need for further study.



Downtown Richmond

RICHMOND
Bicycle Master Plan

Figure 3-11: Short-Term Network Recommendations

Existing Bicycle Facilities

- Bike Lane
- Shared Lane
- Shared Use Path
- Greenway

Areas of Interest

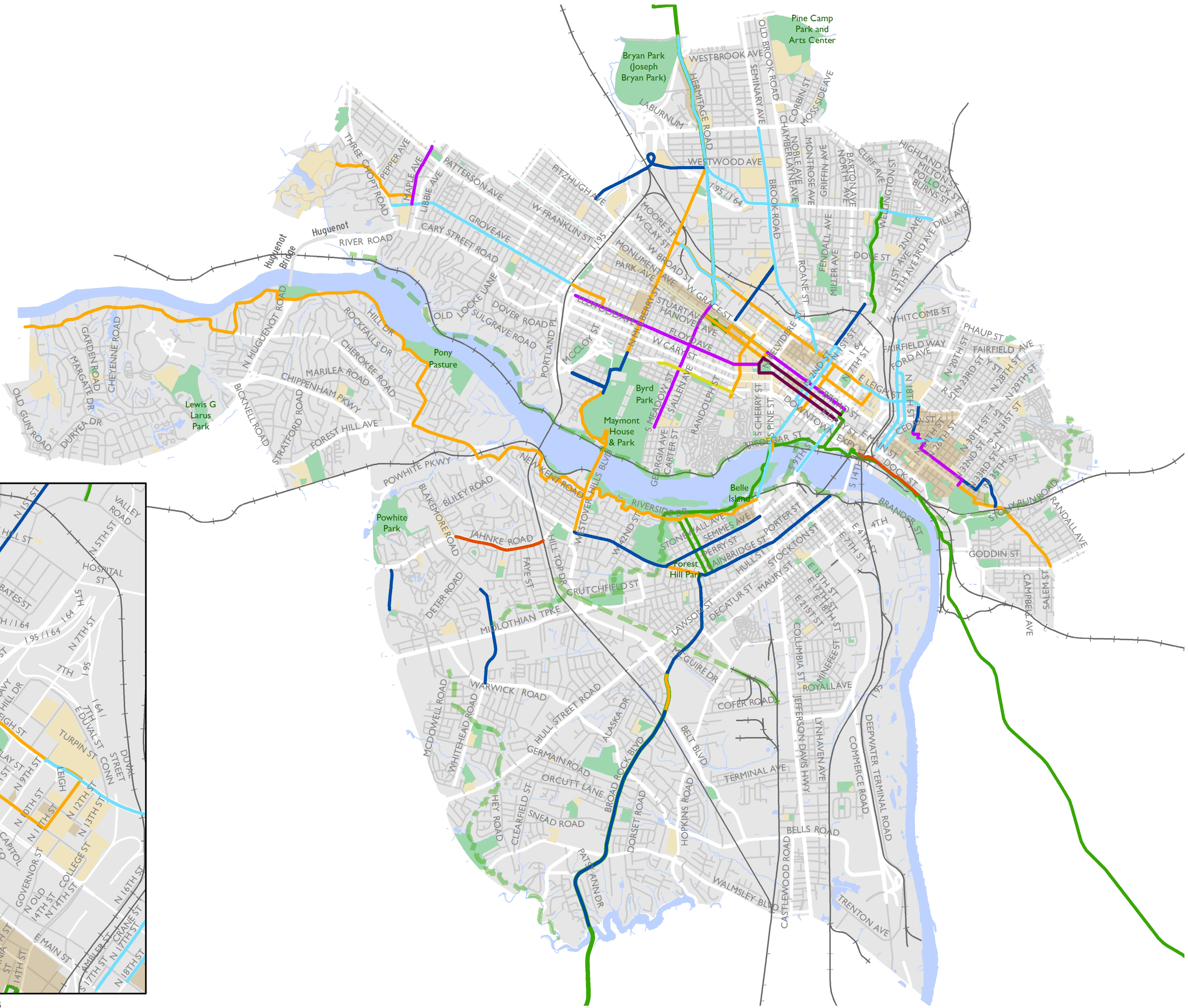
- Parks
- Historic Districts
- Educational Facilities

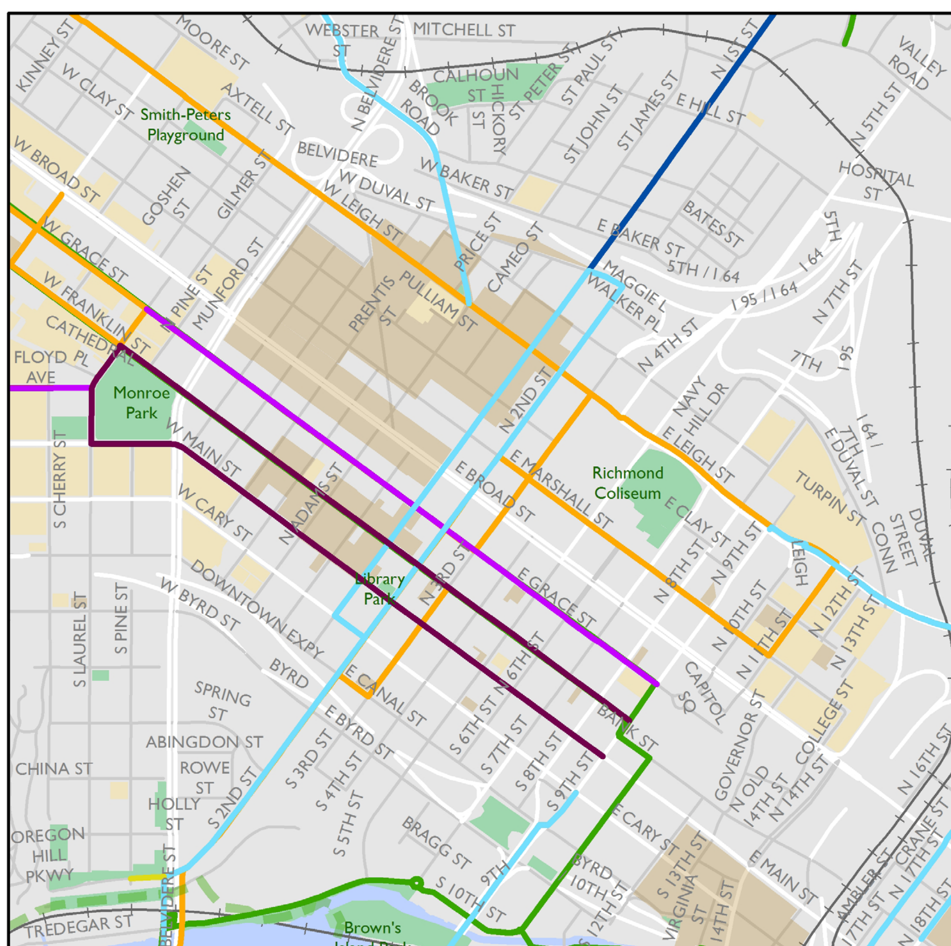
Proposed Short-Term Network

- Bike Lane
- Shared Use Path
- Cycle Track
- Buffered Bike Lane
- Contra Flow Bike Lan
- Bike-Walk Street
- Greenway*

0 0.5 1 2 Miles

Greenway recommendations are from previous city planning efforts. The corridors are conceptual and illustrated with a slightly transparent and thicker line to indicate the alignment variance and need for further study.





Downtown Richmond

0 0.25 0.5 Miles

Figure 3-12: Mid-Term Network Recommendations

Existing Bicycle Facilities

- Bike Lane
- Shared Lane
- Shared Use Path
- Greenway

Areas of Interest

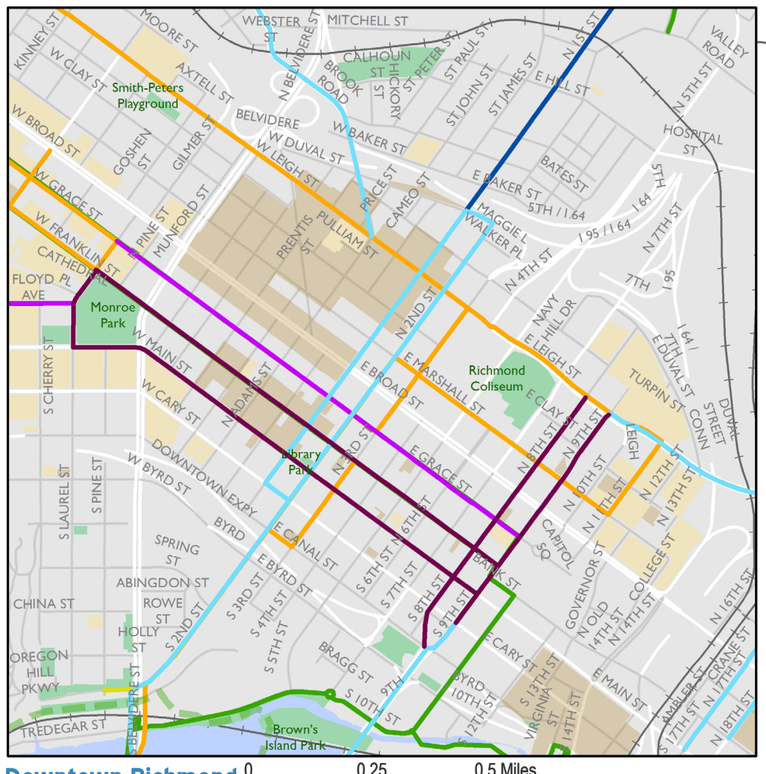
- Parks
- Historic Districts
- Educational Facilities

Proposed Mid-Term Network

- Bike Lane
- Shared Use Path
- Cycle Track
- Buffered Bike Lane
- Contra Flow Bike Lan
- Bike-Walk Street
- Greenway*

0 0.5 1 2 Miles

**Greenway recommendations are from previous city planning efforts. The corridors are conceptual and illustrated with a slightly transparent and thicker line to indicate the alignment variance and need for further study.*



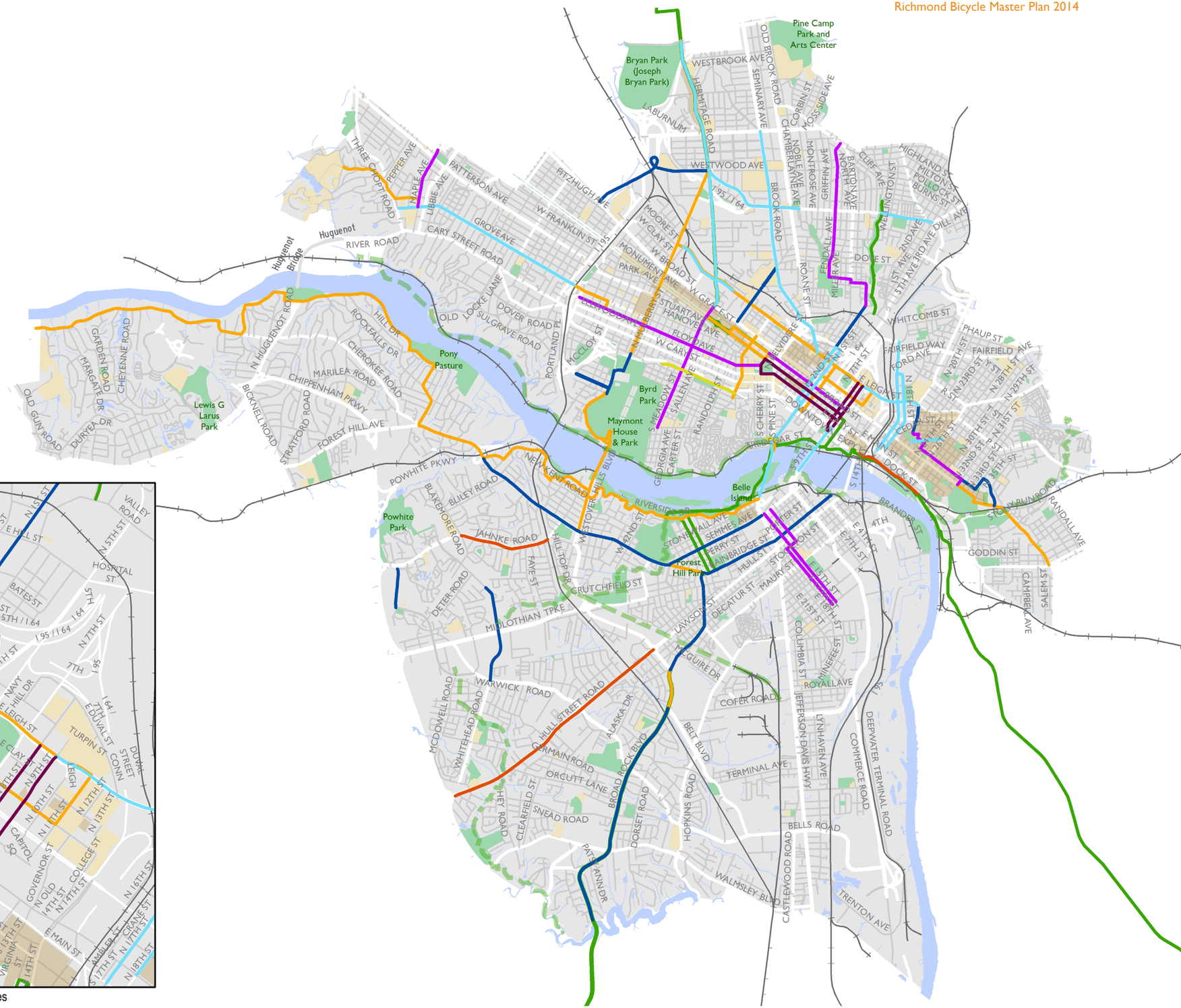


Figure 3-13: Long-Term Network Recommendations

Existing Bicycle Facilities

- Bike Lane
- Shared Lane
- Shared Use Path
- Greenway

Areas of Interest

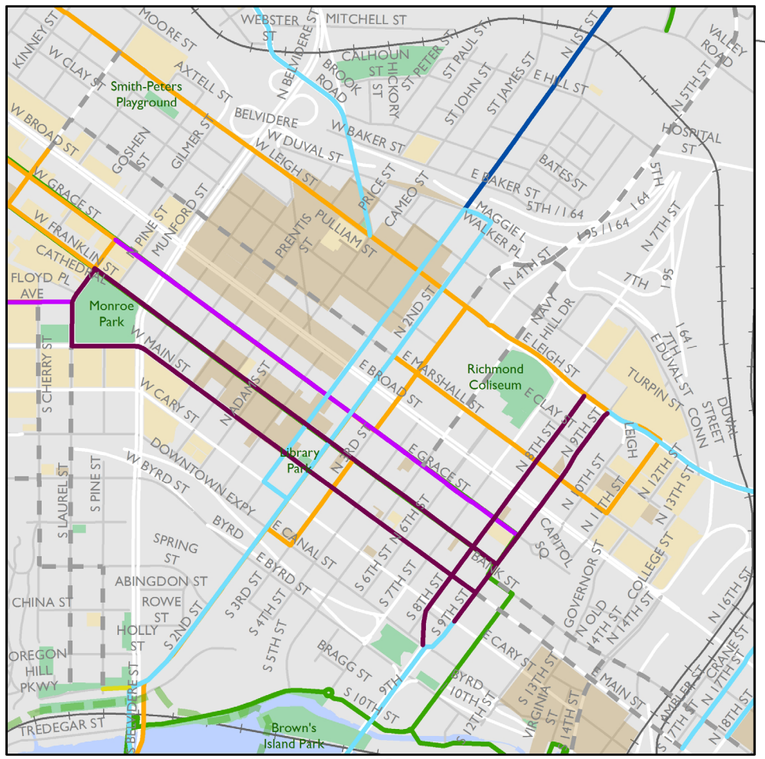
- Parks
- Historic Districts
- Educational Facilities

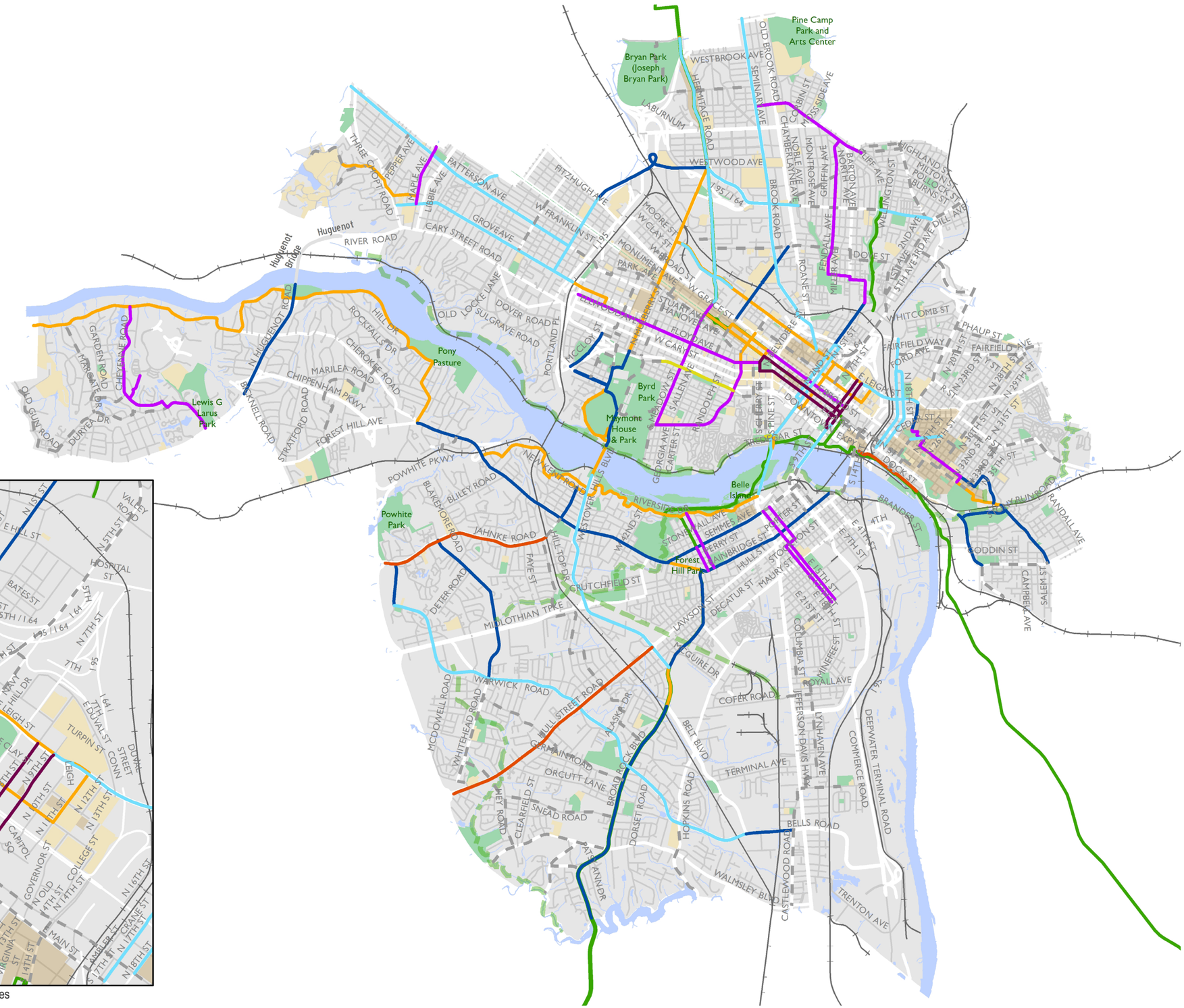
Proposed Long-Term Network

- Bike Lane
- Shared Use Path
- Cycle Track
- Buffered Bike Lane
- Contra Flow Bike Lan
- Bike-Walk Street
- Greenway*
- Future Facility

0 0.5 1 2 Miles

*Greenway recommendations are from previous city planning efforts. The corridors are conceptual and illustrated with a slightly transparent and thicker line to indicate the alignment variance and need for further study.





DEMONSTRATION PROJECTS

The following pages provide additional details on ten demonstration projects. Each cut sheet includes a snapshot with short description of the character of the roadway, a typical cross section for the recommendation, and symbols indicating where further feasibility, design, and engineering are required to fully understand how to successfully implement this project with a variety of treatment types. Each spread is intended to initiate the process of feasibility and design and is not a final engineering solution that will be implemented for the entire alignment. Surveys, detailed fieldwork, and investigation will be required to complete each project.

General Guidance for Challenging Areas

Many of the projects included in these recommendations should be accompanied by a thorough exploration of conflict points. These include intersections, other crossings, driveways, and ramps, among others. Below are a few examples of potential treatments that organize modes, make bicyclists more visible, and help communicate behavior of both bicyclists and motorists. When tools are used in the built environment to provide expectations for bicyclist movement, e.g. green lanes at driveway crossings, both drivers and bicyclists are alerted to be attentive.

For the purpose of being as innovative as possible, and citing examples from a nationally recognized source, the images below are from the *NACTO Urban Bikeway Design Guide*. These guidelines may not currently be approved by VDOT or the city, but these types of treatments, as demonstration projects, are Richmond's opportunity to show innovation and commitment to being a bicycle friendly community. Additional details about these treatments and compliance with national and local guides can be found in the Design Guidelines (Appendix A). Further details and original graphics can be found by visiting nacto.org/cities-for-cycling/design-guide. As with the recommended facilities in this plan, the treatments below and indicated on the cut sheets should be fully vetted during the feasibility and design phase of each project. These images should serve as inspiration for the final design.

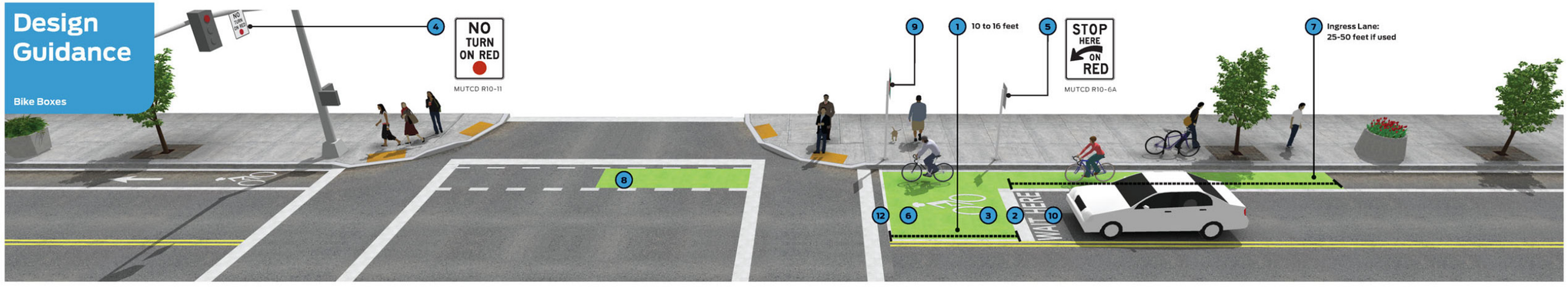
The colorful, circular indicators shown below and on the following pages correspond to the various treatments recommended on the cut sheets starting on page 3-22. Please refer back to this section for a visual representation of each recommended treatment as needed.

Intersection Marking
Conflict Markings
Bike/Walk Street Treatments
Miscellaneous Treatment

A Bike Boxes

Design Guidance

Bike Boxes



B Intersection Markings

Design Guidance

Intersection Crossing Markings

Required Features

1. Dotted lines shall bind the bicycle crossing space. See MUTCD Section 3B.08 for dotted line extensions through intersections.[64]

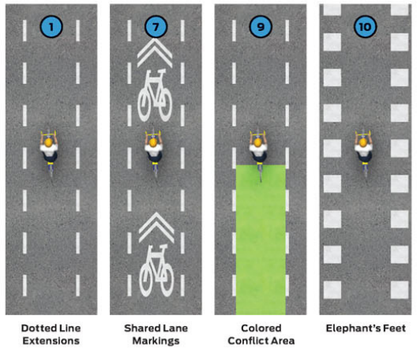
2. Striping width shall be a minimum of 6 inches adjacent to motor vehicle travel lanes and shall otherwise match the width and lateral positioning of leading bike lane striping, except when using elephant's feet markings.[65]

Recommended Features

3. Dotted lines should be 2 foot lines with 2 to 6 foot spacing. Markings should be white, skid resistant and retro-reflective.

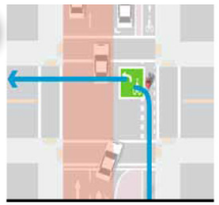
4. Crossing lane width should match width and positioning of the leading bike lane.

5. On crossings of two-way paths and cycle tracks, markings should indicate that there is two-way traffic either by marking the path center line through the intersection, or by marking bicycle silhouettes and/or chevrons in opposite directions in the two lanes. See Two-Way Cycle Tracks.

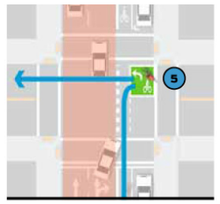


Dotted Line Extensions | Shared Lane Markings | Colored Conflict Area | Elephant's Feet

C Two-Stage Turn Queue Box

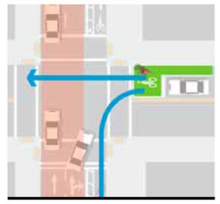


Cycle Track Buffer Configuration



Parking Lane Configuration

Crosswalk Setback Configuration
Wider corner radii, set back pedestrian crossing, and/or narrowed bikeway space, provides opportunity for queue box.

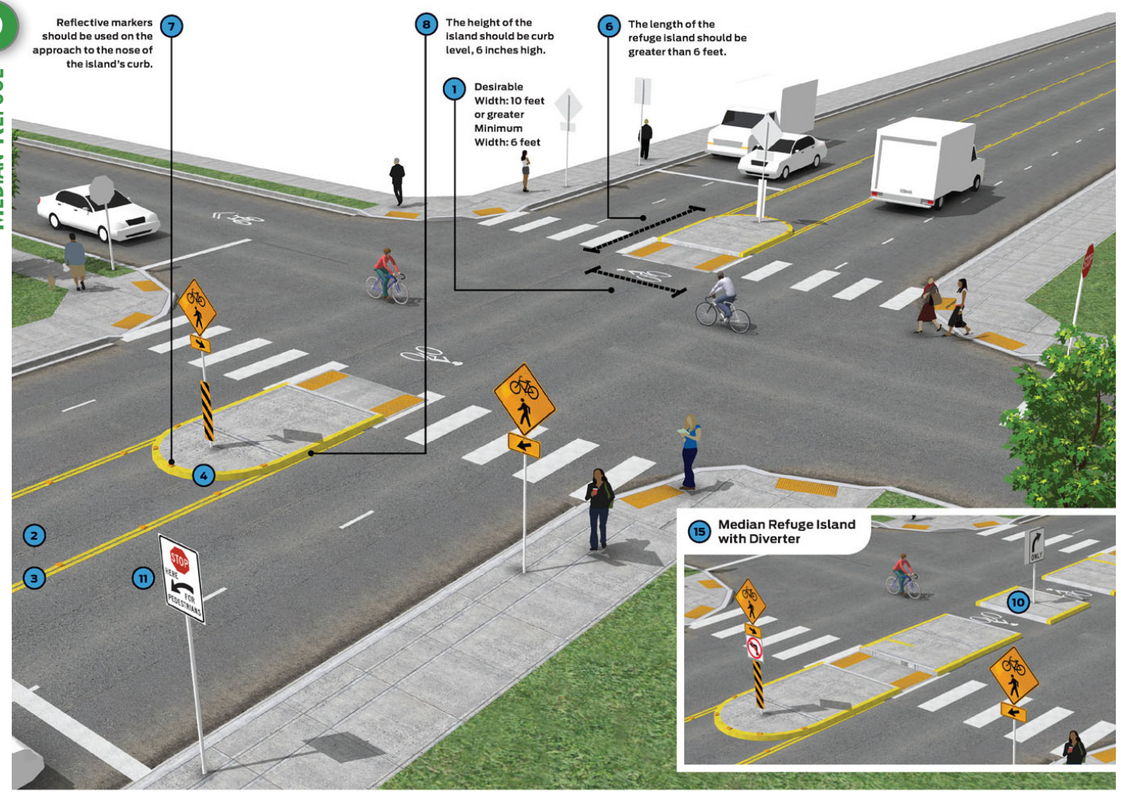


Bike Box Configuration
Bicyclists yield to pedestrians. Not recommended in areas with high pedestrian volumes.

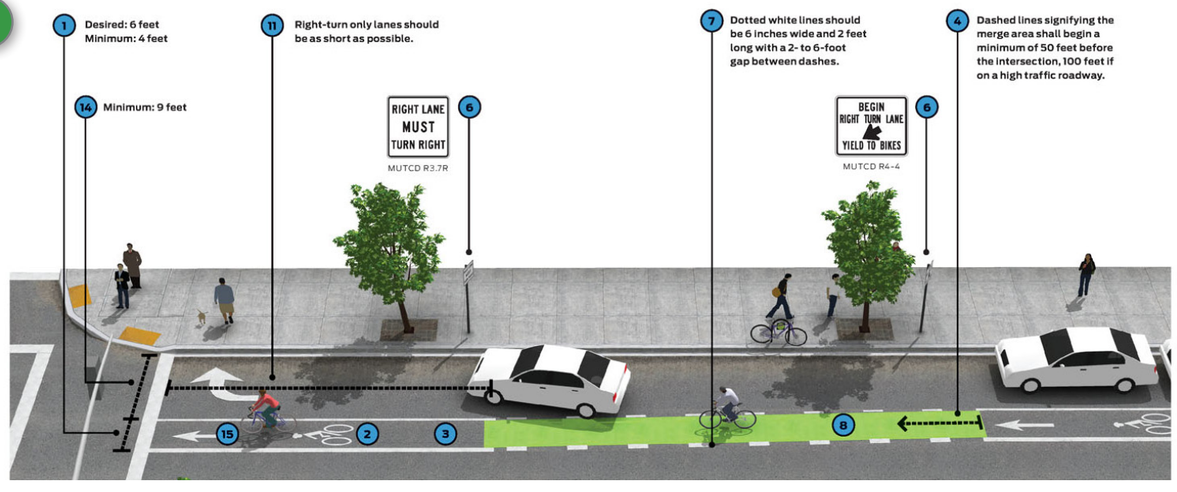
T-intersection Parking Lane Configuration

T-intersection "Jughandle" Sidewalk Configuration

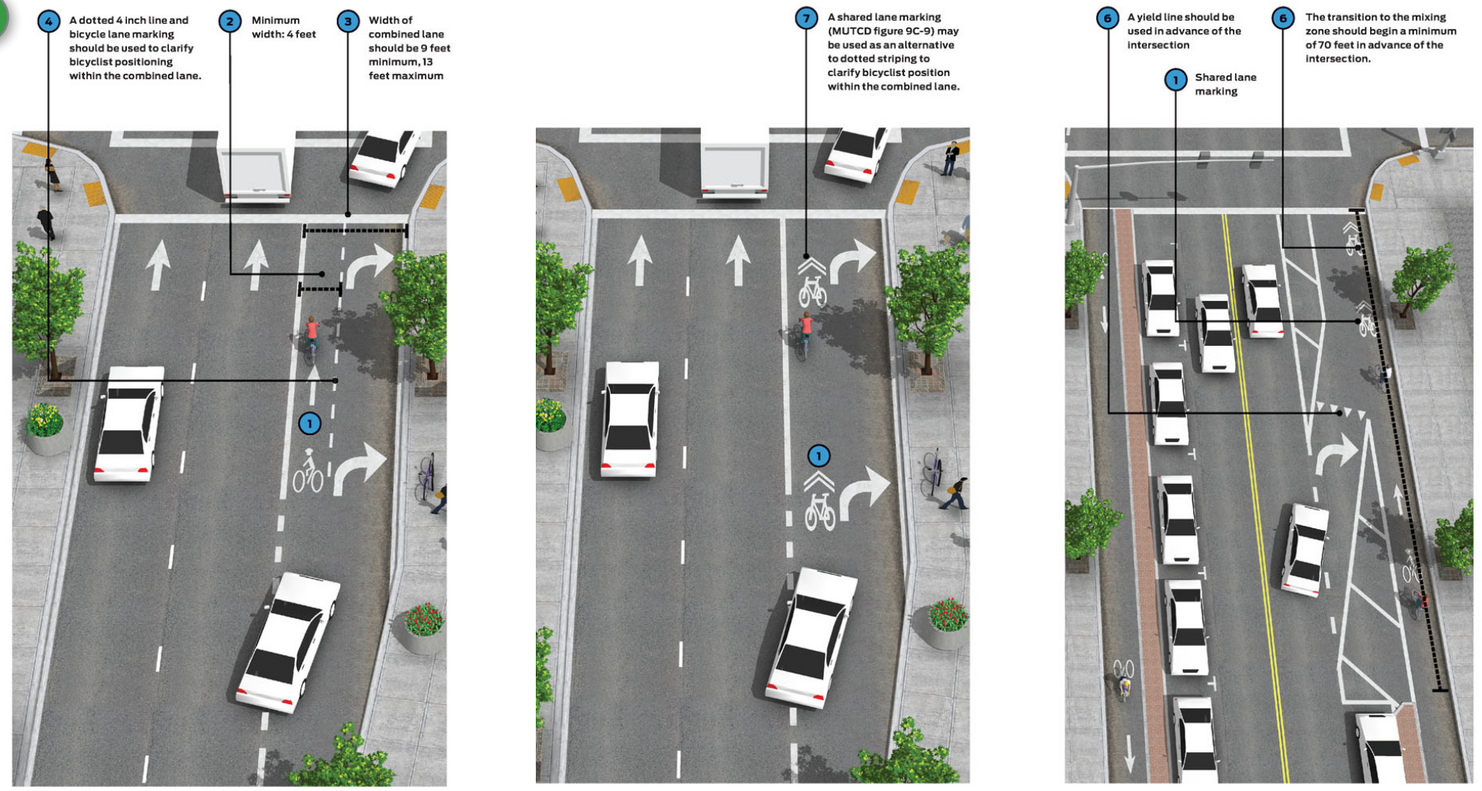
D Median Refuge



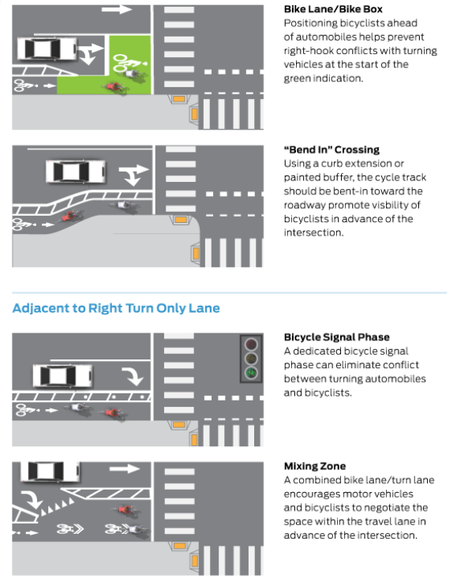
E Through Bike Lane



F Combined Bike/Turn Lane

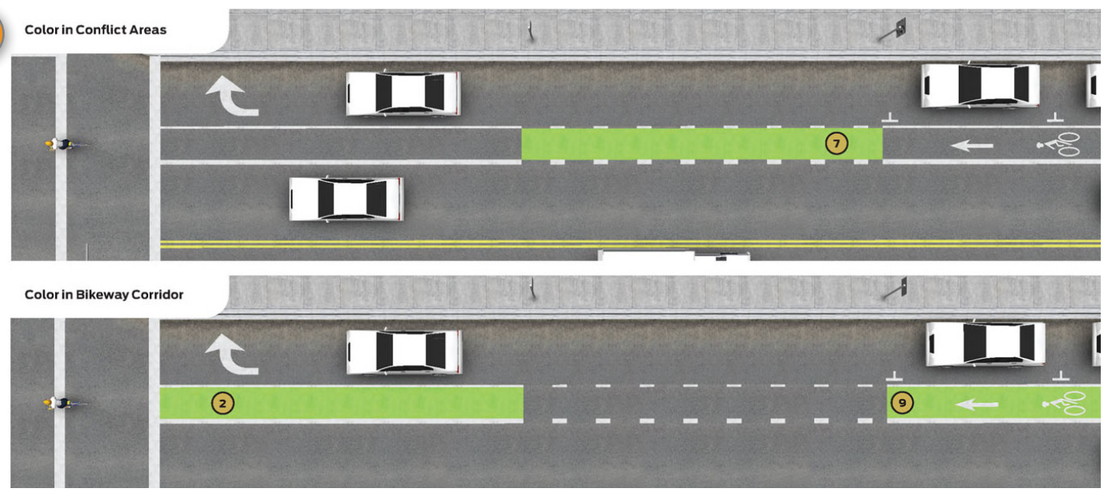


G Cycle Track Approach



Lane transitions show here are for illustration purposes only and are not meant to reflect actual design dimensions.

