GUIDE FOR REVIEWING

Public Road Design and Bicycling Accommodations

FOR

Virginia Bicycling Advocates

Fairfax Advocates for Better Bicycling • 2010

Guide for Reviewing Public Road Design and Bicycling Accommodations for Virginia Bicycling Advocates

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Acronyms

AASHTO	American Association of State Highway and Transportation Officials
APBP	Association of Pedestrian and Bicycling Professionals
CTB	Commonwealth Transportation Board
DOT	Department of Transportation
DPW	Department of Public Works
FABB	Fairfax Advocates for Better Bicycling
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
MUTCD	Manual of Uniform Traffic Control Devices
NACTO	National Association of City Transportation Officials
PBIC	Pedestrian and Bicycling Information Center
ROW	Right-of-way
R/W	Right-of-way
TRB	Transportation Research Board
VDOT	Virginia Department of Transportation
WABA	Washington Area Bicyclist Association

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INTRODUCTION

The purpose of this guide is to help bicycle advocates review transportation projects to ensure that bicycle facilities are included in the design. The construction, retrofit or expansion of a public road involves many steps by local, regional and state governmental agencies. In a complicated process that can extend over many years, these agencies make critical planning, design and budgeting decisions that shape the new facilities that become part of the overall transportation system. Advocates can influence this process in many ways.

How can bicycling advocates play a role?

The design of Virginia's road transportation system affects the daily life of its residents. Governmental agencies encourage full citizen participation in the design process. Bicycling advocates can engage in every step from planning through construction by adding their comments and ideas. Early and continued participation in the project development process helps ensure that bicycling needs are addressed to the fullest extent possible. By paying close attention to the details of the design process, advocates can request specific changes that accommodate bicyclists. Advocates can and do influence the outcome of the final design.

Why advocate for bicycling needs?

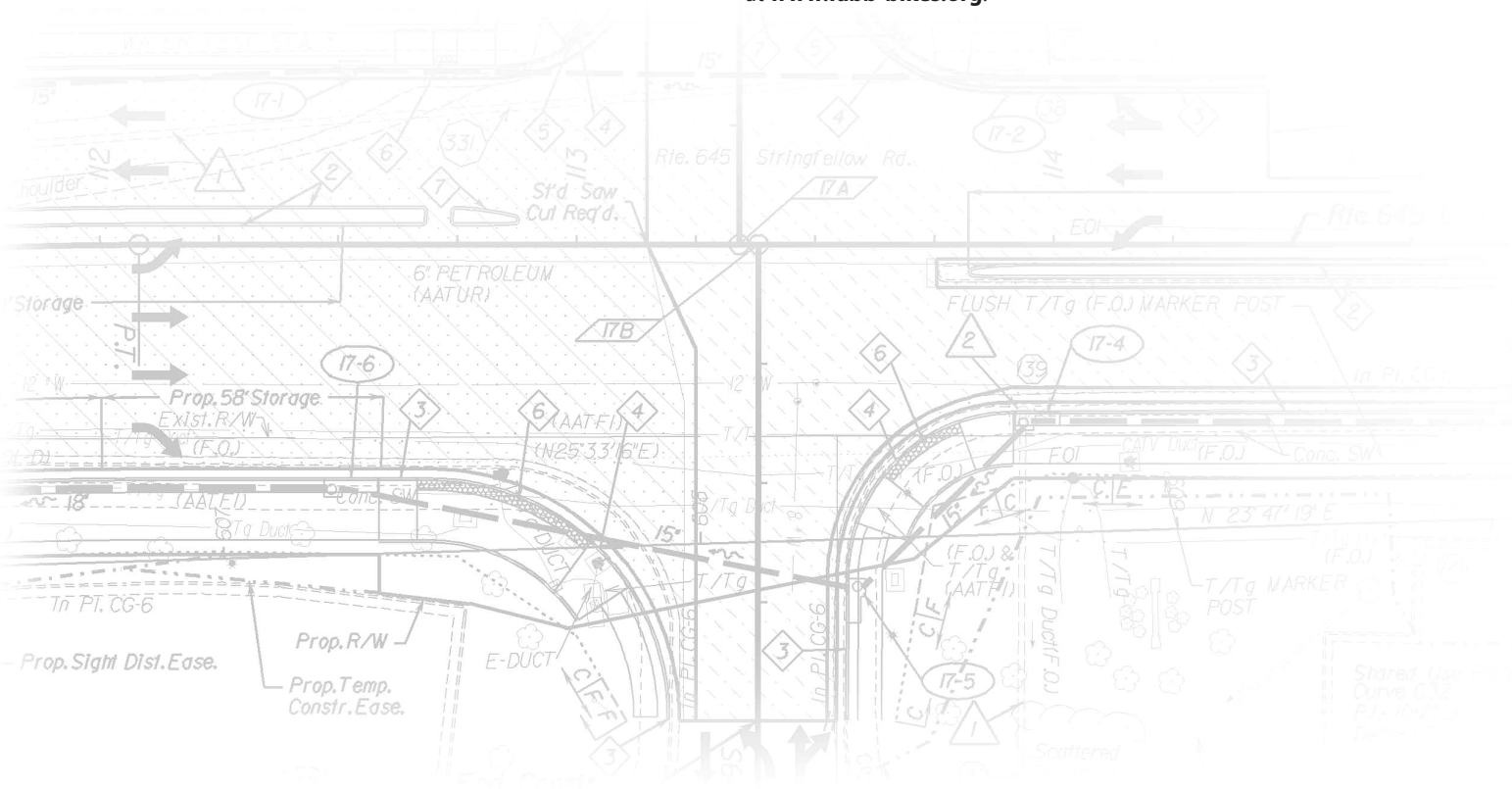
A new public road project is an important opportunity for creating a bicycle-friendly community and adding to the bicycling network. Decades could pass before any construction is again proposed. Including bicycling accommodations in an integrated fashion when a road is undergoing design is less expensive and technically easier than doing so after the project is built. Advocates can make a difference and leave a legacy by getting changes to the future plans.

What is the best type of bicycling facility?

No one has a one-size-fits-all answer. Engineers have a diverse array of designs at their disposal and must consider many factors for each particular location. Virginia bicyclists live in rural, suburban, urban and small town areas with many different needs and traffic situations. All designs have advantages and disadvantages, and bicyclists have different preferences depending on their age, ability and comfort level. Advocates can follow the advances in bicycling facility design that are taking place nationally so as to make the best suggestions for the local situation.

How can advocates use this guide?

This guide provides advice on when and how to engage in the design process and what issues to pursue. Advocates will need to learn how to become aware of upcoming projects in their community and to do their own local research. With that information in hand, advocates can add valuable input to the design based on their experience and understanding of bicycling. The authors hope that insights included in this guide will stimulate bicycling advocates to provide creative and thoughtful input into public road plans in their community. Additional information is included at **www.fabb-bikes.org**.



PARTICIPANTS IN THE ROAD DESIGN PROCESS

Public officials

Public officials and agency websites offer a wealth of information and advice. Understanding the financial or regulatory constraints under which officials work may help advocates target requests and comments. Always treat public officials professionally and with respect, and recognize that most are dedicated to public service. Feel free to get in touch with local officials with comments or questions at any point in the design process. However, although their offices are public, notify them before you visit.

Engineers and planners

Engineers and planners work together to bring a new or expanded project from an idea to completion. Some work for governmental agencies while others are employed by consulting firms to work on public projects. Initially, the advocate may find the technical language used by these professionals intimidating and be put off by their seemingly non-emotional attitude to "life-or-death" issues. Understanding the technical jargon of such professionals and their solution-focused approach will help the advocate engage in a more productive dialogue and ultimately be more successful.

The general public

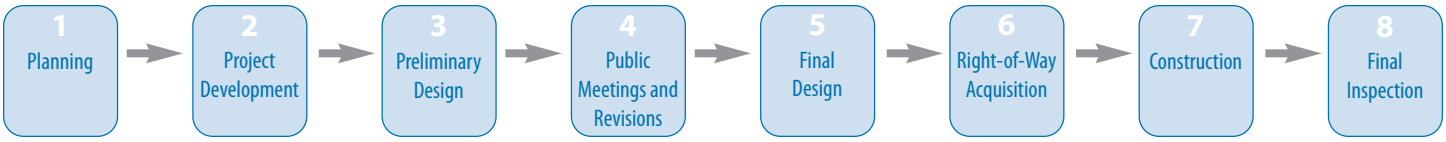
The general public, as pertains to road projects, is everyone affected by how the project is designed and built. Specific interests depend on proximity to the construction and planned mode of use as well as personal values placed on safety, speed, environmental issues and aesthetics. Some of these disparate interests may conflict with each other. Generally, interest is higher among the residents closest to the project, with the adjacent property owners generally becoming the most involved.

Bicycling advocates

Bicycling advocates become involved for a variety of reasons but all have recognized the need for improved and safer riding facilities in the community. Well-informed advocates can speak to the rights of bicyclists and educate others regarding the benefits of particular designs. They can build relationships with public officials, monitor future plans and provide both policy and design input. Advocates can become recognized stakeholders by making their interests known to public officials. This allows advocates to make long-term relationships and to be included in projects in a more consistent fashion from planning through construction. Rarely does a project proceed quickly or without changes, so the advocacy commitment may extend through several years.

THE DESIGN PROCESS AND BICYCLING ADVOCATES

Projects start by identifying a problem, a need or an opportunity. Then through many separate steps, shown below, decisions are made about how to actually construct a new or expanded facility. To be most effective, advocates need to provide suggestions early in the process but they can become involved at almost any point and still make a difference. The input should fit with where the project is in the design process. Demanding a complete redesign during a late stage of a project would be unrealistic.



