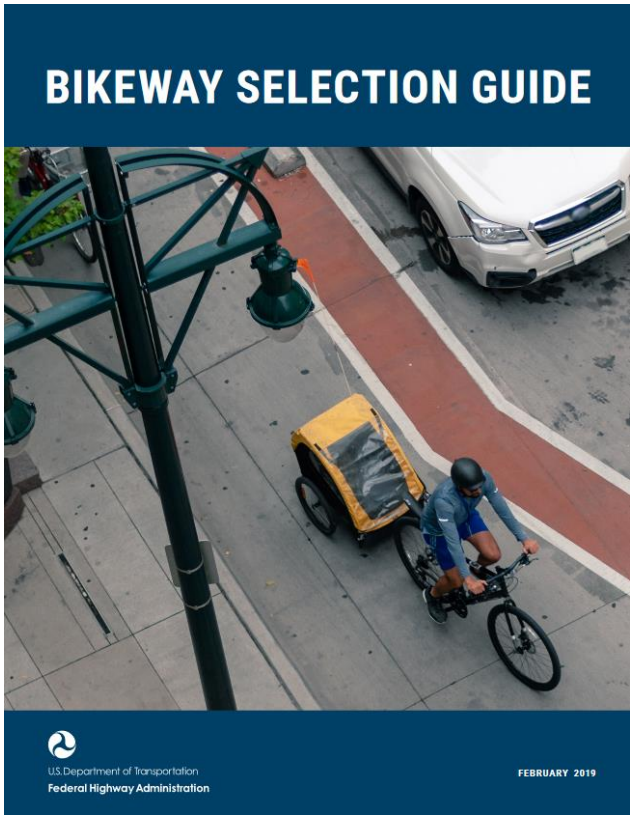
FHWA Bikeway Selection Guide

Tamara Redmon
Federal Highway Administration

Bill Schultheiss
Toole Design

Lauren Blackburn
VHB



March 26, 2019

Housekeeping

- **Problems with audio?**
  Dial into the phone line instead of using "mic & speakers"
- **Webinar issues?**
  Re-Load the webpage and log back into the webinar. Or send note of an issue through the Question box.
- **Questions?**
  Submit your questions at any time in the Questions box.

Archive and Certificates

Archive posted at www.pedbikeinfo.org/webinars

- ⇨ **Copy of presentations**
- ⇨ **Recording (within 1-2 days)**
- ⇨ **Links to resources**

Follow-up email will include…

- ⇨ **Link to certificate of attendance**
- ⇨ **Information about webinar archive**

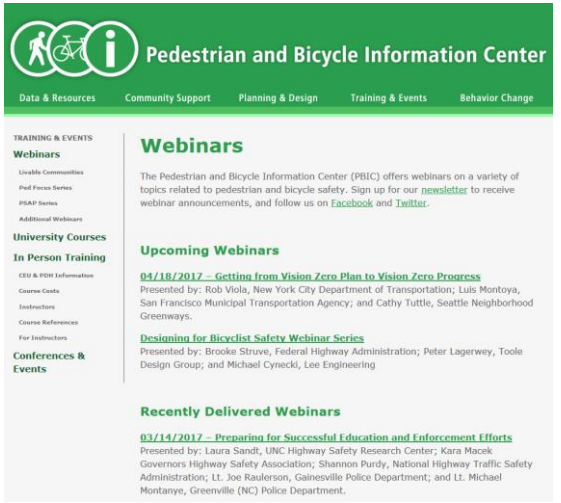
PBIC Webinars and News

- **Find PBIC webinars and webinar archives**
  pedbikeinfo.org/webinars

- **Follow us for the latest PBIC News**
  facebook.com/pedbikeinfo
  twitter.com/pedbikeinfo

  - **Join us on Twitter using #PBICWebinar**

- **Sign up for our mailing list**
  pedbikeinfo.org/signup



Discussion

- Send us your questions 
- Follow up with us:
  - Tamara Redmon tamara.redmon@dot.gov
  - Bill Schultheiss wschultheiss@tooledesign.com
  - Lauren Blackburn lblackburn@vhb.com
  - General Inquiries pbic@pedbikeinfo.org
- Archive at www.pedbikeinfo.org/webinars

Bikeway Selection Guide

Background

U.S. Department of Transportation
Federal Highway Administration

Safe Roads for a Safer Future
Investment in roadway safety saves lives
http://safety.fhwa.dot.gov