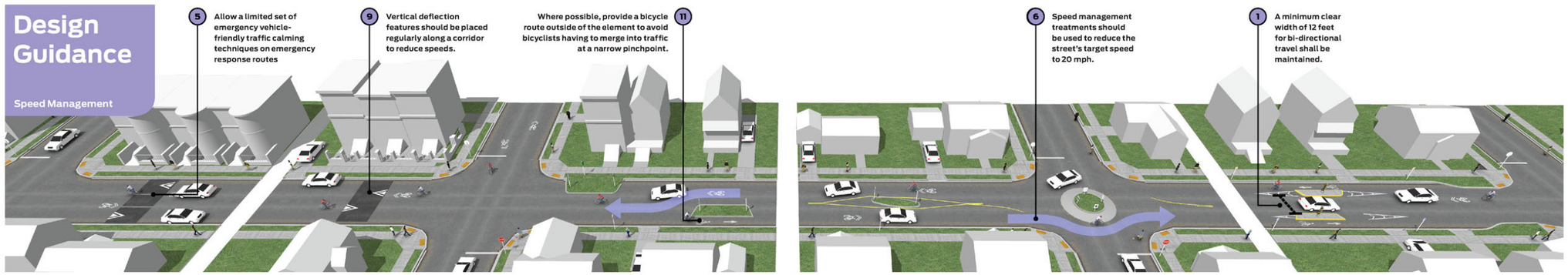
H Colored Bike Facilities



I Speed Management*

Design Guidance

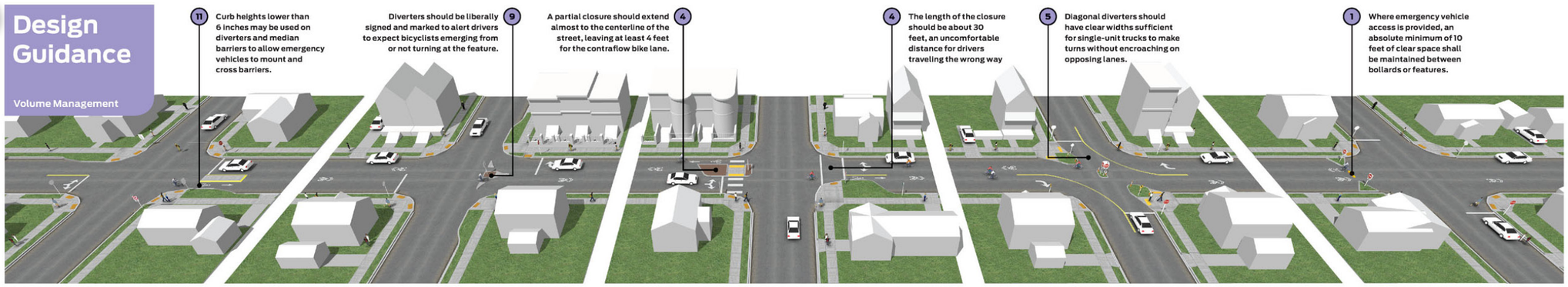
Speed Management



J Volume Management*

Design Guidance

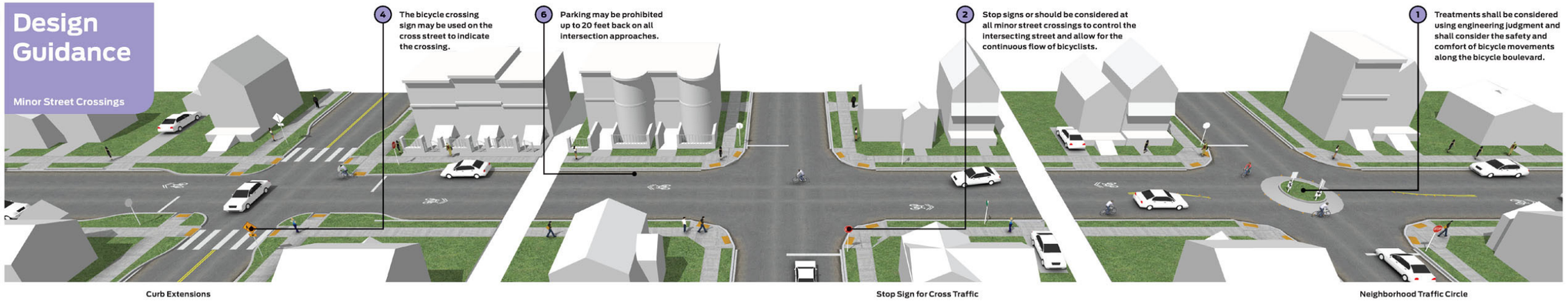
Volume Management



K Minor Street Crossings*

Design Guidance

Minor Street Crossings



*While no Bike/Walk street facilities were selected in the top 10 priority projects, these guidelines have been included to supplement the Design Guidelines in Appendix A and aid in the development and design of the many Bike/Walk streets recommended in this Plan.

L Major Street Crossings*

Design Guidance

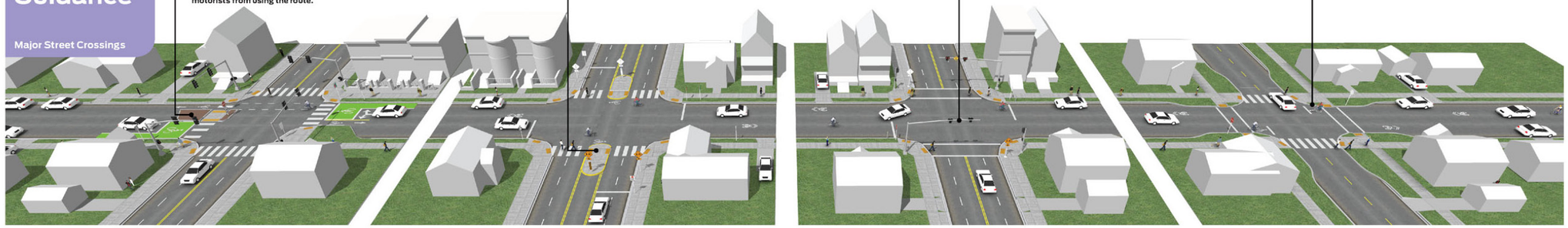
Major Street Crossings

5 Volume management should be considered at signalized intersections along the bicycle boulevard to discourage motorists from using the route.

1 Treatments should be selectedbased on the number of existing gaps and the desired gap profile.

2 All beacons and signals shall be installed with appropriate detection and actuation.

7 At stop-controlled unsignalized crossings with curb extensions, forward stop bars for bicyclists may be provided.



Bike Box with Partial Closure | Median Refuge Island | Hybrid Beacon | Bicycle Forward Stop Bar

M Offset Crossing*

Design Guidance

Offset Intersections

6 4 3 Crossing treatments appropriate to the roadway characteristics shall be provided to assist bicyclists in making turning movements in order to stay on the bicycle boulevard.

5 Pavement markings indicating the change in direction from the bicycle boulevard may supplement wayfinding signs on the approach to a jog.

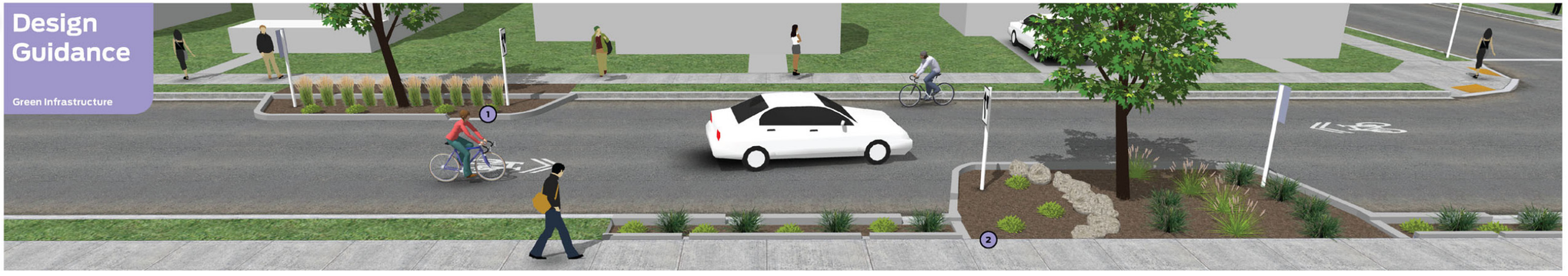
5 A bicycle crossing sign may be used on the cross street to indicate the crossing.

Two-Stage Turn Queue Boxes at Signalized Intersection | Median Refuge Turn Pocket | Cycle Track Connection | Bike Lane Connection

N Green Infrastructure

Design Guidance

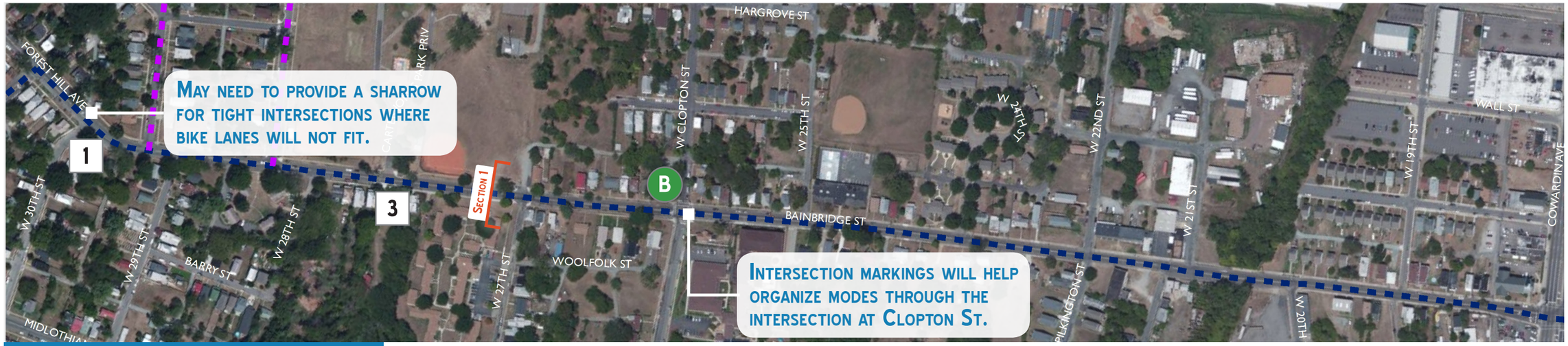
Green Infrastructure



*While no Bike/Walk street facilities were selected in the top 10 priority projects, these guidelines have been included to supplement the Design Guidelines in Appendix A and aid in the development and design of the many Bike/Walk streets recommended in this Plan.

RICHMOND Bicycle Master Plan

Shared Use Path | Cycle Track | Buffered Bike Lane | Bike Lane | Contra Flow Bike Lane | Bike-Walk Street | Shared Lane



0 0.05 0.1 Miles

Recommendation Type *Bike Lane*

Bainbridge Street

From: Broad Rock

To: Brander Street

1.7 Miles

25 MPH

5200-9500 Average Daily Traffic

Primary Land Uses

Residential, Park, Commercial

Score: 28

Reason for Priority Ranking

- Key Connection for bicyclists parallel to Semmes Ave and Hull St
- Lower traffic volumes than other parallel streets
- Connects residential area to facilities that provide access to downtown

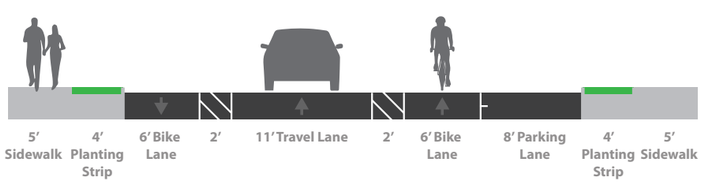
Planning Level Cost Estimate: $61,860

PHOTO OF TYPICAL CONDITIONS

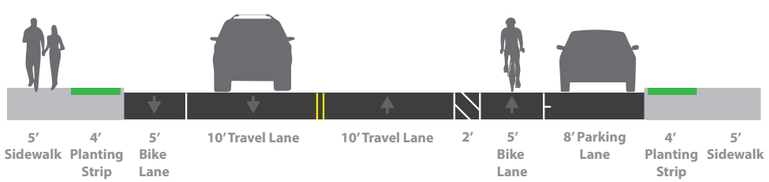
Two 20 ft lanes with intermittent curb bulbouts, on-street parking, and turning lanes. There are 5 ft sidewalks with a vegetative strip on both sides.

RECOMMENDED CROSS SECTION

Section 1: Bainbridge Street



Section 2: Bainbridge Street



BAINBRIDGE STREET CONTINUED

Intersection Treatments will be required to safely cross Cowardin Ave.

Curb Bulbouts and Green Infrastructure could be used to calm traffic along the corridor.

Intersection Treatments will be required to safely cross Commerce Road.

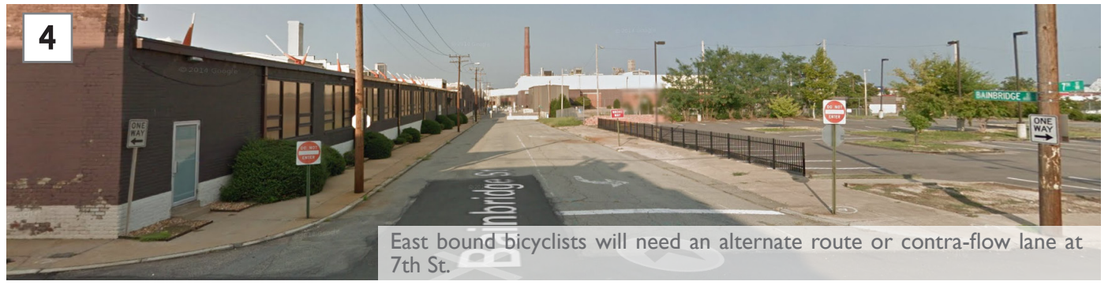
Explore transition to contra-flow or re-route between 7th and Brander St.

KEY AREAS TO ANALYZE

Transitions will be needed when bike lanes do not fit, such as on this approach to Broad Rock Road.

Bulbouts help calm traffic but will need to be vetted for appropriate bicycle movements to negotiate the narrowing of the road.

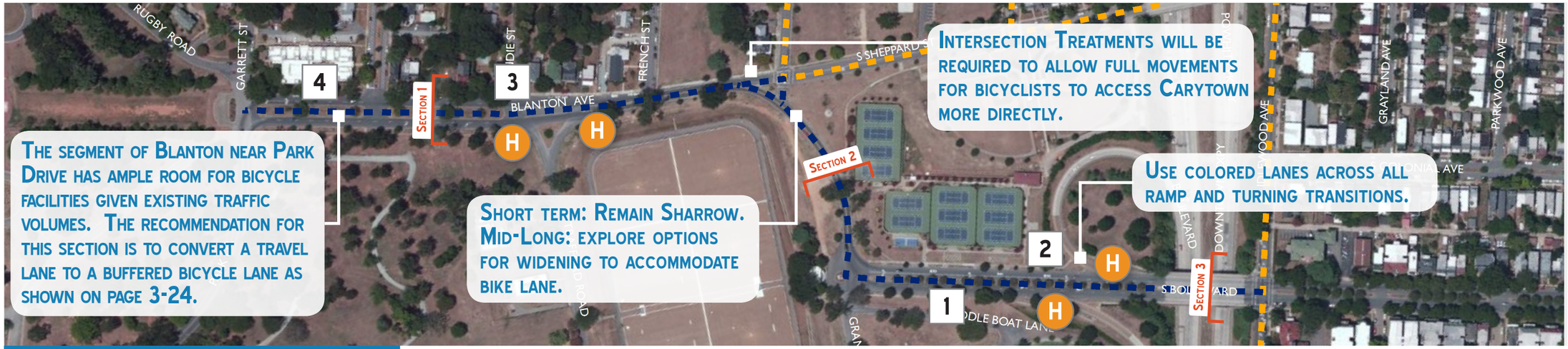
Safety will be critical when crossing Commerce. Striping through the intersection will help provide visibility of bicyclists and organize all modes.



East bound bicyclists will need an alternate route or contra-flow lane at 7th St.

RICHMOND
Bicycle Master Plan

Shared Use Path | Cycle Track | Buffered Bike Lane | Bike Lane | Contra Flow Bike Lane | Bike-Walk Street | Shared Lane



0 0.05 0.1 Miles

RECOMMENDATION TYPE *BIKE LANE*

BLANTON AVE / S BOULEVARD
FROM: IDLEWOOD
TO: PARK DRIVE

0.6 MILES
25 MPH
12000 AVERAGE DAILY TRAFFIC

PRIMARY LAND USES
PARK, RESIDENTIAL

SCORE: 26

REASON FOR PRIORITY RANKING

- Key Connection from Carytown to points south across the James River
- Provides a connection to the trails and park facilities at Maymont/William Byrd Park
- Provides organization for a highly traveled roadway

PLANNING LEVEL COST ESTIMATE: $21,529

PHOTO OF TYPICAL CONDITIONS

The bridge has a 19 ft and an 11 ft lane on either side with an 8 ft concrete median in the middle. This overpass includes two ramps and has 8 ft sidewalks.

Two 12 ft lanes with no shoulder and existing sharrows.

RECOMMENDED CROSS SECTION FOR S BOULEVARD

SECTION 1: BLANTON AVENUE (SOUTH)

KEY AREAS TO ANALYZE

Providing a through lane with green paint will help alert motorists to be aware of bicycles along S Boulevard.

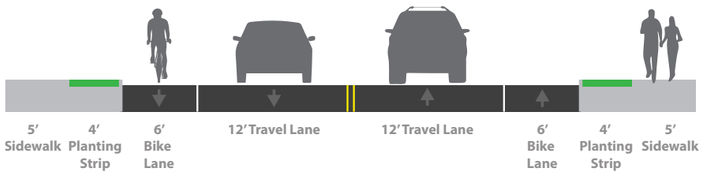
The non-traditional T-Intersection with Trafford should also use through lanes and green paint to increase visibility of bike facilities.

A through lane would also provide increased safety for bicyclists entering Carytown.

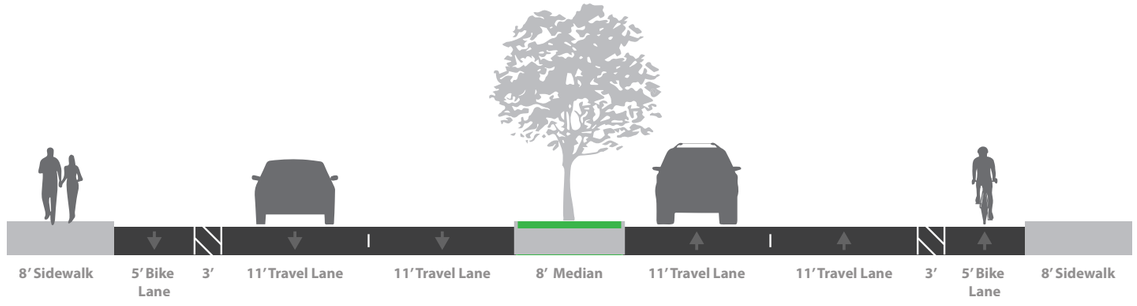
The segment of Blanton near park drive has ample room for bike facilities. This can be accomplished via parking or lane takes, and should be examined for which option minimizes impacts on current and projected traffic volumes.

RECOMMENDED CROSS SECTION FOR BLANTON AVE

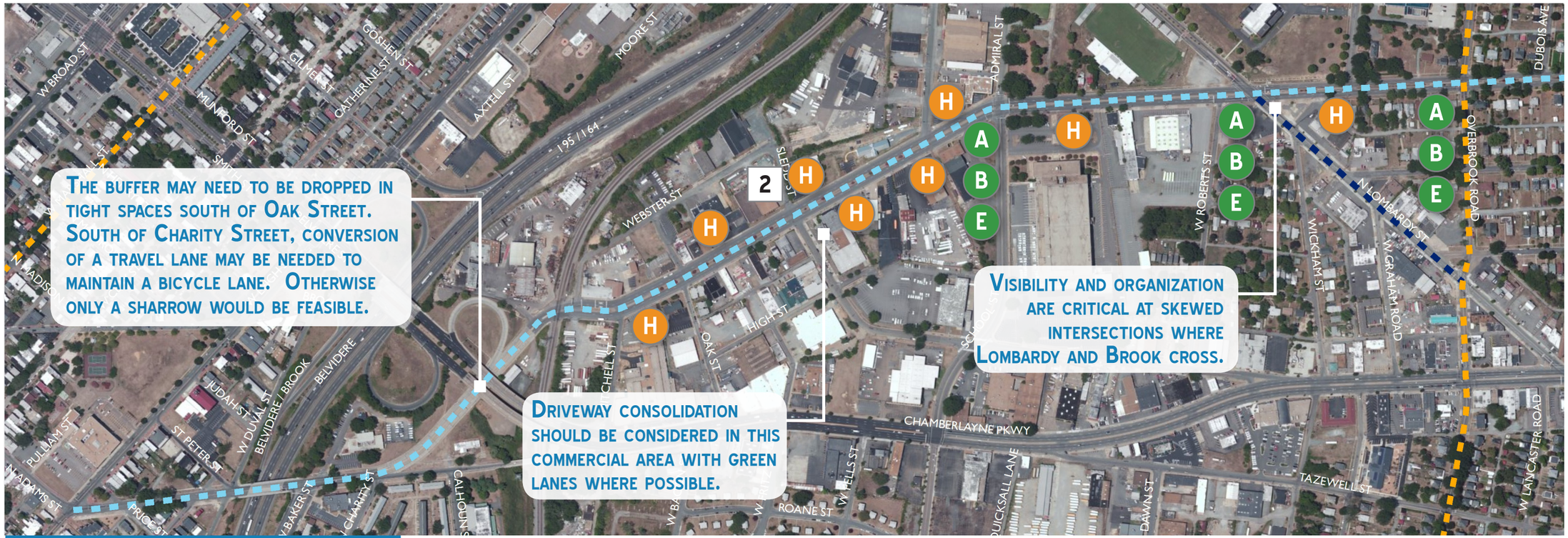
Section 2: Blanton Avenue (North)



Section 3: S Boulevard Street over the Downtown Expressway



Shared Use Path | Cycle Track | Buffered Bike Lane | Bike Lane | Contra Flow Bike Lane | Bike-Walk Street | Shared Lane



0 0.125 0.25 Miles

RECOMMENDATION TYPE BUFFERED *BIKE LANE*

BROOK ROAD

FROM: W LABURNUM AVENUE

TO: E LEIGH STREET

2.6 MILES

25MPH 35MPH

8100-11000 AVERAGE DAILY TRAFFIC

PRIMARY LAND USES

RESIDENTIAL, COMMERCIAL

SCORE: 25

REASON FOR PRIORITY RANKING

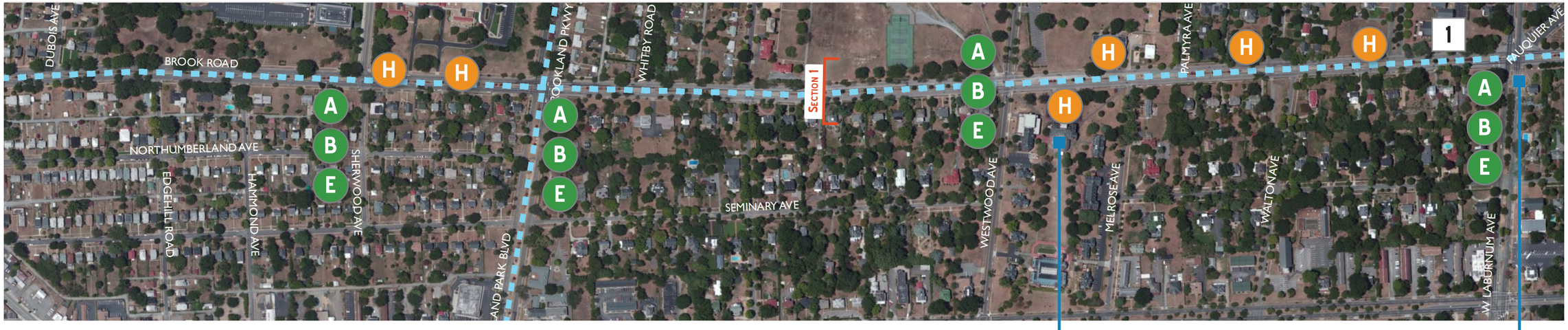
- Major north/south connection in and out of downtown
- Major connection to daily uses
- Connects to Bus Routes 22, 93, and 91

PLANNING LEVEL COST ESTIMATE: $149,961

PHOTO OF TYPICAL CONDITIONS

Two 19 ft and 11 ft lanes (varying in width at times to accommodate parking) on either side with a 12 ft vegetated center median (varies), intermittent turn pockets and large driveways. There are 4 ft sidewalks with a 9 ft vegetative strip on both sides.

BROOK ROAD CONTINUED



CHURCHES AND LARGE NEIGHBORHOOD ENTRANCES SHOULD BE VETTED FOR USE OF COLORED FACILITIES.

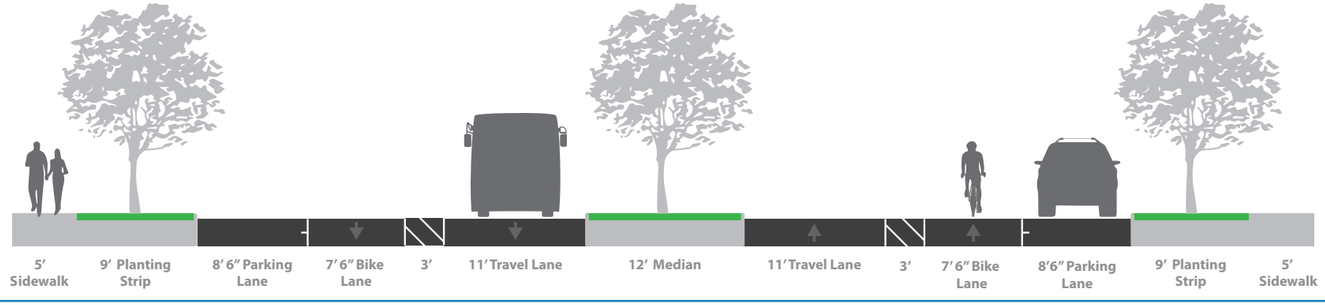
INTERSECTION TREATMENTS WILL BE REQUIRED TO SAFELY CROSS LABURNUM AND CONTINUE THE FACILITY NORTH.

Major intersections, like this one at Laburnum Ave will need to be designed to create clear distinctions between bike space and vehicle space and how to behave when sharing space.

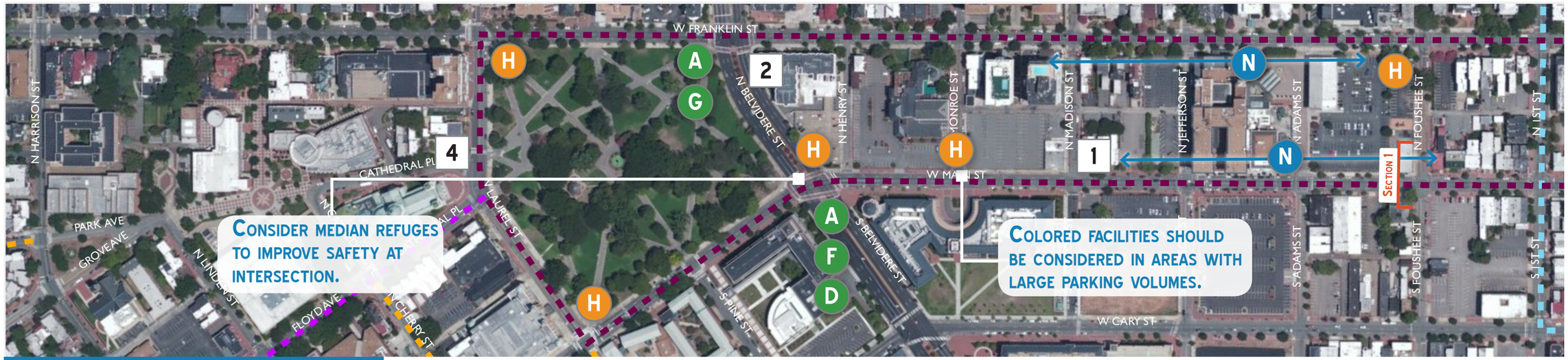
Commercial areas with multiple frequent driveways are hazardous to bicyclists. Attempts can be made to consolidate driveways and/or provide green lanes in these conflict areas.

RECOMMENDED CROSS SECTION FOR BROOK ROAD

SECTION 1: BROOK ROAD



Shared Use Path | Cycle Track | Buffered Bike Lane | Bike Lane | Contra Flow Bike Lane | Bike-Walk Street | Shared Lane



0 0.05 0.1 Miles

Recommendation Type *Cycle Track*

Franklin St & Main St (Couplet)

From: S Cathedral Place

To: N 9th Street

2.2 Miles

25 MPH

6600 - 9900 Average Daily Traffic

Primary Land Uses

Residential, Commercial, Park

Score: 27/26

Reason for Priority Ranking

- Key Connection to Floyd bicycle boulevard
- Establishes two strong downtown corridors that act as a couplet
- Connects Monroe Park, the Public Library, and additional important destinations to downtown

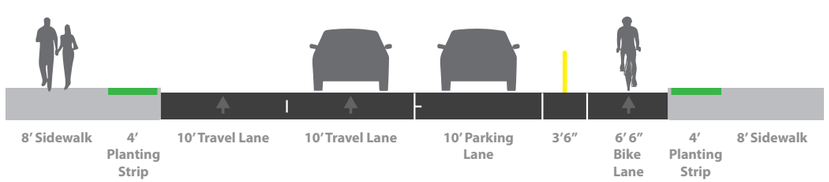
Planning Level Cost Estimate: $188,251

Photo of Typical Conditions

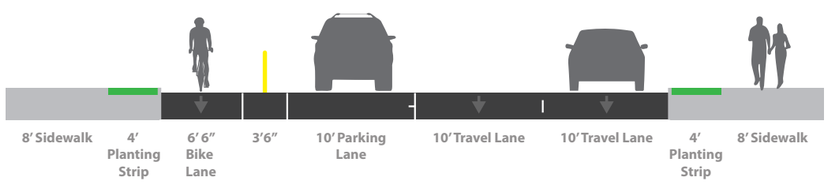
Two 10 ft lanes with 10 ft intermittent on-street parking and turning lanes. There are 8 ft sidewalks with street trees on either side.

Recommended Cross Section

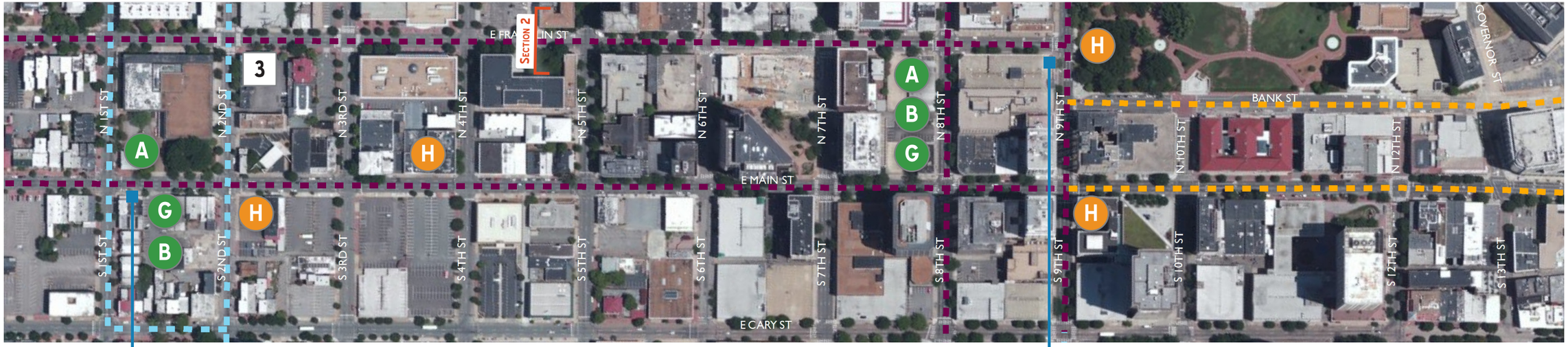
Section 1: Main Street



Section 2: Franklin Street



FRANKLIN ST. 7 MAIN ST. CONTINUED



AT INTERSECTIONS WHERE BICYCLE FACILITIES INTERSECT SPECIAL TREATMENTS SHOULD BE CONSIDERED TO IMPROVE SAFETY AND WAYFINDING.

COLORED MARKING SHOULD BE USED AT THE UNUSUAL CONNECTION BETWEEN FRANKLIN AND BANK STREETS VIA 9TH STREET TO IMPROVE VISIBILITY AND SAFETY.

KEY AREAS TO ANALYZE

Special attention will need to be paid where the VCU campus starts along Franklin & Main Streets. Bicyclists will likely be entering the campus at multiple junctures and access conflicts may become an issue.

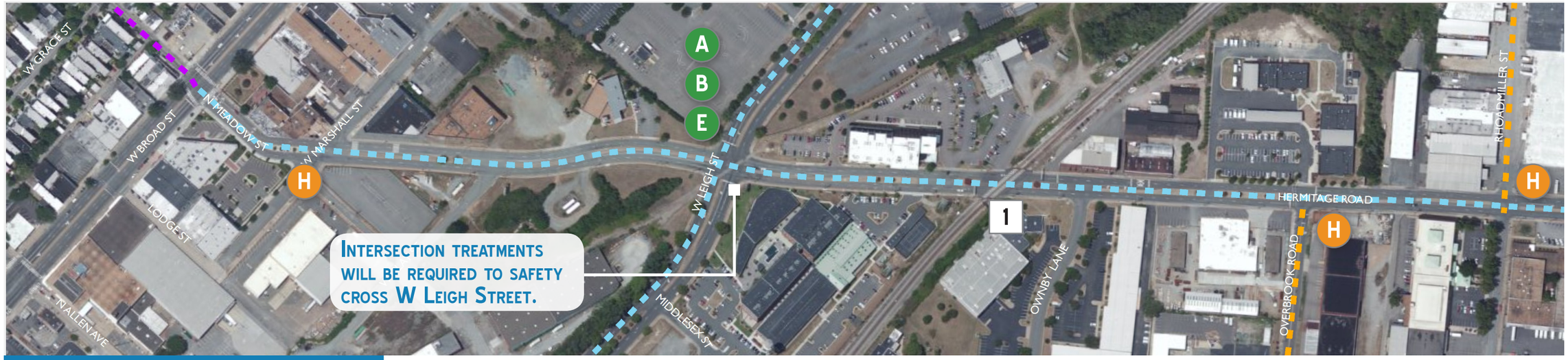
Combo bike/turn lanes or bike boxes will need to be used at major intersections or at intersections with multiple conflicts.

The intersection of N Franklin St and N Belvidere St is a great example of where and how to implement a median refuge.

The large intersection at S Cathedral Place and N Laurel Street will require intersection treatments to improve safety and awareness.

RICHMOND Bicycle Master Plan

Shared Use Path | Cycle Track | Buffered Bike Lane | Bike Lane | Contra Flow Bike Lane | Bike-Walk Street | Shared Lane



0 0.05 0.1 Miles

RECOMMENDATION TYPE BUFFERED BIKE LANE

HERMITAGE ROAD
FROM: BROOKLAND PARKWAY
TO: W BROAD STREET

1.5 MILES
25 MPH
35 MPH
2000-10000 AVERAGE DAILY TRAFFIC

PRIMARY LAND USES
INDUSTRIAL & COMMERCIAL

SCORE: 21

REASON FOR PRIORITY RANKING

- Functions as the primary north-south corridor
- Provides access to The Diamond and Sports Backers Stadiums and the northside neighborhoods

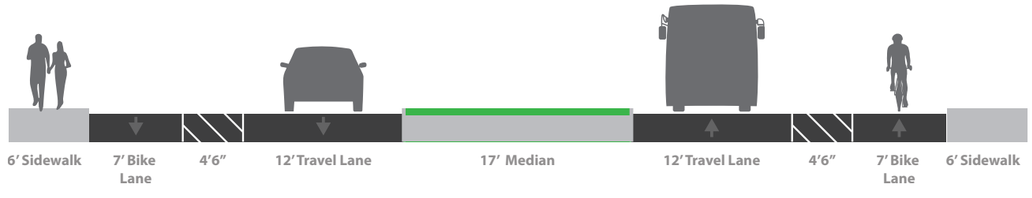
PLANNING LEVEL COST ESTIMATE: $85,461

PHOTO OF TYPICAL CONDITIONS

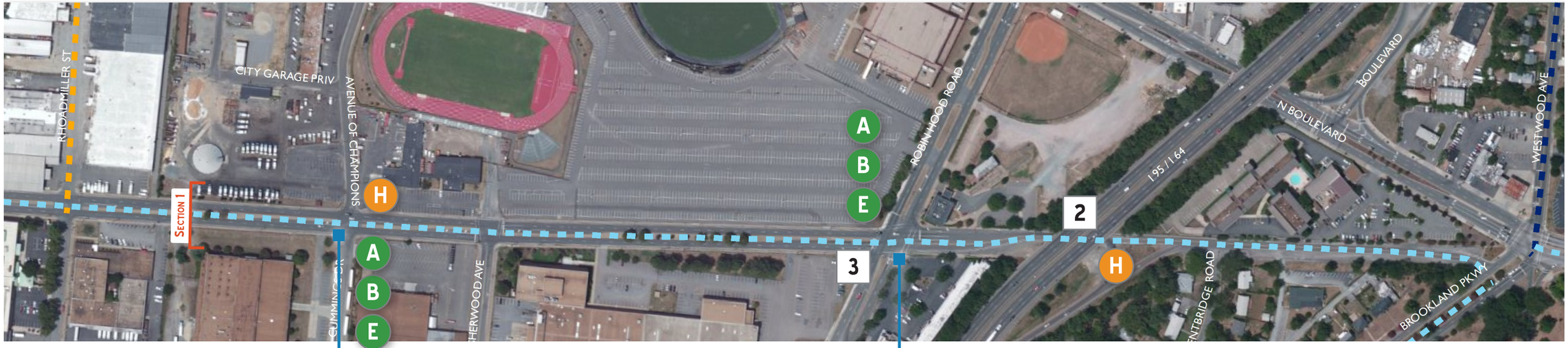
Existing conditions include two travel lanes in each direction, approximately 10' wide each, a 17' concrete median with intermittent turn lanes, and a narrow shoulder between the right lane and gutter pan.

RECOMMENDED CROSS SECTION

SECTION 1: HERMITAGE ROAD



HERMITAGE ROAD CONTINUED



INTERSECTION TREATMENTS WILL BE REQUIRED TO IMPROVE INTERSECTION SAFETY DURING SPORTING OR OTHER EVENTS WHEN VEHICULAR TRAFFIC IS CONGESTED.