Stage of Process	General Tasks	How Advocates Can Participate
1 **Planning** Defining problems and opportunities and planning a course of action	• Agencies identify needs • Decide what to fund • Agencies advertise and hold public meetings • Revise planning based on technical input, citizen requests and local funding decisions	• Submit requests to be included in long-term plans • Request specific facilities and funding for bicycling • Attend public meetings • Write letters to agencies and elected officials • Meet with local officials • Volunteer on advisory committees and commissions
2 **Project Development** Starting a project	• Consider and select design alternatives • Collect data and perform field surveys • Establish design assumptions and values	• Get to know the project manager • Provide input on alternatives and recommend inclusion of bicycling accommodations • Question assumptions and check for incorrect data • Investigate through local officials why survey crew or stakes are in field as these may indicate future project
3 **Preliminary Design** Preparing initial engineering plans and calculations	• Determine project size, type, location • Prepare design based on available right-of-way, existing facilities, safety, obstacles and funds • Prepare design in accordance with standards and adopted policies • Prepare detailed plans and studies to 30-40 percent completion	• Find out what is specifically proposed to accommodate bicycling • Insist that locally-adopted policies and plans be followed and ask why exceptions are made • Visit site with plans to look for missed details and unaddressed concerns or opportunities • Watch for public meeting advertisements • Make suggestions early as changes are harder to incorporate further along in the process
4 **Public Meetings and Revisions** Conduct meetings and hearings to involve the general public in the decisions	• Present plans and studies to citizens and other stakeholders in open forum • Agency ensures hearing location and information is accessible to all of public • Change plans based on internal reviews and comments from other agencies • Consider comments from public with some possibly triggering changes to plans	• Attend public meetings and hearings • Alert other community members about plans • Coordinate among advocates for consistency • Educate officials about bicycling safety needs • Remind officials of policies and bicycling guidelines • Ask about bicycling access during all phases of construction • Submit detailed written comments within deadlines • Check revised plans to ensure that bicycling accommodations are not impaired during redesign



Stage of Process	General Tasks	How Advocates Can Participate
5 **Final Design** Prepare final detailed engineering plans to construct the project	• Finalize plans for construction • Plans can vary from preliminary design • Some projects may become "Design/Build" and move through a compressed schedule handled by a private firm	• Monitor for possible design changes • Stay in touch with project manager • Once in final design, changing plans becomes considerably more difficult • Review and comment on items that may be prepared late in the process such as traffic striping and construction detour plans
6 **Right-of-Way (ROW) Acquisition** Agency or its agents enter negotiations with landowners	• Negotiate and purchase ROW from adjacent property owners • Purchase offers determined based on fair market value • Contact utility companies about relocations • Obtain permits and authorizations • Issue notice to proceed	• Monitor plans for possible late-stage design changes • Check for utility relocation impact on bicycling
7 **Construction** Project is awarded and built in accordance with the approved plans	• Invite bids and award project • Agree on cost and time to completion • Hand over day-to-day management from project manager to construction manager • Supervise and inspect project for quality and conformity to plans • Manage traffic flow and access during construction per the plans • Change plans when unexpected situations arise in the field • Construction delays can be expected due to weather, supply problems and unforeseen discoveries	• Monitor to ensure that unexpected field changes do not impact bicycling facilities • Check for safe ongoing bicycling access • Construction trailer offices are sometimes open to the public (call first) • Bring field problems to the construction manager rather than addressing them to construction workers • Take photos to document problematic conditions
8 **Final Inspection** Road or facility is opened and put into use	• Conduct final inspection of new construction • Open new facility after final approval • Plans available on file at agency for future reference	• Publicize project • Thank and recognize officials • Ride on new facilities

STEPS TO REVIEW AND COMMENT ON PROJECTS

To be more effective, advocates need to learn as much as possible about the proposed project. Outlined below are suggested steps for finding information about the project and preparing specific, constructive comments about the design.

Gather project information → Determine the best facility → Seek expert advice and consult guides → Attend public meetings → Submit comments

Gather project information

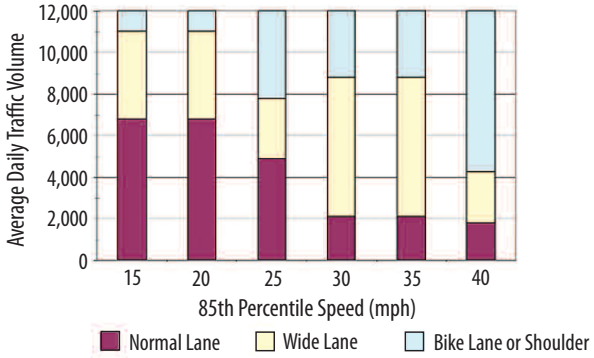
Copies of the engineering plans, even if they seem overly detailed, contain much important information. To get the plans, establish who owns or has jurisdiction over the road, which agency is handling the project and who is the project manager. Local officials, particularly the project manager, will be an important source of this information. Copies of plans are kept on file and are usually available at a nominal cost from the agency. A full set of drawings can be a lot of work for the agency to assemble. They contain more information than is needed for most advocates' purposes. Copies of the *plan view* sheets provide most of the needed information and are likely all that is needed. Plans become obsolete whenever the design is changed, and revised plans are typically available after each of the key design stages, replacing the previous versions.

Information to determine when first looking at the project plans:

- ✔ What bicycling facilities are proposed for the location?
- ✔ Is this new construction, reconstruction or rehabilitation?
- ✔ Are dedicated bicycling facilities needed?
- ✔ Are existing or planned bike facilities nearby?
- ✔ Who are the future potential bicycle users?
- ✔ What are the future lane widths and speeds?
- ✔ What is the future traffic mix and volume?
- ✔ Are there many driveways and intersections?
- ✔ How will bicyclists and pedestrians interact?
- ✔ Can bicyclists see and be seen at all points?
- ✔ How do bicyclists enter and exit the bike facility?
- ✔ Will there be on-street parking?

Determine the best facility

Lane width, traffic speed, and traffic volume are the main considerations in determining whether or not a road needs dedicated bicycle facilities. On-road bicycling accommodations include regular shared travel lanes, bike lanes, wide curb lanes, and paved shoulders. Some roads need no special on-road bicycle facilities due to the low traffic volumes and speed. The following chart gives guidance on the type of bicycling accommodation to select as operating speed and traffic volume vary. Charts of this type are used in some bicycling design manuals. However, recommendations should not be regarded as absolute as it may make sense to select facilities based on the specific location. For example, extending an existing bike lane may be better than shifting bicyclists from a bike lane to a shoulder and back. Continuity and well-planned transitions are essential for safety.



Source: *King, M., Bicycle Facility Selection*, PBIC, August 2002

Differing philosophies within the bicycling community:

"Vehicular bicyclists" believe that they are safest when they act and are treated as drivers of vehicles, and they ride on the road together with motor traffic. Other bicyclists prefer to ride partially or completely segregated from motorized traffic. A single road project should be able to meet the needs of different types of bike riding.

Seek expert advice and consult guides

Building up a network of advocates with knowledge of bicycling design details will prove valuable in examining proposed projects. Some local advocates may already have some type of engineering or technical background and may be willing to review or interpret the plans. It is also always useful to seek out local bicyclists who ride the location for their insights and recommendations. Reviewing the plans together should generate some specific comments and requests for submission to the design agency. Another good source of expert information is the project manager and the engineering staff working on the project. They may be willing to meet to go over the plans and explain the design details.

The American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities (the Bike Guide)* is an excellent resource when looking at what is proposed for a particular location. Appendices D and E list a number of other manuals and websites with additional technical assistance.

Attend public meetings

Showing up at public meetings is a key piece of advocating for improvements. The Virginia Department of Transportation (VDOT) is responsible for holding most public meetings in Virginia as VDOT controls most of the public roads. Meetings may be formal, informal or a combination of the two. While some public meetings are required to meet the project implementation rules, others are held at the agency's discretion. Check local newspapers for advertisements, or check the VDOT website for notifications. Local county and city department of transportation (DOT) offices provide information about upcoming county or city public meetings also. Many county supervisors will notify interested parties or homeowner associations about upcoming meetings, and local officials may notify known stakeholders.

Types of VDOT public meetings:

Public Scoping Meeting
Citizen Participation Meeting
Citizen Information Meeting
Community Workshop and Information Meeting
Public Hearing
Location Public Hearing
Design Public Hearing

Public hearings:

A *public hearing* is a formal type of advertised meeting for a project that occurs after the project has completed the preliminary design stage. At the hearing, the design group usually does an engineering presentation, which is followed by questions from the audience. To take full advantage of the hearing, do some advance preparation: view the plans, visit the site or research designs and design issues. When speaking at the hearing, stay on message and within time limits and avoid side issues. Frequently, constructive ideas will be considered by the agency. Advocates should note their approval of good features of the design for the record to try to protect the accommodation from elimination during subsequent revisions.

Coordinate with other advocates, so that even if they don't share the same perspective on the improvements, everyone will reinforce one another rather than argue in a manner that could cancel out their respective comments. For example, one advocate may insist upon an on-road bike lane and another may prefer an adjacent shared-use path. Simply emphasize the advantages of the preferred accommodation rather than publicly bicker about its relative merits.

Responding to criticisms that arise in public forums:

Many present at a public hearing own frontage along the project and may view the space required for bicycling accommodations as coming directly from their front yard. Adjacent property owners will likely be the most motivated to oppose any bicycling improvements, so be respectful and highlight benefits to the wider community.

Explain how bicycling accommodations will benefit non-bicyclists. Antagonizing officials or members of the public may cause a backlash against the bicycling accommodations and will not help in achieving goals. The best policy is to be patient, polite, and persistent.

Some audience members may oppose bicycling facilities. Others may oppose bicycling or have mistaken beliefs about bicyclists' rights. While some of the issues raised may have little to do with design concerns, be prepared to correct inaccuracies and also to disassociate the vast majority of bicyclists from the poor behavior of the few. A number of websites such as the League of American Bicyclists (bikeleague.org) offer excellent information directly addressing these issues.

Submit comments

Generally, few take the time to submit comments on how a design could be improved or expanded to accommodate bicyclists but it is extremely important that agencies receive written feedback on projects. Written comments allow for more thoughtful explanation of the issues than is possible in the short time allotted at a hearing. Comments should be submitted within the specified time period via e-mail, letters, or public hearing comment sheets. Comments may also be submitted to a court reporter, if present, at a public hearing. Other cyclists in the community should be encouraged to send in letters of support as well.

- ✔ Submit comments via e-mail, letters or comment sheets
- ✔ Submit comments by closing date per the agency instructions
- ✔ Be specific about issues and request particular design features
- ✔ Write as an individual or organization
- ✔ Include contact information
- ✔ State whether or not you support the design feature
- ✔ Sort separate issues under clear headings
- ✔ Correct misinformation from public meetings or the media
- ✔ Copy your local elected officials and other interested groups
- ✔ If necessary, ask elected officials for their support
- ✔ Be respectful and thank officials and agencies for their work

The primary purpose of a set of engineering plans or drawings is to provide instructions to the contractor to turn the engineer's vision into a new facility. The plans include a visual representation of what is proposed for the site layered on top of what currently exists at that location. The plan view sheets show what the project looks like from above and provide the best view of the proposed work. Seek assistance from engineers in the community or the design engineers at public hearings or stakeholder meetings to interpret drawings and read details. Understanding ALL of the symbols or lines to review for bicycling accommodations is not necessary. Mark up drawings and write any questions you have on the drawing, too – that's what engineers do when they look at plans.

Bicycle facility design review

The sample engineering plan on the next page shows the design for a shared-use path along a road with a wide curb lane. The drawing depicts major design features, illustrates a typical cross section, and contains various symbols used on engineering plans. The example also shows how highlighting the bicycling accommodations with colors allows the reviewer to more easily "see" what is proposed.