Presenters

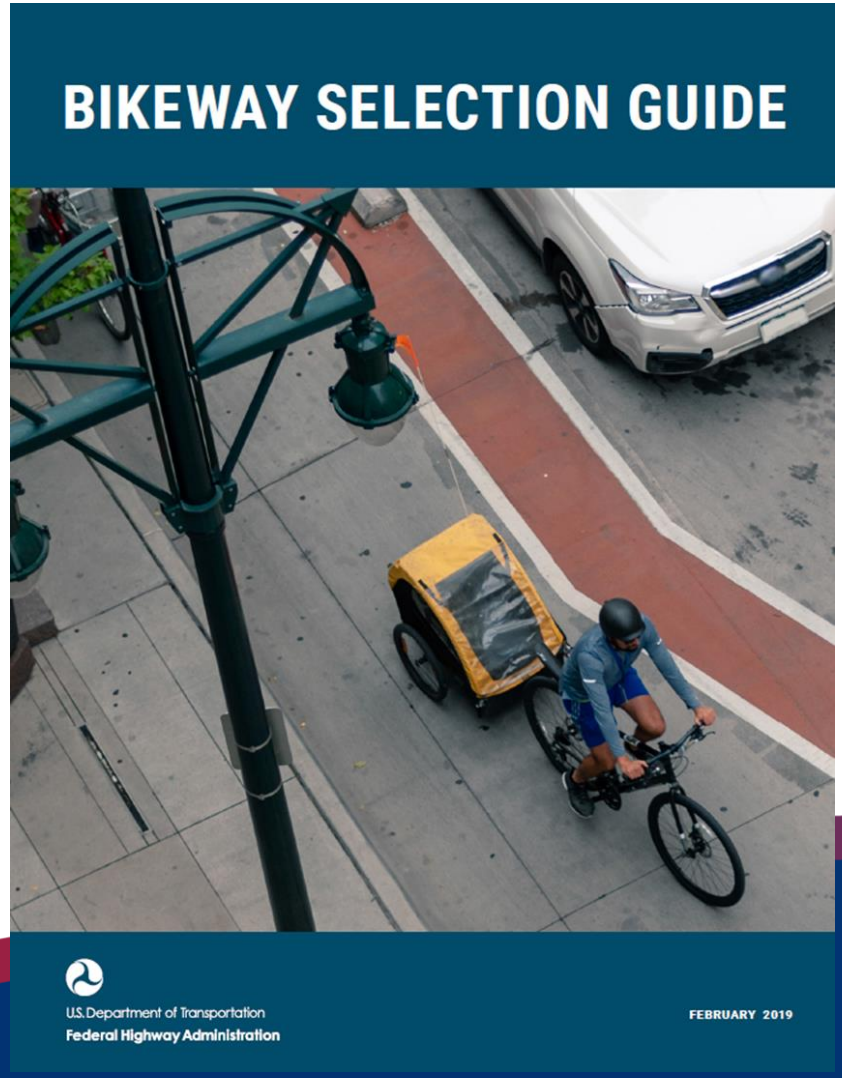
Tamara Redmon, FHWA

Lauren Blackburn, VHB

Bill Schultheiss, Toole Design Group

Project Goal

- To develop a new resource guide that will help **state and local agencies** identify the most appropriate types of bike facilities **per user and roadway characteristics**, as well as to provide **technical assistance** on use of the guide with pilot communities



Project Background and Objectives

- Existing guidance available for design of various bicycle facility types
- Recent focus on multimodal networks and connectivity
- Technical guidance needed for “protected intersections”
- Support and supplement to AASHTO Bike Guide update expected 2018

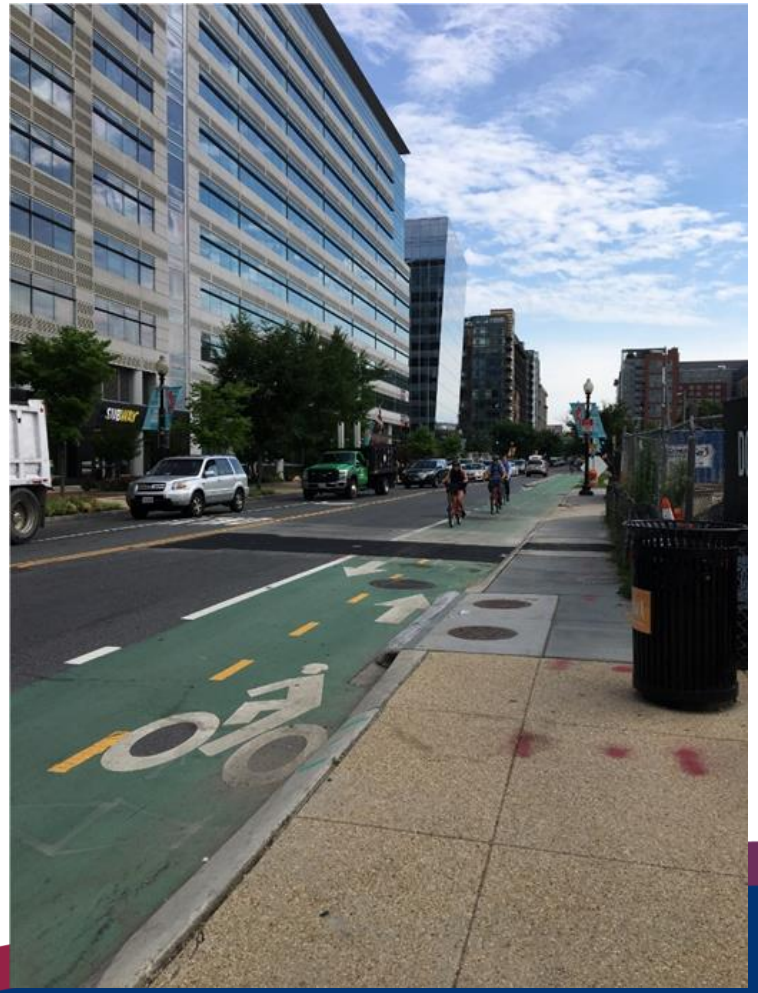
Bikeway Selection Guide

Provides detailed information about the key steps in the process, including:

- Establishing policies.
- Planning for connected, safe, and comfortable bicycle networks.
- Identifying projects and determining the purpose.
- Identifying the desired bikeway type.
- Assessing and refining the bikeway type.
- Evaluating feasibility.
- Selecting the preferred bikeway type.
- Establishing a parallel route if necessary.

Project Deliverables

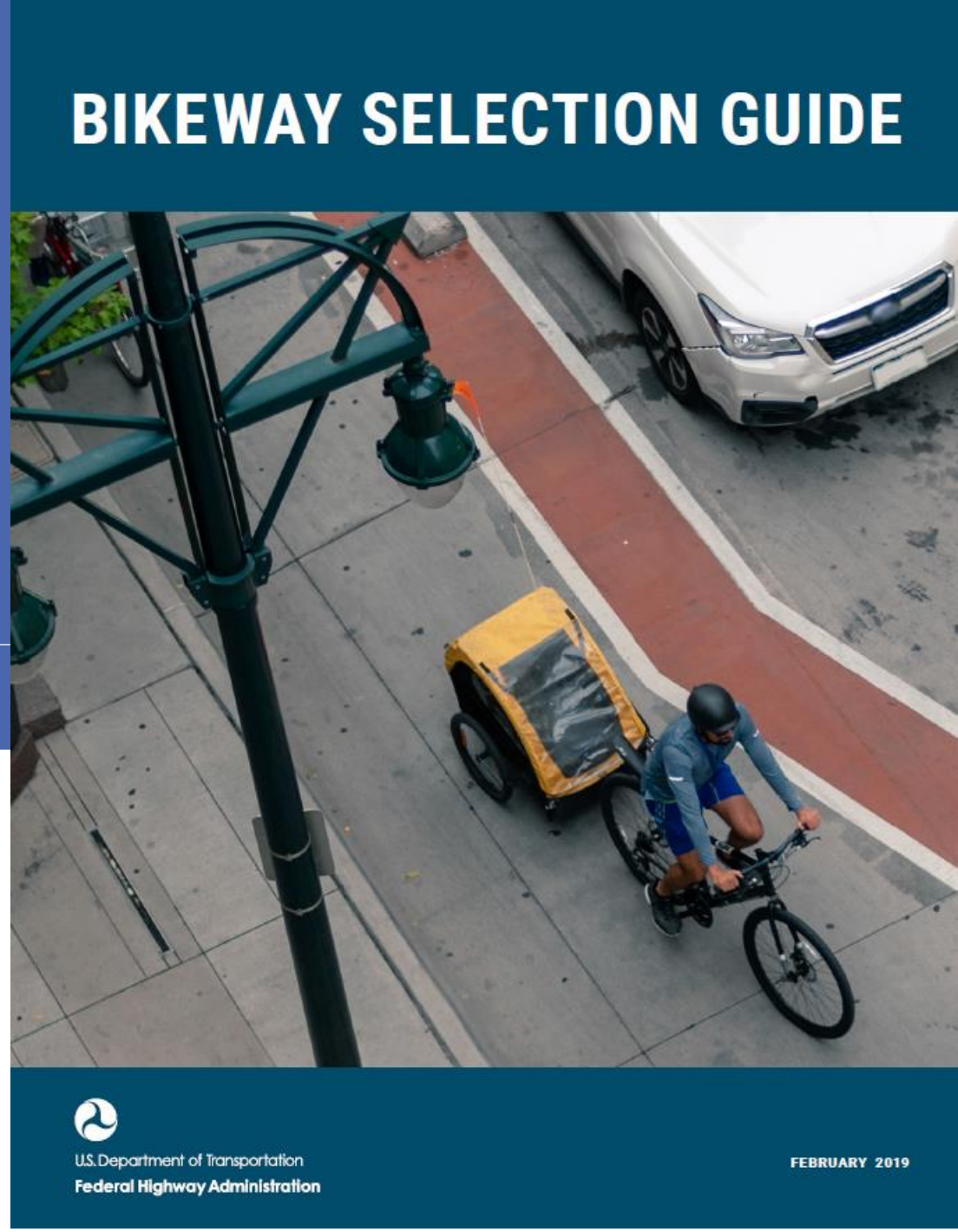
- Literature Review and Synthesis
- Bikeway Selection Guide
- Marketing Materials
- Instructional Materials and Training Events
- Technical Assistance