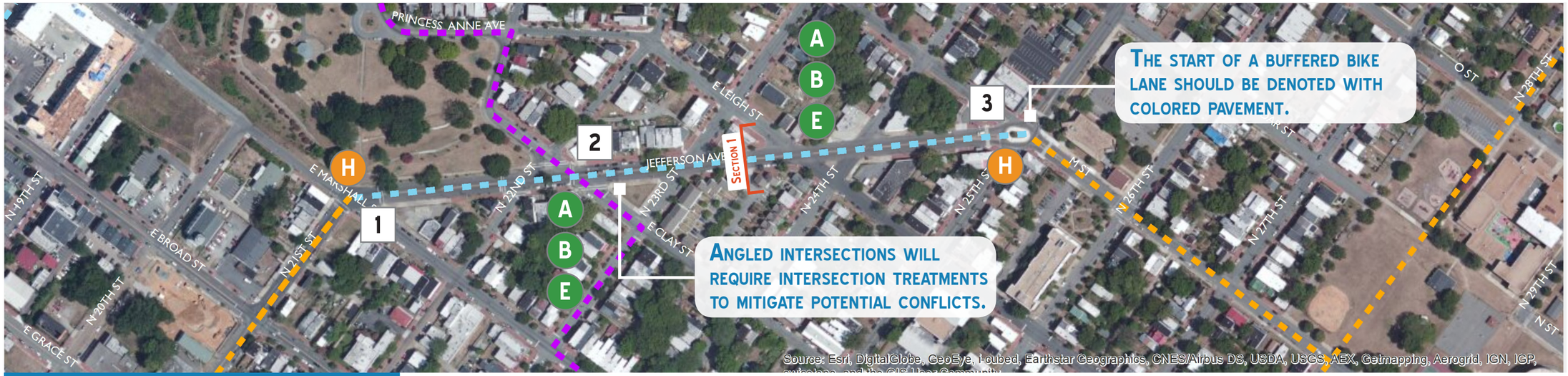
KEY AREAS TO ANALYZE

The railroad crossing along Hermitage will require special treatments to improve comfort and safety when crossing.

The I-95 underpass has reduced visibility and reduced shoulders due to the bridge pillars. Lighting, colored bicycle facilities, and signage should be considered to improve the safety and visibility of bicyclists.

Safety will be critical when crossing Robin Hood Rd. Intersection treatments such as striping through the intersection will improve visibility and awareness.

Shared Use Path | Cycle Track | Buffered Bike Lane | Bike Lane | Contra Flow Bike Lane | Bike-Walk Street | Shared Lane



0 0.05 0.1 Miles

RECOMMENDATION TYPE BUFFERED BIKE LANE

JEFFERSON AVENUE
FROM: M STREET
TO: E MARSHALL STREET

0.3 MILES
25 MPH
4400 AVERAGE DAILY TRAFFIC

PRIMARY LAND USES
RESIDENTIAL, PARK, COMMERCIAL

SCORE: 23

REASON FOR PRIORITY RANKING

- Provides access to Jefferson Park
- Important connection from Shockoe Bottom to northern Church Hill and Union Hill
- Numerous angled street intersections: Improved bicycle facilities will increase the safety and access of this corridor

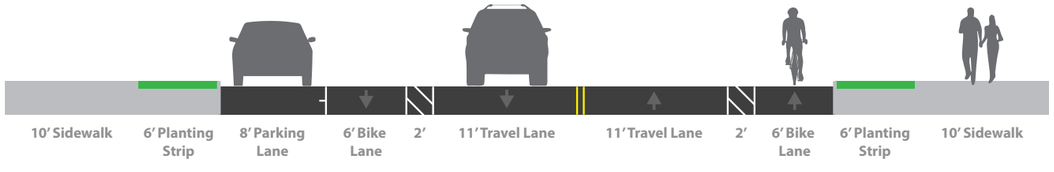
PLANNING LEVEL COST ESTIMATE: $19,629

PHOTO OF TYPICAL CONDITIONS

Two 23 ft lanes with intermittent on-street parking. Both sides have 12 ft sidewalks and 6 ft vegetative strips with street trees.

RECOMMENDED CROSS SECTION

SECTION 1: JEFFERSON AVENUE



KEY AREAS TO ANALYZE

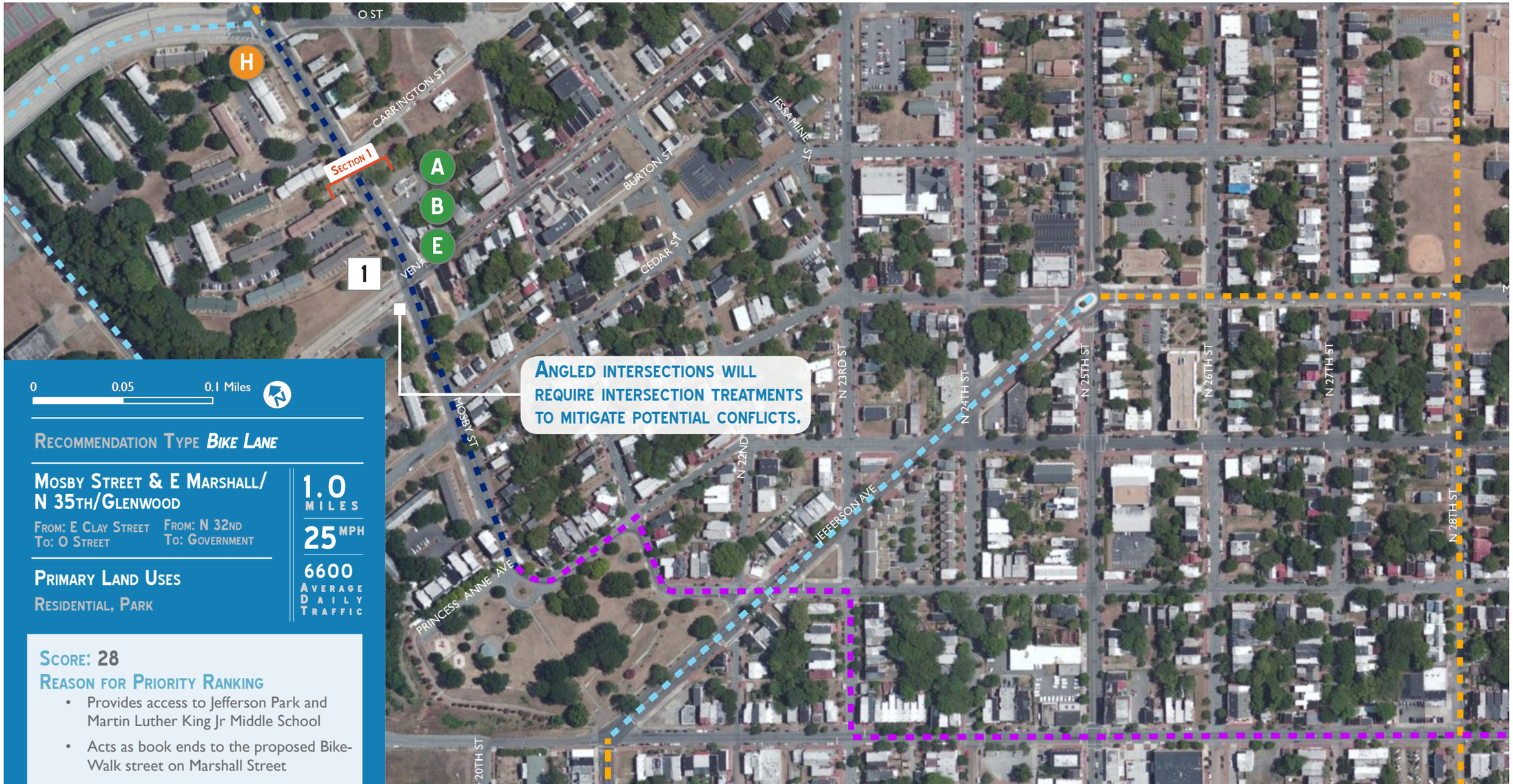
Entrances to Jefferson Park should seamlessly coordinate with proposed bicycle facilities.

The start of the buffered bike lane should be colored to promote visibility and awareness.

Angled intersections throughout Jefferson Avenue will require special treatments to improve wayfinding, visibility, and safety for bicyclists.

RICHMOND
Bicycle Master Plan

Shared Use Path | Cycle Track | Buffered Bike Lane | Bike Lane | Contra Flow Bike Lane | Bike-Walk Street | Shared Lane



0 0.05 0.1 Miles

RECOMMENDATION TYPE *BIKE LANE*

MOSBY STREET & E MARSHALL/ N 35TH/GLENWOOD

FROM: E CLAY STREET
TO: O STREET

FROM: N 32ND
TO: GOVERNMENT

1.0 MILES

25 MPH

6600 AVERAGE DAILY TRAFFIC

PRIMARY LAND USES

RESIDENTIAL, PARK

SCORE: 28

REASON FOR PRIORITY RANKING

- Provides access to Jefferson Park and Martin Luther King Jr Middle School
- Acts as book ends to the proposed Bike-Walk street on Marshall Street
- Connects Union Hill and Church Hill to MLK (Leigh Street) Bridge and downtown

PLANNING LEVEL COST ESTIMATE: $36,440

PHOTO OF TYPICAL CONDITIONS

Two lanes with intermittent on-street parking. Portions of the sidewalks have a vegetative strip, vary between 5 and 10 feet, and are constructed of bricks in some sections.

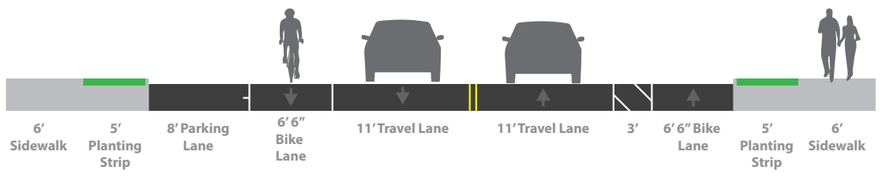
KEY AREAS TO ANALYZE

The intersection at Venebale Street is angled and has wide lanes. Intersection treatments such as bike boxes, intersection crossings, and a road diet along Mosby Street would improve safety and wayfinding.

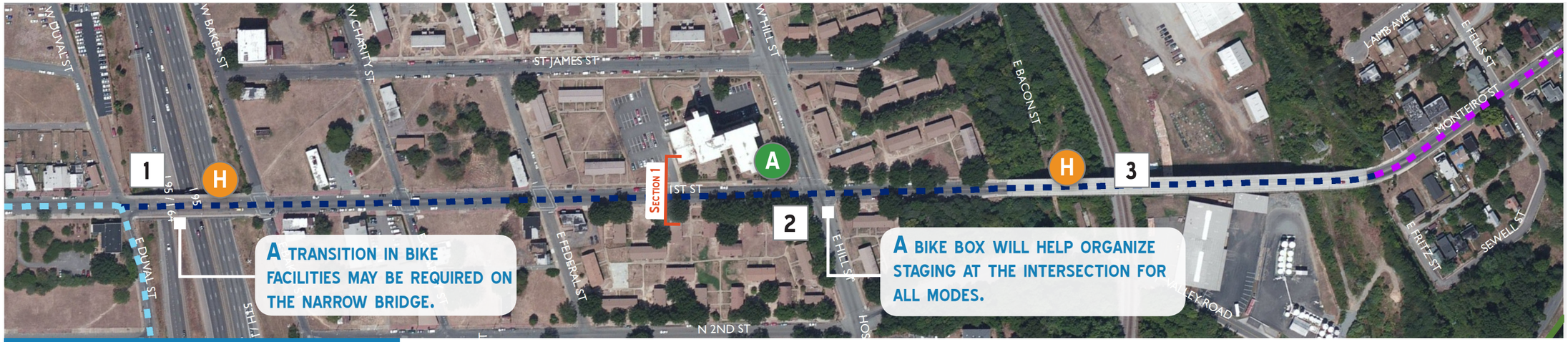
The transition from a bike lane to a bike/walk street should include various green street and traffic calming treatments to improve roadway safety and accessibility.

RECOMMENDED CROSS SECTION

Section 1: Mosby Street



Shared Use Path | Cycle Track | Buffered Bike Lane | Bike Lane | Contra Flow Bike Lane | Bike-Walk Street | Shared Lane



0 0.05 0.1 Miles

RECOMMENDATION TYPE *BIKE LANE*

N 1ST STREET

FROM: MONTEIRO STREET

TO: E DUVAL STREET

0.6 MILES

25 MPH

PRIMARY LAND USES

RESIDENTIAL

3700 AVERAGE DAILY TRAFFIC

SCORE: 24

REASON FOR PRIORITY RANKING

- Key connection across the railroad and I-95
- Provides access to downtown for residential areas N of I-95

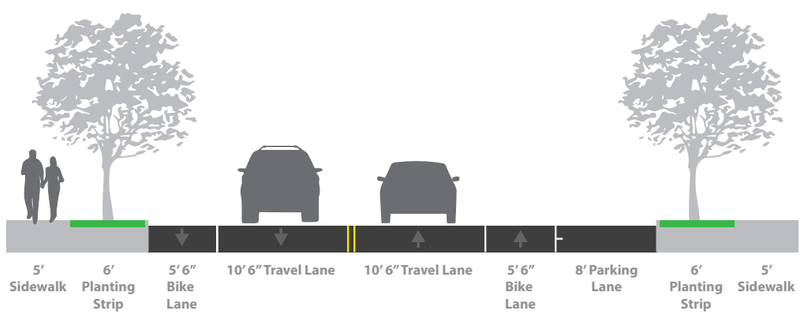
PLANNING LEVEL COST ESTIMATE: $20,922

PHOTO OF TYPICAL CONDITIONS

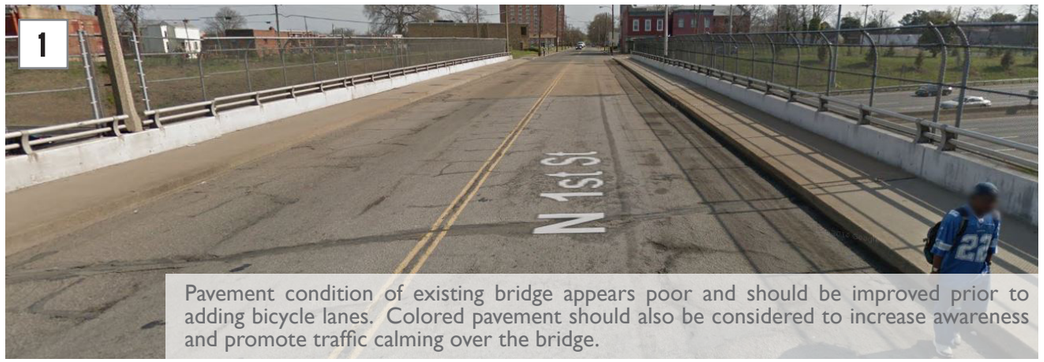
Two 20 ft lanes with intermittent on-street parking and transit stops. The corridor has 5 ft sidewalks with 6 ft vegetative strips and intermittent street trees.

RECOMMENDED CROSS SECTION

SECTION 1: NORTH FIRST STREET



KEY AREAS TO ANALYZE



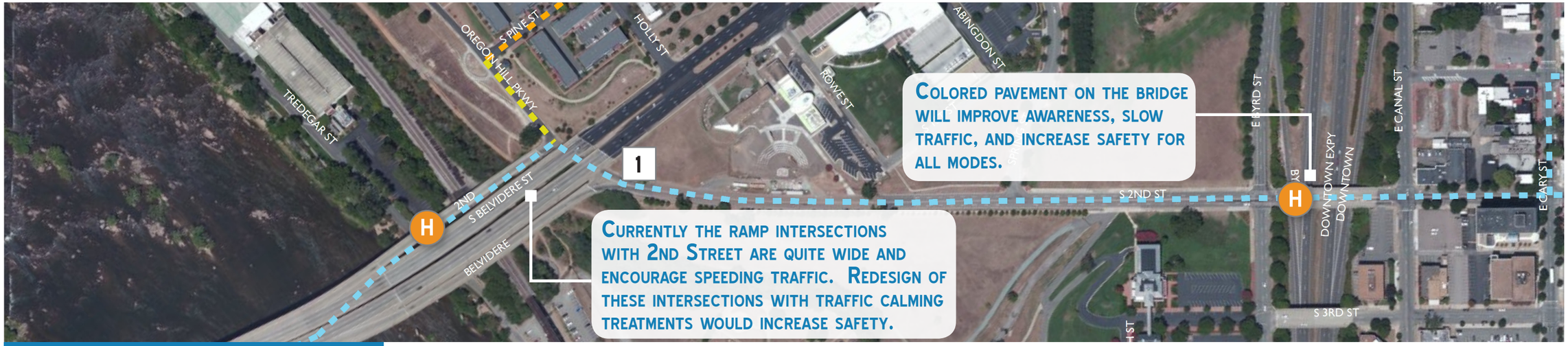
Pavement condition of existing bridge appears poor and should be improved prior to adding bicycle lanes. Colored pavement should also be considered to increase awareness and promote traffic calming over the bridge.

Bike lanes may need to reduce width or sharrows may be needed to provide a route across this narrow bridge. All grates should be upgraded to a diagonal or perpendicular design to improve the safety of bicyclists.

Further analysis needs to be conducted on bus stop location at intersections. The example at the Hill Street intersection creates a conflict with the proposed bicycle lane and can also reduce bicyclists comfort and perceived safety. The bus stop and bench may need to be moved to the far side of the intersection or moved further back from the stop bar to increase safety.

RICHMOND Bicycle Master Plan

Shared Use Path | Cycle Track | Buffered Bike Lane | Bike Lane | Contra Flow Bike Lane | Bike-Walk Street | Shared Lane



0 0.05 0.1 Miles

RECOMMENDATION TYPE *BUFFERED BIKE LANE*

S 1ST ST & N 2ND ST (COUPLET)

FROM: E DUVAL STREET

TO: E CARY ST / S BELVIDERE ST

2.2 MILES

25 MPH
55 MPH

3700-7400 AVERAGE DAILY TRAFFIC

PRIMARY LAND USES

COMMERCIAL, RESIDENTIAL

SCORE: 28

REASON FOR PRIORITY RANKING

- Key connection for travelling North-South downtown
- Runs parallel to additional facilities to facilitate greater access downtown.
- Access to several important commercial and residential locations

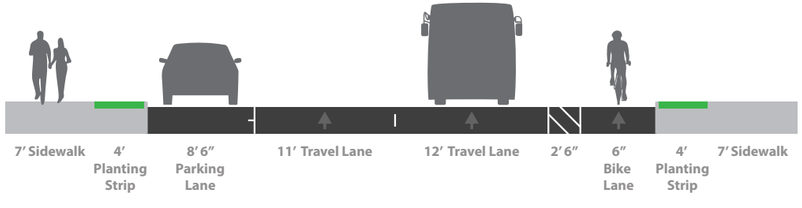
PLANNING LEVEL COST ESTIMATE: $125,906

PHOTO OF TYPICAL CONDITIONS

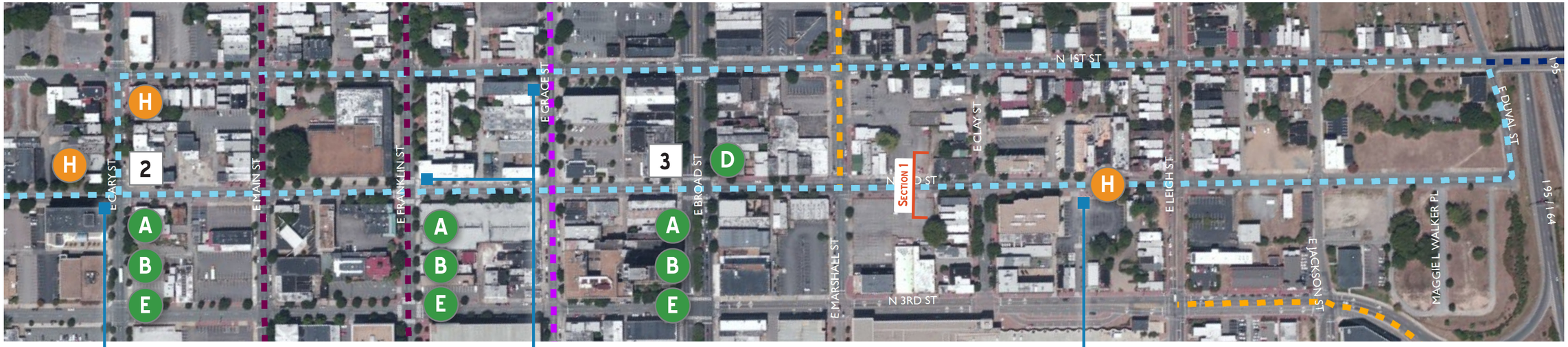
Currently two main travel lanes in the center (10' each) with 10' parking lanes on each side. Parking in the right hand curb lane is generally prohibited in peak hours to increase roadway capacity. There are 7 ft sidewalks and 4 ft vegetative strips.

RECOMMENDED CROSS SECTION

SECTION 1: SOUTH 1ST STREET & NORTH 2ND STREET



S 1ST ST. & N 2ND ST. CONTINUED



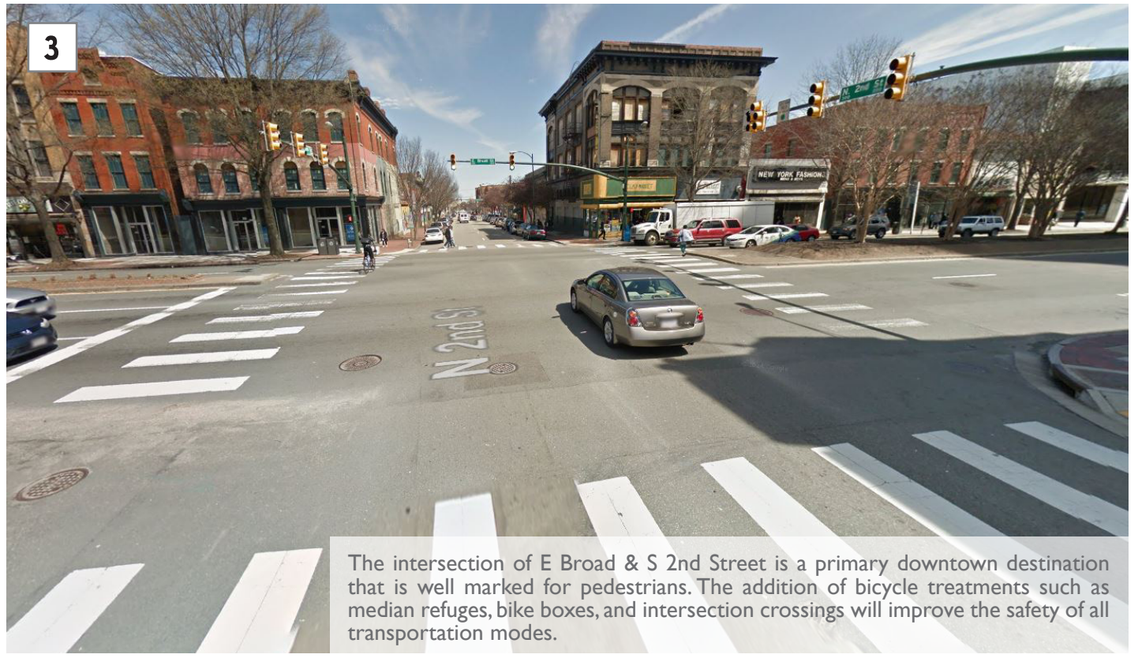
VARYING DEGREES OF INTERSECTION TREATMENTS WILL BE REQUIRED AT DOWNTOWN INTERSECTIONS.

COLORED PAVEMENT SHOULD BE USED AT ACCESS POINTS THAT HAVE A HIGH VOLUME OF PARKING.

KEY AREAS TO ANALYZE

The buffered bike lane may need to be reduced in width at the narrow interchange onto the bridge. Further analysis will need to be completed to design safe entrance for bicyclists onto the bridge.

The intersection of E Cary Street & S 2nd Street are where the parallel buffered bike lanes connect. Intersection treatments, colored pavement, and route signs should be used to improve wayfinding and awareness.



The intersection of E Broad & S 2nd Street is a primary downtown destination that is well marked for pedestrians. The addition of bicycle treatments such as median refuges, bike boxes, and intersection crossings will improve the safety of all transportation modes.

Shared Use Path | Cycle Track | Buffered Bike Lane | Bike Lane | Contra Flow Bike Lane | Bike-Walk Street | Shared Lane

0 0.05 0.1 Miles

RECOMMENDATION TYPE *BIKE LANE*

WESTWOOD AVE
FROM: W BROAD STREET
TO: HERMITAGE ROAD

1.6 MILES

30 MPH
35 MPH

6400-12000 AVERAGE DAILY TRAFFIC

PRIMARY LAND USES
RESIDENTIAL, COMMERCIAL

SCORE: 24

REASON FOR PRIORITY RANKING

- Provides access to the Richmond Technical Center, and the United Methodist Family Services of VA Campuses
- Provides direct connection from northside neighborhoods to commercial and residential areas in the west end

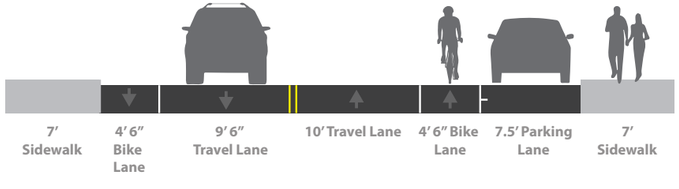
PLANNING LEVEL COST ESTIMATE: $59,164

PHOTO OF TYPICAL CONDITIONS

Two 9 ft eastbound lanes and one 18 ft westbound lane with intermittent on-street parking. The corridor changes cross section after the interchange with Saunders Rd and the railroad overpass.

RECOMMENDED CROSS SECTION

SECTION 1: WESTWOOD AVENUE

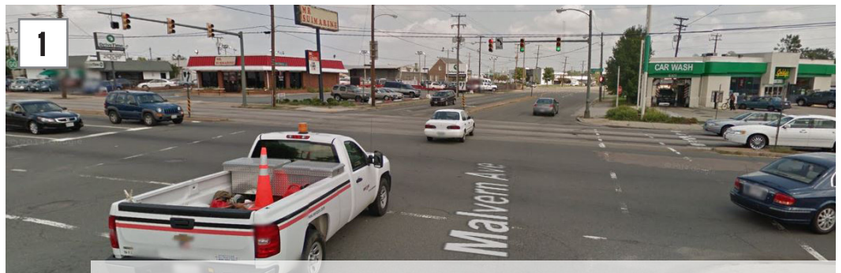


This section of Westwood Avenue from W Broad Street to Hermitage Road is an important corridor, connecting north side neighborhoods to the commercial and residential districts on the west end. Due to limited right-of-way, a bicycle lane is recommended from Hermitage to the train tracks/overpass; however, a buffered or protected bicycle facility may be more appropriate due to traffic speed, volume, and potential truck traffic along the corridor. Further study is needed by the City of Richmond to assess the feasibility of implementing a protected bicycle facility along this section of Westwood Avenue.

Additionally, W Broad Street to the train tracks/overpass exists within Henrico County and varies considerably. Coordination with Henrico County and VDOT staff is recommended prior to assessing existing conditions and producing a recommended cross section for this portion of the corridor. As such, a recommended cross section was only developed for Westwood Avenue from Hermitage Road to the train track/overpass.

WESTWOOD AVE. CONTINUED

KEY AREAS TO ANALYZE



W Broad Street is a busy intersection with high daily traffic. Intersection treatments such as bike boxes, intersection crossings, through bike lanes, and colored pavement will improve the safety and accessibility of the crossing.

Transitions will be needed throughout this route as the cross section and lane widths change multiple times.

COLORED PAVEMENT CAN BE USED TO IMPROVE AWARENESS IN RESIDENTIAL AREAS WITH PRIVATE DRIVEWAYS THAT HAVE REDUCED VISIBILITY DUE TO INTERMITTENT STREET PARKING.

RICHMOND
Bicycle Master Plan

4 Implementation Strategies

OVERVIEW

This chapter defines a structure for managing the implementation of the *2015 Richmond Bicycle Master Plan*. Creating an interconnected and coherent bicycle network requires a long-term commitment and a comprehensive vision that are beyond the often times ad-hoc, piecemeal approach. Just as localities plan for their network of roadways, parks, utilities, etc., they should also plan for a bicycle network. Implementing the recommendations within this plan will require leadership and dedication to bicycle facility 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 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. Funding resources that may be available to Richmond are presented in Appendix C of this plan.

Given the present day economic challenges faced by local governments (as well as state, federal, and private sector partners), it is difficult to know which financial resources will be available at different time frames during the implementation of this plan. There are still important actions to take in advance of major investments though, including key organizational steps, the initiation of education and safety programs, and the development of strategic, lower-cost on-road bicycle facilities. Following through on these priorities will allow the key stakeholders to prepare for the development of the network over time while taking advantage of strategic opportunities as they arise.

Key action steps are typically segmented into three categories: policies, programs, and infrastructure. Since policy and programming are not components of this plan, future steps by City Staff will need to be initiated to funnel the implementation steps from this plan into an overall action table aimed at the successful creation of an environment that is safe and comfortable for biking. The table on page 4-8 summarizes implementation action steps, along with all other recommendations made throughout the plan, and defines recommended actions, responsible agencies, and phasing.

KEY ACTION STEPS

While this plan focuses mainly on implementation, policy and programming highlights are included to provide some guidance for Virginia communities, including Richmond. The city should plan to evaluate policy and bicycle related programming to complete their efforts to build a more bicycle-friendly environment.

Policy Action Steps

The Virginia Department of Transportation (VDOT) initiates all projects with the assumption that bicycle and walking accommodations will be included. VDOT provides the following factors for a project that support these accommodations:

- Is the facility identified in an adopted transportation or related plan?
- Does it accommodate existing and future bicycle and pedestrian use?
- Does it improve or maintain safety for all users?

CHAPTER CONTENTS

- Does the facility provide a connection to public transportation services and facilities?
- Does the facility serve areas or population groups with limited transportation options?
- Does the facility provide a connection to bicycling and walking trip generators such as employment, education, retail, recreation, residential centers, and public facilities?
- Is it identified in a Safe Routes to School program or provides a connection to a school?
- Does it provide a regional connection or is it of regional or state significance?
- Does the facility provide a link to other bicycle and pedestrian accommodations?
- Does the facility provide a connection to traverse natural or man-made barriers?
- Does the facility provide a tourism or economic development opportunity?

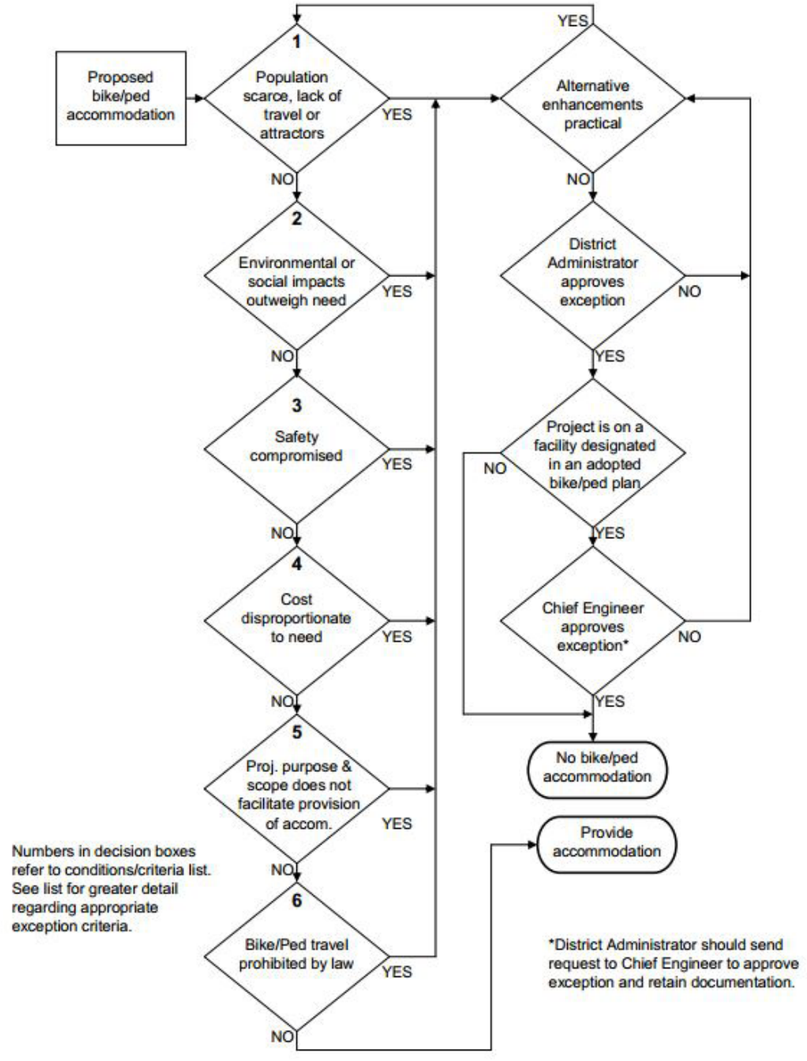
The Commonwealth Transportation Board's policy on bicycle accommodations is that all construction projects start with the assumption that some accommodation will be provided. Exceptions to this policy are:

Policies promoting the inclusion of bicycle facilities on new and existing bridges can help close gaps like this one on Grove Ave.

1. Scarcity of population, travel, and attractors, both existing and future, indicate an absence of need for such accommodations.
2. Environmental or social impacts outweigh the need for these accommodations.
3. Safety would be compromised by the accommodations.
4. Total cost of bicycle and pedestrian accommodations to the appropriate fund (i.e., interstate, primary, secondary, or urban system) would be excessively disproportionate to the need for the facility.
5. Purpose and scope of the specific project do not facilitate the provision of such accommodations (e.g., projects for the Rural Rustic Road Program are defined as paving unpaved (gravel) roads, which are considered to be a bicycle accommodation).
6. Bicycle and pedestrian travel is prohibited by state or federal law.

A flow chart of VDOT's Bicycle and Pedestrian Accommodation Decision for Construction Projects has been included for reference. The decision tree is initially applied to projects at the scoping stage and again at a point where sufficient information is available to determine if cost and environmental exceptions are met or if new information invalidates scoping stage assumptions.

Figure 4-1: Bicycle and Pedestrian Accommodation Decision Process



Additionally, VDOT recognizes the importance of incorporating bicycle facilities into zoning bylaws and ordinances. They provide the examples of:

- Zoning requirements — in a simple requirement situation, a zoning bylaw could define how many bicycle parking spaces would be required per 1,000 square feet of space (or other relevant measure, such as seats, beds, or classrooms). These requirements would have to be

met before the regulatory body grants an occupancy permit. For example, both Gloucester and York Counties have developed requirements for bicycle parking facilities within their parking ordinances.

- Development guidelines — within the zoning process, design guidelines provide a mechanism for a locality to discuss adjustments to a proposed development plan with the developer. These discussions and negotiations generally occur when the developer submits site plans for approval and/or requests a special permit. During this process, the locality can suggest and/or require measures to accommodate bicycle travel and use.
- Subdivision regulations — subdivision regulations could include specific requirements for inclusion of bicycle facilities depending on the size and density of the proposed development. These requirements could vary from inclusion of a shared use path through the development to bicycle lanes on proposed streets.

For the development of bicycle parking policy, Richmond can refer to Cambridge, Massachusetts as a case study. Cambridge, provides guidance for bicycle parking in their Zoning Ordinances. They define parking as follows:

- Long-Term Bicycle Parking shall be located within an enclosed, limited-access area designed so as to protect bicycles from precipitation and from theft. Long-Term Bicycle Parking shall be intended primarily to serve residents, employees, or other persons who would require storage of a bicycle for a substantial portion of the day, for an overnight period, or for multiple days; however, it may serve other bicycle users as needed. Long-Term Bicycle Parking may be provided within the following types of facilities:
  - Enclosed spaces within a building, such as bicycle rooms or garages.
  - Bicycle sheds, covered bicycle cages, or other enclosed structures designed to provide secure and fully covered parking for bicycles.
  - Bicycle lockers, or fixed-in-place containers into which single bicycles may be securely stored and protected.
  - Weather-protected bicycle parking spaces that are monitored at all times by an attendant or other security system to prevent unauthorized use or theft.
- Short-Term Bicycle Parking shall be located in a publicly accessible space near pedestrian entrances to the uses they are intended to serve. Short-Term Bicycle Parking shall be intended primarily to serve visitors, such as retail patrons, making trips of up to a few hours to a particular use; however, it may serve other bicycle users as needed. Short-Term Bicycle Parking may be provided adjacent to public streets and sidewalks, or in some cases within the public right of way.

Cambridge also provides guidance for the amount of bicycle parking per land use category as seen in table 4-1 to the right. "Categories" refer to land use categories and are followed by residential and non-residential uses as well as minimum parking rates. The full ordinance update can be found here: http://www.cambridgema.gov/cdd/projects/planning/~/media/E555613476974 4E09C9BB99748C70F06.ashx.

Table 4-1: Cambridge Short and Long-Term Bicycle Parking Requirements by Land Use

Category	Included Residential Uses	Min. Long-Term Bicycle Parking Rate
R1	Single-family dwellings, existing single-family dwellings converted for two families, two-family dwellings, rectory or parsonage	No minimum
R2	Townhouse dwellings, multifamily dwellings, trailer park or mobile home park	1.00 space per dwelling unit for the first twenty (20) units in a building; 1.05 spaces per dwelling unit for all units over twenty (20) in a building
R3	Elderly oriented housing, elderly oriented congregate housing	0.50 space per dwelling unit
R4	Group housing, including: lodging houses, convents or monasteries, dormitories, fraternities and sororities	0.50 space per bed
R5	Transient accommodations, including: tourist houses in an existing dwelling, hotels, motels	0.02 space per sleeping room

Category	Included Non-Residential Uses	Min. Long-Term Bicycle Parking Rate
N1	Offices, including: medical, professional, agencies, general, government; radio/television studios, arts/crafts studios	0.30 space per 1,000 square feet
N2	Technical offices, research facilities	0.22 space per 1,000 square feet
N3	Hospitals and clinics; veterinary clinics; public safety facilities; restaurants and eating establishments	0.20 space per 1,000 square feet
N4	Retail stores, consumer service uses, commercial recreation and entertainment	0.10 space per 1,000 square feet
N5	Transportation and utility uses; religious and civic uses; manufacturing, storage and other industrial uses, auto-related uses	0.08 space per 1,000 square feet
E1	Primary or secondary schools, vocational schools	0.30 space per classroom or 0.015 space per auditorium seat, whichever is greater
E2	College or university facilities (excluding residences)	0.20 space per 1,000 square feet
P	Automobile parking lots or parking garages for private passenger cars	1.00 space per 10 motor vehicle parking spaces

Category	Included Residential Uses	Min. Short-Term Bicycle Parking Rate
R1	Single-family dwellings, existing single-family dwellings converted for two families, two-family dwellings, rectory or parsonage	No minimum
R2	Townhouse dwellings, multifamily dwellings, trailer park or mobile home park	0.10 space per dwelling unit on a lot
R3	Elderly oriented housing, elderly oriented congregate housing	0.05 space per dwelling unit
R4	Group housing, including: lodging houses, convents or monasteries, dormitories, fraternities and sororities	0.05 space per bed
R5	Transient accommodations, including: tourist houses in an existing dwelling, hotels, motels	0.05 space per sleeping room

Category	Included Non-Residential Uses	Min. Short-Term Bicycle Parking Rate
N1	Convenience and food stores, restaurants and eating establishments, theaters and commercial recreation	1.00 space per 1,000 square feet
N2	Retail stores and consumer service establishments	0.60 space per 1,000 square feet
N3	Passenger transportation; religious and civic uses; government offices, medical offices and clinics, agency offices, banks (ground floor only); veterinary clinics	0.50 space per 1,000 square feet
N4	Hospitals and infirmaries	0.10 space per 1,000 square feet
N5	Non-passenger transportation and utility uses; laboratories and research facilities; general, professional and technical offices; radio/television and arts/crafts studios; manufacturing, storage and other industrial uses; auto-related uses	0.06 space per 1,000 square feet
E1	Primary or secondary schools	1.70 space per classroom or 0.085 space per auditorium seat, whichever is greater
E2	College or university academic or administrative facilities	0.40 space per 1,000 square feet
E3	College or university student activity facilities	1.00 space per 1,000 square feet
P	Automobile parking lot or parking garage for private passenger cars (6.36.2 b)	No additional requirement for Short-Term Bicycle Parking; however, if motor vehicle parking is provided on an open lot, then required Long-Term Bicycle Parking Spaces may be converted to Short-Term Bicycle Parking Spaces.