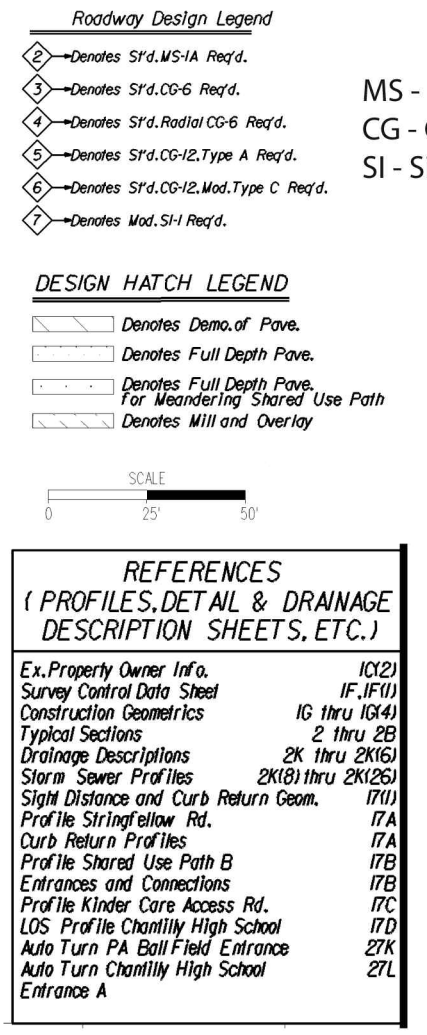
The bicycling facility information sheets on the pages following the sample engineering plan provide tips and ideas on what to look for on the drawings for each type of accommodation.

Each sheet addresses:

- ✔ Specific design guidelines from the AASHTO *Bike Guide* for that type of bicycling accommodation
- ✔ Design and safety points to evaluate when considering that design or asking questions
- ✔ Review checklist to examine the details of the design

Reviewing the drawings and using the facility checklists will help you understand the project. Given this background, you are in a better position to provide feedback to the project engineers and to develop comments for the public hearing or letters to local officials.

Symbol Legend



MS - Median Strip
CG - Curb and Gutter
SI - Sign Island

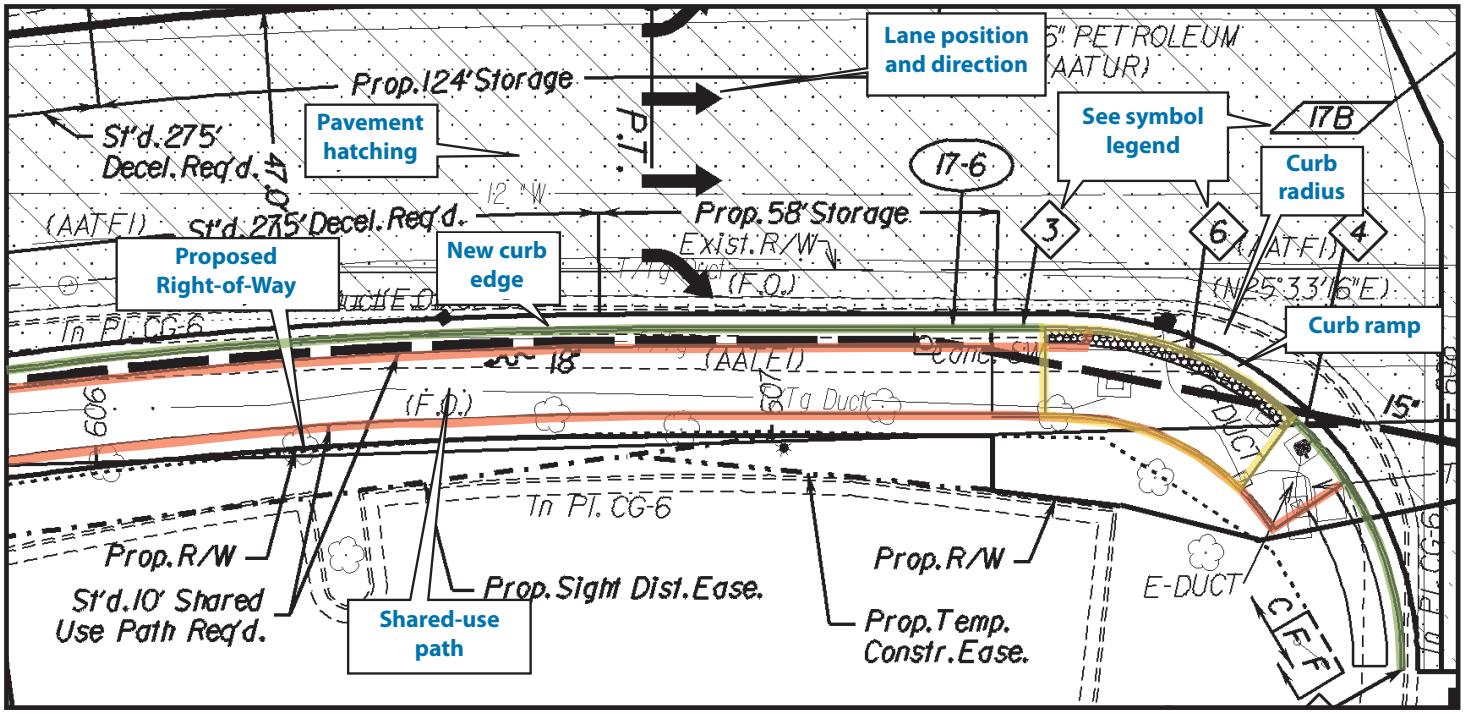
Engineering plans show the following information:

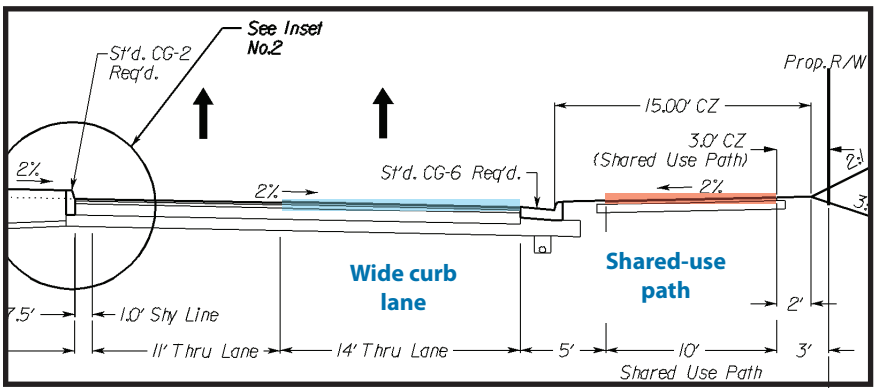
- Names and signatures of the design engineers
- Dates of drawing preparation and any revisions
- Drawing scale and feature dimensions
- Existing and proposed above- and below-ground features
- Existing and proposed property lines, right-of-way lines and easements
- Typical details of recurring features
- Notes about the site and the proposed construction

Getting oriented on the engineering plans:

- Inspect location map on plans
- Determine in what direction you are viewing the plans
- Check location on satellite images such as *Google Maps* or *Bing*
- Line up and tape together plan sheets in sequence
- Inspect plans from left to right
- Look for intersections and landmarks
- Note the scale used on the drawing

Stringfellow Road, Fairfax, Virginia





Curb ramp
Shared-use path
Edge of curb
Wide curb lane

Typical Cross Section

Mark the following lines with colored highlighters:

- Existing and proposed edge of road or curb
- Right-of-way (ROW or R/W) lines
- Proposed vehicle travel lanes
- Bike lanes, wide outside lanes, and shared-use paths
- Driveways, entrances and curb ramps
- Bridges and culverts
- Walls, poles, bollards and drainage
- Any other features such as railroad tracks

When taking the plans to the project site:

- Compare the plans with existing conditions
- Visualize the bicycling facilities
- Take photos of existing features and bicyclists using facilities
- Use aerial photos from online mapping applications
- Look for overlooked details and evidence of bicycle or pedestrian usage ("goat trails")

BICYCLE FACILITY DESIGN REVIEW / GENERAL ROADWAY ISSUES

All roadways should be designed with the assumption that they will be used by bicyclists, unless bicycling is specifically prohibited on a road by the Virginia Commonwealth Transportation Board (CTB). Safe, convenient and well-designed roadways benefit road users and can encourage bicycle use and transit connections. Any new facilities may be in service for decades, so the design is critical for users. Once construction is completed, changes are not easy to make. Many small design details affect safety and connectivity for bicycling.

Design Standards & Guidelines:

Numerous standards, guidelines and policies are followed in roadway design including:

- AASHTO, *A Policy on Geometric Design of Highways and Streets (the Green Book)*: road design guidelines
- FHWA, *Manual on Uniform Traffic Control Devices (MUTCD)*: standards for all signs, signals and markings
- AASHTO, *Guide for the Development of Bicycle Facilities (the Bike Guide)*: guidelines for bicycling facilities
- TRB, *Highway Capacity Manual (HCM)*: computations for road facility capacity and quality of service
- VDOT engineering design manuals: Virginia-specific guidance and standards
- County/City standards: standards and requirements that may differ on a local basis
- AASHTO guidance is for lanes of **10 to 12 feet** in width. The VDOT standard design is **11 or 12 feet** depending on the design speed and amount of truck traffic. In some locations, local roads have **10-foot** wide travel lanes.

If minimum standards or guidance cannot be met, it may be possible to obtain a design exception or variance at the local level.

Design & Safety Issues to Consider:

- Bicyclists should be considered in all phases of road design from planning through construction
- Bicycle users have the same destination and access needs as other users of the road
- Crash reduction and prevention are important design factors
- Trip convenience and connectivity need to be accommodated to encourage use
- Bicyclists must be able to see and be seen and have sufficient reaction time
- On-street parking or bus stops may increase the potential for conflict with vehicles
- Signs are needed for bicycle users as well as motorized users
- Better lighting can alleviate concerns and increase bicycle usage rates as well as improve safety
- Skills, confidence and preferences of a range of bicycle users should be considered
- Planned future maintenance requirements should be taken into account in design decisions

Review Checklist:

- ☐ Bicycling accommodated?
- ☐ Types/range/volume of users
- ☐ Design speed/operating speed
- ☐ Trip convenience, connections
- ☐ Intersections and crossings
- ☐ Adequate sight distances
- ☐ Type and location of parking
- ☐ Location of bus stops
- ☐ Obstructions, buffers and clearances
- ☐ Lighting, signs, and paint markings
- ☐ Drainage and water pooling
- ☐ Curving roads and hills

BICYCLE FACILITY DESIGN REVIEW / OPERATING SPACE

Operating space takes into account the dimensions necessary for exclusive and preferential operation of a bicycle including the space needed to ride comfortably and safely under different conditions. It also considers the unique needs related to powering a bicycle and staying balanced. Operating space may take into account that the facility may have multiple users (including non-bicyclists) traveling at different speeds who all need space to safely maneuver and pass each other.