FHWA Bikeway Selection Guide

Bill Schultheiss, PE
Director of Sustainable Safety

U.S. Department of Transportation
Federal Highway Administration



Chapter 1: Introduction
Purpose of the Guide

This document **is a resource to help transportation practitioners consider and make informed trade-off decisions relating to the selection of bikeway types**. It is intended to supplement planning and engineering judgment. It incorporates and builds upon the Federal Highway Administration's (FHWA) support for design flexibility to assist transportation agencies in the development of connected, safe, and comfortable bicycle networks that meet the needs of people of all ages and abilities.

Chapter 1: Introduction
Purpose of the Guide

FHWA goals

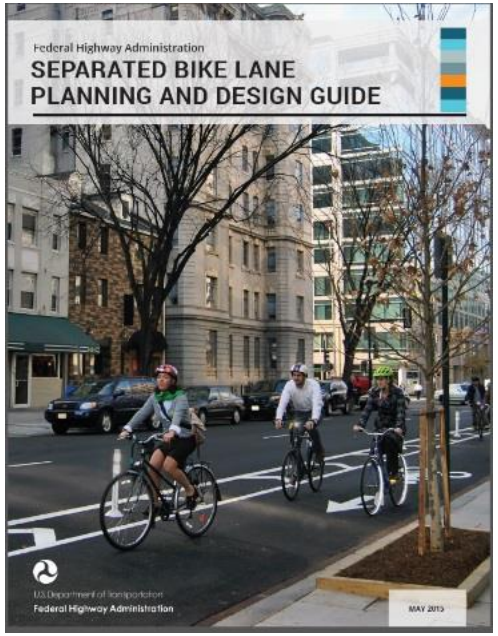
- Increase the number of short trips made by bicycling and walking to 30% by 2025
- Reduce pedestrian and bicyclist fatalities
  - by 80% in 15 years
  - to zero in 20 – 30 years

Disclaimer

This guide IS NOT A DESIGN GUIDE which provides dimensional guidance for bikeways. It's sole purpose is to help practitioners make informed decisions for selecting a bikeway.

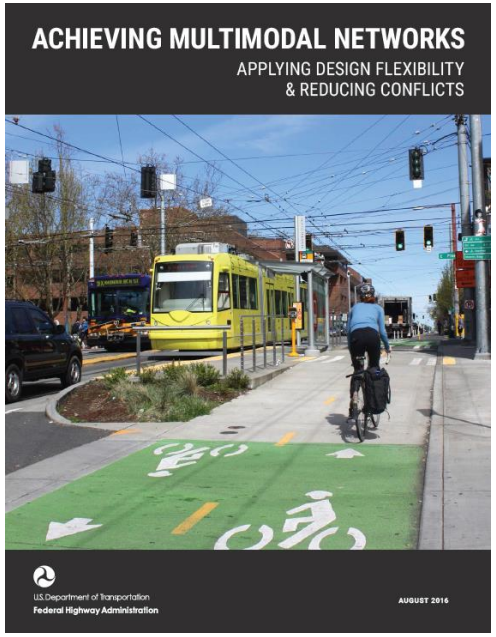
Design guidance for bikeways should be referenced from AASHTO, FHWA, MUTCD, and NACTO sources.

Chapter 1: Introduction
Bikeway Selection Guide Supports



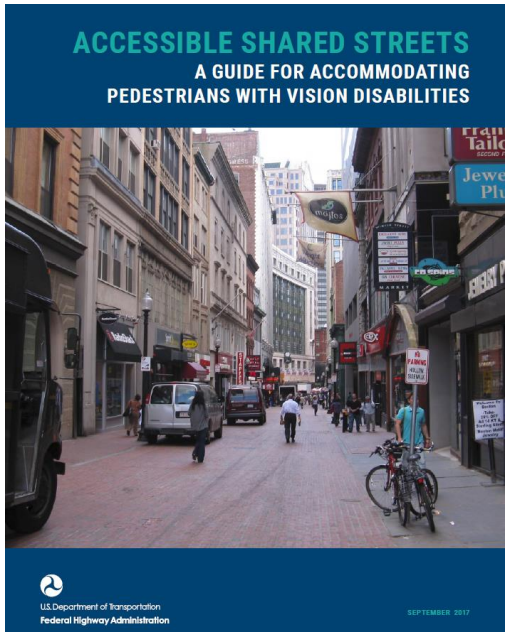
FHWA Separated Bike Lane Planning and Design Guide