Many other communities, including the Capitol Area Metropolitan Organization (Raleigh, NC area), require within their Unified Development Ordinances (UDO) for Subdivision that on-road facilities are added on any thoroughfare or collector when widened, improved, extended, or constructed due to private development. Other communities, like Apex, NC, require within their UDO that a greenway be provided to connect to the network of paths within the city.

While not a component of this study, further research and communication with similar cities can provide a foundation for review and modification to Richmond's zoning and development ordinances to enable City Staff to craft revisions that will support the vision for safe, well-connected bikeways.

Program Action Steps

Equally as important as providing bicycle and pedestrian infrastructure is educating users about facility types, how to safely use them, and how to interact with motorists. Education programs targeting the University community are recommended to complement existing efforts at the city level. Similar to education programs, encouragement programs can provide incentives and benefits to the public for trying bicycling as a mode of transportation.

While the purpose of this plan does not include a full analysis of existing programs and development of new initiatives, it is critical for the city to evaluate existing programs, plan for new programs, and develop a concise document that details and tracks programming efforts by the city and other parties that are working toward a more bicycle friendly Richmond.

Infrastructure Action Steps

While establishing the policies and programs described above, Richmond should move forward with the design and construction of priority projects. They should also work to identify funding for long-term, higher-cost projects.

COMPLETE SHORT-TERM PRIORITY PROJECTS

The City of Richmond will demonstrate its commitment to carrying out this Plan by quickly moving forward on priority projects in the near future. Furthermore, doing so will better sustain the enthusiasm generated during the public outreach stages of the planning process. Refer to Chapter 3 for priority project rankings and the prioritization methodology.

IDENTIFY FUNDING

Achieving the vision 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 bicycle 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 municipal, state, and federal partners to generate funds sufficient to implement the network.

The ability of local agencies to generate a source of funding for bicycle facilities 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 facilities.

Federal and state grants should be pursued along with local funds to pay for necessary ROW acquisition and project design, construction, and maintenance expenses. "Shovel-ready" designed projects should be prepared in the event that future federal stimulus funds become available. A more in-depth discussion of funding sources can be found in Appendix C.

PERFORMANCE MEASURES

The City of Richmond should establish performance measures to benchmark progress toward fulfilling the recommendations of this Plan. These performance measures should be stated in an official report within two years after the Plan is adopted. Performance measures should align with the goals of the plan. An initial list of objectives and performance measures are below and summarize and support the detailed metrics from Chapter One.

Table 4-2: Initial Performance Measures for the City of Richmond

Goal	Objectives	Performance Measure
Ridership	Increase outreach and education about the social, economic, and health benefits of bicycling Increase bicycle mode share Encourage and support activities and groups that will improve the bicycling culture of Richmond	Business and universities designated as Bicycle Friendly by the League of American Bicyclists Total funding dedicated to bicycle related programming Number of schools participating in bicycle safety education/encouragement programs Bicycle mode share Bicycle counts Number of advocacy groups promoting bicycling
Safety	Reduce cyclists crashes and fatalities Engage law enforcement in bicycle safety Improve cyclists and driver compliance with traffic laws	Bicyclists crash and fatality rates per capita Percentage of police department that has completed bicycle education courses Number of citations related to bicycle safety violations by bicyclists and motorists
Connectivity	Increase connections between neighborhoods, schools, and businesses Integrate the Plan's vision and goals across departments and agencies Increase bicycle facilities	Bicycle Friendly Report Card - survey response to improvements in connectivity to where they live, work, and play Percentage of roadway projects (new and funded) that incorporate bicycle facilities or modify existing plans to include bicycle facilities Percentage of roadways that have designated or separated bicycle facilities Percentage of signalized intersections that have bicycle and pedestrian-friendly accommodations Percentage of bridges with bicycle facilities Total funding dedicated to the construction of bicycle facilities
Equity	Increase ridership for all races, ages, and genders Improve connections in areas with low vehicle ownership and socioeconomic status Improve resources for first time bicyclists	Bicycle mode share by demographic group Number of low vehicle ownership and low socioeconomic status neighborhoods with facility connections within the neighborhood Number of low vehicle ownership and low socioeconomic status neighborhoods with facilities connecting outside of the neighborhood Number of brochures, guides, or training events available to individuals who are interested or new to bicycling
Livability	Increase bicycle exercise and activity rates among all age groups Increase access to bicycle facilities Increase multimodal connections, i.e. bike facilities that intersect with transit routes	Reduction in transportation-related emissions from increase in bicycling trips Mileage of bicycle facilities per capita Average distance to a bicycle facility for a city resident Percentage of multimodal facilities connected with bicycle facilities Demand on bicycle rack facilities on GRTC buses Percentage of transit stops, park and ride locations, and parking garages with bicycle facilities

KEY PARTNERS IN IMPLEMENTATION

Role of the Richmond City Council

The Richmond City Council will be responsible for adopting this Plan. Through adoption, the City of Richmond's leadership is further recognizing the value of bicycle transportation and is putting forth a well-thought out set of recommendations for improving public safety and overall quality of life (see the 'Benefits of a Walkable and Bikeable Community' section starting on page 1-3). By adopting this Plan, the City Council is also signifying that they are prepared to support the efforts of other key partners in the Plan's implementation, including the work of city departments and VDOT.

Adoption of this plan is in line with public support. Richmond's online comment form for the bicycle planning process yielded over 2,700 responses and showed strong support for improving bicycling conditions. Though not a statistically valid survey, the comment form results do represent the opinions of hundreds of local residents. See appendix D for more information.

Role of the City of Richmond Planning Commission

The City of Richmond Planning Commission is responsible for the conduct of planning related to the orderly growth and development of the city, including adequate and appropriate resources for transportation, recreation, health, and welfare of its population. The Planning Commission should be prepared to become familiar with the recommendations of this Plan, and endorse the Plan for adoption.

Role of the City of Richmond Public Works Department

The Public Works Department handles the responsibility for the construction and maintenance of bicycle facilities on locally owned and maintained roadways. The department should be prepared to:

- Communicate and coordinate with other city departments and the Pedestrian Bicycle and Trails Commission on priority bicycle projects.
- Become familiar with the standards set forth in Appendix A of this plan, as well as state and national standards for bicycle facility design.
- Design, construct, and maintain bicycle facilities.
- Communicate and coordinate with bordering counties, the Richmond Area Metropolitan Planning Organization (MPO), and neighboring municipalities to incorporate city bicycle facilities into the regional network and to partner for joint-funding opportunities, such as a regional trail network.

Role of the City of Richmond Planning and Development Review

Planning and Development Reviews' planning staff will take primary responsibility for the contact with new development to implement the plan (with support from the Public Works Department). For example, the staff should be prepared to:

- Communicate and coordinate with local developers on adopted recommendations for bicycle facilities, including end-of-trip accommodations such as bicycle parking.
- Assist the Public Works Department in communicating with VDOT and regional partners.

Role of the Pedestrian, Bicycle, & Trails Commission

The Pedestrian, Bicycle, & Trails Commission was established in 2010 to provide advice to City Staff on ways to incorporate bicycling and walking as viable means of transportation in the City of Richmond. This group is available to review documents to make suggestions about improvements, vet future projects, and promote biking and walking in Richmond. The PBTC should be prepared to:

- Become familiar with the recommendations of this Plan and support its adoption and implementation.
- Become familiar with the phasing of facility recommendations and support City Staff in moving recommendations into feasibility studies and implementation projects.
- Take formal action to expand the responsibility of the Commission to include advising the Mayor, Council, City Administration, and public bodies (the City) on all aspects of Richmond's non-motorized transportation system. This may requiring forming a new body with a revised purpose, responsibilities, and formal structure.
- Provide support for public input for engineering and programmatic bicycle related projects.

Role of VDOT

VDOT is responsible for the construction and maintenance of pedestrian and bicycle facilities on VDOT-owned and maintained roadways in the City of Richmond, OR are expected to allow for the city to do so with encroachment agreements (depending on the facility type). VDOT should be prepared to:

- Recognize this Plan as an adopted plan of the City of Richmond and coordinate with the city to implement recommendations that affect VDOT maintained roadways (such as interstate ramps).
- Become familiar with facility recommendations that connect to or affect VDOT maintained roadways identified in this Plan (Chapter 3); take initiative in incorporating this Plan's recommendations into their schedule of improvements whenever possible.
- Become familiar with the standards set forth in Appendix A of this plan, as well as state and national standards for facility design; construct and maintain recommended facilities using the highest standards allowed by the State (including the use of innovative treatments on a trial-basis).
- If needed, seek guidance and direction from the VDOT Bicycle and Pedestrian Advisory Committee or the State or District Bicycle and Pedestrian Coordinator on issues related to this plan and its implementation.

Role of the City of Richmond Police Department

The City of Richmond Police Department is responsible for providing the community with the highest quality law enforcement service and protection to ensure the safety of the citizens and visitors to the city. The Police Department should be prepared to:

- Become experts on bicycle and pedestrian-related laws in Virginia (see: www.virginiadot.org/programs/bk-laws.asp).
- Continue to enforce not only bicycle-related laws, but also motorist laws that affect walking and bicycling, such as speeding, running red lights, aggressive driving, etc.
- Participate in bicycle-related education programs.
- Review safety considerations with the Public Works Department as projects are implemented.

Role of Developers

Developers in Richmond can play an important role in facility development whenever a project requires the enhancement of transportation facilities or the dedication and development of on-road bicycle facilities, trails, or crossing facilities. Developers should be prepared to:

- Become familiar with the benefits, both financial and otherwise, of providing amenities for bicycling (including trails) in residential and commercial developments.
- Become familiar with the standards set forth in Appendix A of this plan, as well as state and national standards for facility design.
- New developments should consider the proposed bicycle network outlined in this Plan to design linking facilities that encourage bicycling trips to and from the establishment.
- Add end-of-trip bicycle amenities such as short- and long-term bicycle parking, shower facilities, and lockers for residents, employees, customers, and visitors, as appropriate.
- Be prepared to account for bicycle circulation and connectivity in future developments.

Role of Local & Regional Stakeholders

Stakeholders for bicycle and pedestrian facility development and related programs, such as bordering counties, the Richmond Area MPO, Virginia Commonwealth University (VCU), and local economic development organizations play important roles in the implementation of this plan. Local and regional stakeholders should be prepared to:

- Become familiar with the recommendations of this Plan, and communicate & coordinate with the city for implementation, specifically in relation to funding opportunities, such as grant writing and developing local matches for facility construction.
- The MPO should work with the City of Richmond on populating the Transportation

Improvement Program (TIP) with pedestrian and bicycle infrastructure projects.

- Area counties should coordinate with the city on trail development and SRTS grants.
- VCU and local economic development groups, such as downtown organizations and chambers, should look for opportunities to partner on specific projects or comprehensive signage and wayfinding projects.

Role of Local Residents, Clubs and Advocacy Groups

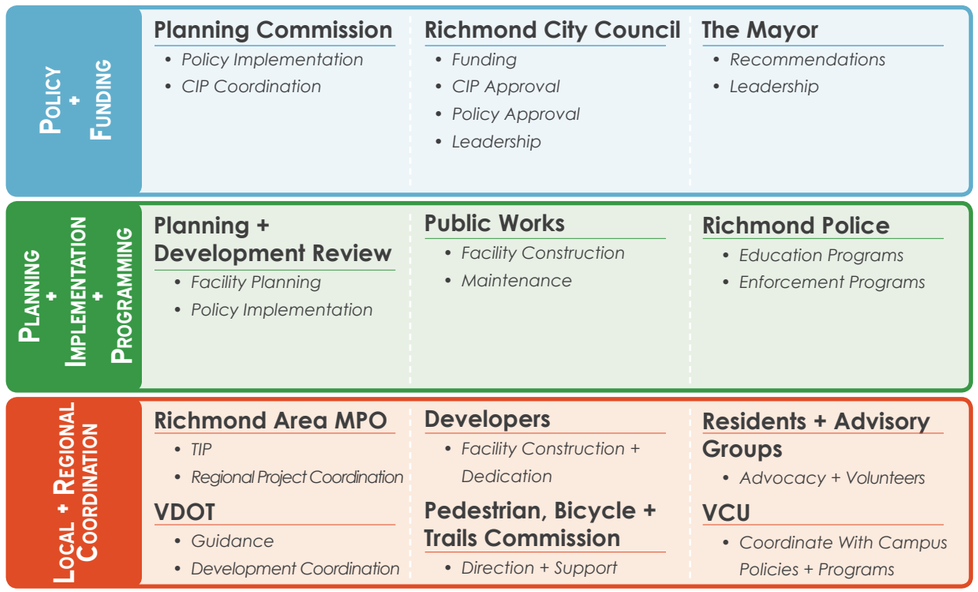
Local residents, clubs and advocacy groups play a critical role in the success of this plan. They should be prepared to:

- Continue offering input regarding bicycling issues in Richmond.
- Assist City of Richmond staff by volunteering for bicycle and pedestrian-related events and educational activities and/or participate in such activities.
- Assist City of Richmond staff by speaking at City Council meetings and advocating for local bicycle project and program funding.

Role of Volunteers

Services from volunteers, student labor, and seniors, or donations of material and equipment, may be provided in-kind, to offset construction and maintenance costs. Formalized maintenance agreements, such as adopt-a-trail/greenway or adopt-a-highway, can be used to provide a regulated service agreement with volunteers. Other efforts and projects can be coordinated as needed with senior class projects, scout projects, interested organizations, clubs or a neighborhood's community service. Advantages of utilizing volunteers include reduced or donated planning and construction costs, community pride, and personal connections to the city's bicycle network.

Figure 4-1: Organizational Framework for Implementation



COMMUNICATION, COLLABORATION, AND IMPLEMENTATION

This section describes how collaboration between departments can result in greater opportunities for implementing the proposed facilities in Chapter Three. Since many types of transportation facility construction and maintenance projects can be used to create new bicycle and pedestrian facilities, it is important to coordinate with VDOT and other city agencies to ensure that all applicable projects consider bicycle accommodations during the planning and design phases. It is much more cost-effective to provide bicycle and pedestrian facilities during roadway construction and re-construction projects than to initiate the improvements later as "retrofits."

To take advantage of upcoming opportunities and to incorporate bicycle facilities into routine transportation and utility projects, the City of Richmond should keep track of VDOT's projects and any other local transportation improvements. While doing this, City Staff should be aware of the different procedures for state and local roads and interstates.

VDOT Statewide Transportation Improvement Program

The Statewide Transportation Improvement Program (STIP) is an ongoing program at VDOT that is federally required every four-years to identify the transportation projects that will utilize federal transportation funding or will require approval from either the Federal Highway Administration (FHWA) or Federal Transit Administration (FTA). The transportation projects in the STIP must include all projects included in a Metropolitan Planning Organization (MPO) Transportation Improvement Program (TIP) as well as all federally funded projects in rural areas. The City of Richmond should actively work with VDOT to ensure that state planned roadway improvements routed through the municipality coordinate with the Plan and all opportunities to include bicycle facilities are considered during the planning and design phases.

Local Roadway Construction or Reconstruction

Bicyclists should be accommodated any time a new road is constructed or an existing road is reconstructed (as should pedestrians). In the longer-term, all new roads with moderate to heavy vehicle traffic should have sidewalks for pedestrians, bicycle facilities, and safe intersections. However, alternative paths can be an acceptable solution when a road with heavy vehicle traffic has few driveways and high-speed traffic.

Residential and Commercial Development

The construction of sidewalks, bicycle facilities, trails, and safe crosswalks should be required during development. Construction of bicycle facilities that corresponds with site development construction is more cost-effective than retro-fitting. In commercial development, emphasis should also be focused on safe pedestrian and bicyclist access into, within, and through large parking lots. This ensures the future growth of the bicycle network and the development of safe communities.

City Easements

The City of Richmond should explore opportunities to revise existing easements to accommodate public access greenway/path facilities. Similarly, as new easements are acquired in the future, the possibility of public access should be considered. Sewer easements are very commonly used for this purpose, offering cleared and graded corridors that easily accommodate trails. This approach avoids the difficulties associated with acquiring land while better utilizing the city's resources.

Repaving

Repaving projects provide a clean slate for revising pavement markings. When a road is repaved, the roadway can be restriped to create narrower vehicle travel lanes and provide space for bicycle lanes and shoulders, where feasible. In addition, if the spaces on the sides of non-curb and gutter streets have relatively level grades and few obstructions, the total pavement width can be widened to include paved shoulders.

Bus Routes and Stops

As the transit network evolves and expands to meet demand, it is important for bicycle facilities to be considered during route reorganization and transit station upgrades. The inclusion of existing and proposed bicycle facilities when planning route designations and stop locations will strengthen multimodal connectivity options, help avoid safety concerns, and reduce redundancy. Additionally, including bicycle parking to transit stop upgrades will strengthen the bicycle and transit connection and avoid retrofitting post upgrade.

Bridge Construction/Replacement

Provisions should always be made to include a walking and bicycling facility as a part of vehicular bridges, underpasses, or tunnels. All new or replacement bridges should accommodate two-way travel for all users. Even though bridge construction and replacement does not occur regularly, it is important to consider these policies for long-term bicycle and pedestrian planning. The VDOT State Bicycle Policy Plan states the following:

"In any case where a highway bridge deck is being replaced or rehabilitated with Federal financial participation, and bicyclists are permitted on facilities at or near each end of such bridge, and the safe accommodation of bicyclists can be provided at reasonable cost as part of such replacement or rehabilitation, then such bridge shall be so replaced or rehabilitated as to provide such safe accommodations."

A determination of providing sidewalks on one or both sides is made during the planning process. Facility design standards such as widths of facilities and heights of handrails are presented in Appendix A: Design Guidelines.

One-Way to Two-Way Street Conversion

In some cases, a one-way to two-way street conversion can create an opportunity to include bicycle facilities similar to local roadway reconstruction. In other cases, poorly planned conversions can negatively affect bicycle safety and access. Altering traffic patterns can create safety and connectivity issues or render current or proposed facilities obsolete. Including bicycle considerations during the planning phases will address these issues and avoid retrofits.

Retrofit Roadways with new Bicycle and Pedestrian Facilities

There may be critical locations in the bicycle network that have bicycle safety issues or are essential links to destinations. In these locations, it may be justifiable to add new bicycle facilities before a roadway is scheduled to be repaved or reconstructed. In some other locations, it may be relatively easy to add sidewalks or to add extra pavement for shoulders, but other segments may require removing trees, relocating landscaping or fences, re-grading ditches or cut and fill sections. Retrofitting roadways with side paths creates similar challenges. Improvements in these locations are typically recommended in the long-term.

Some roads may require a "road diet" solution in order to accommodate bicycle facilities. Road diets involve reallocating motor vehicle travel lanes for the benefit of increasing roadway safety and efficiency for all users, and in some cases, increasing space for other uses such as parking, on-street bicycle facilities, sidewalks, and/or side paths. These are generally recommended only in situations where the annual average daily traffic (AADT) can be safely and efficiently accommodated with a reduced number of travel lanes. However, when considering how a road diet might affect road capacity, it is important to keep in mind that bicycle facilities may increase roadway capacity by allowing a greater number of total vehicles - including bicycles - to move along the roadway in a given time period. Further study may be necessary for recommended road diets to ensure that the needs of all road users are being met.

GENERAL ACTION STEPS AND ACTION STEPS BY GOAL

The tables below highlight some of the action steps that should be taken to implement and support a more bicycle friendly Richmond. Where appropriate, action steps are organized by the Plan goals.

Action Step	Lead	Support	Details	Phase
Present Plan to the Planning Commission and the City Council	Pedestrian, Bicycle and Trails Coordinator	Public Works	Presentation to City Council	Short -term
Support/Approve this Plan	Richmond District Staff	Project Consultants	Official letter of approval	Short-term
Adopt this Plan	Planning Commission City Council	Public Works, Project Consultants	Through adoption, the Plan becomes an official planning document of the City. Adoption shows that the City of Richmond has undergone a successful, supported planning process.	Short-term
Begin Annual Meeting with Key Project Partners	Pedestrian, Bicycle and Trails Coordinator	Public Works, Planning & Development Review, Pedestrian, Bicycle and Trails Commission (PBTC), VDOT, and local and regional stakeholders	Key project partners (see key partners in Ch. 4) should meet on an annual basis to evaluate the implementation of this Plan.	Short-term/ Ongoing
Designate Staff Roles and Responsibilities	Mayor Chief Administration Officer	Leadership of City Departments	Designate staff to oversee the implementation of this Plan and the proper maintenance of the facilities that are developed. It is recommended that a combination of existing staff from Public Works, Planning & Development Review, and the Pedestrian, Bicycle and Trails Coordinator oversee the day-to-day implementation of this Plan.	Short-term

Goal	Action Step	Lead	Support	Details	Phase
Ridership	Evaluate Existing Programs and Launch New Programs	Pedestrian, Bicycle and Trails Coordinator	Public Works, Planning & Development Review, PBTC	Build a manual of programs with action steps, responsible parties, and evaluation measures. Evaluate each program for effectiveness and lessons learned after completion of each event. Build new programs based on VDOT efforts and inspiration from other communities.	Ongoing
	Apply for Safe Routes to School Grants and infrastructure Funding	Pedestrian, Bicycle and Trails Coordinator	VDOT, RAMPO, PBTC	Establish "bike-to-school" groups, "walking school buses" or other similar activities for children through the Safe Routes to School Program.	Ongoing
	Improve Local Policies	City Council (May be initiated by other parties)	Planning and Development Review, Public Works, PBTC, VDOT	Richmond should adopt a Complete Streets policy, following VDOT's adopted Complete Streets Policy and flow chart and create a Complete Streets Manual for the city.	Mid to Long Term

Goal	Action Step	Lead	Support	Details	Phase
Safety	Provide Enforcement and Education	Richmond Police Department	VDOT	Provide police officers with training through free online resources available from the National Highway Traffic Safety Administration, and through webinars available through the Association of Pedestrian and Bicycle Professionals. Provide police officers with an informational handout to be used during bicycle and pedestrian-related citations and warning.	Short-term

Goal	Action Step	Lead	Support	Details	Phase
Connectivity	Ensure Planning Efforts are integrated across departments and agencies	Pedestrian, Bicycle and Trails Coordinator	City Council, Public Works, Planning & Development Review, PBTC	Develop a process by which the Pedestrian, Bicycle, and Trail Coordinator is aware of and can be involved in planning, design, construction, and maintenance of roadway and development projects that affect bicycle circulation throughout the city.	Short -term
	Develop Bicycle and Pedestrian Facility Specifications	Public Works	Planning and Development Review, VDOT	City staff should prepare (or hire a consultant to craft) specifications for bicycle facility projects using the design guidelines of this Plan as starting points. Specifically, the resources listed in Appendix A will be useful in drafting such documents.	Mid-term
	Complete Two of the Short-Term Priority Projects	Pedestrian, Bicycle, and Trails Coordinator, Public Works	RAMPO, Pedestrian, Bicycle and Trails Coordinator	Chapter Three provides a list of bicycle projects with a general priority ranking. Immediate attention to the higher ranking projects will instantly have a large impact on the bicycle environment in Richmond. Aim to complete at least two of these projects by 2016.	Short-term

Goal	Action Step	Lead	Support	Details	Phase
Connectivity	Establish a Monitoring Program/ Bicycle Friendly Report Card	Pedestrian, Bicycle and Trails Coordinator	Public Works, Planning & Development Review, PBTC, General Public	The Pedestrian, Bicycle and Trails Coordinator should develop specific benchmarks to track through a monitoring program, or report card, and honor the completion of projects with public events and media coverage. The Report Card should be updated each year.	Ongoing
	Design Orientation	Public Works	VDOT	Become familiar with the standards in Appendix A as well as state and national standards for bicycle facility design. (In the mid-long term hire a consultant to conduct a complete streets and/or NACTO training to familiarize staff on best practices and innovative solutions).	Short-long term
	Develop a Long Term Funding Strategy	Pedestrian, Bicycle and Trails Coordinator, Public Works	City Council, Planning & Development Review, PBTC	To allow continued development of the overall system, capital funds for bicycle facility construction should be allocated in the budget for each fiscal year. Funding for an ongoing maintenance program should also be including in the City's operation budget.	Short-term
	Seek Multiple Funding Sources and Facility Development Options	Pedestrian, Bicycle and Trails Coordinator, Public Works	PBTC	Appendix B contains potential funding opportunities for local, state, federal and private and non-profit sources. Identify which options to pursue and develop a schedule for applications.	Ongoing

Goal	Action Step	Lead	Support	Details	Phase
Equity	Prioritize Projects in Disadvantaged Areas	Pedestrian, Bicycle and Trails Coordinator, Public Works	PBTC	Work toward implementing projects in low vehicle ownership and socioeconomically disadvantaged areas. Bicycle facilities in these areas may have a higher likelihood of being used due to a higher density of transit-dependent residents.	Ongoing
	Develop Safety and Encouragement Materials for Limited English Proficiency (LEP) Groups	Pedestrian, Bicycle and Trails Coordinator, Public Works	PBTC	Safety and encouragement materials should be offered in multiple languages or translated on request to mitigate cultural barriers.	Mid-term
	Design Bicycle Facilities for All Riders	Public Works	PBTC, VDOT	When designing bicycle facilities, it is important to consider the gamut of users and what is appropriate based on comfort level and ability. Develop a checklist to accompany feasibility and design studies that considers demographics and poteintial user types. Exceptions to design guidelines may need to be considered to accommodate different levels of riders who need to be served by specific bikeways.	Mid-term

Goal	Action Step	Lead	Support	Details	Phase
Livability	Seek Designation as a Silver Level Bicycle-Friendly Community	Pedestrian, Bicycle and Trails Coordinator	City Council, Public Works, Planning & Development Review, PBTC	The development and implementation of this Plan is an essential step toward increasing the City's status as a Bicycle-Friendly Community. With ongoing efforts and short-term implementation of projects and programs, the City should be in a position to elevate their status to a silver level Bicycle-Friendly Community within the mid-term timeframe.	Mid-term
	Develop public transit standards that facilitate and foster ridership by bicyclists	Pedestrian, Bicycle and Trails Coordinator, Public Works	GRTC, Planning & Development Review	The *Richmond Connects Plan* has established the importance of multimodal transportation for the city in the next 20 years. To fulfill the recommendations in the Plan, it is important that bicycle facilities that connect to multimodal facilities are vetted for appropriate facility design and characteristics to provide seamless and safe connections. It is also critical to develop standards for each transit mode that accommodate bicyclists such as bike racks on buses and covered or secure bicycle parking at major transit hubs.	Mid-term

This page intentionally left blank.

RICHMOND
Bicycle Master Plan

A Design Guidelines

OVERVIEW

The sections that follow serve as an inventory of bicycle design treatments and provide guidelines for their development. These treatments and design guidelines are important because they represent the tools for creating a bicycle-friendly, safe, and accessible community. The guidelines are not, however, a substitute for a more thorough evaluation by a landscape architect or engineer upon implementation of facility improvements. Some improvements may also require cooperation with VDOT for specific design solutions. The following standards and guidelines are referred to in this guide.

- The Federal Highway Administration's **Manual on Uniform Traffic Control Devices** (MUTCD) is the primary source for guidance on lane striping requirements, signal warrants, and recommended signage and pavement markings.
- 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 National Association of City Transportation Officials' (NACTO) 2012 **Urban Bikeway Design Guide** is the newest publication of nationally recognized bikeway designs, and offers guidance on the current state of the practice. All of the NACTO Urban Bikeway Design Guide treatments are in use internationally and in many cities around the US, although some featured treatments are considered experimental by FHWA.
- Meeting the requirements of the Americans with Disabilities Act (ADA) is an important part of any bicycle facility project. The United States Access Board's proposed **Public Rights-of-Way Accessibility Guidelines** (PROWAG) and the **2010 ADA Standards for Accessible Design** (2010 Standards) contain standards and guidance for the construction of accessible facilities.
- The Virginia Department of Transportation **Road Design Manual,** with revisions released in 2012, provide VDOT and municipality staff with a guide to planning and designing streets that meet the needs of all users, including pedestrians, bicyclists, and motor vehicles. The guidelines emphasize the importance of Context Sensitive Solutions and AASHTO minimum design standards.

Should these standards be revised in the future and result in discrepancies with this chapter, the standards should prevail for all design decisions. A qualified engineer or landscape architect should be consulted for the most up to date and accurate cost estimates.

CHAPTER CONTENTS

DESIGN NEEDS OF BICYCLISTS

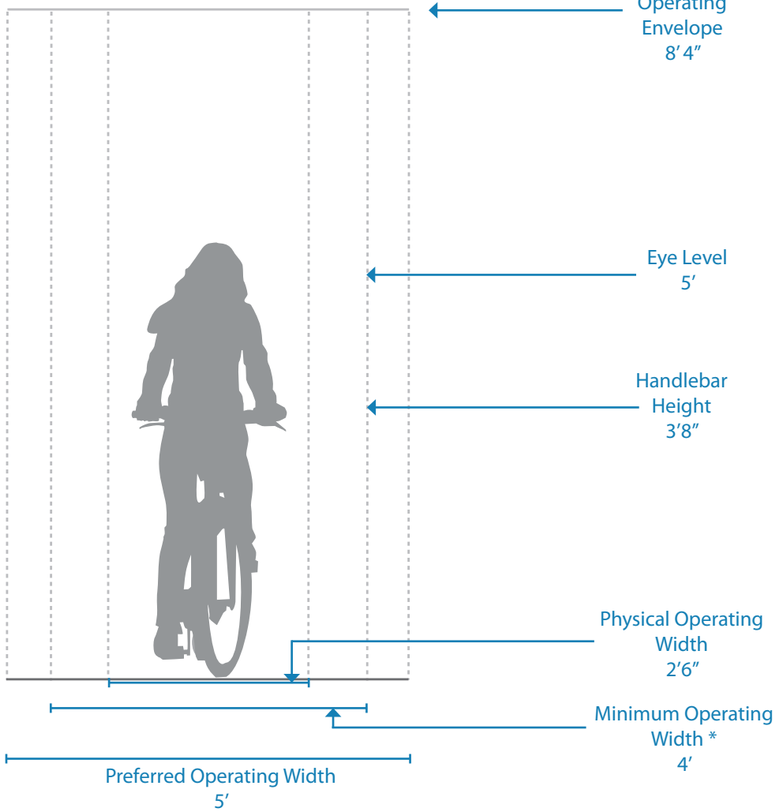
The purpose of this section is to provide the facility designer with an understanding of how bicyclists operate and how their bicycle influences that operation. Bicyclists, by nature, are much more affected by poor facility design, construction and maintenance practices than motor vehicle drivers. Bicyclists 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.

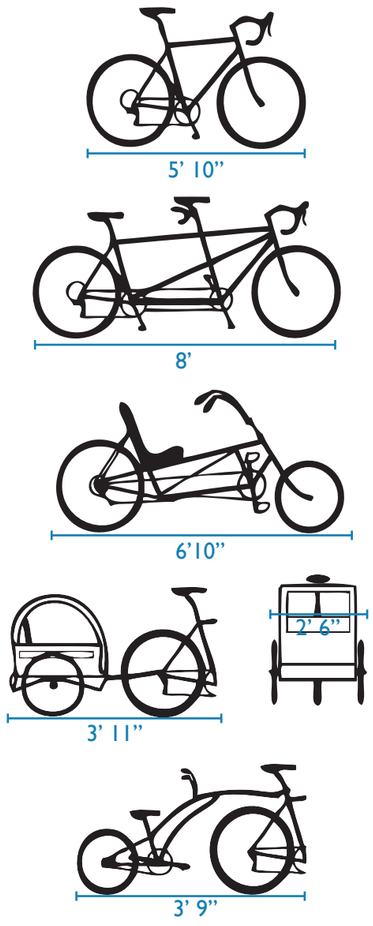
The figure below illustrates the operating space and physical dimensions of a typical adult bicyclist, which are the basis for typical facility design. Bicyclists require clear space to operate within a facility. This is why the minimum operating width is greater than the physical dimensions of the bicyclist. 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*, 4th Edition. 2012.
*Minimum operating width differs from minimum bicycle facility width. See bicycle facility guidance in this guide for more information.

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*, 4th 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
	Approximate center of gravity	2 ft 9 in - 3 ft 4 in
Recumbent Bicyclist	Physical length	8 ft
	Eye height	3 ft 10 in
Tandem Bicyclist	Physical length	8 ft
Bicyclist with child trailer	Physical length	10 ft
	Physical width	2 ft 6 in

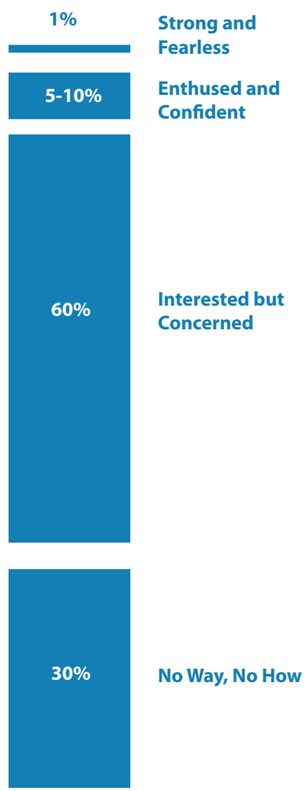
Bicycle as Design Vehicle - Design Speed Expectations

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

*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. 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 current AASHTO Guide to the Development of Bicycle Facilities encourages designers to identify their rider type based on the trip purpose (Recreational vs Transportation) and on the level of comfort and skill of the rider (Causal vs Experienced). A more detailed framework for understanding of the US population's relationship to transportation focused bicycling is illustrated in the figure below. Developed by planners in Portland, OR[1] and supported by research[2], this classification provides the following alternative categories to address varying attitudes towards bicycling in the US:



Typical Distribution of Bicyclist Types

- **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.
- **Enthused 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 shared 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 shared use paths 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 "Enthused & 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.

1 Roger Geller, City of Portland Bureau of Transportation. Four Types of Cyclists.
2 Dill, J., McNeil, N. Four Types of Cyclists? Testing a Typology to Better Understand Bicycling Behavior and Potential. 2012.

BICYCLE FACILITY SELECTION

This section summarizes the bicycle facility selection typology developed for Richmond. 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 shared use paths 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.

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. Shared-lane markings are included in this class of treatments.

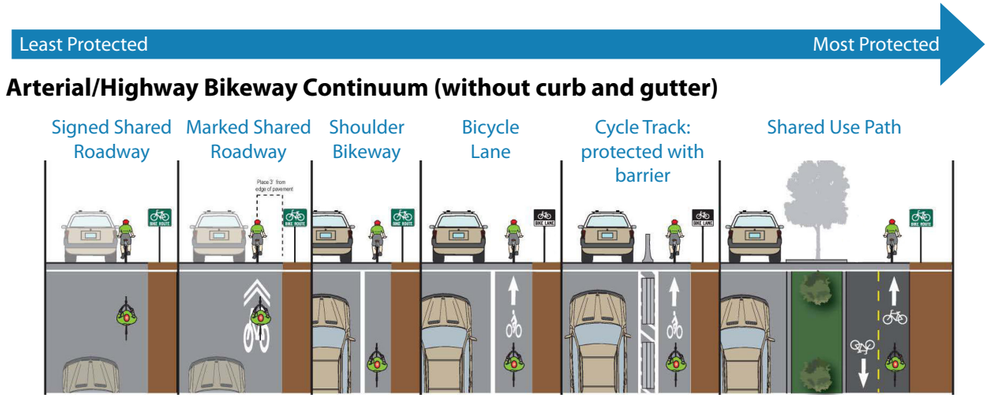
Separated Bikeways, such as bike lanes, use signage and striping to delineate the right-of-way assigned to bicyclists and motorists. Bike lanes encourage predictable movements by both bicyclists and motorists. Paved Shoulders are also included in this classification.

Cycle Tracks are bicycle-only facilities that combine the user experience of a separated path with the on-street infrastructure of conventional bike lanes. Cycle tracks are physically separated from the roadway and distinct from the sidewalk.

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

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.



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.

Signed Shared Roadway


Marked Shared Roadway


Bike-Walk Street

SIGNED SHARED ROADWAYS

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.

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.

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 **Bike-Walk Street** 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. *Guide for the Development of Bicycle Facilities*. 2012.
FHWA. *Manual on Uniform Traffic Control Devices*. 2009.
VDOT. *Road Design Manual.* 2012.