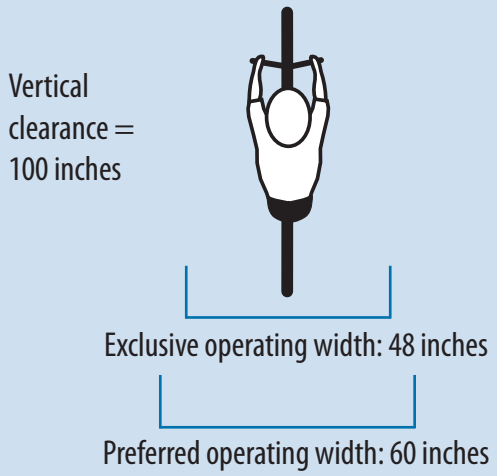
Design Standards & Guidelines:

- Bicyclist essential physical operating width: **40 inches min**.
- Operating width to exclusively or preferentially accommodate forward movement: **48 inches min**.
- Preferred operating width: **60 inches**
- Essential physical operating width to accommodate bicycling with adjacent barrier (guardrail, curb, etc.) or in stressful environment: **60 inches or more**
- Vertical clearance to accommodate adult bicyclist standing upright on pedals: **100 inches**
- Distance bicyclists tend to ride from curb: **32-40 inches**
- Eye height of adult bike rider: **60 inches approx**.
- Eye height of recumbent bike rider: **46 inches approx**.

Design & Safety Issues to Consider:

- Providing sufficient operating space eliminates the need for bicyclists to shift position
- Room is needed for bicyclists to react to unexpected events in their path
- Extra width is required to allow passing and to maintain balance at low speeds or in windy conditions
- Space may be required to accommodate non-standard bicycles (for example recumbents and cargo bikes)
- Bicyclists may need to pedal upright (such as going uphill) and require additional vertical clearance
- Bicyclists' skill, confidence and comfort levels vary so operating space comfort levels differ
- Gutter area directly next to the curb should not be included in calculating available operating space
- Area close to curb where most bicyclists tend to ride should be kept clear of road hardware
- In assigning space in the roadway, the design should recognize that bicyclists are more vulnerable to injury when in a crash

Bicycle operating space



Review Checklist:

- ☐ Width of exclusive space
- ☐ Passing space
- ☐ Conflicts with other users
- ☐ Lateral and vertical clearance
- ☐ Non-standard bicycles
- ☐ Low-hanging branches
- ☐ Traffic mix and volume
- ☐ Obstacles and road hardware
- ☐ Buffers around fixed objects
- ☐ Gutter space not part of operating space

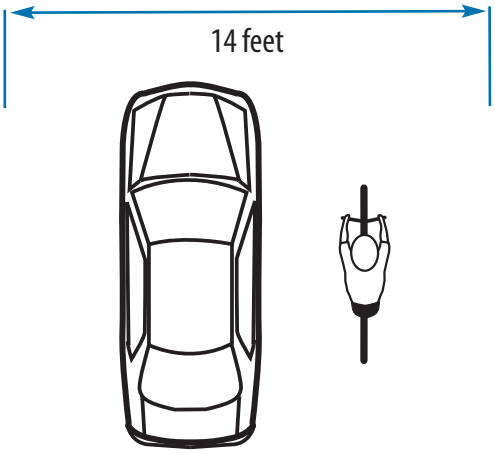
BICYCLE FACILITY DESIGN REVIEW / WIDE CURB LANE

Bicycles share travel lanes with motorists without any special facilities throughout the road network. However, a wide curb (or outside) lane allows motorists and bicyclists to comfortably share the lane side-by-side and lets a motorist safely pass a bicyclist without encroaching on the adjacent lane. A wide outside lane can improve traffic flow while also providing significant improvements for bicyclists.

Design Standards & Guidelines:

- Wide curb lane width that accommodates motorist and bicycle sharing: **14 feet min.**
- Wide curb lane width that accommodates motorist and bicycle sharing with steep uphill grade, obstacles or on-road parking: **15 feet**
- Maximum recommended wide curb lane width to discourage side-by-side motor vehicles: **15 feet**

Wide curb lane



Design & Safety Issues to Consider:

- It may be possible to restripe to create a wide curb lane by reducing width of adjacent lanes to as little as 10 feet and still retain adequate capacity for vehicles
- Wide curb lanes may encourage motorists to drive faster
- Gutter area should not be included in calculating width of curb lane
- Consider striping a bike lane if curb lane is wider than 15 feet
- The "Share the Road" sign can be used to alert motorists to the expected presence of bicyclists: see MUTCD for guidance on use
- Shared lane marking (formerly known as sharrow) can assist with lateral positioning of bike in wide curb lane: see MUTCD for guidance on dimensions and use

Review Checklist:

- ☐ Can motorists safely pass bicyclist in same lane?
- ☐ Road surface condition
- ☐ Obstacles or road hardware
- ☐ Gutter space not included in width calculation
- ☐ Signs and wayfinding
- ☐ Would shared lane marking assist with bike positioning?

Wide curb lane with shared lane marking (sharrow) and share the road sign

BICYCLE FACILITY DESIGN REVIEW / BIKE LANE

A bike lane is the portion of a roadway designated by striping, signing and pavement markings for the preferential use of bicyclists. Generally, a bike lane is one way and bicycles travel in the same direction as traffic. A bike lane should provide enough road pavement for a bicyclist to ride comfortably between the adjacent travel lane and the curb and gutter or on-road parking. In general in the U.S., bike lanes are on the right-side of the road although alternative configurations are possible.

Design Standards & Guidelines:

- Bike lane width without curb, gutter or parking: **4 feet min.**
- Bike lane width with high traffic volumes without curb, gutter or parking: **5 feet min.**
- Bike lane width with curb or guardrail: **5 feet min.**
- Bike lane width between parking and travel lane: **5 feet min.**
- Bike lane width adjacent to narrow parking lane: **6-7 feet**
- Bike lane width with high bicycle use: **6-8 feet**
- Bike lane dashed white line prior to intersections (signalized or with high level of right turns): **50-200 feet**
- Bike lane solid white line width: **4-6 inches** (some locations require **8 inches**)
- Colored asphalt bike lanes: not in current standards but may be possible to get experimental approval for use

Design & Safety Issues to Consider:

- Bike lanes increase total road capacity
- Wider bike lanes are needed where vehicle speeds are higher
- Bike lanes are more typically used in urban and suburban areas
- Adequate space is required around parked car doors and where parking changeover is frequent
- Refer to AASHTO *Bike Guide* for alternative bike lane configurations for different situations
- Accommodating many vehicular turning movements at intersections complicates design of bike lanes
- Bike lanes can be dashed in segments where frequent crossing or merging occur
- Bike lanes should terminate prior to roundabouts
- Roadway debris sweeps to edge of bike lane area
- Striped buffers may be used to separate bike lanes from other road features
- Raised items such as low curbs used to delineate bike lanes create hazards
- Bicyclists may leave the bike lane for such maneuvers as passing and making turns
- Shared lane markings can be used to fill gaps between two sections of roadway with bike lanes

Review Checklist:

- ☐ Adequate lane width
- ☐ Turning and straight through movements at intersections
- ☐ Road hardware in bike lane
- ☐ Drainage to prevent pooling and debris accumulation
- ☐ Markings and paint symbols
- ☐ Dashed striping where needed
- ☐ Signs and striping
- ☐ On-street parking and turnover
- ☐ Width of parking lane
- ☐ Extra pavement for car door zone

BICYCLE FACILITY DESIGN REVIEW / PAVED SHOULDER

This is the part of the roadway that is adjacent to and on the same level as the travel lanes. Adding or increasing the width of paved shoulders can provide improved accommodations for bicycling particularly where vehicle speeds are high or lanes are narrow. Paved shoulders are frequently used on rural roadways.

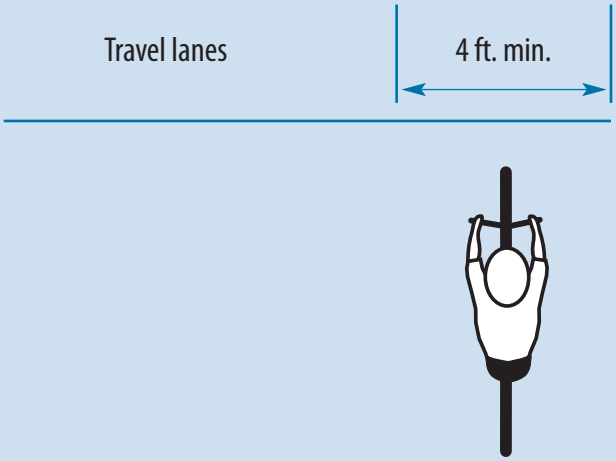
Design Standards & Guidelines:

- Paved shoulder width to accommodate bicycling: **4 feet min.**
- Paved shoulder width to accommodate bicycling with adjacent barrier (guardrail, concrete barrier, etc.): **5 feet**
- Painted edge stripe: **4 inches min.**
- Rumble strips clear distance from edge of paved shoulder: **4 feet min.**
- Rumble strip gaps for bicyclists: **40-60 feet** interval spacing, **12 feet min.** length

Design & Safety Issues to Consider:

- Shoulder must be paved to be usable by bicyclists
- Parking can be allowed on paved shoulders unlike bike lanes
- Additional shoulder width desirable if road speed exceeds 50 mph or bike volumes are high
- Shoulders improve safety for motorized vehicles and extend service life of road
- Shoulders on up-hill areas assist slower bicyclists
- Deterioration occurs at edge of paved shoulder over time
- Rumble strips not recommended and can make shoulder unusable for bicyclists
- Shoulder can be signed as bike route (although typically not as a bike lane)
- In Virginia, bicyclists can legally ride in the travel lane even when a shoulder is present
- Suggest paving portion of intersecting driveways to prevent gravel spilling onto shoulder
- Paved shoulders should be provided on both sides of a road

Paved shoulder



Review Checklist:

- ☐ Adequate shoulder width
- ☐ Paved to edge
- ☐ Paved shoulders on both sides of road
- ☐ Shoulder pavement same thickness/specification as road pavement
- ☐ Design of rumble strips and impact on bicyclists
- ☐ If rumble strips are used, gaps should always be provided to allow crossing by bicycles
- ☐ Adjacent drainage to prevent pooling, washouts and debris accumulation
- ☐ Check for gravel driveways along shoulder

BICYCLE FACILITY DESIGN REVIEW / INTERSECTION

An intersection is where two or more roads meet or where a road and sidepath or trail meet. Intersections can include several travel lanes, divided or undivided, with varying traffic speeds and volumes. Intersections may be controlled through signs or traffic lights or may be uncontrolled. Four-way intersections are the most usual type although several other common geometries such as three-way (or T-intersections) exist. Roads may also cross over each other above grade but only intersections with roads at the same level (at-grade crossings) are considered here.