May 2013

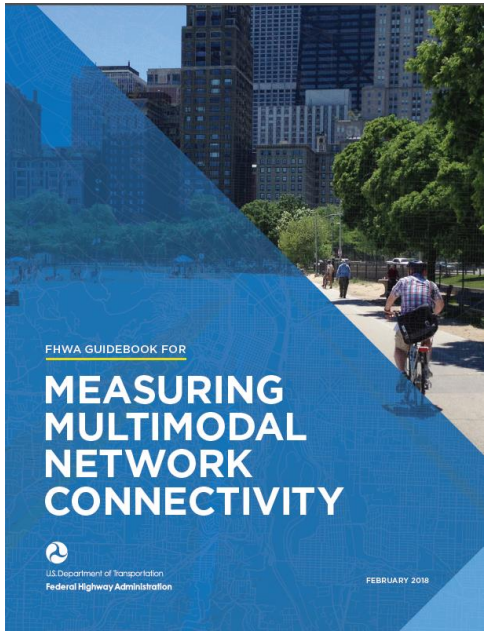


FHWA Achieving Multimodal Networks

August 2016



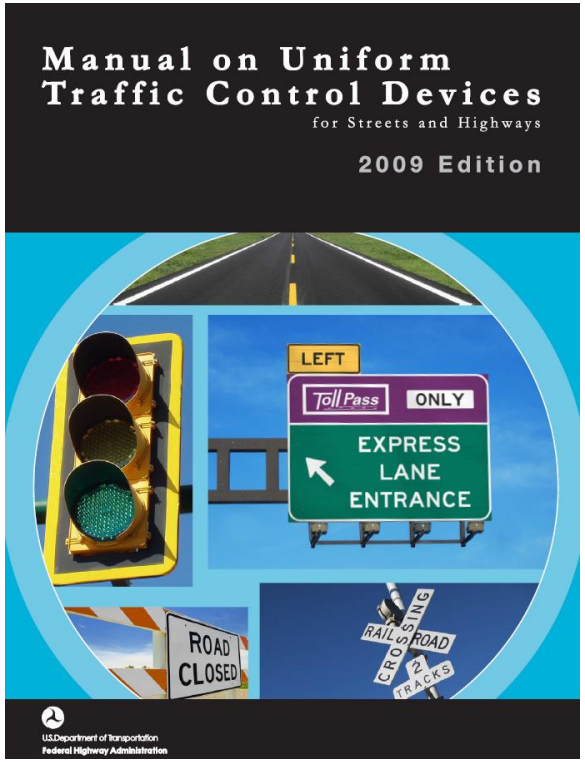
FHWA Accessible Shared Streets
September 2017



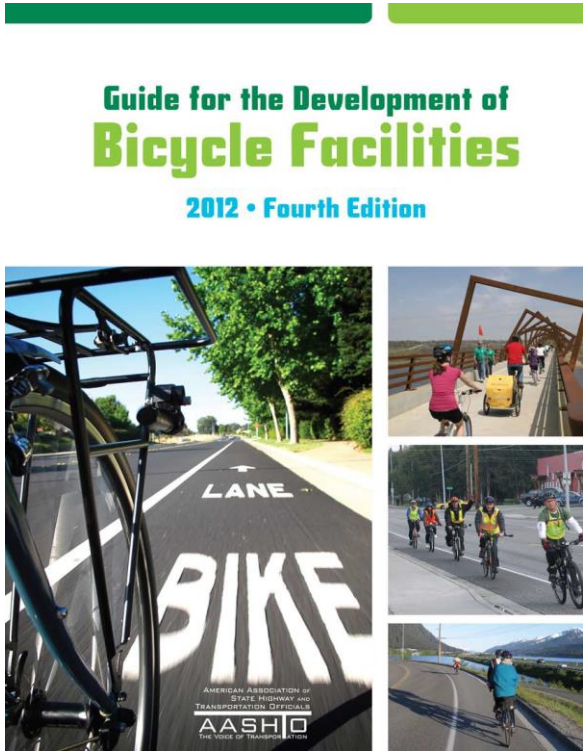
FHWA Measuring Multimodal Network Connectivity

February 2018

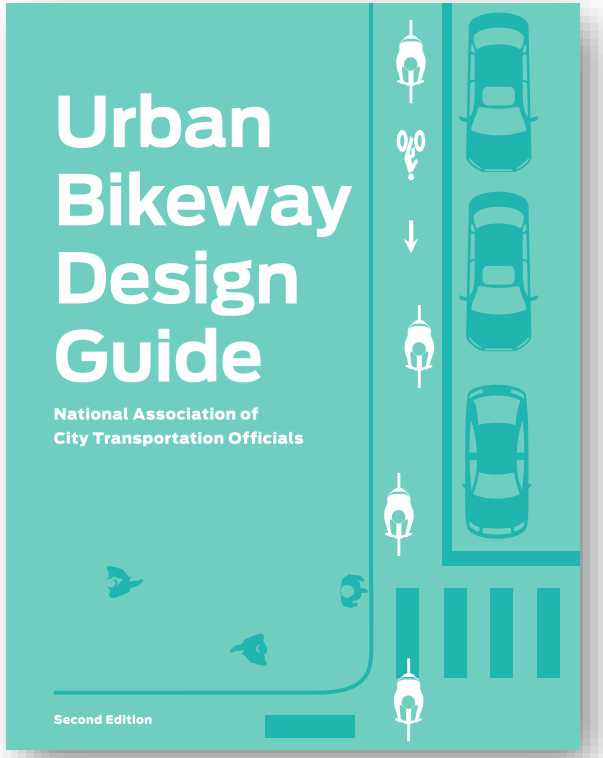
Chapter 1: Introduction
Bikeway Selection Guide Supports



FHWA



AASHTO
(under update)



NACTO & ITE

What is a “bikeway”?

Bikeway – A facility intended for bicycle travel which **designates space for bicyclists distinct from motor vehicle traffic**. A bikeway does not include shared lanes, sidewalks, signed routes, or shared lanes with shared lane markings, but does include bicycle boulevards.

1. Introduction

This document is a resource to help transportation practitioners consider and make informed trade-off decisions relating to the selection of bikeway types. It is intended to supplement planning and engineering judgment. It incorporates and builds upon the Federal Highway Administration's (FHWA) support for design flexibility to assist transportation agencies in the development of connected, safe, and comfortable bicycle networks that meet the needs of people of all ages and abilities.