MATERIALS AND MAINTENANCE

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

MARKED SHARED ROADWAY

Description

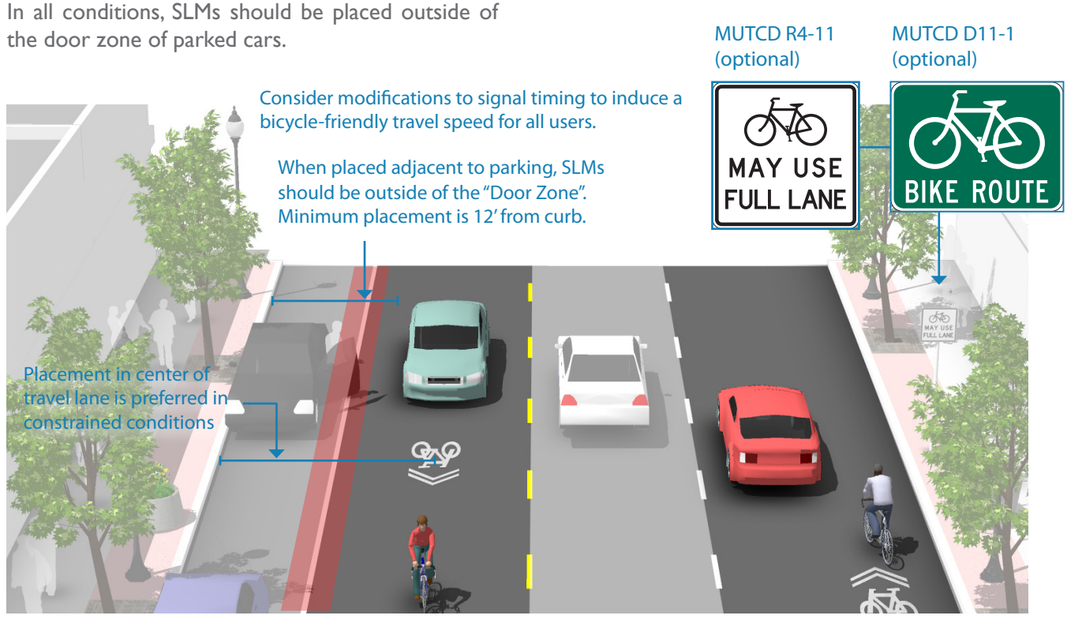
A marked shared roadway is a general purpose travel lane marked with shared lane markings (SLM) used to encourage bicycle travel and proper positioning within the lane.

In constrained conditions, the SLMs are placed in the middle of the lane to discourage unsafe passing by motor vehicles. On lanes 14 feet wide or wider, the SLMs can be placed 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.

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 12 feet from edge of curb where on-street parking is present, 5 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.



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 **Bike-Walk Street** 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

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

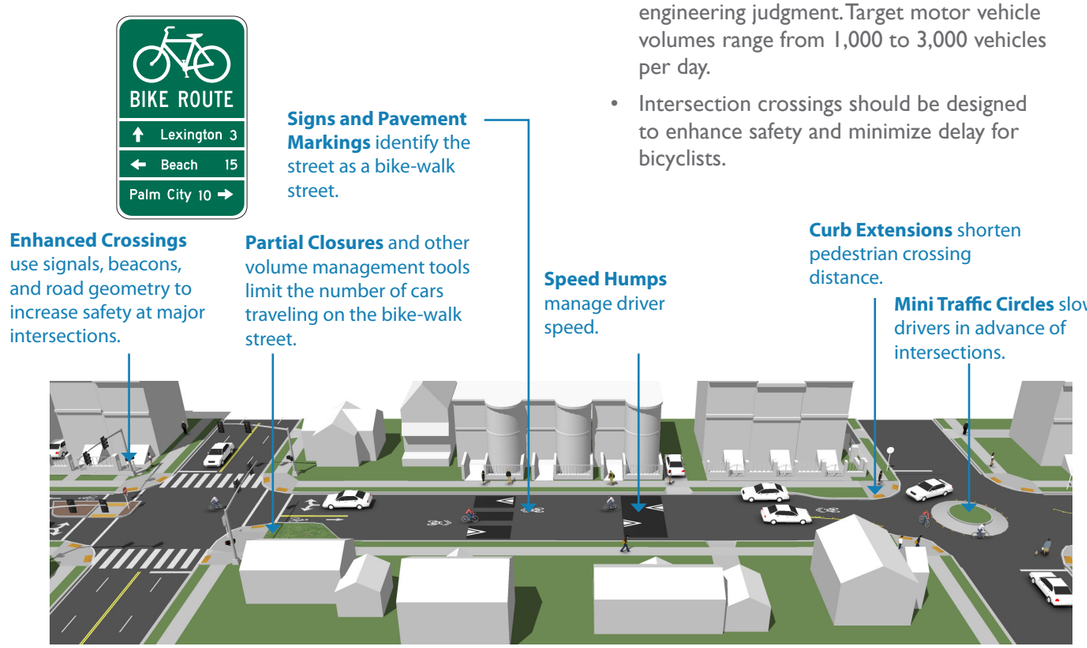
Materials and Maintenance

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

BIKE-WALK STREET

Description

Bike-walk streets (also called bicycle boulevards) are a special class of shared roadways designed for the priority and comfort for bicyclists and pedestrians. They are low-volume, low-speed local streets modified to enhance bicyclist comfort 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.



Guidance

- Signs and pavement markings are the minimum treatments necessary to designate a street as a bike-walk street.
- Bike-walk streets should have a maximum posted speed of 25 mph. Use traffic calming to maintain an 85th percentile speed below 22 mph.
- Implement volume control treatments based on the context of the bike-walk street, using engineering judgment. Target motor vehicle volumes range from 1,000 to 3,000 vehicles per day.
- Intersection crossings should be designed to enhance safety and minimize delay for bicyclists.

Discussion

Bike-walk street retrofits to local streets are typically located on streets without existing signalized accommodation at crossings of collector and arterial roadways. Without treatments for bicyclists and pedestrians, these intersections can become major barriers along the bike-walk street and compromise safety.

Traffic calming can deter motorists from driving on a street. Anticipate and monitor vehicle volumes on adjacent streets to determine whether traffic calming results in inappropriate volumes. Traffic calming can be implemented on a trial basis.

Additional References and Guidelines

NACTO. *Urban Bikeway Design Guide*. 2012.
Ewing, Reid and Brown, Steven. *U.S. Traffic Calming Manual*. 2009.

Materials and Maintenance

Vegetation should be regularly trimmed to maintain visibility and attractiveness.

SEPARATED BIKEWAYS

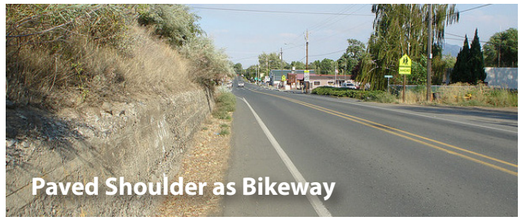
Designated for bicycle travel, separated bikeways are separated from vehicle travel lanes by striping, and can include pavement stencils and other treatments. Separated bikeways are most appropriate on arterial and collector streets where higher traffic volumes and speeds warrant greater separation.

Separated bikeways can increase safety and promote proper riding by:

- Defining road space for bicyclists and motorists
- Reducing the likelihood that motorists will stray into the bicyclists' path
- Discouraging bicyclists from riding on the sidewalk
- Reducing the incidence of wrong way riding.

Paved Shoulder as a Bikeway

Paved shoulders on highways accommodates stopped vehicles, emergency use and lateral support of the roadway materials. They also offer many benefits to roadway users, including use as potential place for people to ride bicycles. While they may appear similar to bicycle lanes, shoulders do not offer the exclusivity or consistent quality of a designated bicycle facility.


Paved Shoulder as Bikeway


Bicycle Lanes


Buffered Bike Lanes


Uphill Bicycle Climbing Lane

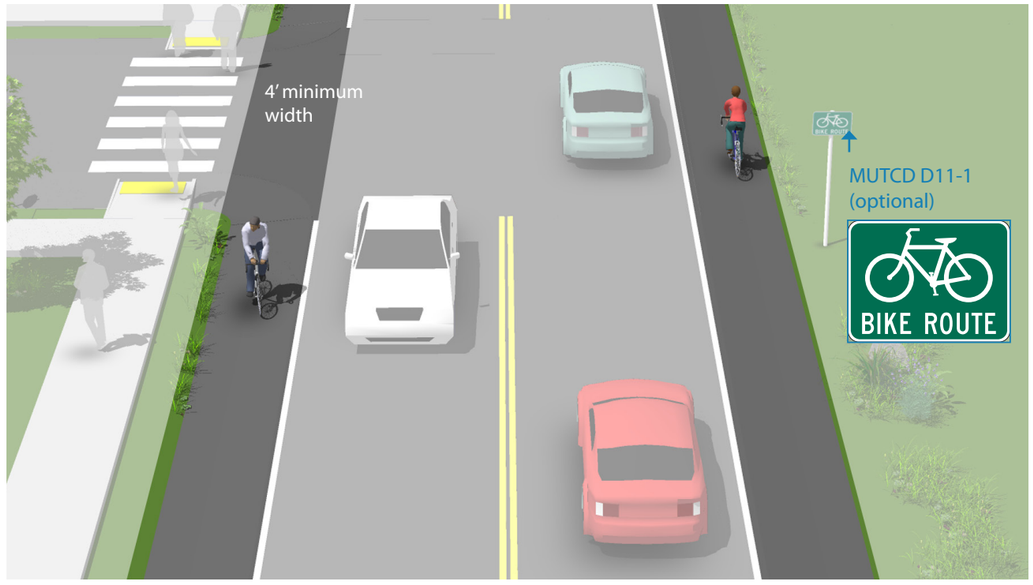
PAVED SHOULDER AS A BIKEWAY

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.

Guidance

- 5 foot preferred width, 4 foot minimum.
- Additional width is desirable on higher-speed (50+ mph) and/or higher-volume roads.



Discussion

Where feasible, roadway widening should be performed with pavement resurfacing jobs to provide additional usable shoulder space.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities*. 2012.
FHWA. *Manual on Uniform Traffic Control Devices*. 2009.
VDOT. *Road Design Manual*. 2012.

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.

BICYCLE LANES

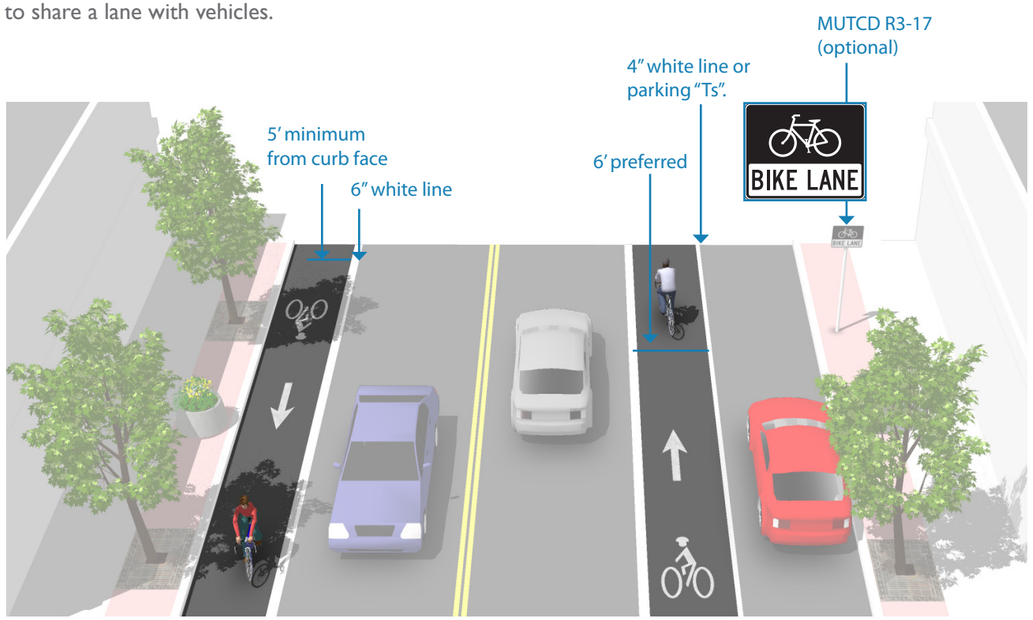
Description

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.

Guidance

- 5 foot minimum when adjacent to curb and gutter or 4 feet more than the gutter pan width.
- 5 foot minimum next to parking. Greater width preferred next to narrow parking lanes, or parking lanes with high vehicle turnover.
- 7 foot maximum width for use adjacent to arterials with high travel speeds. Greater widths may encourage motor vehicle use of bike 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. *Guide for the Development of Bicycle Facilities*. 2012.
FHWA. *Manual on Uniform Traffic Control Devices*. 2009.
NACTO. *Urban Bikeway Design Guide*. 2012.
VDOT. *Road Design Manual*. 2012.

Materials and Maintenance

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

BUFFERED BIKE LANES

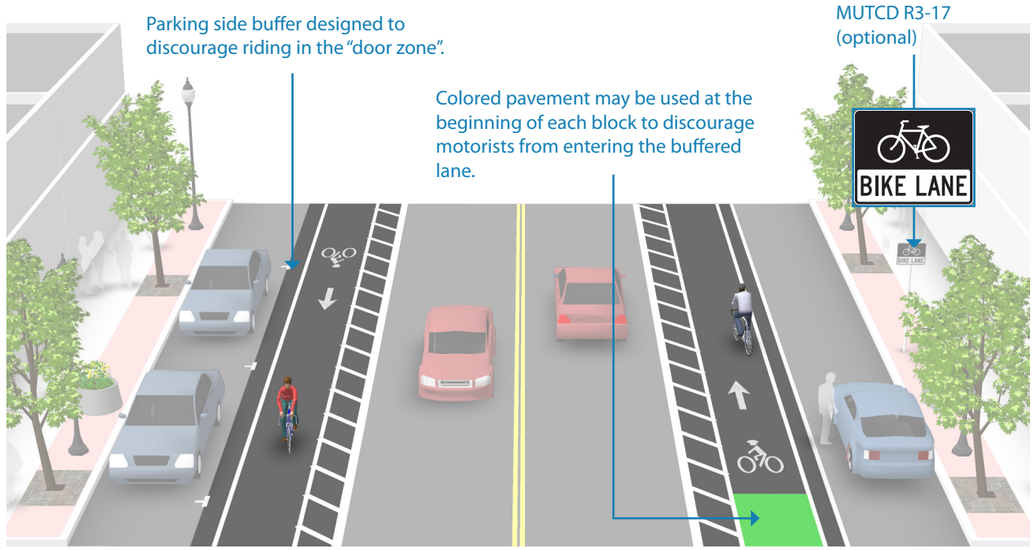
Description

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.

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 or colored pavement for the inside buffer boundary where cars are expected to cross.



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

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

Materials and Maintenance

Paint can wear more quickly in high traffic areas or in winter climates. Colored pavement should employ an anti-skid treatment and retro-reflective.

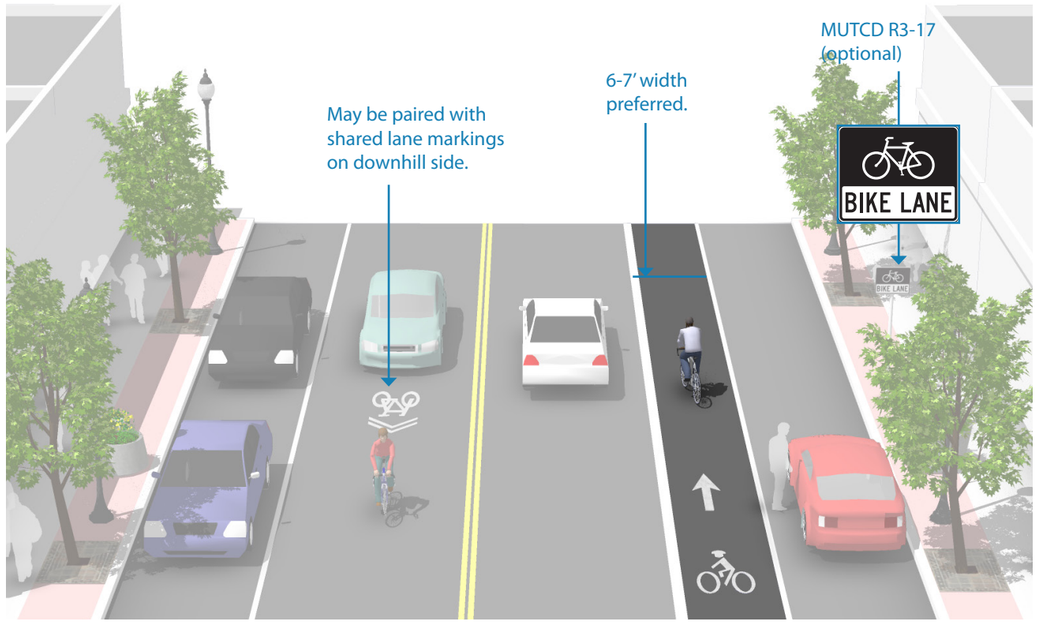
UPHILL BICYCLE CLIMBING LANE

Description

Uphill bike lanes (also known as "climbing lanes") enable motorists to safely pass slower-speed bicyclists, thereby improving conditions for both travel modes.

Guidance

- Uphill bike lanes should be 6-7 feet wide (wider lanes are preferred because extra maneuvering room on steep grades can benefit bicyclists).
- Can be combined with Shared Lane Markings for downhill bicyclists who can more closely match prevailing traffic speeds.



Discussion

This treatment is typically found on retrofit projects as newly constructed roads should provide adequate space for bicycle lanes in both directions of travel. Accommodating an uphill bicycle lane often includes delineating on-street parking (if provided), narrowing travel lanes and/or shifting the centerline if necessary.

Additional References and Guidelines

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

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 planters, raised medians, on-street parking or bollards.

A two-way cycle track may be 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. Two-way cycle tracks have similar operational concerns to shared use paths along roadways.

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.

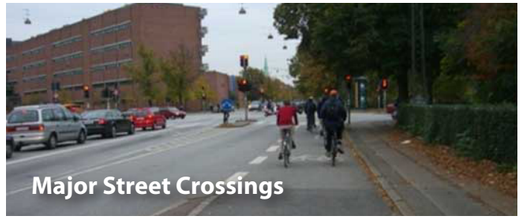
The guidance in this section is meant to present the basics of design for cycle tracks. As an emerging practice area, practitioners should always refer to the detailed guidance in NACTO and AASHTO guides to inform design decisions.


Cycle Track Separation and Placement


One-Way Cycle Tracks


Two-Way Cycle Tracks


Driveways and Minor Streets


Major Street Crossings

CYCLE TRACK SEPARATION AND PLACEMENT

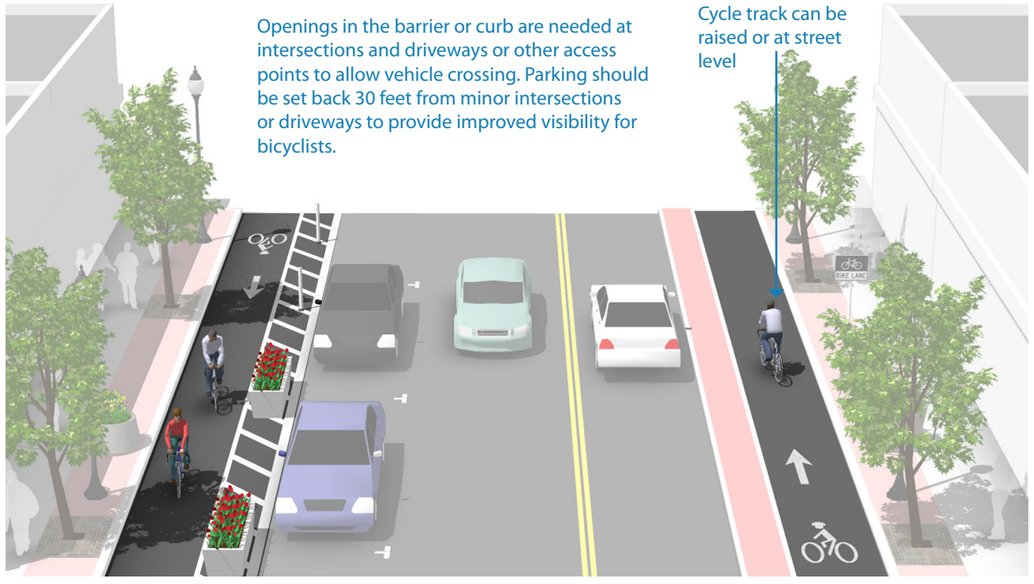
Description

Physical protection of the cycle track is provided through physical barriers and can include bollards, parking, a planters, an extruded curb, on-street parking, or other methods. 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.

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).



Discussion

In general, 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. *Urban Bikeway Design Guide*. 2012.
ITE. *Separated Bikeways*. 2013.

Materials and Maintenance

In cities with winter climates, barrier separated and raised cycle tracks may require special equipment for snow removal. Narrow cycle tracks may require non-standard street sweeping equipment.

ONE-WAY CYCLE TRACKS

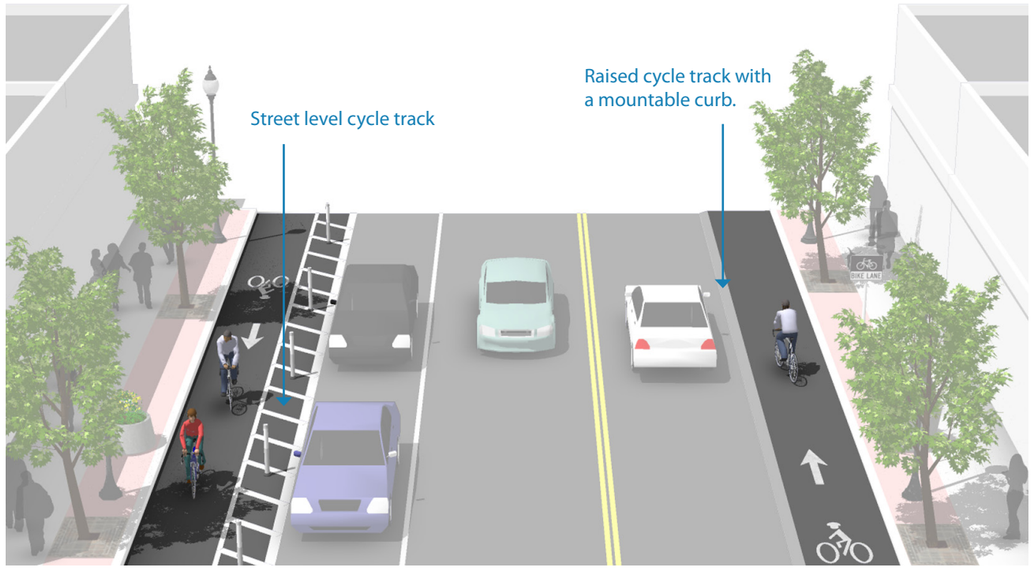
Description

One-way cycle tracks are physically separated from motor traffic and distinct from the sidewalk. Bicyclists ride in the same direction as motor vehicle traffic.

Cycle tracks are either raised or at street level and use a variety of elements for physical protection from passing traffic.

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.



Discussion

Special consideration should be given at transit stops to manage bicycle and pedestrian interactions. Conflicts with turning cars at driveways are a unique challenges to cycle track design, see Driveways and Minor street Crossings in this guide for additional guidance.

It is important to provide access into and out of the cycle track for users wishing to access destinations on either side of the street. Failure to accommodate access for bicyclists may lead to wrong way riding.

Additional References and Guidelines

NACTO. *Urban Bikeway Design Guide*. 2012.
ITE. *Separated Bikeways*. 2013.

Materials and Maintenance

In cities with winter climates, barrier separated and raised cycle tracks may require special equipment for snow removal. Narrow cycle tracks may require non-standard street sweeping equipment.

TWO-WAY CYCLE TRACKS

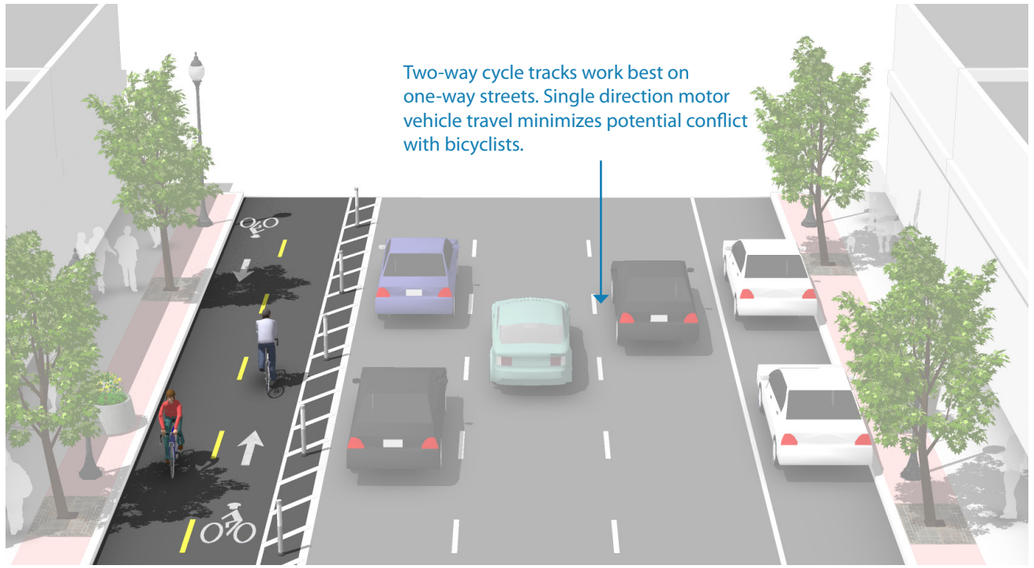
Description

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.

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.



Discussion

Cycle tracks will require careful assessment of intersection traffic operation, including traffic signal control, to ensure safe and efficient travel is maintained. Turning movements should be guided by separated signals for bicycles and conflicting 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. *Urban Bikeway Design Guide*. 2012.
ITE. *Separated Bikeways*. 2013.

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

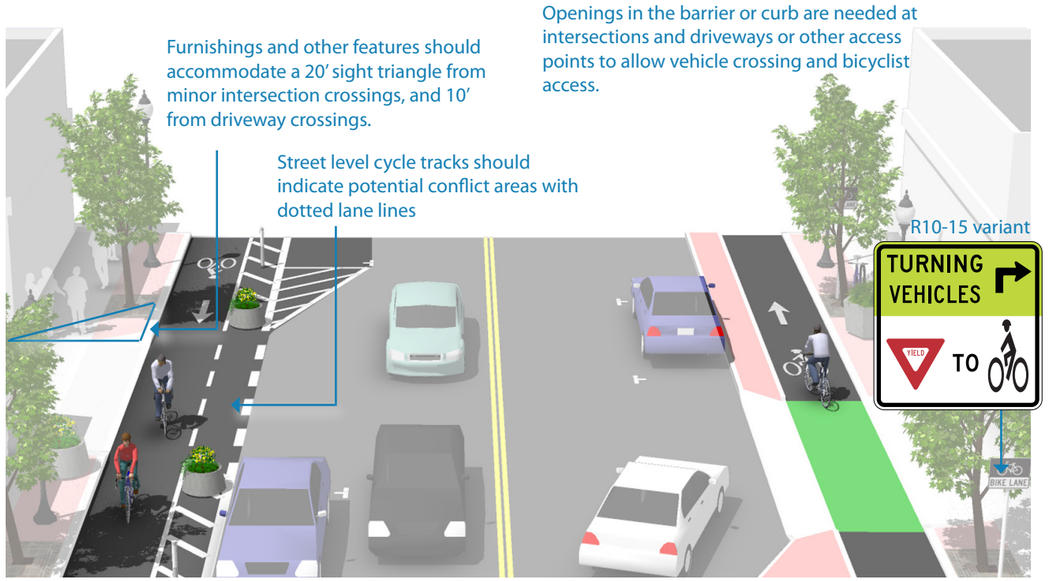
Description

The added separation provided by cycle tracks creates additional considerations at driveways intersections that should be addressed to mitigate conflicts related to turning vehicles.

The cycle track should have priority over driveways and crossings of minor streets. Bicyclists should not be expected to stop at these minor intersections if the major street does not stop.

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.



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. *Urban Bikeway Design Guide*. 2012.
ITE. *Separated Bikeways*. 2013.

Materials and Maintenance

In cities with winter climates, barrier separated and raised cycle tracks may require special equipment for snow removal. Narrow cycle tracks may require non-standard street sweeping equipment.

MAJOR STREET CROSSINGS

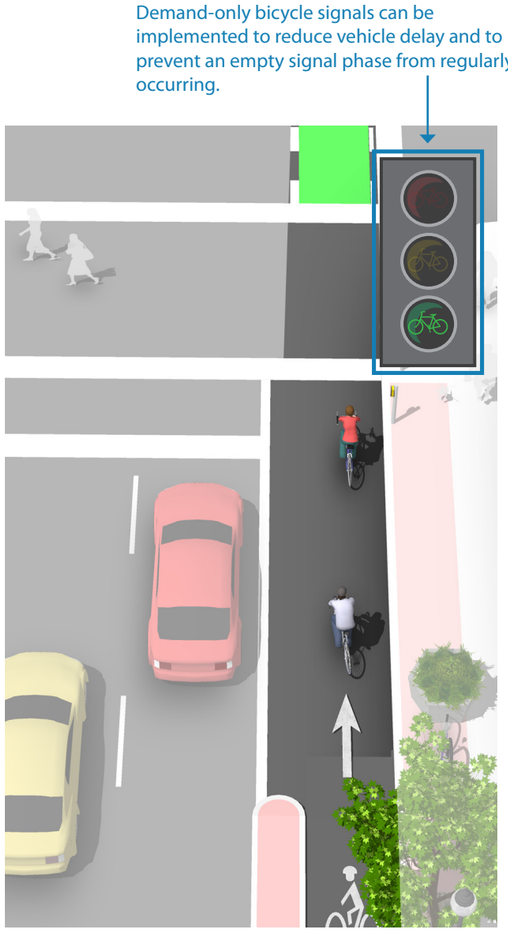
Description

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.
- Consider using 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 combined bike lane/turn lane.



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

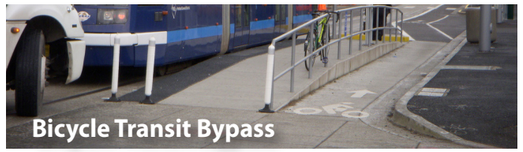
Materials and Maintenance

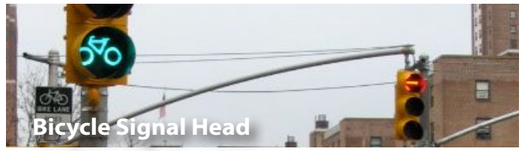
In cities with winter climates, barrier separated and raised cycle tracks may require special equipment for snow removal.

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 colored pavement, 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.





BIKE LANES AT ADDED RIGHT TURN ONLY LANES

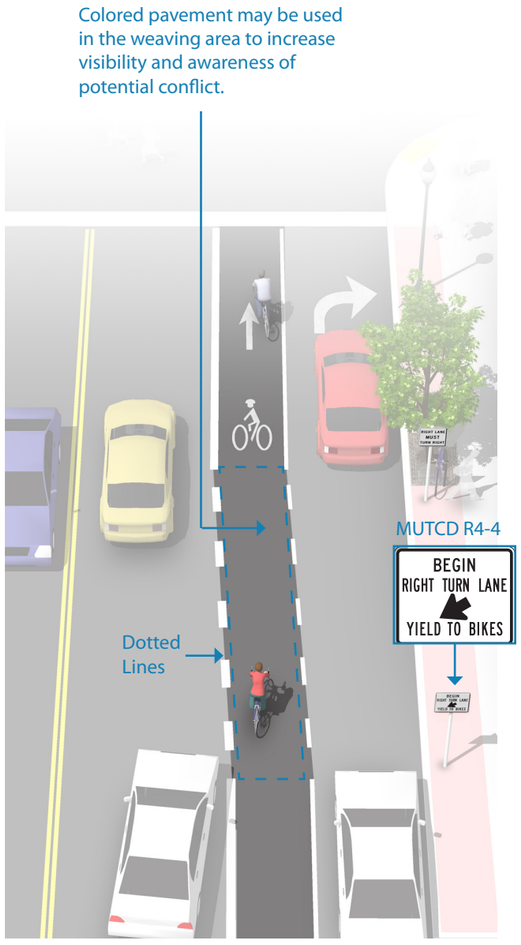
Description

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 through bike lane, with signage indicating that motorists should yield to bicyclists through the conflict area.

Guidance

- 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.



Discussion

For other potential approaches to providing accommodations for bicyclists at intersections with turn lanes, please see **shared bike lane/turn lane, bicycle signals.**

Additional References and Guidelines

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

Materials and Maintenance

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

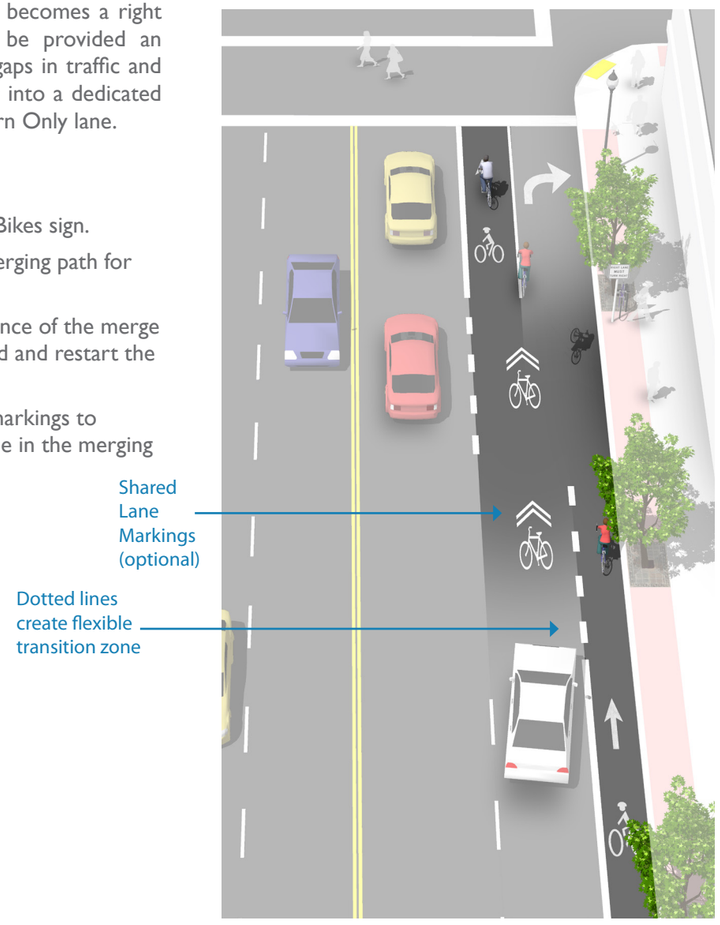
BIKE LANES WHEN A THROUGH LANE BECOMES A RIGHT TURN ONLY LANE

Description

In locations where a through lane becomes a right turn only lane, bicyclists should be provided an opportunity to take advantage of gaps in traffic and safely merge across the travel lane into a dedicated bike lane to the left of the Right Turn Only lane.

Guidance

- Do not post a R4-4 Yield to Bikes sign.
- Do not define prescribe a merging path for bicyclists.
- Drop the bicycle lane in advance of the merge area, using dotted lines to end and restart the bike lane.
- Consider using shared lane markings to indicate shared use of the lane in the merging zone.



Discussion

Unlike added right turn only lanes, bicyclists do not have priority at these locations and drivers are not expected to yield to through-traveling bicyclists.

Use of dotted line extensions or green colored pavement to prescribe a narrow bicyclist travel path is inappropriate in these locations.

Additional References and Guidelines

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

Materials and Maintenance

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

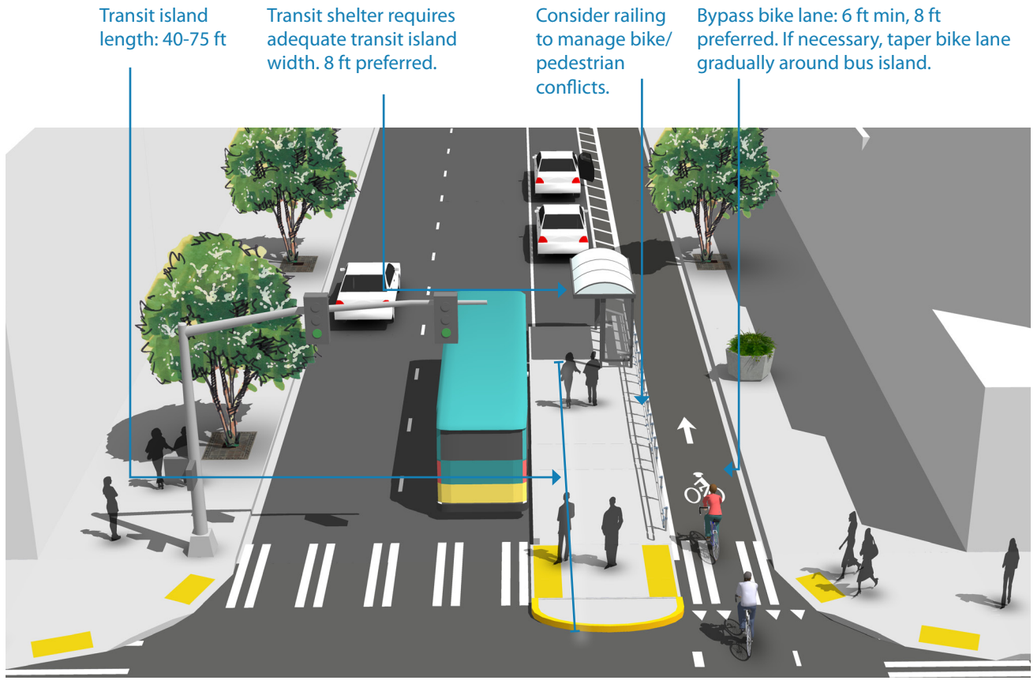
BICYCLE TRANSIT BYPASS

Description

The bicycle lane transit bypass is a channelized lane for bicycles designed to allow bicyclists to pass stopped buses, and prevent conflicts with buses pulling to the curb. This is particularly helpful on corridors with high volumes of transit vehicles and bicyclists, where "leapfrogging" may occur.

Guidance

- Appropriate in areas with high volumes of buses and bicyclists.
- 6 foot minimum width bypass lane.
- Transit island should be wide enough to hold all waiting transit riders.



Discussion

Ensure an adequate width bicycle lane where the bypass lane rejoins the roadway so that bicyclists do not encroach into adjacent lanes.