Design & Safety Issues – On-road intersection:

- Compact intersections with roads meeting at right angles are safer for bicyclists to navigate
- Free-flowing and high-speed turning by vehicles should be avoided
- Vehicles may turn right into forward-moving bicyclists (known as the "right hook")
- Right-turning trucks or buses in particular have significant blind spots when turning
- Right-turn only lanes can cause conflicts with through riders
- Tighter curb radii are effective in slowing down turning vehicles
- Lighting is important for safe riding, particularly at intersections
- Bike lanes may be dashed prior to intersections and are usually not striped through intersections although some marking guidance may be provided

Design & Safety Issues – Off-road intersection:

- Drivers may not see bicyclists entering crosswalks, causing a high crash rate
- Drivers do not anticipate bicyclists appearing from unexpected path directions
- Visibility of crossing should be increased for both road and path users
- Clear sight distance needs to be maintained for all paths, driveways and turns
- Intersection crossings should be as close as possible to 90 degrees

Traffic Lights:

- Signal should be timed so that bicyclists do not have excessively long waits
- Traffic signal system should be able to detect bicycles (see AASHTO *Bike Guide*)
- Suggest pavement marking or sign indicating where bicyclist must stop in order to activate the signal
- Extra time is needed for bicyclists to clear green light phases, more if starting from a stop
- Sidepath users need crossing signals at some road intersections
- Consider converting complex intersections to roundabouts
- Video detection signals, which can more successfully detect bicycles over a wider area, are being used more widely in Virginia

Review Checklist:

- ☐ Layout and design for bicycling
- ☐ Through-riders and positioning
- ☐ Off-road crossings
- ☐ Left- and right-turning movements
- ☐ Right-turn only lane
- ☐ Sight distance and visibility
- ☐ Location and design of crosswalks and driveways
- ☐ Signal detector system
- ☐ Curb depressions and radii
- ☐ Bus stops around intersection
- ☐ Bike lanes and markings

BICYCLE FACILITY DESIGN REVIEW / ROUNDABOUT

The modern roundabout is an increasingly popular type of intersection that usually operates with a yield traffic control at the entry points and gives priority to vehicles within the roundabout. Bicyclists can generally mix easily with low-speed traffic on single-lane roundabouts. On some multi-lane roundabouts, options such as providing a bicycle ramp exit to sidepaths should be considered to reduce potential conflicts. More than 40 roundabouts have been built recently in Virginia, and another 50 are in various stages of development.

Design Standards & Guidelines:

- Urban roundabouts maximum entry speed: **20-30 mph**
- Bike lane termination prior to roundabout, distance from edge of circulatory road: **100 feet**
- Dash bike lanes prior to tapering into pedestrian crosswalk at roundabout: **50-100 feet**
- Bike lane taper rate prior to bicycle ramp access to path: **7:1**

One of four roundabouts installed at Gilberts Corner, Loudoun County, Virginia

Design & Safety Issues to Consider:

- Single-lane roundabouts can provide safety benefits for bicyclists when their needs are incorporated
- High-speed multi-lane roundabouts require special design solutions for bicycles
- Bike lanes are usually discontinued prior to the roundabout and are not striped on the roundabout as they would create turning conflicts at entrances and exits
- Bicyclists are most vulnerable when circulating on the roundabout and entering traffic does not yield or when circulating traffic exits across the path of the bicyclist
- Good visibility and yield enforcement are very important for the safety of bicyclists
- Some bicyclists will choose to travel on the roundabout roadway while others may choose to exit immediately prior and use the pedestrian system to navigate the roundabout
- Bicycle ramps can be provided to allow access to the path system at a roundabout but care must be taken to avoid potential confusion for pedestrians

Review Checklist:

- ☐ No bike lanes on roundabout
- ☐ Number of lanes on roundabout
- ☐ Merging of bicyclists with roundabout traffic
- ☐ Termination of bike lane prior to roundabout
- ☐ Vehicle entry speed
- ☐ Signs and striping
- ☐ Visibility and sight distance

Recently installed traffic roundabout, Midlothian, Virginia

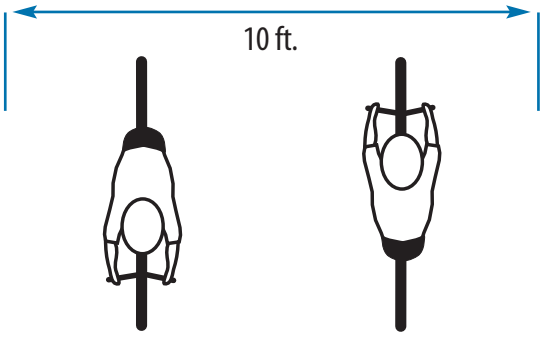
BICYCLE FACILITY DESIGN REVIEW / SHARED-USE PATH

This is a type of path physically separated from motorized traffic, usually made of asphalt and generally with two-way bike traffic. A shared-use path will be used by a variety of other users including pedestrians, runners, walkers with strollers, wheelchair users, toddlers and dogs. Preventing wrong-way bike usage when the path is designed for one-way travel is virtually impossible.

Design Standards & Guidelines:

- Two-way path width: typically **10 feet min.**
- Two-way path width (heavy traffic): **12 or more feet**
- One-way path width: **6 feet min.**
- Right-of-way constraints: an **8-foot** width can be adequate in rare instances for two-way paths
- Lateral clearance to trees, poles, walls: **2 feet min.**
- Side-grading each side of path: **3-5 feet** at max. slope of **6:1**
- Separation from adjacent roadway: **5 feet min.**
- Recommended barrier height when inadequate separation from roadway: **42 inch min.**

Shared-use path



Design & Safety Issues to Consider:

- A shared-use path can serve a variety of uses including providing short cuts, connections, and commuter routes
- A shared-use path is not a substitute for safe on-road design
- Consider reducing the path width when inadequate right-of-way is available
- In Virginia, bicyclists are permitted to use roadway even when shared-use path parallels the road
- Intersections at path crossings have more safety issues
- Path slopes should be kept to a minimum and a straighter path is generally safer for bicyclists
- Warning signs may be needed when inadequate clearance provided to obstructions
- Consider personal safety and lighting on isolated stretches
- In addition to lighting, a painted white edge stripe can assist with night visibility
- Frequent stops such as at crossings or driveways are a major disincentive to bicycling
- Connections are needed between path and street system
- Undesirable to locate path directly next to roadway as contraflow riders confuse motorists

Review Checklist:

- ☐ Appropriate width for projected path users
- ☐ Frequent driveways or intersections?
- ☐ Will path be blocked by waiting vehicles?
- ☐ Sight distance, bushes, trees
- ☐ Striping, signs and lighting
- ☐ Signs positioned for contraflow riders
- ☐ Check for wrong-way bike travel beyond path end
- ☐ Utility/rescue vehicles may need path access

ROADWAY TUNNEL AND UNDERPASS

These are types of enclosed roadways with access at both ends.

Design & Safety Issues to Consider:

- Absence of bicycle facility on approaches should not prevent bicycle accommodation within the tunnel/underpass
- Options include widening or eliminating existing sidewalks in tunnels
- Sidewalks in tunnels may act as barriers to prevent vehicles getting too close to the side or for emergency use
- Good lighting is important so that motorists can see and react to bicyclists
- Consider personal safety in tunnels
- Overhead clearance needs to be maintained throughout
- Unexpected ice patches can form from overhead drips
- Road hardware in tunnel pavement can be less visible and cause problems

Review Checklist:

- ☐ Provision of adequate width bike accommodations on both sides of roadway through tunnel
- ☐ Adequate vertical clearance
- ☐ Tunnel abutments clearly marked
- ☐ Road hardware and obstacles

BRIDGE AND CULVERT

These are structures erected over a depression or an obstruction such as water or a roadway.

Design & Safety Issues to Consider:

- Bridges can be a significant barrier to bicycling due to lack of dedicated space
- Bridges are often narrower than approach roads
- Absence of bicycle facility on approach should not prevent bicycle accommodation on bridge
- Sidewalks may be acceptable bicycle facility for long narrow bridge
- Consideration should be given to shared-use path with concrete barrier on both sides of bridge
- Where bridge is too narrow, it may be possible to add cantilever structure to accommodate bikes

Review Checklist:

- ☐ Side rail heights: **42 inches min.**
- ☐ Side rail heights with higher bicycle speed: **48 inches**
- ☐ Full pavement width maintained
- ☐ Provision of bike accommodations on both sides of roadway
- ☐ Bridge deck surface and joints
- ☐ Road hardware on bridge deck
- ☐ Signs and markings

RAILWAY AND LIGHT RAIL CROSSING

These are the intersections of a roadway or a path with a railway line or tram line.

Design & Safety Issues to Consider:

- Railroad tracks that cross the route of a bike on an angle can cause steering difficulties for bicyclists
- Angle of track should be at least 60 degrees or better so bicyclist can safely cross
- Railroad crossing surfaces vary: concrete, rubber, asphalt, or timber
- Concrete provides the smoothest and least slippery riding surface
- Shared lane markings may be used to guide bicyclists to the best route and angle of crossing

Review Checklist:

- ☐ Angle of railroad track relative to path or bike travel
- ☐ Crossing surface and condition
- ☐ Width and depth of flange opening
- ☐ Signs and markings

COMMON ISSUES THAT AFFECT PROJECTS

Buses and bus stops:

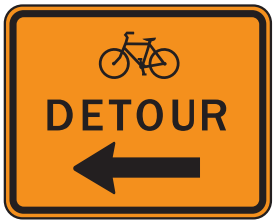
Buses stopping at the curb and pulling back into traffic may cause problems for on-road bicyclists. Many bus stops are located before an intersection (near-side location) and relocating to the far side can reduce conflicts. Where a bike lane is striped in the vicinity of a bus stop, it should be dashed to indicate that buses can pull across to reach the stop. Adding pavement or placing the bus stop in line with on-street parking may assist passing bicyclists.

Common crashes:

Most bicycle crashes involve falls, often caused by hazards such as potholes, debris, or drainage grates. Only a small portion of crashes involve motor vehicles with most of these crashes occurring at intersections. When bicyclists are at fault, the crash cause is often riding the wrong way or turning left across traffic. Crashes caused by motorists are frequently related to vehicles turning left and failing to yield in front of a bicyclist ("left hook") or vehicles turning right in front of a through rider ("right hook"). Right-turn-on-red crashes occur when motorists look for vehicles approaching from the left and fail to see the bicyclist approaching on a sidepath, crossing from the right. Mapping crash data for a particular location may illuminate a design deficiency.

Construction:

Construction time can be lengthy so safe bicycling access must be planned for the duration. During construction, VDOT policy requires maintenance of bicycle traffic in accordance with the MUTCD and the VDOT *Work Area Protection Manual*. Adequate access to the roadway or shared-use paths should be provided and if a designated bicycle route is closed, a signed alternative should be provided. Bicyclists should not be directed onto pedestrian sidewalks. Temporary surfaces should be suitable for riding, and warning devices are required for drops or obstacles. Bicyclists need to be notified in advance of restrictions, detours and closures. Although all signs must be in English to comply with the MUTCD, notifications may need to be posted in other languages. Bicycle access and safety should also be maintained during advance utility relocation.



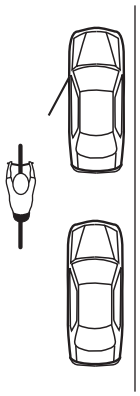
Design speed vs. operating speed:

The design speed of a road is the maximum speed at which a vehicle can be operated safely in perfect conditions on that road. The operating speed is the speed at which vehicles are actually observed traveling on that road. Design speed takes into account braking and reaction time to unexpected events. Note that the design speed or operating speed and the posted speed limit may not be directly related.