This guide references existing national resources from FHWA, the American Association of State Highway and Transportation Officials (AASHTO), the National Association of City Transportation Officials (NACTO), the Institute of Transportation Engineers (ITE), and others. It is not intended to supplant existing design guides, but rather serve as a decision support tool. It points to relevant sources of design information and focuses on the following question:

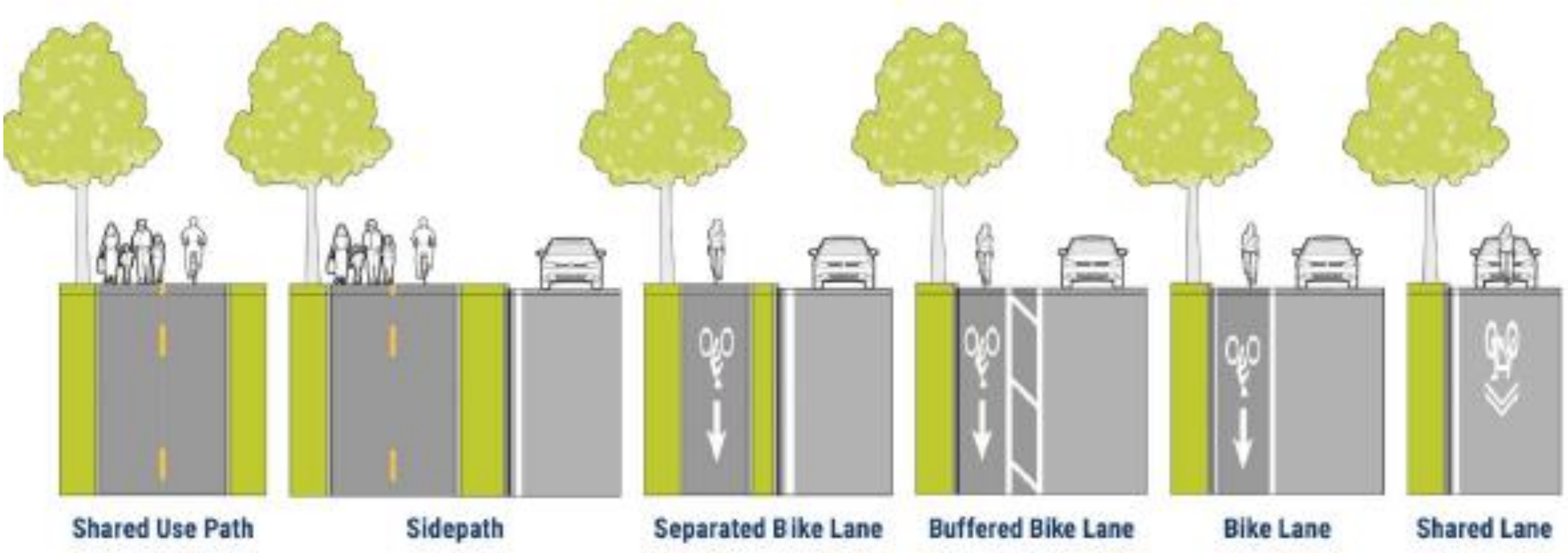
What type of bikeway[1] should be chosen on this particular street or in this plan given real-world context, constraints, and opportunities?

1 Bikeway – A facility intended for bicycle travel which designates space for bicyclists distinct from motor vehicle traffic. A bikeway does not include shared lanes, sidewalks, signed routes, or shared lanes with shared lane markings, but does include bicycle boulevards.

2

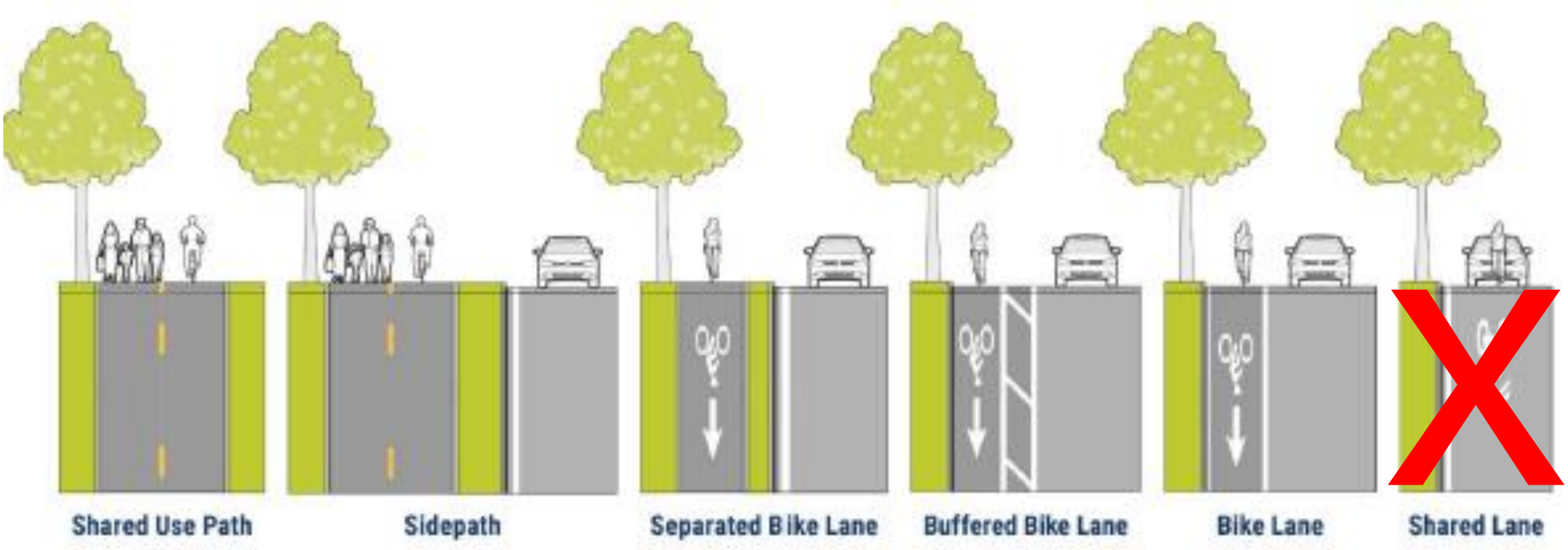
U.S. Department of Transportation
Federal Highway Administration