Conflicts with pedestrians may be increased over conventional bus stop designs. Consider railings to direct pedestrians to a single location where they may cross to the sidewalk.

Additional References and Guidelines

NACTO. *Urban Bikeway Design Guide.* 2012.
NACTO. *Urban Street Design Guide.* 2013.

Materials and Maintenance

The channelized bicycle lane may require additional sweeping to maintain free of debris.

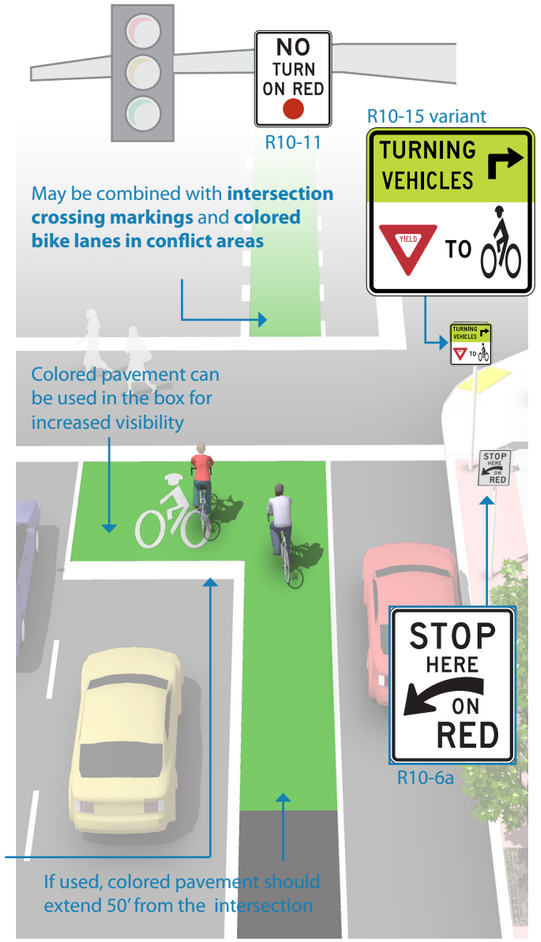
BIKE BOX

Description

A bike box is a designated area located at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible space to get in front of queuing motorized traffic during the red signal phase. Motor vehicles must queue behind the white stop line at the rear of the bike box.

Guidance

- 14' minimum depth
- A "No Turn on Red" (MUTCD R10-11) sign shall be installed overhead to prevent vehicles from entering the Bike Box.
- A "Stop Here on Red" sign should be post-mounted at the stop line to reinforce observance of the stop line.
- A "Yield to Bikes" sign should be post-mounted in advance of and in conjunction with an egress lane to reinforce that bicyclists have the right-of-way going through the intersection.
- An ingress lane should be used to provide access to the box.
- A supplemental "Wait Here" legend can be provided in advance of the stop bar to increase clarity to motorists.



Discussion

Bike boxes are considered experimental by the FHWA.

Bike boxes should be placed only at signalized intersections, and right turns on red shall be prohibited for motor vehicles. Bike boxes should be used in locations that have a large volume of bicyclists and are best utilized in central areas where traffic is usually moving more slowly. Prohibiting right turns on red improves safety for bicyclists yet does not significantly impede motor vehicle travel.

Additional References and Guidelines

NACTO. *Urban Bikeway Design Guide.* 2012.
FHWA. 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. 2011.

Materials and Maintenance

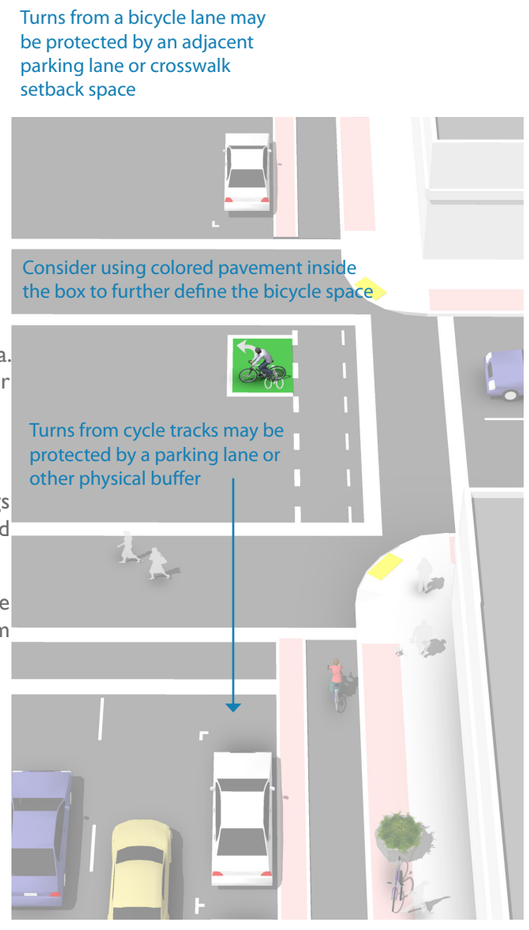
Because the effectiveness of markings depends entirely on their visibility, maintaining markings should be a high priority.

TWO-STAGE TURN BOXES

Description

Two-stage turn queue boxes offer bicyclists a safe way to make left turns at multi-lane signalized intersections from a right side cycle track or bike lane.

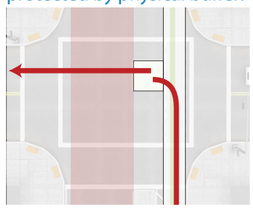
On right side cycle tracks, bicyclists are often unable to merge into traffic to turn left due to physical separation, making the provision of two-stage left turn boxes critical. Design guidance for two-stage turns apply to both bike lanes and cycle tracks.



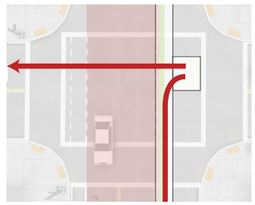
Guidance

- The queue box shall be placed in a protected area. Typically this is within an on-street parking lane or cycle track buffer area.
- 6' minimum depth of bicycle storage area
- Bicycle stencil and turn arrow pavement markings shall be used to indicate proper bicycle direction and positioning.
- A "No Turn on Red" (MUTCD R10-11) sign shall be installed on the cross street to prevent vehicles from entering the turn box.

Cycle track turn box protected by physical buffer:



Bike lane turn box protected by parking lane:



Discussion

A two-stage turn box in any use other than for a jughandle turn at a T-intersection is considered experimental by FHWA.

While two stage turns may increase bicyclist comfort in many locations, this configuration will typically result in higher average signal delay for bicyclists due to the need to receive two separate green signal indications (one for the through street, followed by one for the cross street) before proceeding.

Additional References and Guidelines

NACTO. *Urban Bikeway Design Guide*. 2012.

Materials and Maintenance

Paint can wear more quickly in high traffic areas or in winter climates.

BICYCLE SIGNAL HEADS

Description

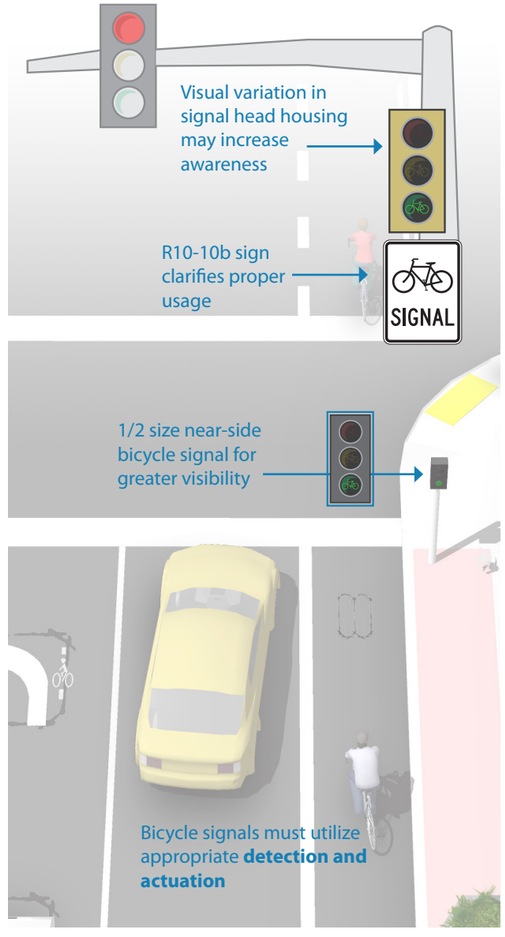
A bicycle signal is an electrically powered traffic control device that should only be used in combination with an existing traffic signal. Bicycle signals are typically used to improve identified safety or operational problems involving bicycle facilities. Bicycle signal heads may be installed at signalized intersections to indicate bicycle signal phases and other bicycle-specific timing strategies. Bicycle signals can be actuated with bicycle sensitive loop detectors, video detection, or push buttons.

Bicycle signals are typically used to provide guidance for bicyclists at intersections where they may have different needs from other road users (e.g., bicycle-only movements).

Guidance

Specific locations where bicycle signals have had a demonstrated positive effect include:

- Those with high volume of bicyclists at peak hours
- Those with high numbers of bicycle/motor vehicle crashes, especially those caused by turning vehicle movements
- At T-intersections with major bicycle movement along the top of the "T."
- At the confluence of an off-street bike path and a roadway intersection
- Where separated bike paths run parallel to arterial streets



Discussion

Local municipal code should be checked or modified to clarify that at intersections with bicycle signals, bicyclists should only obey the bicycle signal heads. For improved visibility, smaller (4 inch lens) near-sided bicycle signals should be considered to supplement far-side signals.

Additional References and Guidelines

FHWA. *MUTCD - Interim Approval for Optional Use of a Bicycle Signal Face (IA-16)*. 2013.
NACTO. *Urban Bikeway Design Guide*. 2012.

Materials and Maintenance

Bicycle signal heads require the same maintenance as standard traffic signal heads, such as replacing bulbs and responding to power outages.

COMBINED BIKE LANE / TURN LANE

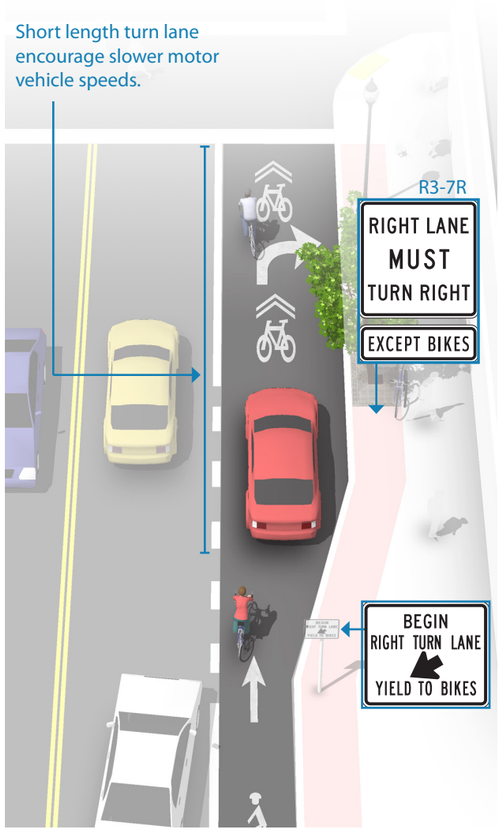
Description

The combined bicycle/right turn lane places Shared Lane Markings wihtin a right turn only 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.
- SLM should indicate preferred positioning of bicyclists within the combine lane.
- A "RIGHT LANE MUST TURN RIGHT" sign with an "EXCEPT BIKES" plaque may be needed to make it legal for through bicyclists to use a right turn lane.



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. *Urban Bikeway Design Guide.* 2012.

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.

INTERSECTION CROSSING MARKINGS

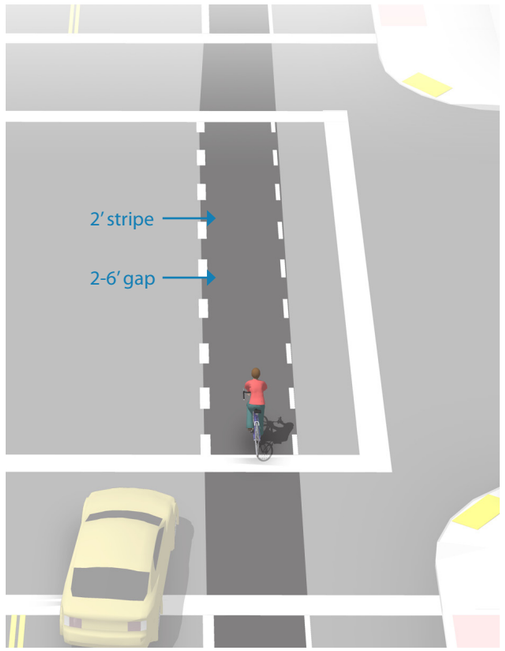
Description

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.

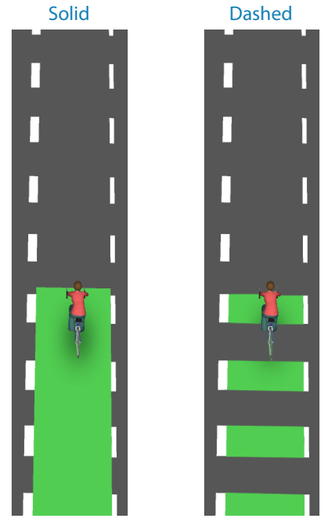
Guidance

- 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.

Dotted Line Extensions



Colored Conflict Area



Colored pavement may be marked through the intersection to indicate where a potential conflict point is per FHWA Interim Approval IA-14.

Discussion

The use of colored pavement is recommended to identify where permissive right turns might lead to conflicts with through bicyclists. Common applications in the US use either solid or dashed striping though the intersection or conflict area.

Additional markings such as chevrons, shared lane markings and elephants feet are strategies currently in use in the United States, and may be available through a request to experiment with FHWA.

Additional References and Guidelines

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

Materials and Maintenance

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

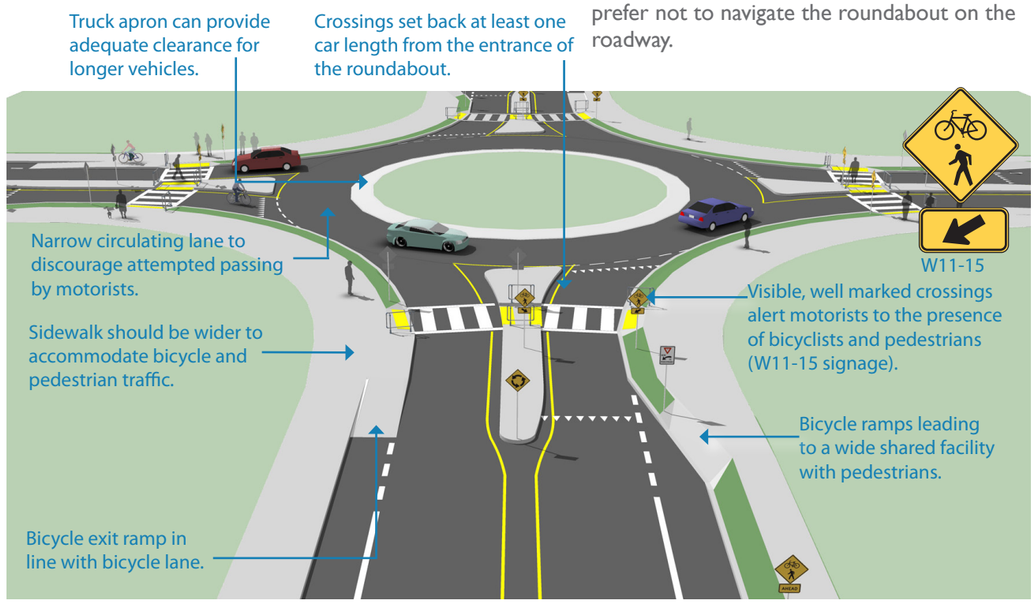
BICYCLISTS AT SINGLE LANE ROUNDABOUTS

Description

In single lane roundabouts it is important to indicate to motorists, bicyclists and pedestrians the right-of-way rules and correct way for them to circulate, using appropriately designed signage, pavement markings, and geometric design elements.

Guidance

- 25 mph maximum circulating design speed.
- Design approaches/exits to the lowest speeds possible.
- Encourage bicyclists navigating the roundabout like motor vehicles to "take the lane." Shared lane markings may be used in the circulating lanes.
- Maximize yielding rate of motorists to pedestrians and bicyclists at crosswalks.
- Provide separated facilities for bicyclists who prefer not to navigate the roundabout on the roadway.



Discussion

Research indicates that while single-lane roundabouts may benefit bicyclists and pedestrians by slowing traffic, multi-lane roundabouts may present greater challenges and significantly increase safety problems for these users.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities*. 2012.
FHWA. *Roundabouts: An Informational Guide, Second Edition. NCHRP 672*. 2010.

Materials and Maintenance

Signage and striping require routine maintenance.

BIKEWAY SIGNING

The ability to navigate through a town is informed by landmarks, natural features and other visual cues. Signs throughout the town 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)

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.


Signage Programs

Wayfinding Sign Types


Wayfinding Sign Placement

SIGNAGE PROGRAMS

A comprehensive system of signage ensures that information is provided regarding the safe and appropriate use of all facilities, both on-road and on shared use paths. The bicycle network should be signed seamlessly with other alternative transportation routes, such as bicycle routes from neighboring jurisdictions, paths, historic and/or cultural walking tours, and wherever possible, local transit systems.

Directional Signs

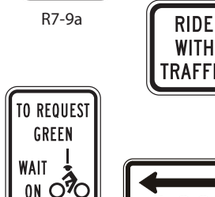
Implementing a well-planned and attractive system of signing can greatly enhance bikeway facilities by signaling their presence and location to both motorists and existing or potential bicycle users.

See **Wayfinding Sign Types** and **Wayfinding Sing Placement** on the following pages for a possible framework for planning your bicycle wayfinding system.

Regulatory/Warning Signs

Regulatory and warning bicycle signage like the examples shown below should conform to the Manual on Uniform Traffic Control Devices (MUTCD).

Use of the "BIKES MAY USE FULL LANE" (R1-11) may need to meet certain requirements described in the Virginia MUTCD Supplement. Basic requirements include:



R4-11

- Use only on roadways with no on-road bicycle facilities.
- Use on roads with marked travel lanes.
- Use on roads 35 mph or below.


W3-1


W3-2


W7-5


W8-10

W8-10P


W11-15

W11-15P


W10-12


W11-1


W11-2


W15-1

R3-17

R4-11

R7-9

R7-9a

R5-1b

R9-3cP

R4-4

R9-5

R9-6

R9-7

R10-24

R10-22

R15-8

R5-3

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 functional types of wayfinding signs:

Confirmation Signs

Alternative Bike Route Guide (D11-1c) signs are used to Indicate to bicyclists that they are on a designated bikeway and make motorists aware of the bicycle route. The use of the D11-1c sign (which includes a destination or route name) is preferred whenever practical, as it provides the reader with more useful information than the D11-1.

D11-1c

Turn Signs

A Bicycle Destination Sign (D1-1) with one or more destination in a single direction indicates where a bike route turns from one street onto another street. This signage can be used with pavement markings, and includes destinations and arrows.

D1-1

Decisions Signs

Decision sign assemblies are a combination of D11-1c and D1-3a signs used to mark the junction of two or more bikeways and inform bicyclists of the designated bike route to access key destinations. Commonly includes destinations and arrows and distances.

D11-1/D1-3a

Numbered Bicycle Route Signs

Numbered Bicycle Route (M1-8, M1-8a) signs are used to establish a unique identification of state or local bicycle routes. U.S. Bicycle Route (M1-9) signs shall contain the AASHTO designated route number.

M1-8

M1-9

Discussion

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.

While not included in the MUTCD, some jurisdictions include travel time on Bicycle Destination Signs to help communicate and inform users of realistic bicycle travel times based on a 10 mph travel speed.

Additional References and Guidelines

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

Materials and Maintenance

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

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.

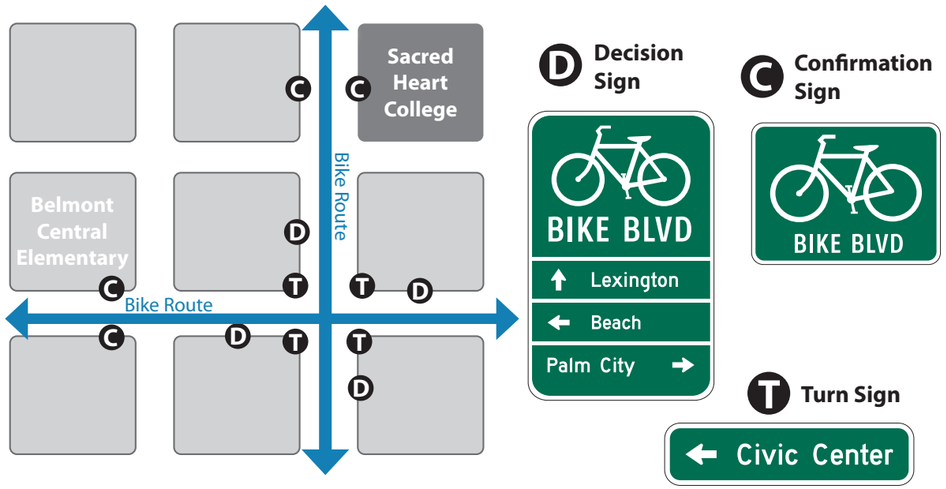
Along a route to indicate a nearby destination.

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

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

Materials and Maintenance

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

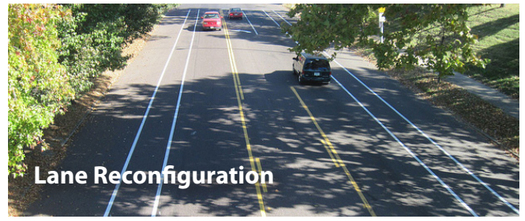
RETROFITTING STREETS TO ADD BIKEWAYS

Most major streets are characterized by conditions (e.g., high vehicle speeds and/or volumes) for which dedicated bike lanes are the most appropriate facility to accommodate safe and comfortable riding. Although opportunities to add bike lanes through roadway widening may exist in some locations, many major streets have physical and other constraints that would require street retrofit measures within existing curb-to-curb widths. As a result, much of the guidance provided in this section focuses on effectively reallocating existing street width through striping modifications to accommodate dedicated bike lanes.

Although largely intended for major streets, these measures may be appropriate for any roadway where bike lanes would be the best accommodation for bicyclists.


Roadway Widening


Lane Narrowing


Lane Reconfiguration


Parking Reduction

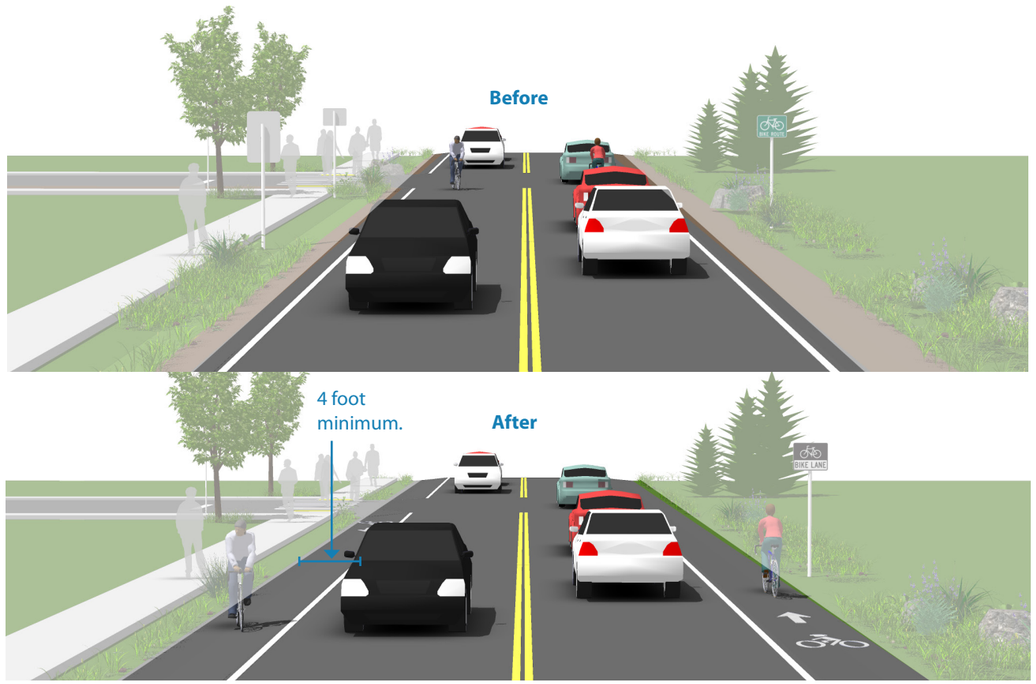
ROADWAY WIDENING

Description

Bike lanes can be accommodated on streets with excess right-of-way through shoulder widening. Although roadway widening incurs higher expenses compared with re-striping projects, bike lanes can be added to streets currently lacking curbs, gutters and sidewalks without the high costs of major infrastructure reconstruction.

Guidance

- Guidance on **bicycle lanes** applies to this treatment.
- 6 foot width preferred.
- 4 foot minimum width when no curb and gutter is present.



Discussion

Roadway widening is most appropriate and affordable on roads lacking curbs, gutters and sidewalks.

AASHTO Guide for the Design of Bicycle Facilities suggests that "... undesignated paved shoulders can improve conditions for bicyclists on constrained roadways where obtaining the preferred shoulder widths is not practical... [provide] a minimum of 4 ft (1.2 m) of operating space between the edge line and the edge of paved shoulder (where no curb is present) or the curb face (where curb is used without a gutter)."

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.

Materials and Maintenance

The extended bicycle area should not contain any rough joints where bicyclists ride. Saw or grind a clean cut at the edge of the travel lane, or feather with a fine mix in a non-ridable area of the roadway.

LANE NARROWING

Description

Lane narrowing utilizes roadway space that exceeds minimum standards to provide the needed space for bike lanes. Many roadways have existing travel lanes that are wider than those prescribed in local and national roadway design standards, or which are not marked. Most standards allow for the use of 11 foot and sometimes 10 foot wide travel lanes to create space for bike lanes.

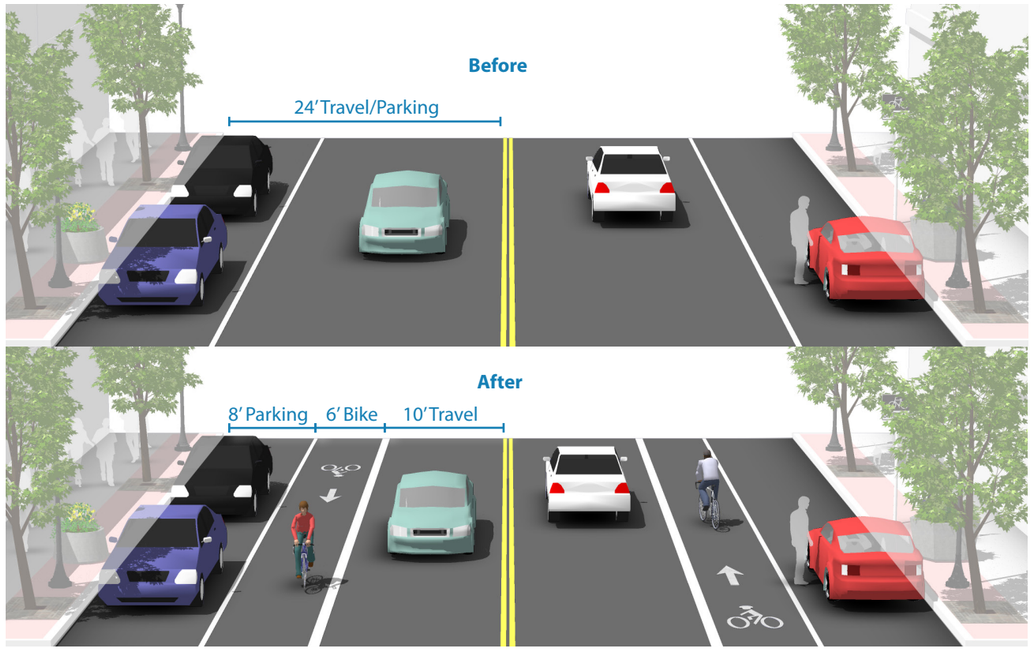
Guidance

Vehicle lane width:

- Before: 10-15 feet
- After: 10-11 feet

Bicycle lane width:

- Guidance on **Bicycle Lanes** applies to this treatment.



Discussion

Special consideration should be given to the amount of heavy vehicle traffic and horizontal curvature before the decision is made to narrow travel lanes. Center turn lanes can also be narrowed in some situations to free up pavement space for bike lanes.

AASHTO supports reduced width lanes in *A Policy on Geometric Design of Highways and Streets*: "On interrupted-flow operation conditions at low speeds (45 mph or less), narrow lane widths are normally adequate and have some advantages."

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
AASHTO. *A Policy on Geometric Design of Highways and Streets.* 2011.

Materials and Maintenance

Repair rough or uneven pavement surface. Use bicycle compatible drainage grates.

LANE RECONFIGURATION

Description

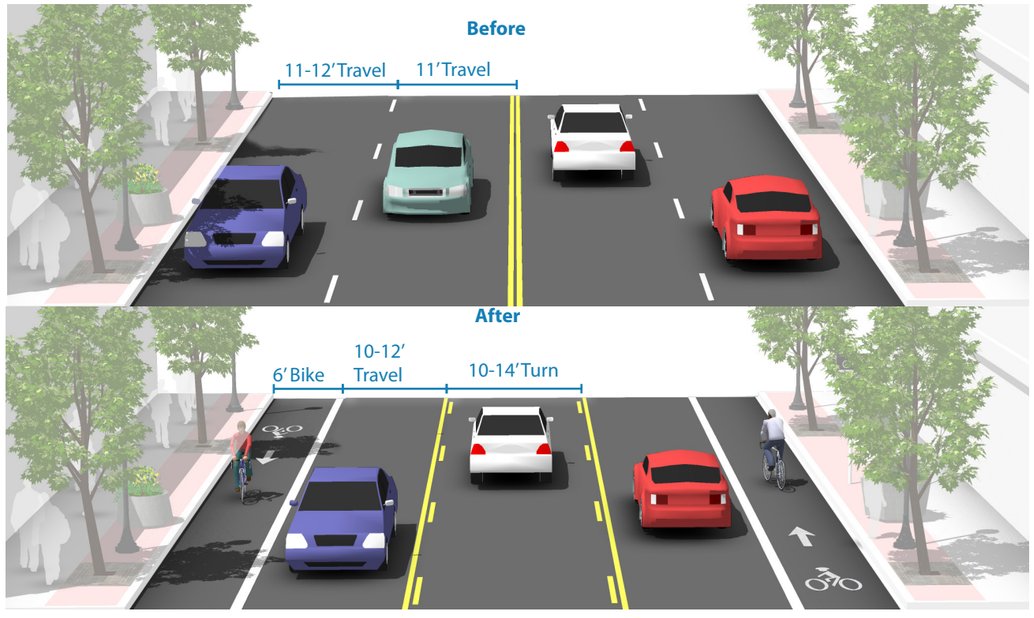
The removal of a single travel lane will generally provide sufficient space for bike lanes on both sides of a street. Streets with excess vehicle capacity provide opportunities for bike lane retrofit projects.

Often called a "Road Diet" a common reconfiguration is from 4-lanes to 3-lanes, which may provide enough room to establish bicycle lanes.

Guidance

Traffic Context

- 4-to-3 lane reconfigurations have been shown to have very good results on roads with 15,000 ADT or less.
- 4-to-3 lane reconfigurations may work well on streets with higher volumes (up to 20,000 ADT) if demand for left turns frequently interfere with through traffic flow.



Discussion

Depending on a street's existing configuration, traffic operations, user needs and safety concerns, various lane reduction configurations may apply. Prior to implementing this measure, a traffic analysis should identify potential impacts.

AASHTO supports 10 ft center turn lanes in *A Policy on Geometric Design of Highways and Streets*: "Where continuous left-turn lanes are provided, a lane width of 10 to 16 ft provides the optimum design."

Additional References and Guidelines

FHWA. *Proven Safety Countermeasures: "Road Diet" (Roadway Reconfiguration).* 2013.
NACTO. *Urban Street Design Guide.* 2013. AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.

Materials and Maintenance

Repair rough or uneven pavement surface. Use bicycle compatible drainage grates. Raise or lower existing grates and utility covers so they are flush with the pavement.

PARKING REDUCTION

Description

Bike lanes can replace one or more on-street parking lanes on streets where excess parking exists and/or the importance of bike lanes outweighs parking needs. For example, parking may be needed on only one side of a street. Eliminating or reducing on-street parking also improves sight distance for bicyclists in bike lanes and for motorists on approaching side streets and driveways.

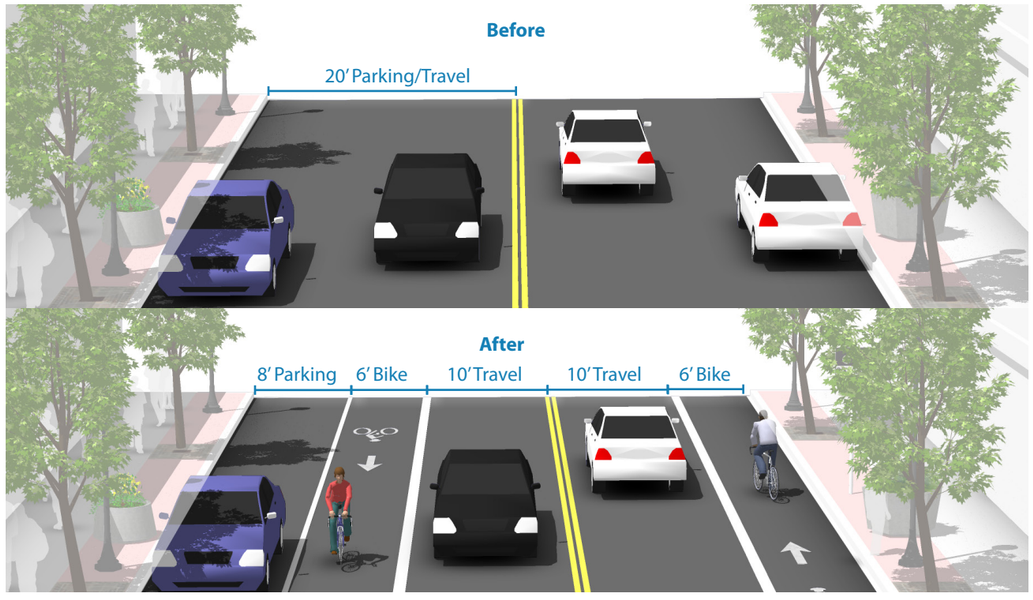
Guidance

Vehicle lane width:

- Parking lane width depends on project. No travel lane narrowing may be required depending on the width of the parking lanes.

Bicycle lane width:

- Guidance on Bicycle Lanes applies to this treatment.



Discussion

Removing or reducing on-street parking to install bike lanes requires comprehensive outreach to the affected businesses and residents. Prior to reallocating on-street parking for other uses, a parking study should be performed to gauge demand and to evaluate impacts to people with disabilities.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
AASHTO. *A Policy on Geometric Design of Highways and Streets.* 2011.

Materials and Maintenance

Repair rough or uneven pavement surface. Use bicycle compatible drainage grates. Raise or lower existing grates and utility covers so they are flush with the pavement.

SHARED USE PATHS

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. Path facilities can also include amenities such as lighting, signage, and fencing (where appropriate).

Key features of shared 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.

GENERAL DESIGN PRACTICES

Description

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

A shared use paths may be used by pedestrians, skaters, wheelchair users, joggers and other non-motorized users. These other users may significantly impact the usefulness of shared use paths for use by bicyclists for transportation.

Guidance

Width

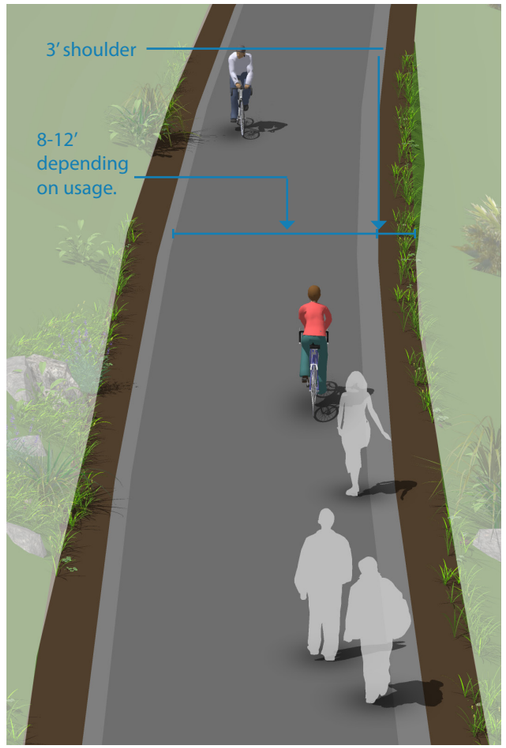
- 8 feet is the minimum allowed for a two-way shared-use path and is only recommended for low traffic situations.
- 10 feet is recommended in most situations and will be adequate for moderate to heavy use.
- 12 feet is recommended for heavy use situations with high concentrations of multiple users. A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

Lateral Clearance

- A 3 foot or greater shoulder on both sides of the path should be provided. This provides space for the installation of signage or other furnishings.

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.

Discussion

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.

The AASHTO Guide for the Development of Bicycle Facilities generally recommends against the development of shared use paths along roadways because of operational and safety concerns. See guidance later in this guide for more information.

Additional References and Guidelines

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

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.

SHARED USE PATHS IN RIVER AND UTILITY CORRIDORS

Description

Utility and waterway corridors often offer excellent shared use 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.

Guidance

See the shared use path general design practices guidance sheet for basic dimensions. 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 shared use 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

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

Materials and Maintenance

If using concrete surfacing, use saw-cut joints rather than troweled to improve the experience of path users.

SHARED USE PATHS IN ABANDONED 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.