When evaluating a road design, check to see if the design speed planned is higher than the desired speed of traffic through the community. The selection of the design speed for a road influences the operating speed of future users, as most users drive at the speed at which they are comfortable. A useful question to ask the design engineer is how the design would change if the design speed were raised by 10 mph. If the design would not change much with a higher design speed, it may be safe to assume that operating speeds will be higher than the proposed design speed. At times, operating speed may exceed design speed by a considerable margin.

Doors and parked cars:

The door zone is the 4 to 5 foot area next to a parking lane where car doors swing open. Bicyclists can be thrown into the path of passing vehicles by an opening door. Dooring can be a particular problem when bike lanes are placed next to parking. Where parking lanes are narrow (7 feet or less), parked cars may also encroach into the bike lane. Wider bike lanes are recommended next to parked vehicles, preferably with striping on both sides. Where no bike lane exists, a shared lane marking may be used to indicate the recommended safe riding distance away from parked vehicles.



Intersection design:

Intersections are controlled in various ways. The design must accommodate turning movements and crossings in many directions with numerous potential conflict points. Users include motorized vehicles, bicycles and pedestrians, all with different operating speeds. Driveways, business entrances and bus stops add to the potential problems for bicyclists. Each approach and crossing at an intersection should be examined from the perspective of bicycle users to see what will make their passage safer. Properly placed crosswalks and signs will increase the visibility of bicyclists on shared-use path crossings. Intersection angles for streets and crossings should be as close as possible to 90 degrees so as to maximize sight distances and reduce crossing distances.

Maintenance:

Future maintenance of new facilities should be addressed, particularly for shared-use paths that might not be included in routine road maintenance programs. Regular maintenance of bike facilities includes debris removal and repairs required due to wear and tear. Additional issues on shared-use paths include damage to the surface caused by invasive roots from close-by trees or by maintenance vehicles using the path, and the need for snow removal. Without a maintenance program with designated responsibility and funding, safe bicycling conditions and facility usage rates cannot be sustained.

Ramps and interchanges:

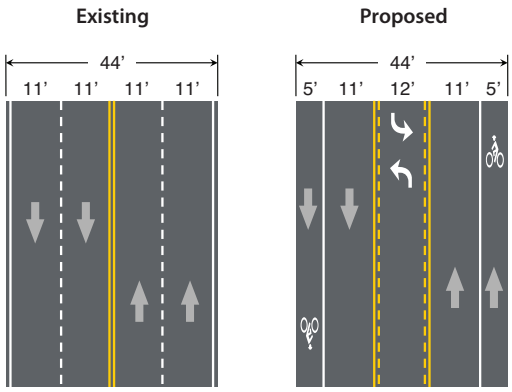
There are many configurations for ramps and interchanges connecting into local cross streets and most are difficult for bicyclists to negotiate safely. Ramps are often designed to facilitate high-speed merges and exits. Ramp angles can reduce sight distance of motorists, or prevent them from seeing approaching cyclists. Possible improvements include ramp crossings at right angles with clear traffic controls for motorists or alternatively, bicyclists riding with the through traffic with additional guidance on lateral positioning.

Right hook:

On-road bicyclists are vulnerable to being hit by vehicles turning right into their path. This is known as a "right hook." In particular, trucks and buses have significant blind spots that block the operator's view of adjacent bicyclists. Extra design attention is needed for an uncontrolled fast-moving right-turn lane or dual right-turn lanes. At signalized or stop-controlled intersections with right-turning motor vehicles, the bike lane striping should be replaced with a broken line in the approach indicating bicyclists can merge with adjacent traffic. The length of the broken line section is typically 50 feet to 200 feet before the intersection.

Road diet:

A typical road diet involves reducing the number of lanes to improve safety. One common application is to convert from two travel lanes to one travel lane in each direction, with enough paved area remaining to add bike lanes on each side plus a two-way turning lane in the middle. No new pavement width is added to the road and operational and safety improvements for motor vehicles may result due to the new design for left turns. Four-lane to three-lane road diets can typically be used on roads with average daily traffic of up to 20,000 vehicles without impacting capacity or Level of Service.

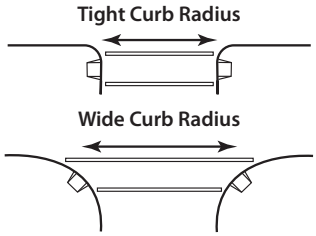


Sight distance:

Sight distance is a measure of how far a driver or a bicyclist can see before the line of sight is blocked by an object such as a hill, a hidden dip or an obstacle on the inside of a curve. Sight lines can also be impaired by signs, encroaching vegetation and snow piles. There are various types of sight distances and the specific distance required for different situations can be found in road design manuals. When measuring sight distance, the height of the eye of a bicyclist is measured from a higher point than that of a motorist. **Stopping sight distance** is the distance traveled after perceiving a situation requiring a stop, realizing that stopping is necessary, braking and then coming to a stop. This distance is needed to allow a vehicle traveling at design speed to stop before reaching a stationary object in its path. **Intersection sight distance** is the clear distance needed to safely proceed through an intersection. This distance depends on the type of traffic control at the intersection, and the maneuver (left turn, right turn, or heading straight).

Smaller (or tight) curb radius:

Reducing the size of the curb radius at an intersection tends to reduce motor vehicle turning speeds. A tighter curb radius also shortens street crossing distances and improves sight lines. However with tighter curb radii, large vehicles may be more likely to ride over the curb.



Traffic signals and controls:

Stopped bicyclists waiting at an intersection need time to accelerate and cross once the light turns green. Rolling bicyclists who enter at the end of the green time require adequate clearance time for crossing the intersection. In addition, the detector used for traffic-actuated signals needs to detect the presence of a bicyclist so that the green phase can be triggered.

Types of bikes:

When evaluating such factors as sight distance, path widths and turning radii on shared-use paths, the full range of bicycle types should be considered. Some bikes are longer, wider or lower than the standard adult bicycle and may have different operating characteristics. Bicycle types include recumbents, bicycles with trailers, tandems, tag-along children's trailers, adult tricycles, cargo bikes and children's bicycles. With the aging of the population, more people likely will be using some of these non-standard bicycles.

STANDARDS, GUIDELINES, POLICIES AND ORDINANCES

Designing a road project is very complex, in part because of applicable standards, guidelines and policies. Advocates may need to familiarize themselves with some of the rules and details from these documents. At a minimum, bicycling advocates should be conversant with the AASHTO *Bike Guide*. Some or all of the following are referenced on all projects.

Agency or Organization	Standards, Guidelines, Policies or Ordinances Governing the Design of Road Projects
American Association of State Highway and Transportation Officials (AASHTO) National standards-setting body made up of state department of transportation (DOT) officials	***Guide for the Development of Bicycle Facilities (the Bike Guide):*** • National guidelines for recommended bicycling facilities along roadways • Currently under major revision with substantially expanded version due shortly • VDOT has adopted the current guide for design and it is widely available online ***A Policy on Geometric Design of Highways and Streets (the Green Book):*** • Guidelines for the geometric and functional design of roads and highways
Transportation Research Board (TRB) Division of the National Research Council	***Highway Capacity Manual (HCM):*** • National guidelines for the design of roads • Currently under final revision with revised version due 2010 • Additional bicycling details to be integrated into the revised design chapters
Federal Highway Administration (FHWA) Division of the United States Department of Transportation	***Manual on Uniform Traffic Control Devices (MUTCD):*** • National standards for installation of all traffic control devices (signs, signals, markings) • Newly revised (late 2009) containing new bicycle signs and markings • VDOT is expected to adopt the new version within two years
Americans with Disabilities Act of 1990 (ADA) Civil rights law	***Accessibility Guidelines:*** • Prohibit discrimination based on disability • Ensure new or altered facilities are usable and readily accessible by persons with disabilities • ADA accessible features such as curb ramps benefit bicyclists
Virginia Department of Transportation (VDOT) Agency responsible for building and maintaining most roads in Virginia	***Engineering Design Manuals:*** • VDOT has many detailed manuals for road design, traffic engineering, bridges and tunnels • Additional design-related information includes access management regulations, secondary street design, and context sensitive design policy • Copies of all these documents are available on the VDOT website (virginiadot.org) ***Policy for Integrating Bicycle and Pedestrian Accommodations:*** • Adopted by the Virginia Commonwealth Transportation Board (CTB) in 2004 • All highway projects are initiated with the presumption that bicycling will be accommodated • Serves as Virginia's Complete Street Policy ***Statewide Bicycle Policy Plan:*** • New document, currently in development, not yet available
County, City or Town Local administrative authority	***Engineering Design Manuals or Local Public Works Facilities Manual:*** • Available at local department of transportation or department of public works ***Comprehensive Plan:*** • Serves as a formal blueprint for the community goals and objectives • Enables officials and the public to anticipate and deal with community changes ***Subdivision and Site Plan Regulations:*** • Set minimum standards for design and construction of residential and commercial development, including streets and shared-use paths ***Zoning Ordinance:*** • Legislative means by which all aspects of land use are controlled ***Bicycle Master Plan:*** • Describes the local plan and strategy to accommodate and encourage bicycling • Must be adopted to become an officially recognized plan by VDOT ***Trails Plan:*** • Locally adopted plan or map identifying location and type of future trails

NON-STANDARD PROJECTS, EXCEPTIONS AND INNOVATIONS

Flexibility in design standards:

While public policies and design standards lead to improved road designs, engineers frequently cite the same standards as the reason a particular bicycle facility design request cannot be considered. Although not always obvious, design standards or guidelines usually have a degree of flexibility. There is never just one design solution. The Federal Highway Administration (FHWA) has produced an easy-to-read manual, *Flexibility in Highway Design*, on the topic. A public road project is designed based on assumptions, future projections, and desired outcomes. Advocates can ask for the actual values or assumptions used (for example design speed, road classification) and may find some room for discussion and debate.

VDOT exception process:

All VDOT construction projects start with the assumption that some bicycling accommodation will be provided unless an exception has been granted. The VDOT *Policy for Integrating Bicycle and Pedestrian Accommodations* lists six conditions where an exception is possible. These include such factors as disproportionate cost, compromised safety and environmental impacts. Even if the project meets the criteria for an exception, the project manager must still determine whether any practical enhancements may be provided to improve the environment for bicyclists. Even for facilities that may meet the requirements for an exception, special circumstances may dictate that an accommodation must be provided.

Small or minor projects:

Many projects are so minor that they do not go through the usual design process. These projects could still provide an opportunity to add bicycle facilities. For example, when a road is repaved, the pavement can be reassigned and restriped to create wide outside lanes. The road could also be considered for a road diet. Replacing a small bridge or culvert is a critical opportunity to request bicycle accommodations. These structures often cause dangerous pinch points for bicyclists and may not be replaced again for decades. Asking local officials about upcoming small replacement or maintenance projects is important as they may not have been advertised publicly.