Bikeway Types



Graphic Source: Toole Design

Bikeway Types



Graphic Source: Toole Design

Shared lanes (even with sharrows) are not a bikeway

Bikeway Types

Bicycle Boulevards

Shared Streets with

- Low Volumes

  < 3,000 ADT

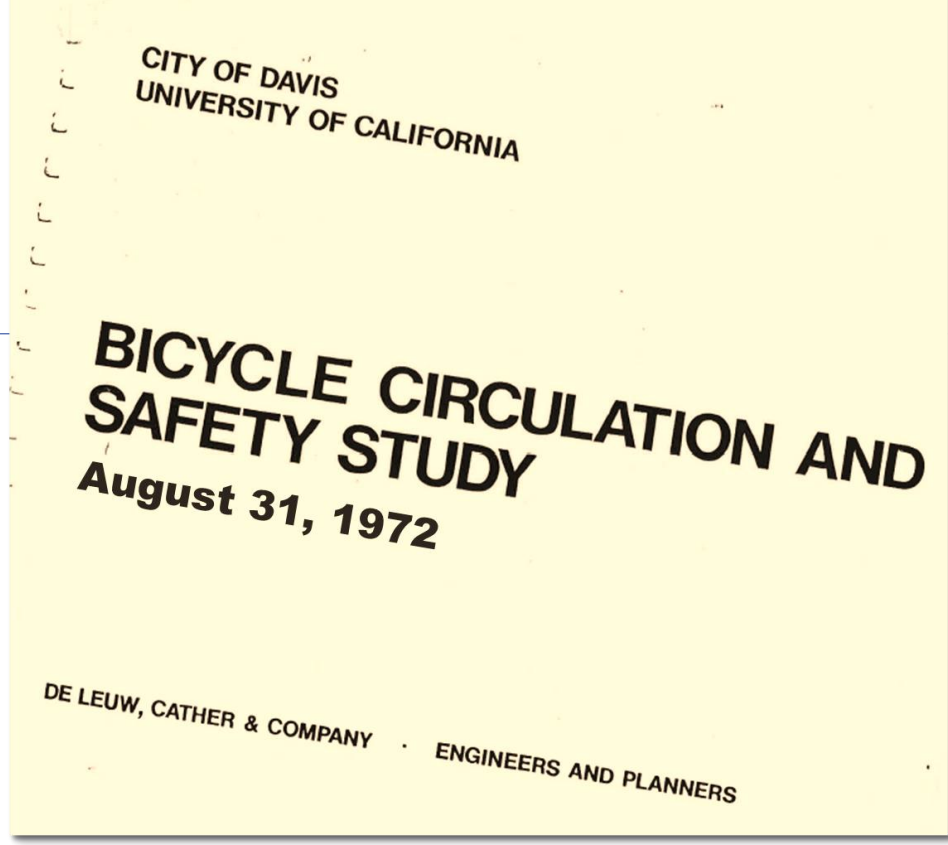
- Low Speeds

  < 25 mph

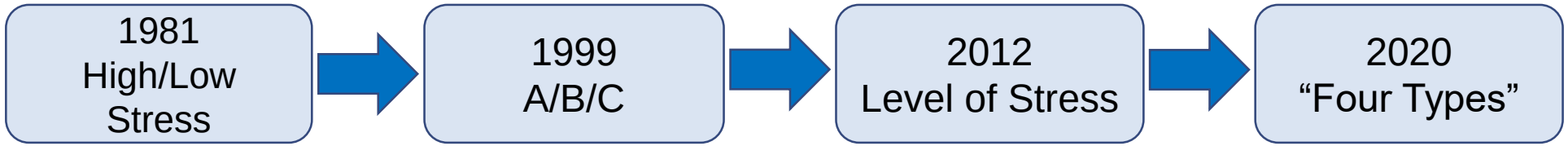
Graphic Source: NACTO

Literature Review

- Historical context of design guidance in the US
- Bicyclists typology (design user)
- Bikeway selection tools and decision matrices
- Safety of bikeways



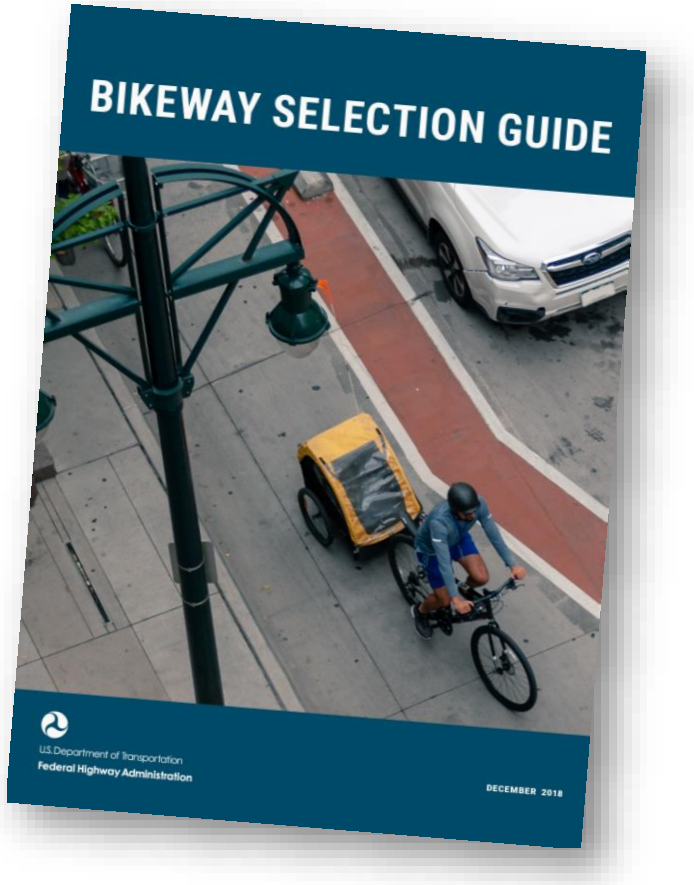
AASHTO Bicycle Guide Typology History



Literature Review Online:
https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/fhwasa18030.pdf