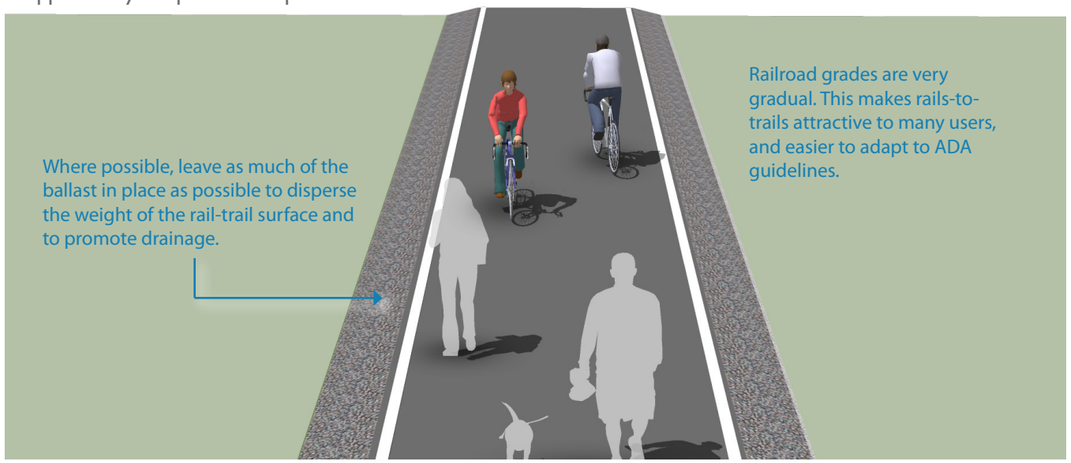
The railroad may form an agreement with any person, public or private, who would like to use the banked rail line as a path or linear park until it is again needed for rail use. Municipalities should acquire abandoned rail rights-of-way whenever possible to preserve the opportunity for path development.

Guidance

Shared 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 Shared use paths in Existing Active Rail Corridors.



Discussion

It is often impractical and costly to add material to existing railroad bed fill slopes. This results in paths 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. *Guide for the Development of Bicycle Facilities*. 2012.
FHWA. *Manual on Uniform Traffic Control Devices*. 2009.
Flink, C. *Greenways: A Guide To Planning Design And Development*. 1993.

Materials and Maintenance

Concrete paths may cost more to build than asphalt paths but do not become brittle, cracked and rough with age, or deformed by roots.

SHARED USE PATHS IN ACTIVE RAIL CORRIDORS

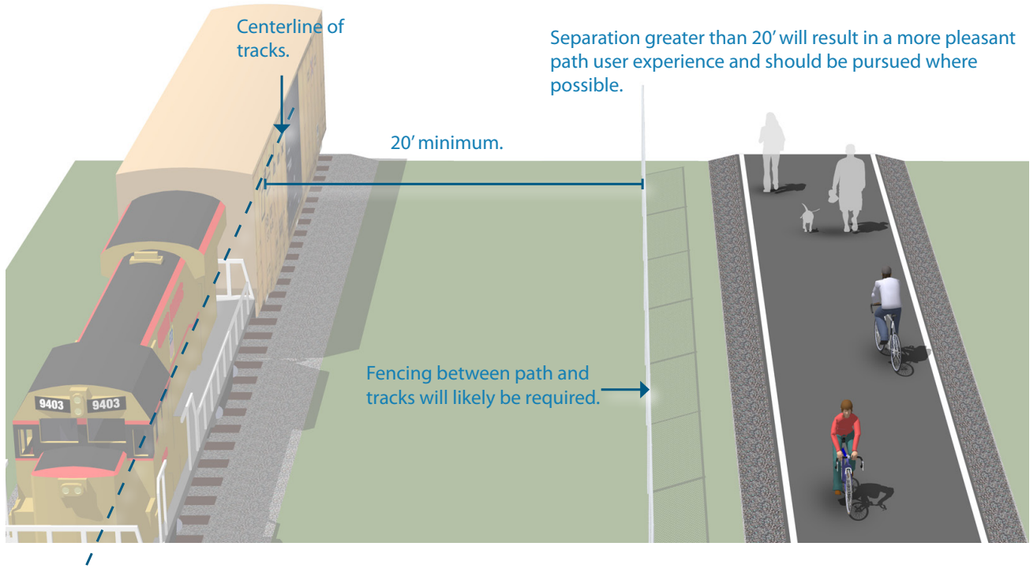
Description

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 crossings may affect a project's feasibility.

Guidance

Shared use paths in active rail corridors should meet or exceed general design standards. 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 than 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.



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 shared use path, i.e. whether the section of track is in an urban or rural setting.

Additional References and Guidelines

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

Materials and Maintenance

Concrete paths may cost more to build than asphalt paths but do not become brittle, cracked and rough with age, or deformed by roots.

LOCAL NEIGHBORHOOD ACCESSWAYS

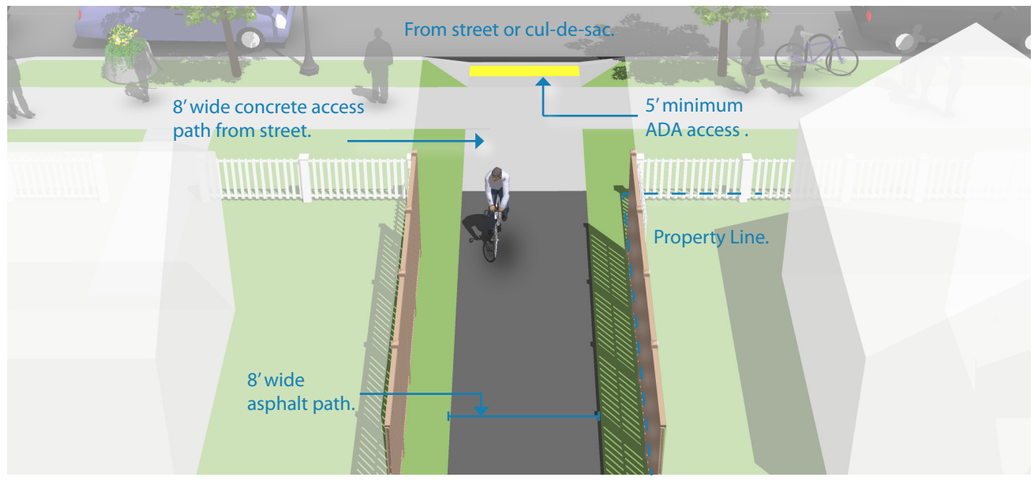
Description

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

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

Guidance

- Neighborhood accessways should remain open to the public.
- Path pavement shall be at least 8' wide to accommodate emergency and maintenance vehicles, meet ADA requirements and be considered suitable for shared use.
- Path 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 paths should slightly meander whenever possible.



Discussion

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

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

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
FHWA. Manual on Uniform Traffic Control Devices. 2009.
FHWA. *University Course on Bicycle and Pedestrian Transportation. Lesson 19: Greenways and Shared Use Trails*. 2006.

Materials and Maintenance

Consider implications for accessibility when weighing options for surface treatments.

SHARED USE PATHS ALONG ROADWAYS

Description

Shared Use Paths along roadways, also called Sidepaths, are a type of path that run adjacent to a street.

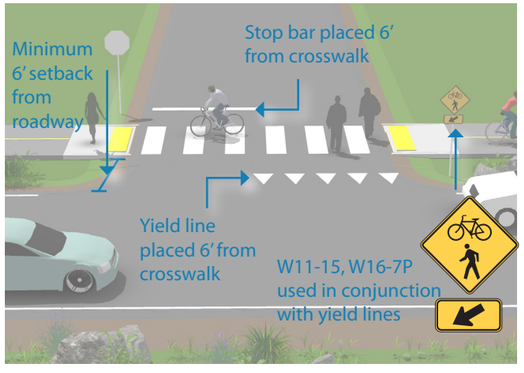
Because of operational concerns it is generally preferable to place paths within independent rights-of-way away from roadways. However, there are situations where existing roads provide the only corridors available.

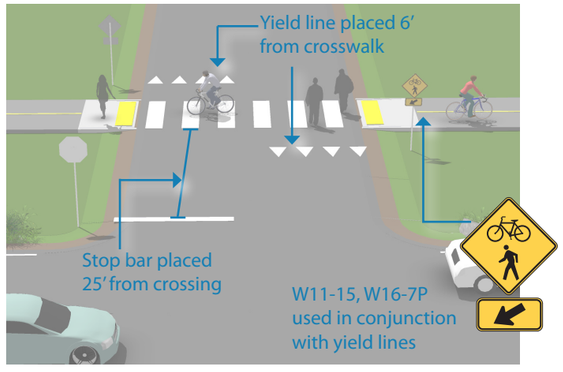
The AASHTO Guide for the Development of Bicycle Facilities cautions practitioners of the use of two-way sidepaths on urban or suburban streets with many driveways and street crossings.

In general, there are two approaches to crossings: adjacent crossings and setback crossings, illustrated below.

Adjacent Crossing - A separation of 6 feet emphasizes the conspicuity of riders at the approach to the crossing. Most appropriate on lower speed roadways.

Setback Crossing - A set back of 25 feet separates the path crossing from merging/turning movements that may be competing for a driver's attention. Most appropriate on higher speed roadways.





Guidance

- Guidance for sidepaths should follow that for general design practises of shared use paths.
- A high number of driveway crossings and intersections create potential conflicts with turning traffic.
- Where a sidepath terminates special consideration should be given to transitions so as not to encourage unsafe wrong-way riding by bicyclists.
- Crossing design should emphasize visibility of users and clarity of expected yielding behavior. High visibility crosswalks are preferred at high volume turn locations.
- Crossings may be STOP or YIELD controlled depending on sight lines and bicycle motor vehicle volumes and speeds.

Discussion

The provision of a shared use path adjacent to a road is not a substitute for the provision of on-road accommodation such as paved shoulders or bike lanes, but may be considered in some locations in addition to on-road bicycle facilities.

To reduce potential conflicts in some situations, it may be better to place one-way sidepaths on both sides of the street.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities*. 2012.

NACTO. *Urban Bikeway Design Guide*. See entry on Raised Cycle Tracks. 2012.

Materials and Maintenance

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

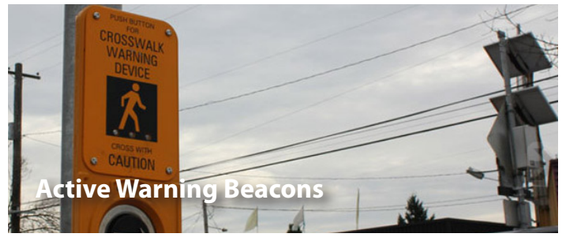
SHARED USE PATH CROSSINGS

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.

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



Active Warning Beacons


Route Users to Existing Signals

UNSIGNALIZED MARKED CROSSINGS

Description

An unsignalized marked 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.

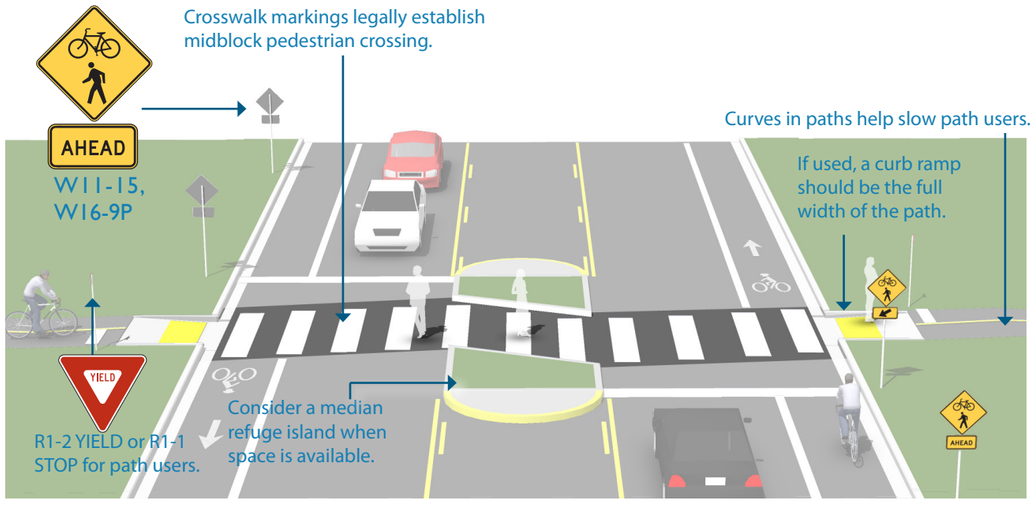
When space is available, using a median refuge island can improve user safety by providing pedestrians and bicyclists space to perform the safe crossing of one side of the street at a time.

Guidance

Refer to the FHWA report, "Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations" for specific volume and speed ranges where a marked crosswalk alone may be sufficient.

Where the speed limit exceeds 40 miles per hour, marked crosswalks alone should not be used at unsignalized locations.

Crosswalks should not be installed at locations that could present an increased risk to pedestrians, such as where there is poor sight distance, complex or confusing designs, a substantial volume of heavy trucks, or other dangers, without first providing adequate design features and/or traffic control devices.



Discussion

Marked crosswalks alone may not make crossings safer, nor will marked crosswalks necessarily result in more vehicles stopping for pedestrians. Whether or not marked crosswalks are installed, it is important to consider other pedestrian facility enhancements (e.g. raised median, traffic signal, roadway narrowing, enhanced overhead lighting, traffic-calming measures, curb extensions, etc.) as needed to improve the safety of the crossing. These are general recommendations; good engineering judgment should be used in individual cases for deciding which treatment to use.

Additional References and Guidelines

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

Materials and Maintenance

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

ACTIVE WARNING BEACONS

Description

Enhanced marked crossings are unsignalized crossings with additional treatments designed to increase motor vehicle yielding compliance on multi-lane or high volume roadways.

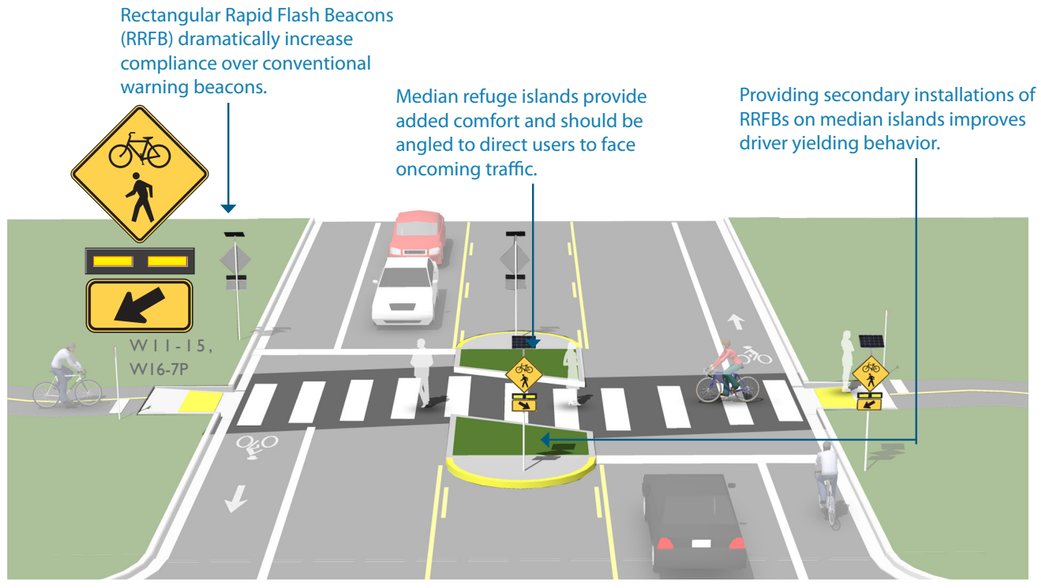
These enhancements include pathway user or sensor actuated warning beacons, Rectangular Rapid Flash Beacons (RRFB) shown below, or in-roadway warning lights.

Guidance

Guidance for Unsignalized Marked Crossings applies.

Warning beacons shall not be used at crosswalks controlled by YIELD signs, STOP signs, or traffic control signals.

Warning beacons shall initiate operation based on user actuation and shall cease operation at a predetermined time after the user actuation or, with passive detection, after the user clears the crosswalk.



Discussion

Rectangular rapid flash beacons show the most increased 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%. Additional studies of long term installations show little to no decrease in yielding behavior over time.

Additional References and Guidelines

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

Materials and Maintenance

Depending on power supply, maintenance of active warning beacons can be minimal. If solar power is used, signals should run for years without issue.

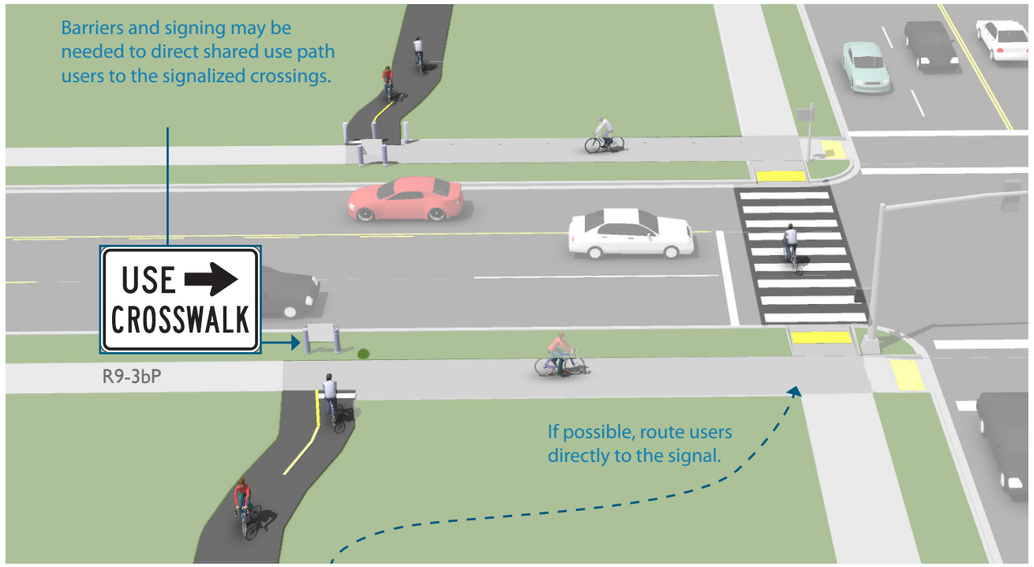
ROUTE USERS TO SIGNALIZED CROSSINGS

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.

Guidance

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



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 undesired midblock crossing may become prevalent if the distance is too great.

Additional References and Guidelines

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

Materials and Maintenance

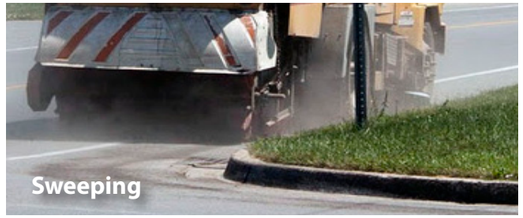
Municipalities should maintain comprehensive inventories of the location and age of bicycle wayfinding signs to allow incorporation of bicycle wayfinding signs into any asset management activities.

BIKEWAY SUPPORT AND MAINTENANCE

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.


Bicycle Racks


Sweeping

Maintenance

Regular bicycle facility maintenance includes sweeping, maintaining a smooth roadway, ensuring that the gutter-to-pavement transition remains relatively flush, and installing bicycle-friendly drainage grates. Pavement overlays are a good opportunity to improve bicycle facilities.

Recommended Bikeway Maintenance Activities

Maintenance Activity	Frequency
Inspections	Seasonal – at beginning and end of Summer
Pavement sweeping/ blowing	As needed, with higher frequency in the early Spring and Fall
Pavement sealing	5 - 15 years
Pothole repair	1 day – 1 month after report depending on severity.
Culvert and drainage grate inspection	Before Winter and after major storms
Pavement markings replacement	As needed
Signage replacement	As needed
Shoulder plant trimming (weeds, trees, brambles)	Twice a year; middle of growing season and early Fall
Tree and shrub plantings, trimming	1 – 3 years
Major damage response (washouts, fallen trees, flooding)	As soon as possible

BICYCLE RACKS

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. Racks should:

- Support the bicycle in at least two places, preventing it from falling over.
- Allow 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.

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.
- Locate racks in areas that cyclists are most likely to travel.

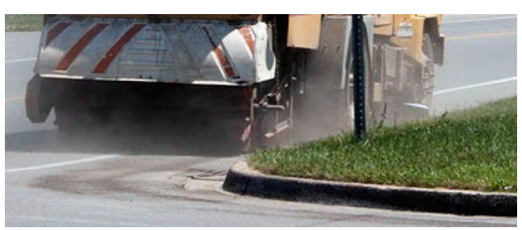
SWEEPING

Guidance

- Establish a seasonal sweeping schedule that prioritizes roadways with major bicycle routes.
- Sweep walkways and bikeways whenever there is an accumulation of debris on the facility.
- In curbed sections, sweepers should pick up debris; on open shoulders, debris can be swept onto gravel shoulders.
- Pave gravel driveway approaches to minimize loose gravel on paved roadway shoulders.
- Perform additional sweeping in the Spring to remove debris from the Winter.
- Perform additional sweeping in the Fall in areas where leaves accumulate.

Description

Bicyclists often avoid shoulders and bike lanes filled with gravel, broken glass and other debris; they will ride in the roadway to avoid these hazards, potentially causing conflicts with motorists. Debris from the roadway should not be swept onto sidewalks (pedestrians need a clean walking surface), nor should debris be swept from the sidewalk onto the roadway. A regularly scheduled inspection and maintenance program helps ensure that roadway debris is regularly picked up or swept.



STANDARDS COMPLIANCE

FHWA Traffic Control Device/Marking Compliance Categories

The FHWA MUTCD is not a facilities manual, but rather identifies describes federally approved traffic control devices (markings, signs and signals). These devices may be in various stages of the FHWA approval process, these are identified below.

SYMBOL	CATEGORY	DESCRIPTION
★★★★	Approved	The traffic control device is included or featured in the MUTCD and can be implemented at this time.
★★★	Compliant	The treatment may be implemented at this time, if MUTCD compliant signs and pavement markings are used.
★★	Interim Approval	Interim approval permits local application of new traffic control devices in accordance with prescribed guidance.
★	Included	The guidelines/standards discuss this topic and provide at least some guidance for application considerations.
☆	Experimental	The treatment may be installed with FHWA approval of a Request To Experiment (RTE), and has been done so by other jurisdictions.
○	N/A	This treatment is not considered a traffic control device and the MUTCD does not apply to this topic. Lack of inclusion should not be considered non compliance.

Facility Design Guidelines Compliance Categories

Facility design guidelines describe the application of various facilities to roadways.

SYMBOL	CATEGORY	DESCRIPTION
✦	Included	The guidelines/standards discuss this topic and provide at least some guidance for application considerations.
✧	Experimental	The guidelines/standards discuss this treatment, and generally discourage their use outside of very specific contexts.
○	N/A	The guidelines/standards are silent to this topic. Lack of discussion is not a statement of non-compliance.

	FHWA MARKING COMPLIANCE	FACILITY DESIGN GUIDELINES COMPLIANCE			
	FHWA MUTCD (2009)	AASHTO GUIDE FOR THE DEVELOPMENT OF BICYCLE FACILITIES (2012)	NACTO URBAN BIKEWAY DESIGN GUIDE (2012)	ITE DESIGNING WALKABLE URBAN THOROUGHFARES: A CONTEXT SENSITIVE APPROACH (2010)	VIRGINIA DEPARTMENT OF TRANSPORTATION ROAD DESIGN MANUAL(REV. 2012)
Bicycle Focused Treatments					
Shared Roadway Facilities					
Unmarked Wide Outside Lane	★★★	✦	○	○	✦
Signed Bike Route	★★★★	✦	○	○	✦
Shared Lane Markings	★★★★	✦	✦	○	○
Bike-Walk Street	★★★	✦	✦	○	○
On-Street Facilities					
Shoulder Bikeway	★★★	✦	○	○	✦
Conventional Bike Lanes	★★★★	✦	✦	✦	✦
Buffered Bike Lanes	★★★	✦	✦	○	○
Contra-Flow Bike Lanes	★★★	✦	✦	○	✧
Left-Side Bike Lanes	★★★★	✦	✦	○	✧
Advisory Bike Lane	☆	○	○	○	○
Uphill Bicycle Climbing Lane	★★★	✦	✦	○	✦
Cycle Track Bikeways					
One-Way Protected Cycle Tracks	○	✦*	✦	○	○
Raised Cycle Tracks (aka Raised Bike Lanes)	○	○	✦	○	○
Two-Way Cycle Tracks	○	○*	✦	○	○
Cycle Track Mixing Zone	★★	○	✦	○	○

Notes

*The 2012 AASHTO Guide to the Design of Bicycle Facilities does not mention "cycle tracks" by name. The provided guidance and discourages two-way operation of bicycles on one side of the street, such as on a two-way cycle track, but does acknowledge that "it may be better to place one-way sidepaths on both sides of the street.." p5-11

	FHWA MARKING COMPLIANCE	FACILITY DESIGN GUIDELINES COMPLIANCE			
	FHWA MUTCD (2009)	AASHTO GUIDE FOR THE DEVELOPMENT OF BICYCLE FACILITIES (2012)	NACTO URBAN BIKEWAY DESIGN GUIDE (2012)	ITE DESIGNING WALKABLE URBAN THOROUGHFARES: A CONTEXT SENSITIVE APPROACH (2010)	VIRGINIA DEPARTMENT OF TRANSPORTATION ROAD DESIGN MANUAL(REV. 2012)
Off-Street Bikeways					
Shared-Use Path	★★★★	✦	○	○	✦
Shared-Use Path adjacent to roadways (aka Sidepath)	★★★	✦	○	○	○
Bikeway Intersection Treatments					
Advance Stop Line for adjacent motor vehicle lane	★★★★	○	○	○	○
Bike Boxes	☆	○	✦	✦	○
Two-Stage Turn Queue Boxes	☆****	○	✦	○	○
Median Refuge Island for Bicycle Use	★★★	✦	✦	✦	○
Through Bike Lanes at Auxiliary Right Turn Only Lanes (aka "add lanes")	★★★★	✦	✦	✦	✦
Combined Bike Lane/Turn Lane Using Shared Lane Markings	★★★	○	✦	○	○
Intersection Crossing Markings	★★★*	✦	✦	✦	○
On-Street Bikeway Intersection Crossings					
Bicycle Signal Heads	★★	○**	✦	○	○
Signal Detection and Actuation	★★★★	✦	✦	✦	○
Rectangular Rapid Flash Beacon for Bike Route crossing at Unsignalized Intersection	★★*	○	✦	○	○
Hybrid Beacon for Bike Route Crossing of Major Street	★★★★***	○	✦	○	○
Off-Street Bikeway Midblock Crossings					
Hybrid Beacon for Off-Street Path Crossing	★★★★	✦	✦	○	○
Active Warning Beacon	★★★★	✦	✦	○	○
Rectangular Rapid Flash Beacon	★★	○	✦	○	○
Bicycle Signal Head	★★	○**	○	○	○
Additional Marking and Signing					
Bike Route Wayfinding Signage	★★★★	✦	✦	○	✦
Colored Bike Facilities	★★	✦	✦	✦	○

Notes

*Use of W11-15 (bike/ped) sign is not addressed in the IA for RRFBs
** The 2012 AASHTO Guide to the Design of Bicycle Facilities refers to the application of conventional traffic signals for bicycle-only use.
*** When used with bicycle signal head, experimentation required
**** Two-stage turn boxes at T-intersections are permitted by FHWA. Installations within intersections require experimentation.

	FHWA MARKING COMPLIANCE	FACILITY DESIGN GUIDELINES COMPLIANCE		
	FHWA MUTCD (2009)	AASHTO GUIDE FOR THE PLANNING, DESIGN, AND OPERATION OF PEDESTRIAN FACILITIES (2004)	ITE DESIGNING WALKABLE URBAN THOROUGHFARES: A CONTEXT SENSITIVE APPROACH (2010)	VIRGINIA DEPARTMENT OF TRANSPORTATION ROAD DESIGN MANUAL (REV. 2012)
Pedestrian Focused Treatments				
Pedestrian Ways				
Buffered sidewalks	○	✦	✦	✦
Pedestrian Scale Lighting	○	✦	✦	✦
Street trees	○	✦	✦	✦
ADA Curb Ramps	○	✦	✦	✦
Shoulders for Pedestrian Travel	★★★	✦	○	✦
Multi-Use Paths	★★★★	✦	○	✦
"Sidepaths"	★★★	✦	○	✦
Un-signalized Crossings				
Midblock Crossings	★★★★	✦	✦	✦
Marked crosswalks	★★★★	✦	✦	✦
Pedestrian Crossing Advanced Warning Signs	★★★★	✦	✦	✦
Pedestrian bridges: overpasses and underpasses	○	✦	○	✦
In-street pedestrian crossing sign	★★★★	✦	○	○
Advance yield/stop lines at crossings	★★★★	✦	✦	○
Raised Crosswalk	★★★★	✦	✦	✦
Refuge Island	★★★★	✦	✦	✦
Two-stage Pedestrian Crossing	★★★★	✦	✦	✦
High visibility crosswalks	★★★★	✦	✦	✦
Crossing Beacons for use at midblock or unsignalized crosswalks				
Pedestrian hybrid beacon	★★★★	○	○	✦
Conventional Continuous Flashing Warning Beacon	★★★★	✦	✦	○
Active Warning Beacons	★★★★	○	✦	✦
Rectangular Rapid Flash Beacon	★★	○	○	✦
Signalized Intersections				
Pedestrian Countdown Signal Head	★★★★	✦	✦	✦
Pedestrian pushbutton actuators	★★★★	✦	✦	○
"No turn on red" sign	★★★★	✦	✦	○
Leading pedestrian interval	★★★★	✦	○	○

	FHWA MARKING COMPLIANCE	FACILITY DESIGN GUIDELINES COMPLIANCE		
	FHWA MUTCD (2009)	AASHTO GUIDE FOR THE PLANNING, DESIGN, AND OPERATION OF PEDESTRIAN FACILITIES (2004)	ITE DESIGNING WALKABLE URBAN THOROUGHFARES: A CONTEXT SENSITIVE APPROACH (2010)	VIRGINIA DEPARTMENT OF TRANSPORTATION ROAD DESIGN MANUAL (REV. 2012)
General Roadway Design				
Median island	★★★★	✦	✦	✦
Curb Extension	○	✦	✦	✦
Curb radius reductions	○	✦	✦	✦
Sight distance considerations	○	✦	✦	✦
Narrow (10') Travel Lanes	○	○	✦	✦
Road Diet Conversions	○	○	✦	✦
Single-Lane Roundabouts	★★★★	✦	✦	✦
Multi-lane roundabouts	★★★★	✦	✦	✦
Access Management				
Pedestrian-Friendly Driveways	○	✦	✦	○
Consolidate driveways	○	✦	✦	○
Right-in, right-out Channelization	○	✦	○	○
Transit Stop Considerations				
Best practice for transit stop placement	○	○	✦	✦
Concrete pads	○	✦	✦	✦
Benches and shelters	○	✦	✦	✦
Lighting	○	○	✦	✦
Other				
Low Impact Development/Green Infrastructure	○	○	✦	✦
Pedestrian Wayfinding Signage	○	○	○	○
Block Length	○	○	✦	✦
Traffic Calming				
Mini traffic circles	★★★★	✦	○	○
Chicanes	○	✦	○	○
Speed humps/tables	★★★★	✦	✦	○
Queueing Streets (narrow, two-way local streets)	○	✦	○	○

This page intentionally left blank.

RICHMOND
Bicycle Master Plan

Bicycle Demand

OVERVIEW

The Bicycle Suitability Index (BSI) provides a general understanding of expected activity in the bicycling environment by combining categories representative of where people live, work, play, access public transit and go to school into a composite sketch of regional demand. Suitability is used to identify levels of comfort of roadways and identify those that may by suitable for bicycle facilities.

BICYCLE SUITABILITY INDEX METHODOLOGY

A BSI analysis overlays "supply" and "demand" factors to graphically show the varying levels of supply and demand and how they overlap throughout the City. The supply factor is created by identifying a bicyclist's level of comfort on each road throughout the city by accounting for factors such as speed limit, Annual Average Daily Traffic (AADT), and whether a bicycle facility currently exists. The demand factor is created by categorizing where people live, work, play, access public transit and go to school and creating a composite map showing areas of high density for these activities. Area specific land use and transportation factors, such as GRTC service, local cultural destinations, schools, trails, and demographic factors, are also considered in the demand analysis. The resulting overlay of demand and supply establishes a BSI Typologies Model that indicates geographic patterns of supply and demand.

The results of BSI can be used to identify areas for improvement and to prioritize potential bicycle projects where infrastructure need meets trip demand.

BSI methodology uses quantitative modeling approaches to identify and prioritize bicycle corridors by visually overlaying local GIS data on the study area.

The steps of the analyses include:

- Collect available local GIS data
- Quantify the elements that impact cycling rates
- Use information to identify areas where cyclists are most likely to be found
- Find the gaps in the existing cycling network
- Identify the possible bicycle corridors
- Provide guidance on how to best prioritize future projects

BSI Demand Analysis Development

BSI's Demand Analysis relies on spatial consistency in order to generate logical distance and density patterns. It is for this reason that all scores are aggregated to a central location at the census block level, the census block corner, referred to as "BSI Point". Census blocks closely represent the street network and therefore census block corners closely represent street corners, where foot and bicycle traffic is prevalent. This method is based on the "Low-Stress Bicycling and Network Connectivity" report (Mineta Transportation Institute, May 2012). The report discusses the benefits of using a smaller geographic setting for pedestrian and bicycle demand analyses rather than using more traditional traffic model features such as census block groups, census tracts, or traffic analysis zones (TAZs). Due to the low speed of pedestrian movement, a

CHAPTER CONTENTS

much smaller geographic unit of analysis is needed.

BSI Supply Analysis Development

BSI's Supply Analysis also relies on spatial consistency. Feature data sets provided for this analysis were collected from a variety of sources and are considered accurate on a variety of geographic scales. The roadway factors that were available for the entire study area and used in the BSI supply analysis include roadway facility classification (e.g., primary, secondary or local), annual average daily traffic counts (AADT), speed limit and proximity to existing bicycle facilities and greenways.

Demand Analysis Scoring Method

Generally speaking, the scoring method is a function of density and proximity. Scores reflect relative impact on bicycling to and from census block corners that are located adjacent to the features used in the analysis. As such, scores are represented as density patterns of census block corners within a ¼ mile of each other. Subsequently, the scores are effectively a result of two complementary forces: distance decay – the effect of distance on spatial interactions yields lower scores for features over ¼ mile away from other features; and spatial density – the effect of closely clustered features yields higher scores. Scores will increase in high feature density areas and if those features are close together. Scores will decrease in low feature density areas and if features are further apart. In essence, the score is the

intersection of distance and density.

Categories are scored on a scale of 1 – 5 based on density and proximity and then assigned weighted multipliers to reflect the relative influence categories have on pedestrian activity. The feature weighting method is discussed in the following section.

Demand Analysis Application

The following equation describes how each demand category is calculated based on scores and weights where:

*Category Score = (MaxF / 5) * FW*
MaxF = Maximum Density Value per Feature
5 = Constant Normalizing Value
FW = Feature Weights

Supply Scoring Method

Including data about the roadway quality further refines the demand analysis. This supply-side of the analyses identifies the quality of a roadway to and from the places in the community where people live, work, play and learn. Road features used in determining quality included annual average daily traffic (AADT) volume, speed limits, block length, and existing on- and off-street bicycle and pedestrian facilities (such as on-street bike facilities and multi-use trails). These road features were assigned scores based on suitability for biking. Generally, roads which had low-volume, low-speed traffic and which included

Category	Category Feature Dataset	Geometry Type	BSI Score	Score Classification Technique	Data Evaluation Technique
Roadway Quality	**Block Length**	Linear		Manual Interval	Scores Summed and Scaled 1-5
	< 365 feet		5		
	365 - 1000 feet		4		
	1001 feet - 1320 feet		3		
	1321 - 2640 feet		2		
	> 2640 feet		1		
	Proximity to Existing Bike Facilities				
	Streets with bike facilities		5		
	Street connected to bike facilities (within 0.25 miles)		4		
	Street connected to bike facilities (within 0.5 miles)		3		
	Street connected to bike facilities (within 1.0 mile)		2		
	Street connected to bike facilities (within 2 miles)		1		
	Interstate		0		
	Posted Speed Limit				
	Speed Limit < 25 mph		5		
	Speed Limit 25-35 mph		4		
	Speed Limit 35-45mph		3		
	Speed Limit > 45 mph		1		
	VDOT AADT Data (2011)				
	< 1500		5		
	1500-3000		4		
	3000-8000		3		
	8000-10,000		**2**		
	< 10,000		**1**		

designated places to bike assigned higher scores. Table B-1 describes the metrics used for this category.

Table B-1: Data Required and Scoring for BSI Roadway Quality

BSI Composite Activity Models

Development of the composite activity models of bicycling in Richmond was conducted in two steps.

- First, by combining the scores for the places in the community where people live, work, play and learn (attractors and generators) to produce a composite set of scores for the areas of interest. This step approximates trip demand.
- Then, by overlaying the appropriate composite roadway quality scores. This step approximates trip supply.

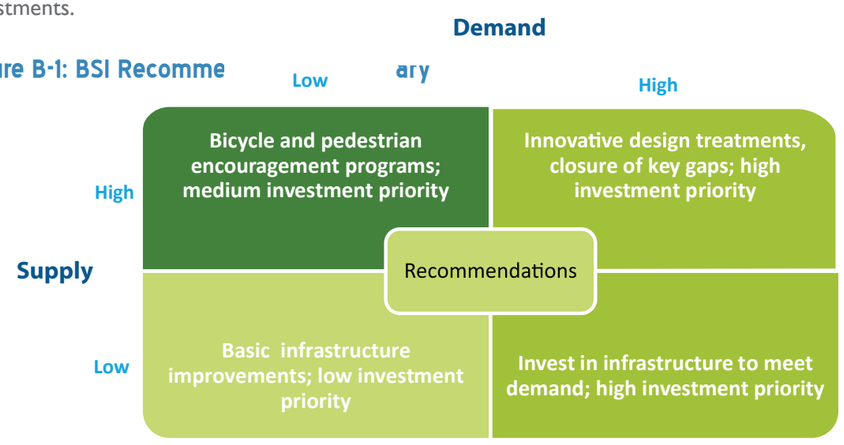
As illustrated in Figure B-1, areas with high levels of demand for bicycling as well as a high supply of suitable facilities can potentially benefit most from innovative programs, capital projects, and closure of key gaps. These are the areas where bicycling improvements would likely have the highest impact on the largest number of existing and potential users. They should be a high priority for investment and should be considered for showcase projects where best practices can be modeled for the region.