Land-use and subdivision rules:

Land-use and subdivision design are regulated at the county or city level and many communities have been developed in a suburban cul-de-sac style. VDOT recently adopted far-reaching requirements for a greater degree of interconnectivity before considering acceptance of new streets into their system. Greater internal connectivity can generally provide safer alternatives for bicyclists compared to higher-speed arterials. Similar regulations may be adopted around the country in the next few years.

Liability issues:

Liability concerns are always an issue when planning bicycle facilities. Courts have recognized that transportation professionals are often faced with the dilemma of making difficult decisions, deciding among competing interests and balancing the safety of different users. Identifying potential risks, designing accordingly, and then evaluating the results as part of a systematic program is proving to be a more defensible approach than not providing accommodations. According to the FHWA *University Course on Bicycle and Pedestrian Transportation*, "the best approach is to develop a strong proactive program to plan, design, build, maintain, and operate a fully balanced transportation system that responds to the needs of all potential users."

Errors, omissions and additional information:

Errors can creep into projects, particularly if the base information is not correct or if time has elapsed since the project was initiated. Reviewing plans in the field and looking for existing worn paths can reveal forgotten connections or other important existing conditions. Tools such as *Bing* or *Google Maps* or *Google Streetview* can provide a good start in evaluating existing and overlooked conditions. Images can be printed for use in meetings and comment letters.

Innovative bicycling designs:

Non-standard features outside of U.S. standards can be considered by the FHWA as experimental treatments. The proposed design will need considerable local official support and must be backed by solid research. All requests for experimentation should originate with the state or local highway agency responsible for managing the location where the experiment will take place. Requests are submitted to the FHWA headquarters. Agencies seldom proceed with a non-standard bicycle facility design without conducting an official experiment through the FHWA.

Cities for Cycling is a recent joint initiative by the National Association of City Transportation Officials (NACTO) to promote innovative non-standard designs in cities. Examples are provided on their website (nacto.org) and include design and implementation information for the following experimental designs:

- **Bike Box:** A painted box at an intersection that positions bicyclists ahead of other vehicles for visibility and priority
- **Bicycle Preferred Street (or Bike Boulevard):** A low speed, low volume local street that has been optimized for bicycle travel using treatments such as traffic calming and reduction, signs, and markings
- **Bike Signal:** A traffic signal head for bicycles
- **Buffered Bike Lane:** A bike lane with a painted buffer between the bike lane and the vehicle travel lane or the parking zone
- **Colored Pavement:** Color is applied to bicycle facilities to alert motorists to the presence of bicyclists, clearly assigning right-of-way to cyclists where motorists are expected to yield
- **Contraflow Bike Lanes:** A one-way motorized traffic street with two-way bicycle facilities, including an opposite direction bicycle-only lane
- **Cycle Track:** A bicycle-exclusive facility that provides physical separation from motor vehicles on the street

LATE STAGES IN THE PROCESS

Design alterations can be made right through construction. Bicycling advocates may need to check periodically that the proposed bicycling accommodations are not changed. Maintaining an ongoing relationship with the project manager and establishing a relationship with the construction team will help advocates become aware of changes.

Late-stage changes to the design:

Delays in construction start-up can lead to design revisions due to changed conditions. Features may be scaled back because of reduced budgets or value engineering processes. Funding issues can cause the project to be split into phases, which in turn can lead to a lack of connectivity for bicycling accommodations. Bridges are particularly expensive and any narrowing to reduce costs can lead to undesirable conditions for bicyclists.

Negotiation and acquisition of right-of-way along the project can lead to delays and occasional changes in the design along a property frontage. Sometimes facilities are installed incorrectly due to field errors, requiring modifications to the design. Other problems occur when there are mistakes in the base design information. These can lead to facilities that do not perform as expected, requiring some reconstruction to meet design standards.

Media reporting:

As stories appear in the media and residents realize the effects of new projects, they may raise objections. Bicycling advocates need to be prepared to respond appropriately to any negative press or misinformation. On the other hand, project completion provides an opportunity for positive publicity, and to publicly thank officials.

CONCLUSION

Bicycling advocates can contribute to the design and implementation of all transportation projects. Many decisions during a project have a cascading effect shaping the ultimate character of the project. Your role as a bicycling advocate can make a critical difference in the bicycle friendliness of future projects. Public participation is fundamental to the design of public projects, and good design can enhance a community for generations to come. This guide gives you tools and insights that can assist you as an advocate for a more bicycle-friendly society.

APPENDIX A: GLOSSARY

AASHTO: The American Association of State Highway and Transportation Officials is a national standards-setting body.

Americans with Disabilities Act (ADA): Law prohibiting discrimination and guaranteeing disabled people access to public facilities.

Annual average daily traffic (AADT): The annual number of vehicles on a road divided by 365 days.

Arterial road: A moderate- or high-capacity road carrying traffic between or through urban areas.

Average daily traffic (ADT): Average number of vehicles on a road passing a specific point both ways in a 24-hour period.

Bicycle Level of Service (BLOS): Estimate of bicyclist's comfort level based on several variables; BLOS ranges from a high of A to a low of F.

Bike Guide: Common name for the nationally-used AASHTO *Guide to the Development of Bicycle Facilities*.

Bike lane: A lane on a roadway designated by striping, signing and pavement markings for the preferential use of bicyclists.

Code of Virginia (1950): The statutory law of Virginia that confers legal rights and responsibilities on bicyclists.

Collector road: A road that carries traffic from local roads to arterial roads.

Complete street: A street designed and operated to enable safe travel for all users, including bicyclists.

Comprehensive Plan (or Master Plan): A long-range plan that defines the community goals for development, including transportation.

Contraflow: Travel in the opposite direction to traffic.

Cover sheet: The first sheet of a set of engineering drawings containing project information.

Cross section: A cut-through view of the road surface perpendicular to the centerline (see also profile).

Curb: A raised-concrete border forming a part of the gutter at the edge of the road, typically located at the corners of street intersections.

Curb radius: The form of the curved raised-concrete edge joining intersecting curbs.

Curb ramp or cut: A ramp leading smoothly from a sidewalk or trail to a street.

Design/build: The practice of using a single contractor to design and build a road project.

Design speed: The speed for which roadway elements such as curves are designed to allow vehicles to travel safely.

Detail drawings: Drawings that depict the planned road facilities. Also known as engineering drawings or plans.

Easement: A legal right to use land owned by another. Used sometimes for paths and utilities.

Final design: Preparation of final detailed engineering drawings for review and approval.

Gutter pan: Concrete channel next to the curb for carrying runoff, typically 1-2 feet wide.

Highway Capacity Manual (HCM): Contains computations for the design performance of traffic volumes on roads, published by the TRB.

Lane: A division of roadway intended for movement of vehicles in a single direction.

Left-turn lane: A lane dedicated to left-turning vehicles.

Level of Service (LOS): Estimate of the service quality of a road facility under certain operating conditions based on traffic delay and congestion, with A representing the best and F the worst.

Line of sight: A straight line from the eye of the driver or bicyclist to a potential object in the road ahead.

Local road: A road that typically has very low volumes, usually in residential or very rural areas.

Manual on Uniform Traffic Control Devices (MUTCD): A document with standards for traffic signs, road markings, and signals, published by FHWA.

On-road (vehicular) bicyclists: Bicyclists who generally travel within a roadway in a lane or a shoulder in accordance with the rules of the road.

Operating speed: The speed at which drivers generally operate vehicles on a particular road.

Plan view: A drawing that provides an overview as if looking straight down on the project.

Preliminary design: The initial phase of design drawings and supporting documents, usually prepared to about 30-40 percent completion.

Profile: A cut-through view of the road surface parallel to a baseline such as the centerline.

Primary road: Two- to six-lane road that connects cities and towns with each other and with interstates; generally numbered under 600.

Public hearing: A formal meeting required by law to discuss a project during which citizens can provide comments.

Public meeting: A meeting in which information about a project is presented to the public.

Right-of-way (ROW or R/W): Land owned by a jurisdiction that is used for the road, services and adjacent access areas.

Road diet: Reduction in the number of through travel lanes on a roadway, usually to make room for a two-way left-turn and bike lanes.

Rumble strip: A road feature that alerts inattentive drivers by causing a tactile vibration and audible rumbling, transmitted through the wheels to the vehicle body.

Secondary road: Local connector or county road that is generally numbered 600 and above.

Shared lane marking (previously sharrow): An arrow-like design with bike symbol to indicate the preferred riding position for a bicyclist.

Shared roadway: A roadway that is open to both bicycles and motorized vehicles.

Shared-use path: A paved bikeway physically separated from motorized traffic that may also be used by pedestrians and others.

Shoulder: The paved or gravel part of the roadway that is adjacent to the vehicular lanes of the road and is on the same level.

Sidepath: A shared-use path located next to a roadway.

Sidewalk: The portion of the right-of-way adjacent to the roadway but intended for use by pedestrians, usually made of concrete or asphalt.

Sight distance: The length of roadway or shared-use path that is visually unobstructed.

Speed limit (or posted speed): The maximum speed allowed by law for vehicles.

Stop bar (or line): A wide solid white line indicating the required position behind which to stop vehicles.

Striping: Road surface paint lines, which can be solid or dashed, white or yellow.

Striping plan: Plans showing traffic control devices including road striping.

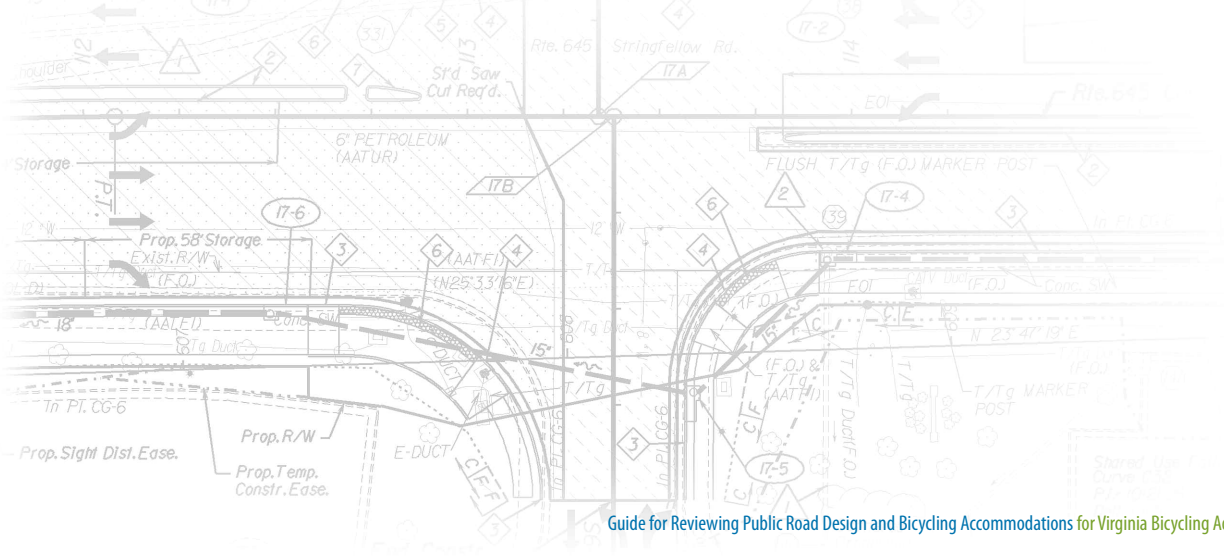
Traffic calming: Set of strategies aimed at slowing down or reducing traffic volume.