Chapter 2:
Bikeway Selection Process

- Policy
- Planning
- Selection
- Design



FHWA Bikeway Selection Process

Figure 1: **FHWA Bikeway Selection Process and Guide Outline**

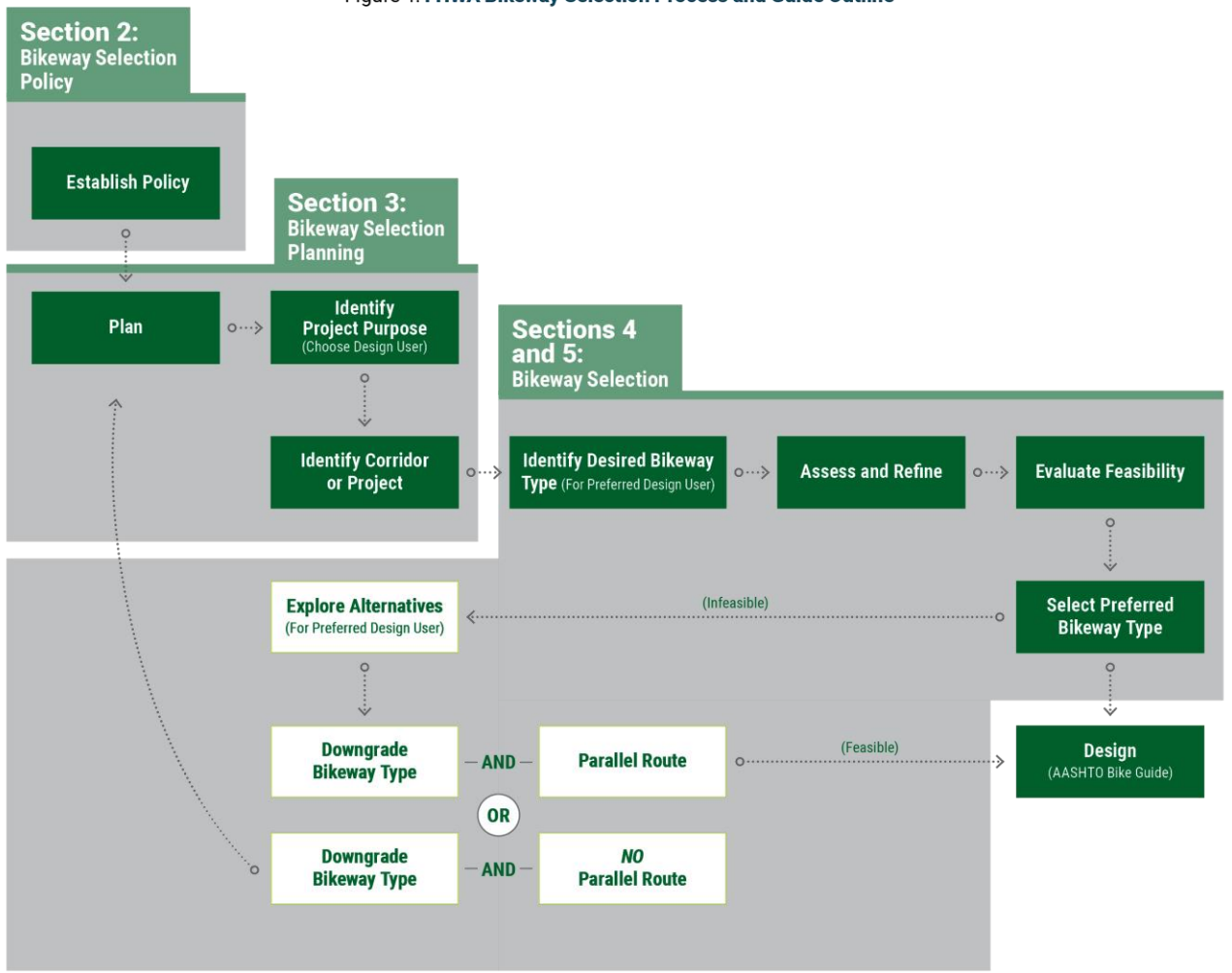
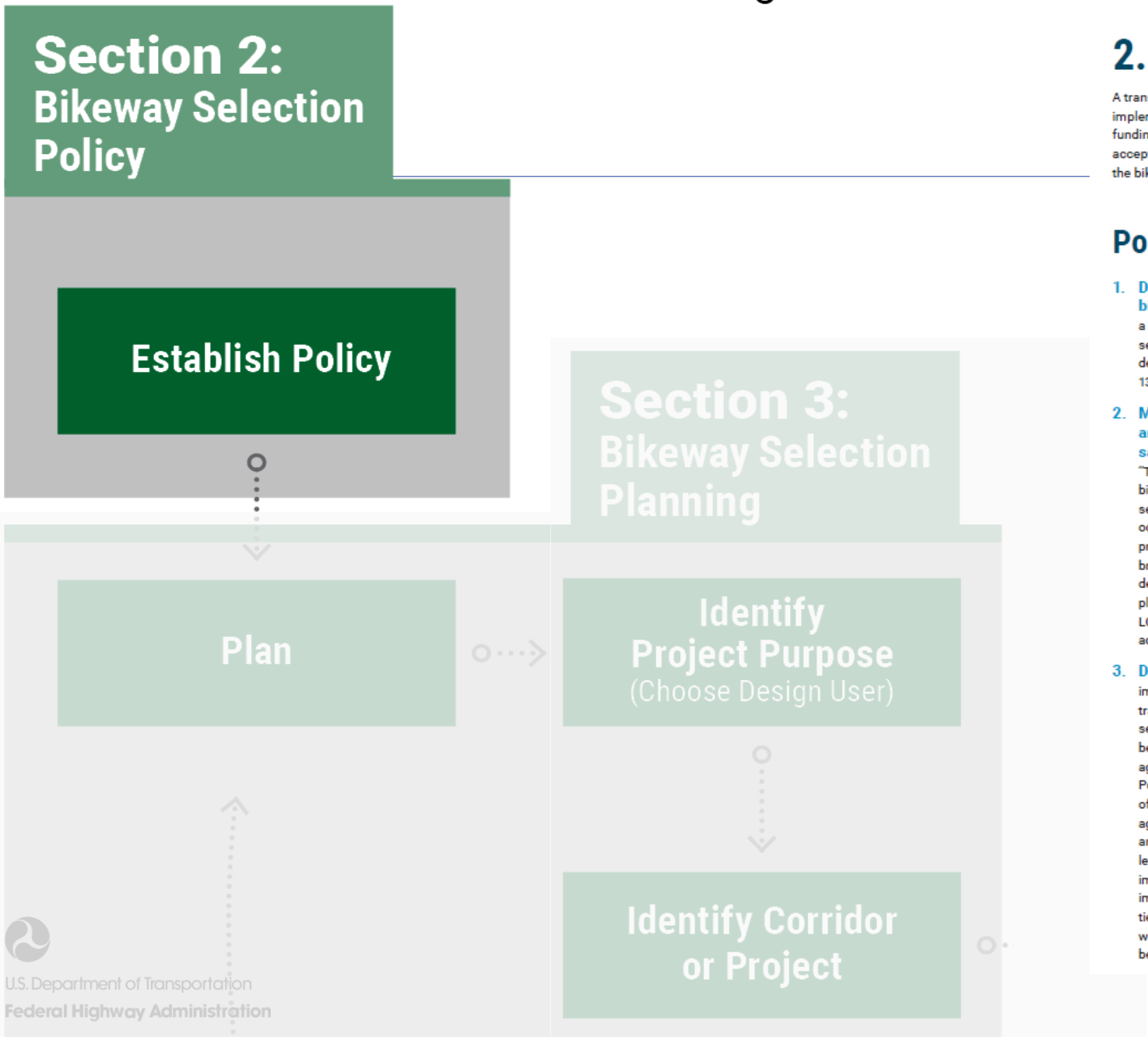


Figure 1: **FHWA**



2. Bikeway Selection Policy

A transportation agency's policies can help to define a vision for the transportation network. They can also support consistent implementation of projects that meet the needs of all users. Policies can address a broad range of topics, such as bikeway selection, funding, project development, planning, design, accessibility, and maintenance. Policies are also useful to guide and prioritize acceptable trade-offs. The following section highlights examples of how policies can provide context and serve as a framework for the bikeway planning and selection process.