Areas with high demand for cycling and a low supply of suitable infrastructure can benefit from infrastructure improvements to improve cycling conditions. Due to conditions such as high traffic volume or speed, these areas may require off-road facilities. They should also be high priority for investment.

Areas with low levels of demand for cycling and walking combined with existing good facilities can potentially benefit from programs targeted to encourage cycling. They may also be areas where land use changes or additional development should be considered. These areas are identified medium priority for investment.

Areas showing low levels of cycling demand as well as a low supply of suitable infrastructure can potentially benefit from basic infrastructure improvements. These areas should be low-priority for investments.

Figure B-1: BSI Recommendations



RICHMOND
Bicycle Master Plan

C Funding Resources

OVERVIEW

A combination of funding sources will be necessary for the City of Richmond to implement this plan. It will be necessary to consider several possible sources of funding, that when combined, will support full project completion. This appendix outlines the most likely sources of funding from federal, state, and local government levels as well as from the private and non-profit sectors.

It should be noted that this appendix reflects the funding available at the time of writing. Funding amounts, cycles, and even the programs themselves are susceptible to change without notice

FEDERAL FUNDING SOURCES

Federal funding is typically directed through state agencies to local governments either in the form of grants or direct appropriations, independent from state budgets. Federal funding typically requires a local match of anywhere from five percent to 50 percent, but there are sometimes exceptions, such as the recent American Recovery and Reinvestment Act stimulus funds, which did not require a match. In Virginia, federal monies are administered through the Virginia Department of Transportation (VDOT) by the Commonwealth Transportation Board (CTB) and metropolitan planning organizations (MPOs), such as the Richmond Area MPO (RAMPO). Most, but not all, of these programs are oriented toward transportation, with an emphasis on reducing auto trips and providing intermodal connections. The following is a list of possible federal funding sources that could be used to support construction of pedestrian and bicycle improvements.

Moving Ahead for Progress in the Twenty-First Century (MAP-21)

The largest source of federal funding for pedestrian and bicycle projects is the USDOT's Federal-Aid Highway Program, which Congress has reauthorized roughly every six years since the passage of the Federal-Aid Road Act of 1916. The current legislation, MAP-21 was enacted in July 2012, and authorizes funding for federal surface transportation programs including highways and transit until September 2014. The Act replaces the Safe, Accountable, Flexible, Efficient Transportation Equity Act – a Legacy for Users (SAFETEA-LU), which was valid from August 2005 through June 2012.

The reauthorization of MAP-21 is currently in progress, so the City of Richmond will need to keep track of potential funding as the legislation is developed. There are a number of programs identified within MAP-21 that are applicable to bicycle and pedestrian projects. MAP-21 programs that are eligible to fund projects include:

- Federal Transit Administration Capital Funds (FTA)
- Associated Transit Improvement (ATI)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- National Highway Performance Program (National Highway System) (NHPP/NHS)
- Surface Transportation Program (STP)
- Transportation Alternatives Program/Transportation Enhancement Activities (TAP/TE)
- Federal Lands Highway Program (Federal Lands Access Program, Federal Lands Transportation Program, Tribal Transportation Program) (FLH)
- Transportation, Community, and System Preservation Program (TCSP) – until funds expended

CHAPTER CONTENTS

Being creative with funding sources can be the difference between implementing bicycle facilities and having gaps in the network. This contraflow bike lane paired with a sharrow completes a key connection in Tacoma, WA.

Most of these programs are competitive and involve documentation of the project need, costs, and benefits. Furthermore, it is not possible to guarantee the continued availability of any listed MAP-21 programs or to predict their future funding levels or policy guidance. Nevertheless, many of these programs have been included in some form since the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991, and, thus, may continue to provide capital for active transportation projects and programs.

For more information, visit: http://www.fhwa.dot.gov/map21/summaryinfo.cfm

Transportation Alternatives

Transportation Alternatives (TAP) is a new funding source under MAP-21 that consolidates three former SAFETEA-LU programs: Transportation Enhancements (TE), Safe Routes to School (SRTS), and the Recreational Trails Program (RTP). These funds may be used for a variety of pedestrian, bicycle, and streetscape projects including sidewalks, bikeways, multi-use paths, school safety, and rail-trails. Each Metropolitan Planning Organization (MPO) in the four identified Transportation Management Areas (TMAs) in Virginia makes the project selections in their area. The next application cycle deadline is November 1, 2014, for fiscal year 2016.

Eligible projects for TAP funding include Transportation Alternatives as defined by MAP-21 Section 1103 (a)(29). This category includes the construction, planning, and design of a range of bicycle and pedestrian infrastructure including "on-road and off-road trail facilities for pedestrians, bicyclists, and other non-motorized forms of transportation, including sidewalks, bicycle infrastructure, pedestrian and bicycle signals, traffic calming techniques, lighting and other safety-related infrastructure, and transportation projects to achieve compliance with the Americans with Disabilities Act of 1990". Infrastructure projects and systems that provide "Safe Routes for Non-Drivers" is a new eligible activity.

For the complete list of eligible activities, visit: http://www.fhwa.dot.gov/environment/transportation_enhancements/legislation/map21.cfm

Average annual funds available through TAP over the life of MAP-21 equal $814 million nationally, which is based on a 2% set-aside of total MAP-21 authorizations. TAP funds for Richmond, VA are administered through the Richmond MPO. Interim guidance released by the Federal Highway Administration clarifies that the Transportation Alternatives Program does not establish specific standards or procedures for the competitive grant process but lists a set of requirements for the selection of projects.

For more information, see: http://www.fhwa.dot.gov/map21/guidance/guidetap.cfm.

Congestion Mitigation/Air Quality Improvement Program

The Congestion Mitigation/Air Quality Improvement Program (CMAQ) provides funding for projects and programs in air quality non-attainment and maintenance areas for ozone, carbon monoxide, and particulate matter, which reduces transportation related emissions. States with no nonattainment areas may use their CMAQ funds for any CMAQ or STP eligible project. These federal dollars can be used to build bicycle facilities that reduce travel by automobile. Communities located in attainment areas who do not receive CMAQ funding apportionments may apply for CMAQ funding to implement projects that will reduce travel by automobile.

For more Information, see: http://www.fhwa.dot.gov/map21/cmaq.cfm

Federal Transit Administration (FTA) Metropolitan Planning

This program provides funding for metropolitan coordinated transportation planning. Federal planning funds are first apportioned to State DOTs. State DOTs then allocate planning funding to MPOs. Eligible activities include pedestrian or bicycle planning to increase safety for non-motorized users and to enhance the interaction and connectivity of the transportation system across and between modes.

For more information, see: http://www.fhwa.dot.gov/map21/mp.cfm

Pilot Transit-Oriented Development Planning

MAP-21 established a new pilot program to promote planning for Transit-Oriented Development also administered by the FTA. The bill text states that the Secretary of Transportation may make grants available for the planning of projects that seek to "facilitate multimodal connectivity and accessibility" and "increase access to transit hubs for pedestrian and bicycle traffic." This program is purposed to support comprehensive planning.

STATE FUNDING SOURCES

The funding sources covered in this section were updated in the summer of 2014. The status of future funding sources is subject to change. Thus, the availability of these funding resources should be confirmed during the implementation of a project.

Transportation Alternatives Funding

As part of MAP-21, previous Transportation Enhancement Program activities were grouped with other programs (RTP and Safe Routes to School) to establish a new program aptly named the Transportation Alternatives Program (TAP). TAP provides for four eligible activities that include planning, construction and design of bicycle and pedestrian facilities. The distribution of funding under MAP-21 divides TAP funds in half (after taking initial funds for RTP), with 50% of the funds distributed based on population and 50% distributed elsewhere statewide. For Fiscal Year 2014, approximately $6.3 million of TAP funding is available for projects in the Richmond Transportation Management Area (TMA). This includes the Richmond and Tri-Cities MPO areas where the MPO selects projects to fund from this portion of TAP funding. The remaining 50% of statewide funding is distributed by the Commonwealth Transportation Board (CTB) at their discretion. Applications for funding are available through the Virginia Department of Transportation (VDOT) Local Assistance Division (www.virginiadot.org/business/prenhancegrants.asp).

The other primary source of funding transportation projects in Virginia is the Commonwealth Transportation Fund (CTF). The CTF is financed through state revenues including, but not limited to, motor vehicle sales, fees and fuel tax. The CTF is divided into four funding programs: the Highway Maintenance and Operating Fund, Transportation Trust Fund, Intercity Passenger Rail Operating and Capital Fund and Priority Transportation Fund. CTF can be utilized to assist localities in construction and maintenance of bicycle and pedestrian projects. Under VDOT's Bicycle and Walking Program, there are implementation guidance documents, to include construction and maintenance scoping forms for project funding. Additionally, VDOT provides planning assistance, coordination, education and safety resources through the Bicycle and Walking Program.

VDOT Safe Routes to School

The Safe Routes to School (SRTS) program is a federally funded program that has been active in Virginia since 2007. The SRTS program was initiated by the passing of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) in 2005, which establishes a national SRTS program to distribute funding and institutional support to implement SRTS programs in states and communities across the country. SRTS programs help schools and communities make walking and biking to school a safe, convenient, and natural activity by facilitating the planning, development, and implementation of projects and activities that will improve safety and reduce traffic, fuel consumption, and air pollution in the vicinity of schools.

State Recreation Access Funds

The purpose of the Recreational Access Program is to provide adequate access to recreational areas or historic sites operated by the Commonwealth of Virginia, a local government, or authority. Funding for these projects is provided through VDOT's Recreational Access Fund and approved by CTB; both roads and bikeways are eligible for program funding.

LOCAL GOVERNMENT FUNDING SOURCES

Cities often plan for the funding of pedestrian and bicycle facilities or improvements through the development of Capital Improvement Programs (CIP). In Raleigh for example, the greenways system has been developed over many years through a dedicated source of annual funding that has ranged from $100,000 to $500,000, administered through the Recreation and Parks Department. CIPs should include all types of capital improvements (water, sewer, buildings, streets, etc.) versus programs for single purposes. This allows municipal decision-makers to balance all capital needs. Typical capital funding mechanisms include the following: capital reserve fund, community development authorities, tax increment financing, taxes, fees, and bonds. Each category is described below. A variety of possible funding options available to Virginia jurisdictions for implementing pedestrian and bicycle projects are described below. However, many will require specific local action as a means of establishing a program, if not already in place.

Capital Reserve Fund

Cities have statutory authority to create capital reserve funds for any capital purpose, including bicycle facilities. The reserve fund must be created through ordinance or resolution that states the purpose of the fund, the duration of the fund, the approximate amount of the fund, and the source of revenue for the fund. Sources of revenue can include general fund allocations, fund balance allocations, grants and donations for the specified use.

Transportation Improvement District (TID)

Transportation Improvement Districts (TIDs) are most often used by cities to construct localized projects such as streets, sidewalks, or bikeways. Through the TID process, the costs of local improvements are generally spread out among a group of property owners within a specified area. The cost can be allocated based on property frontage or other methods such as traffic trip generation. These types of districts have been used for larger projects in Virginia such as the Route 28 Improvement Project and the Silver Line MetroRail project in northern Virginia.

Community Development Authorities (Special Tax Districts)

Cities and counties have statutory authority to establish community development authorities, to levy a property tax in the district additional to the city-wide property tax, and to use the proceeds to provide services in the district. Downtown revitalization projects are one of the eligible uses of service districts and can include projects such as street, sidewalk, or bikeway improvements within the downtown taxing district.

Tax Increment Financing

Virginia Code section 58.1-3245.2 allows local governing bodies to implement tax increment financing, allowing localities to use gains in taxes to finance the current improvements that will create those gains.

When a public project (e.g., a greenway trail) is constructed, surrounding property values generally increase and encourage surrounding development or redevelopment. The increased tax revenues are then dedicated to finance the debt created by the original public improvement project. Streets, streetscapes, and sidewalk improvements are specifically authorized for TIF funding in North Carolina. Tax Increment Financing typically occurs within designated development financing districts that meet certain economic criteria that are approved by a local governing body.

Other local funding options:

- Bonds/Loans
- Taxes
- Impact fees
- Exactions
- Installment purchase financing
- In-lieu-of fees

PRIVATE & NON-PROFIT FUNDING SOURCES

Private foundations and other conservation-minded benefactors are becoming an increasingly important source of funds for bicycle transportation projects. Many corporations or wealthy business families have related foundations that support social causes, and the multifold health benefits of bicycle transportation are attracting public attention. Below are several examples of private funding opportunities available.

The Robert Wood Johnson Foundation

The Robert Wood Johnson Foundation was established as a national philanthropy in 1972 and today it is the largest U.S. foundation devoted to improving the health and health care of all Americans. Grant making is concentrated in four areas:

- To assure that all Americans have access to basic health care at a reasonable cost
- To improve care and support for people with chronic health conditions
- To promote healthy communities and lifestyles
- To reduce the personal, social and economic harm caused by substance abuse: tobacco, alcohol, and illicit drugs

For more specific information about what types of projects are funded and how to apply, visit www.rwjf.org/applications/

Walmart State Giving Program

The Walmart Foundation financially supports projects that create opportunities for better living. Grants are awarded for projects that support and promote education, workforce development/economic opportunity, health and wellness, and environmental sustainability. Both programmatic and infrastructure projects are eligible for funding. State Giving Program grants start at $25,000, and there is no maximum award amount. The program accepts grant applications on an annual, state by state basis January 2nd through March 2nd.

Online resource: http://foundation.walmart.com/apply-for-grants/state-giving

The Rite Aid Foundation Grants

The Rite Aid Foundation is a foundation that supports projects that promote health and wellness in the communities that Rite Aid serves. Award amounts vary and grants are awarded on a one year basis to communities in which Rite Aid operates. A wide array of activities is eligible for funding, including infrastructural and programmatic projects.

Online resource: https://www.riteaid.com/about-us/rite-aid-foundation

Bank of America Charitable Foundation, Inc.

The Bank of America Charitable Foundation is one of the largest in the nation. The primary grants program is called Neighborhood Excellence, which seeks to identify critical issues in local communities. Another program that applies to greenways is the Community Development Programs, and specifically the Program Related Investments. This program targets low and moderate income communities and serves to encourage entrepreneurial business development.

For more information: www.bankofamerica.com/foundation

This page intentionally left blank.

RICHMOND
Bicycle Master Plan

D Public Outreach

OVERVIEW

Public engagement involved numerous outreach components to spread awareness of the *Richmond Bicycle Master Plan*. The city website was used as a portal for the survey and online input map, booths were set up at local events, and local advocacy groups assisted in spreading awareness of the Plan. Sports Backers was particularly helpful with arranging for a booth at events and disseminating information to their database of subscribers. The efforts of the City, the Pedestrian, Bicycle, Trails Commission (PBTC), and Sports Backers provided a variety of local perspectives containing essential insight into the future bicycling network for Richmond, VA. The following sections include materials used during public input events and the survey results.

CHAPTER CONTENTS

PUBLIC INPUT PLAN

A public input plan was crafted to generate ideas that would carry Richmond into the future with efforts to spread awareness about projects and the development of the bicycle network. The plan recommends an outreach approach that requires the community engagement team to be active and have a strong voice for the Plan from pre-launch education through planning and implementation of bicycle facilities. This plan lays the foundation for a public engagement program. It is a living, changing document that sets the foundation for ongoing communication and outreach to city residents and visitors. This plan is a tool to be used as a guide for city staff to build programs for education and encouragement during the planning process and for years to come.

Community engagement requires key staff members to be integrally involved with City of Richmond staff, stakeholders, area residents, and the public through a process that includes deep and broad engagement between the City and the community. The City should work with local advocacy groups, the Pedestrian, Bicycle, and Trail Planning Commission, and other local supporters to initiate and execute a communications plan to provide a consistent message for education and encouragement throughout Richmond. The result is a collaborative effort with the community to enhance safety, comfort, transportation efficiency, and health and economic development benefits associated with bicycle travel for transportation and recreation.

Objectives

1. Fine tune the City's message for community education and engagement.
2. Determine the City's priorities and benchmarks for success.
3. Utilize the most cost-effective techniques to meet the City's objectives.

Strategies

- Communicate with Richmond residents and regional business owners to keep them informed and engaged throughout the life of the plan and into implementation. The City will strive to garner public support for the Plan while developing the public's understanding of the needs and benefits of biking.
- To provide a platform for the City and stakeholders to communicate with the public, creating a two-way dialogue with citizens over the course of engagement.
- To create a network of support within the community.

It is important to focus our overall strategy by age group. We may not achieve the results hoped for if we pursue all residents the same way. Older residents will need a more traditional, relational, and hands-on approach through groups like churches and community organizations. Younger audiences rely on social media and technology for communication.

Target Audiences

The Community Engagement and Outreach Plan will ensure all voices have an opportunity to be heard as well as provide public education. The target groups in Richmond will include:

1. Underserved communities
   - Minority populations
   - Limited English proficiency populations
   - Low income families/individuals
   - Individuals with disabilities
2. Community groups
   - Minority communities
   - Elected and appointed officials
   - Pedestrian Bicycle and Trails Commission
   - Faith-based organizations
   - Businesses (including hospitals & medical centers)
   - Higher education
   - Green Richmond Initiative advocates
   - Community and civic organizations
3. Recreational associations – bicyclists, public transportation commuters, etc.
4. Local schools
5. Motorists
6. Visitors

Some of Richmond's Major Employers

- Dominion
- MeadWestvaco (MWV)
- Universal Corporation
- NewMarket Corporation
- Altria
- State Government
- Financial Institutions
- Virginia Commonwealth University
- University of Richmond
- Anthem -- Blue Cross Blue Shield
- The Martin Agency

Working directly with these organizations will help raise awareness of the plan and its people and remind the community that you care about THEM as well as their quality of life. Exhibits and workshops at major events as well as a presence at key conferences in the secular and faith communities can also help build rapport.

In light of childhood obesity and health issues of adults due to lack of physical activity, it is imperative that a low- cost alternative for mobility be considered. Partnerships with outdoor sports and bicycle retailers will be pursued to help disseminate information to customers.

Possible Metrics and Desired Outcomes

- Positive letters to the editor and other media outlets
- More hits to the city's website
- Requests for community presentations among the grassroots groups
- Increased bicycle sales and safety classes enrollment
- Increased bicycle use in under-represented neighborhoods
- Increased demand for bike racks
- Reduction in bicycle/vehicle conflicts
- Reduction in bicycle/pedestrian conflicts

Outreach Tactics to Reach Target Groups (See Table 1 for Tactics)

1. Conduct outreach to media outlets that target minority groups within the city. Publications include: Richmond Voice; Richmond Free Press; La Prensa Latina
2. Perform grassroots outreach to Faith-based organizations, businesses and civic leagues throughout the Richmond area.
3. Conduct intercept surveys at major public events to gauge stakeholders' level of interest and concern about the City's plan
4. Leverage existing communication tools and resources used by the City or create and tailor them for this Plan. The team will use a variety of communications tools already developed and distribute information about the Plan and its benefits. These materials can include:
   - Program Fact Sheets
   - Rack Cards at retail outlets and gathering spots
   - FAQs
   - Newsletter
   - News Releases
   - Web
   - PowerPoint presentations (tailored for audience)
   - Charitable donations
   - Display Booths
   - Social Media

Through electronic distribution and one-on-one outreach following the vision and direction from this plan, the team will disseminate information as outlined in the table below.

Table D-1: Outreach Method By Audience

Group	Preferred Method of Communication	Planned Outreach
Faith-Based Organizations	Flyers, Brochures, Fact Sheets, Pre-Written Blurb For Inclusion In Bulletin And Website.	Drop Off Materials Prior To Sunday Service For Info Table Inclusion In Bulletin (Submit The Wednesday Prior) Offer Briefings And One-On-One Meetings
Hair Salons/ Barbershops	Flyers Or Rack Cards	Drop Off Materials Seek Input As Appropriate On Materials, Events Offer Briefings To Business Owners And Customers
Public Housing	Flyers, Mailers Or Rack Cards	Resident Mailers (Electronic And Paper) Posts On Community Boards Offer Briefings To Tenants And Management
Hospitals And Regional Medical Facilities, University Student Centers	Flyers, Brochures, Fact Sheets, Pre-Written Blurb For Inclusion In Bulletin And Website, E-Newsletters	Community Information Desks Special Events Information Booth
Apartment Complex And Condos	E-Newsletters, Emails, Flyers	Emails To Property Managers

5. Schedule presentations and arrange meet-and-greets to educate leadership from grassroots community organizations, such as civic leagues, Greek-letter organizations, places of worship, business owners, social groups, health and wellness associations, education and political groups. Some groups in the Richmond area are led by respected leaders who can bring divergent parties together.
6. Also if possible, individual City team members could participate or take a leadership role in one of the following regional community organizations by joining the organization, participating in events/meetings as a presenter and/or moderator, or sponsor major activities to demonstrate community involvement:
   - Senior Center of Greater Richmond
   - The Boys and Girls Club
   - Ride Richmond
   - Fit 4 Kids
   - VCU
   - Sports Backers
   - Minority Health Consortium, Inc.
   - Chamber of Commerce
   - Concerned Black Men of Richmond
7. Capitalize on national encouragement programs including National Bike to Work Month. Research other national programs and learn how to connect with national organizations to launch a successful program in Richmond.
8. Create an area community events calendar.
   - Calendar should include regular and special civic group meetings and events in the Richmond area, two months in advance. The calendar will clearly state why a presence is important at the event.
9. Pedal Points Program
   - Offer rewards for employees who commute by bicycle or participate in biking events such as retail discounts or profile on city's website.

PROJECT RESOURCES

Information cards, intercept survey forms, maps, and educational boards were used at each of the events to collect input from participants. The planning process was introduced at the Moonlight Ride Event on August 17, 2013. Over 3000 riders participated in this annual event that took place this year at Sports Backers Stadium. During the event, the intercept survey was used to interview 144 people.

Of the 144 respondents, 86 were men and 58 were women. The survey and summary of responses can be found on page D-4.

Figure D-1: Intercept Survey

Richmond Bicycle Master Plan Intercept Survey

1. What type of bicyclist are you? (prompt participant with the categories below)
Strong and Fearless Enthused and Confident Interested But Concerned No Way No How

2. How often do you ride your bicycle? (please circle the best match)
Daily A few times a week A few times a month A few times a year
Never or almost never

3. What are the top five destinations that need improved bike access?

4. What are the top five streets in Richmond that need improved bike infrastructure?

5. What type of bicycling would you likely do, or do more of, if the City improved bicycle infrastructure? (sample answers below)

Health/recreation	Competitive sport/training
Commuting to work	Commuting to school
Shopping trips	Socializing/visiting friends

Other daily transportation (meetings, appointments)
I don't bicycle at all
(write other answers here)

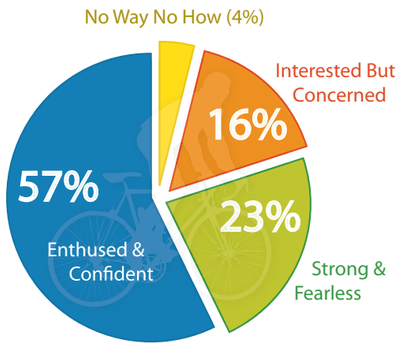
RICHMOND
Bicycle Master Plan

Gender of Participant: M_____ F_____

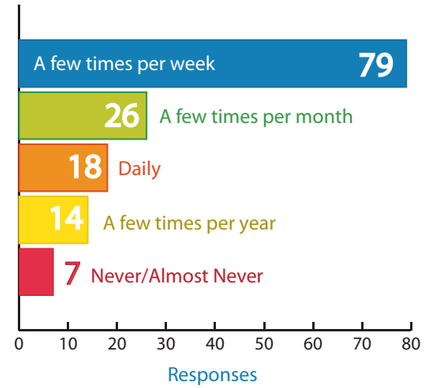
Surveyor Name: _____

CONTACT INFO | Jakob Helmboldt: jakob.helmboldt@richmondgov.com
richmondgov.com/bikeped

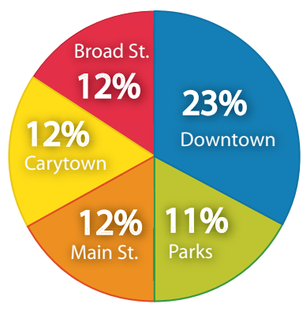
What Type of Bicyclist Are You?



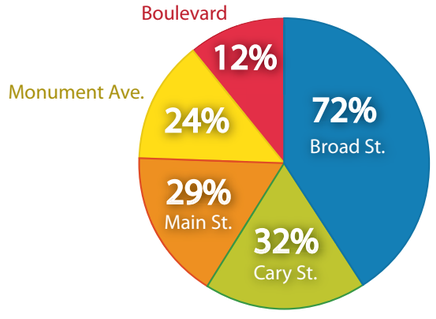
How Often Do You Ride Your Bicycle?



What Are The Top Five Destinations That Need Improved Bike Access?



What Are The Top Five Destinations That Need Improved Bike Access?



What Type Of Bicycling Would You Like To Do, Or Do More Of, If The City Improved Bicycle Infrastructure?

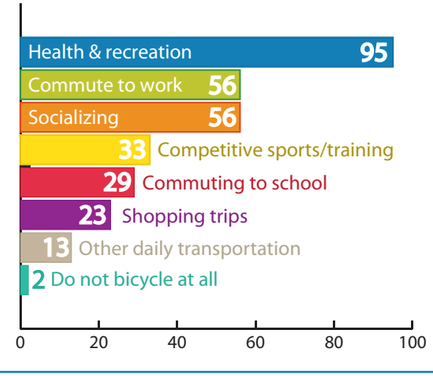


Figure D-2: Other Public Input Materials

Benefits of Bicycling

	Residents + Visitors	Businesses	The City of Richmond
SAFETY	Installing bicycling facilities directly improves safety by separating modes of travel and **reducing the risk of bicycle-automobile crashes**. 	**Safe comfortable streets attract more customers.** When Minneapolis converted two streets to include bike facilities, bike traffic increased by **43%** and total vehicular crashes decreased.	Cities with high use of bikes for routine transportation have lower fatality rates for all road users. When **protected green lanes** were installed in NYC, **injury crashes for all road users (drivers, pedestrians and bicyclists) dropped from 40-50%.**
HEALTH	Bicycling for everyday trips builds recommended physical activity into daily life. **Adults who bike to work have better weight, blood pressure, and insulin levels.** 	Employees who bicycle to work are fitter, healthier, and happier and as a result **miss fewer work days** for health problems. 	City residents can get **more daily physical exercise through active transportation** rather than recreation. 
ECONOMICS	The IRS estimates the cost of driving to be 56.5 cents per mile while AAA estimates the average annual cost of car ownership to be near $9,000. **On a round-trip commute of 10 miles, bicyclists save around $10 daily.** 	Chaotic and unsafe streets stifle economic activity. People who ride bikes spend more money locally. In NYC, **retail sales increased more than 50% after the installation of a protected bike lane** adjacent to shops. 	Neighborhoods become more desirable when traffic slows down and residents have more transportation choices. By mapping real estate transactions, researchers have been able to show that **bike facilities can have positive, statistically significant impacts on home values.**
ENVIRONMENT	A short, four-mile round trip by bicycle keeps about 15 pounds of pollutants out of the air we breathe. 	A MonsterTRAK study states that **80%** of young professionals are **interested in a career that makes a positive impact on the environment**, and **92% prefer to work for a company that is green**. 	Active transportation could reduce greenhouse gas emissions from private vehicles by 3-8%. For every **one mile pedaled rather than driven, nearly one pound of CO^2 is saved.** 
MOBILITY	Making bicycling a more comfortable choice for a broader range of the population **increases mobility options for many who may have limited options due to age or income.** 	Improving mobility options in Richmond will help **move customers, workers, and goods to business destinations more quickly and efficiently.** 	An increase in transportation biking will **reduce congestion and commute times** for all road users.

RICHMOND
Bicycle Master Plan

Bicycle Facility Types

Cycle Tracks

Bike Lanes/Buffered Bike Lanes

Bike Boulevards/ Sharrows

Paved Shoulders/Wide Outside Lanes

Greenways/Shared Use Path/Boardwalks

Intersections/Signals/Parking

RICHMOND
Bicycle Master Plan

PUBLIC COMMENT FORM RESPONSES

Results from the survey are documented below. A summary is provided in the Existing Conditions Chapter.

Are you a resident of the City of Richmond?		
Answer Options	Response Percent	Response Count
Yes	71.5%	1693
No	28.5%	674
answered question		2367
skipped question		370

Do you own or have access to a bike?		
Answer Options	Response Percent	Response Count
Yes	96.3%	2630
No	3.7%	100
answered question		2730
skipped question		7

Which of the following best describes your bicycling habits and comfort level?		
Answer Options	Response Percent	Response Count
Strong & Fearless – I'm willing to ride in almost any traffic conditions.	14.1%	384
Enthused & Confident – I'm willing to ride in traffic, but I prefer dedicated bike infrastructure and will seek out routes with less traffic, even if the route is longer.	55.4%	1513
Interested but Concerned – I would like to bike more, but I prefer to not ride in traffic and am most comfortable on separate bike paths or physically protected bike lanes.	29.4%	802
No Way/No How – I will not ride a bicycle under any circumstances.	1.1%	31
answered question		2730
skipped question		7

How often do you ride your bicycle?		
Answer Options	Response Percent	Response Count
Daily	23.9%	653
A few times a week	42.8%	1169
A few times a month	19.8%	540
A few times a year	8.2%	225
Never or almost never	5.2%	143
answered question		2730
skipped question		7

What type of bicycling do you currently do? (check all that apply)		
Answer Options	Response Percent	Response Count
Health/Recreation	80.4%	2196
Competitive sport/Training	23.0%	629
Commuting to work	37.0%	1011
Commuting to school	15.0%	410
Shopping trips	34.0%	927
Socializing/Visiting friends	51.6%	1410
Other daily transportation (meetings, appointments)	30.6%	835
I don't bicycle at all	4.5%	122
answered question		2730
skipped question		7

What type of bicycling would you likely do if the City improved the infrastructure (more paths, bike lanes, etc)? (Check all that apply)		
Answer Options	Response Percent	Response Count
Health/Recreation	84.2%	2299
Competitive sport/Training	32.3%	883
Commuting to work	65.8%	1796
Commuting to school	26.3%	719
Shopping trips	66.1%	1804
Socializing/Visiting friends	74.7%	2038
Other daily transportation (meetings, appointments)	62.4%	1703
I likely wouldn't bicycle at all	1.9%	52
answered question		2730
skipped question		7

If you commute by bike, how often do you do so?		
Answer Options	Response Percent	Response Count
Every day or most days	23.2%	633
Several days per month	15.6%	425
Several days per year/occasionally	10.7%	293
I don't commute by bike	50.5%	1379
answered question		2730
skipped question		7

Even if you don't own a bike, which of these situations discourages you from riding a bike more often, or at all?					
Answer Options	Not Discouraging	Somewhat Discouraging	Very Discouraging	Extremely Discouraging	Response Count
Speed/volume of traffic	183	820	887	840	2730
Lack of bike lanes/paths	226	713	865	926	2730
No place to park bike	779	993	592	366	2730
Health problems	2372	255	68	35	2730
Fear of crime	1533	871	205	121	2730
Destinations too far away	1044	1092	408	186	2730
Not enough time	1114	1119	372	125	2730
Hot weather	1062	1151	369	148	2730
Cold Weather	999	1291	338	102	2730
Rainy Weather	397	1051	811	471	2730
Too hilly	1493	927	219	91	2730
answered question					2730
skipped question					7

Shared Lane with Sharrows on a Neighborhood Street (low traffic and low speeds)		
Answer Options	Response Percent	Response Count
I'd use it a lot	33.7%	905
I'd use it sometimes	38.2%	1027
I might use it	21.5%	577
I'd never use it	6.6%	177
answered question	2686	2686
skipped question	51	51
Other daily transportation (meetings, appointments)	62.4%	1703
I likely wouldn't bicycle at all	1.9%	52
answered question		2730
skipped question		7

Shared Lane With Sharrows on a Multi-Lane Street		
Answer Options	Response Percent	Response Count
I'd use it a lot	27.5%	739
I'd use it sometimes	39.5%	1062
I might use it	25.8%	692
I'd never use it	7.2%	193
answered question		2686
skipped question		51

Standard Bike Lane		
Answer Options	Response Percent	Response Count
I'd use it a lot	74.5%	2002
I'd use it sometimes	18.7%	501
I might use it	5.3%	143
I'd never use it	1.5%	40
answered question		2686
skipped question		51

Buffered Bike Lane (more separation from vehicles)		
Answer Options	Response Percent	Response Count
I'd use it a lot	85.8%	2304
I'd use it sometimes	10.7%	288
I might use it	2.6%	71
I'd never use it	0.9%	23
answered question		2686
skipped question		51

Protected Bike Lane or Cycletrack (with a physical barrier or parked cars providing a barrier)		
Answer Options	Response Percent	Response Count
I'd use it a lot	91.1%	2448
I'd use it sometimes	5.8%	155
I might use it	2.1%	57
I'd never use it	1.0%	26
answered question		2686
skipped question		51

Shared Use Path		
Answer Options	Response Percent	Response Count
I'd use it a lot	77.7%	2086
I'd use it sometimes	15.2%	407
I might use it	5.5%	149
I'd never use it	1.6%	44
answered question		2686
skipped question		51

Please answer the following statements regarding your perceptions of bicycling.				
Answer Options	True	False	Don't know	Response Count
Bicycling is generally a safe activity or form of transportation	2260	344	82	2686
I am comfortable biking with traffic, and I don't need bike infrastructure	379	2188	119	2686
It is not safe for bicyclists and motorists to share the road in most situations	1095	1399	192	2686
I prefer to bike on the sidewalk	590	2017	79	2686
I am not comfortable riding anywhere in the city	338	2269	79	2686
The City should make it safer and easier for people to use bicycling for transportation	2605	46	35	2686
I would use a bike for some short trips if there were safe routes or facilities to use	2576	59	51	2686
The City should allocate existing roadway space to bike infrastructure where it is needed and feasible	2560	70	56	2686
answered question				2686
skipped question				51

What prevents you from riding more than you do now? (check all that apply)		
Answer Options	Response Percent	Response Count
Distance to my destinations	44.4%	1145
Kids need to be transported	14.5%	374
Difficult to carry belongings on my bike	35.5%	915
No shower and locker facilities at work/ school	27.4%	705
Don't feel safe on Richmond's roads	60.3%	1554
Don't feel safe on available bike routes/ lanes	37.4%	964
Weather	42.2%	1087
Hills	12.2%	313
Other (please specify)	427	427
answered question		2576
skipped question		161

Would you be interested in taking a course on bicycling in an urban environment (city cycling skills)? If so, please provide your contact information at the end of this survey.		
Answer Options	Response Percent	Response Count
Yes	29.0%	780
No	71.0%	1906
answered question		2686
skipped question		51

If you bike now, what are the top-5 destinations that you bike to? (remember, be specific)		
Answer Options	Response Percent	Response Count
Park	99.9%	2342
Carytown	85.5%	2005
VCU	76.0%	1782
Downtown	62.9%	1475
Fan	51.9%	1216
answered question		2344
skipped question		393

What are the top-5 destinations that you think need improved bike access?		
Answer Options	Response Percent	Response Count
Downtown	99.9%	2338
Carytown	78.1%	1827
Fan	63.8%	1493
VCU	48.8%	1142
Park	37.9%	887
answered question		2340
skipped question		397

What are the top-5 roads or corridors that you would like to see improved with better bike infrastructure?		
Answer Options	Response Percent	Response Count
Cary	100.0%	2335
Broad	83.0%	1940
Main	72.0%	1683
Boulevard	58.0%	1355
Monument	46.6%	1088
answered question		2336
skipped question		401

Would more bike parking increase the likelihood you will visit a business?		
Answer Options	Response Percent	Response Count
Yes	82.0%	1948
No	18.0%	428
answered question		2376
skipped question		361

Which category below includes your age?		
Answer Options	Response Percent	Response Count
Under 18	0.3%	7
18-25	14.9%	351
26-35	32.0%	752
36-45	22.4%	527
46-55	16.7%	393
56-65	11.1%	261
66 or older	2.6%	60
answered question		2351
skipped question		386

What is your gender?		
Answer Options	Response Percent	Response Count
Female	43.2%	1012
Male	57.1%	1338
answered question		2345
skipped question		392

What is your marital status?		
Answer Options	Response Percent	Response Count
Single	38.8%	903
Married	54.4%	1266
Divorced	6.4%	148
Widowed	0.5%	11
answered question	2328	2328
skipped question	409	409

Do you have any children under 18 living at home?		
Answer Options	Response Percent	Response Count
Yes	26.6%	623
No	73.4%	1716
answered question		2339
skipped question		398

What is your race? Please choose one or more.		
Answer Options	Response Percent	Response Count
White	90.3%	2069
Black or African-American	3.7%	85
Hispanic or Latino	0.7%	16
Asian	3.3%	75
Native Hawaiian or other Pacific Islander	0.6%	14
American Indian or Alaska Native	1.0%	23
Other	5.2%	119
answered question		2292
skipped question		445

What is the highest level of education you have completed?		
Answer Options	Response Percent	Response Count
Did not complete high school	0.2%	4
High school diploma or GED	2.0%	47
Some college	13.5%	316
Associate's degree or trade school	3.6%	83
Bachelor's degree	42.2%	986
Graduate degree	28.9%	675
Post graduate degree	9.6%	223
answered question		2334
skipped question		403

Which of the following categories best describes your employment status?		
Answer Options	Response Percent	Response Count
Employed, full-time	73.9%	1724
Employed, part-time	12.1%	283
Not employed	3.4%	80
Retired	4.3%	100
Student	6.3%	147
answered question		2334
skipped question		403

What range does your household income fall in?		
Answer Options	Response Percent	Response Count
Less than $25,000	13.9%	303
$25,000-$50,000	18.6%	406
$50,001-$75,000	18.2%	396
$75,001-$100,000	16.4%	357
$100,001-$125,000	11.8%	257
More than $125,000	21.1%	460
answered question	2179	2179
skipped question	558	558