Two-way left-turn lane (TWLTL): A lane between opposing travel directions that can be used by left-turning vehicles traveling in either direction.

Value engineering: An evaluation of the cost-effectiveness of a project with recommendations for alternative solutions.

VDOT: Virginia Department of Transportation is the agency of state government responsible for transportation in the Commonwealth of Virginia.

Wide outside lane (wide curb lane): The lane nearest the curb that is wide enough for a bicyclist to share comfortably with a motor vehicle.



APPENDIX B: LOCAL GOVERNANCE AND RULES IN VIRGINIA

The Commonwealth of Virginia is made up of 95 *counties*, 39 *independent cities* and approximately 190 *incorporated towns*. *Counties* are administrative divisions of Virginia, each with its own government. *Independent cities* are legally distinct from the county that surrounds them and interact with the Commonwealth directly. They are considered county equivalents and have their own government. *Towns* are the only other type of municipal government authority in Virginia and they interact with the Commonwealth through the *county* government. *Towns* are a part of the *counties* within which they are located, with the county usually responsible for some of the town's services.

VDOT maintains all of the interstate and most primary routes throughout Virginia. VDOT maintains the secondary roads for all but two *counties*, Arlington County and Henrico County. *Independent cities* generally are responsible for building and maintaining all secondary roads (streets), and some maintain primary routes within their jurisdiction for which they receive an allocation from the commonwealth. However, for most of Virginia's *towns*, all streets are maintained by VDOT as primary or secondary routes.

Dillon Rule:

The *Dillon Rule* is the doctrine that a unit of local government may exercise only those powers that the state expressly grants to it while *Home Rule* provides a city or county with a greater measure of self-government. Although the Dillon Rule is a concept found in all states, most states have adopted various types of Home Rule provisions that permit some or all of their local governments to undertake those governmental functions that are not specifically precluded by the laws of those states.

Virginia is considered to employ the strictest interpretation of the Dillon Rule and the Virginia courts have determined that local governments have only limited authority based on the specific powers expressly conferred on them by the General Assembly. Among other restrictions, this limits the local governments' ability to raise funds for transportation and other improvements. The Dillon Rule may limit local officials and prevent them from quickly reacting to unique local problems with a specifically tailored local response. For instance, a local government might be prevented by the Dillon Rule from requiring developers to extend improvements off-site of their projects to provide connectivity with an existing bicycling facility. There are periodic calls from within Virginia to reverse the Dillon Rule and institute Home Rule.

The Code of Virginia:

The 1950 *Code of Virginia* is currently in force and is the statutory law of Virginia. Every person riding a bicycle on a road shall be subject to the provisions of the *Code of Virginia* section on motor vehicles and shall have the rights and duties applicable to the driver of a vehicle unless a provision clearly indicates otherwise. Bicyclists and motorists basically have the same rights and duties, and the laws governing traffic regulation apply equally to both. See a summary of Virginia bicycle laws at **www.vdot.virginia.gov/programs/bk-laws.asp.**

APPENDIX C: THE MAJOR GOVERNMENTAL AGENCIES IN TRANSPORTATION DESIGN IN VIRGINIA

Agency or Organization	Description
Metropolitan Planning Organization (MPO) Organization made up of representatives from local government agencies and staff to coordinate work in a region	• Federally-mandated and funded transportation policy planning organization for urban areas with population greater than 50,000 • MPO made up of key decision-makers from member agencies to coordinate decisions • MPO identifies projects to be included in Transportation Improvement Programs (TIP) and the Constrained Long-Range Plan (CLRP) • MPO does not have any taxing authority • MPO holds public meetings annually for soliciting input on the TIP and CLRP • There are 14 MPOs in Virginia, 385 MPOs in the U.S., some of which include multiple states
Virginia Commonwealth Transportation Board (CTB) Board members appointed by Governor. They guide the work of the Virginia Department of Transportation (VDOT)	• CTB guides transportation policy for the entire Commonwealth • CTB declares policies and regulations governing VDOT operations as well as Virginia Department of Rail and Public Transportation (VDRPT) • CTB has no taxing authority but does allocate funding • Long-term improvement programs are generated by the CTB • CTB holds public meetings around Virginia on proposed long-term improvement plans • VTrans is a long-range plan updated every 5 years allowing citizen input • Advocates can comment on proposed road projects as well as on projects linked to transit
Virginia Department of Transportation (VDOT) State governmental organization responsible for most public roads in Virginia	• Agency with responsibility for transportation in Virginia (other than transit) • Builds, operates and maintains the majority of roads, bridges and tunnels in Virginia • State and regional bike coordinators work on bicycling policy and design issues • Employs consultants for design and contractors for construction on many projects • State bike advisory committee, with volunteer roles for advocates • VDOT and VDRPT work closely and both report to the Secretary of Transportation
County Board of Supervisors (BOS) Elected officials who form the local governing body for a county	• Elected governing board of a county with limited taxing authority • Sets priorities for improvements to the secondary highway system • Proposes and approves plans for future land development • Establishes and adopts county policies and commissions • Provides input to CTB and VDOT on future transportation plans at both the planning and design stages • May serve on MPO board
County Department of Transportation (DOT) or Department of Public Works (DPW) or Department of Environmental Services (DES) County government	• Provides guidance and input to CTB or VDOT about specific projects • Most counties (except Arlington and Henrico) have limited authority over roads • Generally county DOT, DPW or DES maintains few local roads • May have county bicycle coordinator working on bicycling policy and design issues • May have bicycle advisory committee or trails committee
City DOT or DPW City government	• Often maintains secondary roads • Sets priorities for improvement on the urban street system within its boundaries • May have considerably smaller staff than county • Unlikely to have dedicated bicycling staff • 39 independent cities in Virginia, not all have their own DOT or DPW • May have local bike advisory committee

APPENDIX D: CURRENT CODES AND MANUALS

AASHTO	1999	*Guide for the Development of Bicycle Facilities (the Bike Guide)*
	2004	*Guide for the Planning, Design, and Operation of Pedestrian Facilities*
	2004	*Policy on Geometric Design of Highways and Streets (the Green Book)*
APBP	2009	*Bicycle Parking Guidelines*
Bikes Belong Coalition	1999	*Guide to Bicycle Advocacy*
Brookings Institution	2003	*Is Home Rule the Answer? Clarifying the Influence of Dillon's Rule on Growth Management*
FHWA	1997	*Flexibility in Highway Design*
	2006	*University Course on Bicycle and Pedestrian Transportation*
	2009	*Manual on Uniform Traffic Control Devices (MUTCD)*
National Capital Region Transportation Planning Board	2008	*A Citizens Guide to Transportation Decision Making in the Metropolitan Washington Region*
National Center for Bicycling & Walking	2009	*Creating a Road Map for Producing & Implementing a Bicycle Master Plan, Peter Lagerway*
Surface Transportation Policy Partnership	2006	*From the Margins to the Mainstream*
United States Access Board	1999	*Accessible Rights-of-Way: A Design Guide*
US DOT	–	*Design Guidance, Accommodating Bicycle and Pedestrian Travel*
Virginia Code Commission	1950	*Code of Virginia*
VDOT	1999	*Policy Manual for Public Participation in Transportation Projects*
	2003	*Public Involvement, Your Guide to Participating in the Transportation Planning and Programming Process*
	2004	*Policy for Integrating Bicycle and Pedestrian Accommodations*
	2005	*Road Design Manual*
	2005	*Work Area Protection Manual*
	2006	*Context Sensitive Design Policy*
	2006	*Designated Bicycle and Pedestrian Accommodations*
	2008	*Bicycle and Pedestrian Accommodation Decision Process For Construction Projects*
	2008	*Highway Plan Reading (slideshow on VDOT website)*
	2009	*Access Management Regulations*
	2009	*Secondary Street Acceptance Requirements*

APPENDIX E: FURTHER INFORMATION

Alliance for Biking & Walking
www.peoplepoweredmovement.org

America Bikes
www.americabikes.org

Association of Pedestrian and Bicycling Professionals
www.apbp.org

Bikes Belong Coalition
www.bikesbelong.org

BikeWalk Virginia
www.bikewalkvirginia.org

Cities for Cycling
www.nacto.org/citiesforcycling.html

City of San Francisco, California
www.sfmta.com/cms/bproj/bikeplan.htm

City of Portland, Oregon
www.oregon.gov/ODOT/HWY/BIKEPED/docs/or_bicycle_ped_plan.pdf

City of Chicago, Illinois
egov.cityofchicago.org/webportal/COCWebPortal/COC_EDITORIAL/bike_lane.pdf

Fairfax Advocates for Better Bicycling
www.fabb-bikes.org

FHWA Bicycle and Pedestrian Program
safety.fhwa.dot.gov/ped_bike

League of American Bicyclists
www.bikeleague.org

National Center for Bicycling & Walking
www.bikewalk.org

National Center for Safe Routes to School
www.saferoutesinfo.org

Pedestrian and Bicycle Information Center (PBIC)
www.bicyclinginfo.org

Code of Virginia (VDOT summary related to bicycling)
www.vdot.virginia.gov/programs/bk-laws.asp

Transportation Research Board
www.trb.org

Virginia Bicycling Federation
www.vabike.org

Washington Area Bicyclist Association
www.waba.org

Washington, DC
app.ddot.dc.gov/information/bicycle_program.shtm

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Pedestrian and Bicycling Information Center (PBIC) www.pedbikeimages.org: Cover Photo 1, 3, & 4; Inside cover 1; Page 3 – 2 & 3; Page 5 – 2 & 3; Page 10; Page 12; Page 13; Page 15; Page 18 – 1; Page 20 – 2 & 3; Page 23 – 1 & 3; Inside back cover; Back cover

VDOT photo collection: Cover Photo 2; Page 1; Page 5 – 1; Page 7; Page 16 – 1 & 2; Page 17; Page 18 – 2 & 3; Page 19 – 2; Page 23 – 2; Page 25; Page 26

FABB private collection: Inside cover 3; Page 3 – 1 & 4; Page 6; Page 11; Page 14; Page 20 – 1

Fairfax DOT: Inside cover 2

MUTCD: Page 19 – 1

FABB

Fairfax Advocates for Better Bicycling

FABB is a local volunteer bicycling advocacy organization in Fairfax, Virginia. We are a group of concerned bicyclists who want to make bicycling an integral part of the transportation network of Fairfax County and the City of Fairfax, Virginia. We are affiliated with the Washington Area Bicyclist Association (WABA), which is a non-profit organization working to create a healthy, more livable Washington, D.C. metropolitan region by promoting and advocating for bicycling.

www.fabb-bikes.org

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