Policies relating to bikeway selection can:

1. **Define specific goals and expectations for the bicycle network.** For example, an agency may establish a policy stating that the primary bicycle network should serve the "interested but concerned" user type and/or be designed to support a target bicycle mode share (see page 13).
2. **Make the linkage between bikeway selection and broader goals for multimodal access and safety.** Vision Zero policies and related "Road to Zero" or "Toward Zero Deaths" initiatives can specifically reference bikeway selection as a strategy for reducing fatalities and serious injuries. Policies can explain how bikeway selection occurs as part of all transportation activities and funding programs. They can also explain the relationship between broader goals for level of service (LOS) and the project's defined purpose. For example, as part of the long-range planning process, an agency can establish a desired LOS for bicyclists and identify the bikeway types that will achieve the desired LOS.
3. **Define the metrics for success.** Complete Streets implementation can be measured by how closely transportation projects match expectations for bikeway selection and achieve desired goals. These metrics can be included and updated in agency policy, and many agencies routinely report on progress toward these goals. Policies can direct the agency to track implementation of the bikeway network and preferred bikeway types. An agency can also evaluate outcomes according to safety and mobility metrics and describe the issues that may have led to a final decision. Tracking and reporting can identify improvements to the agency's bikeway selection policy or implementation strategies. Metrics of success should be tied to performance—instead of using miles of bikeways which may be disconnected, a more effective metric could be low-stress bikeway network connectivity.
4. **Provide a transparent framework for prioritizing and programming transportation projects, including specific bikeway types.** Policies can promote a transparent decision making process for prioritizing and funding transportation projects and bikeways.
5. **Define different planning contexts and design considerations used to select desired bikeways.** Roadways pass through a broad range of land use and development contexts, such as rural areas and urban centers. An agency's policies for bikeway selection can clearly describe planning context and highlight relevant factors such as topography, curbside uses, geographic distribution of destinations, local plans, and traffic characteristics. Policies can also address accessibility requirements and guidelines. For example, agency policy can demonstrate how people with disabilities will be able to cross a separated bike lane.
6. **Explain a preferred approach to design flexibility and experimentation when selecting bikeway types.** Projects often encounter constrained rights-of-way and other factors that influence the selection of a preferred bikeway type or an alternative. Policies can describe how strongly the agency will adhere to its bicycle network plan and to what extent the decision making process will grant exceptions to the preferred bikeway type.

Chapter 2:
Establish Bikeway Selection Policy

Define goals, expectations, and metrics for success

Tied to multimodal network standards

- E.g. Complete Streets, Sustainable Safety, Vision Zero

Transparent project prioritization

Project-level feasibility assessments

Proactively address maintenance

Chapter 2:
Establish Bikeway Selection Policy

Example: The Netherlands

The Dutch Approach to Safety and Bikeway Selection

Between the 1950s and 1970s, the Netherlands and the United States began an intense period of auto-centric planning. The resulting increases in motor vehicle travel led to a steady increase in transportation related fatalities. In 1972 transportation-related fatalities peaked in both countries. Improvements in roadway design, vehicle design, and medical care since the early 1970s have led to decreases in fatalities between 1972 and 2011, and between 1972 and 2017, as shown in Table 1 below.

The Most Effective Features of Sustainable Safety

The Dutch Sustainable Safety program includes traditional reactive strategies to address crashes that have occurred as well as efforts to improve vehicle design. The improved safety outcomes, however, are largely obtained by the preventative approach to roadway design which strives to prevent serious crashes, and where crashes do occur, to minimize the risk of severe injury. This approach assumes human error. This results in roadway design practices which strive to minimize situations where there are likely to be large differences in speed and mass operating together or at conflict points.

Table 1: Comparison of Transportation-Related Fatalities in the United States and the Netherlands, 1972 to 2017

	Fatalities (1972)	Fatalities (2011)	Fatalities (2017)
United States	54,589	32,367 (- 40.7%)	40,100 (- 26.6%)
Netherlands	3,506	661 (- 81.1%)	613 (- 82.5%)

Sustainable Safety Principles:

- Functionality
- Homogeneity
- Predictability
- **Forgiveness**
- State Awareness

Chapter 2:
Establish Bikeway Selection Policy

Example:

What is the opportunity?

- Resurfacing
- Reconstruction
- New Construction

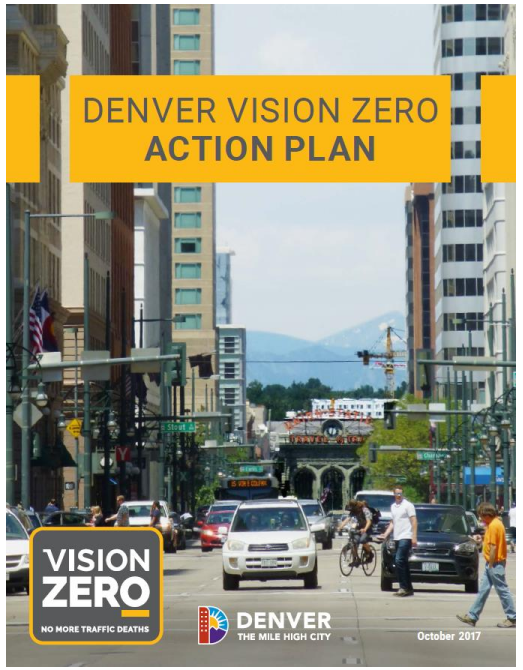
U.S. Department of Transportation
Federal Highway Administration

Chapter 2:
Establish Bikeway Selection Policy

Example:

Define specific goals and expectations for the bicycle network.

- Increase bicycling?
- Improve safety?



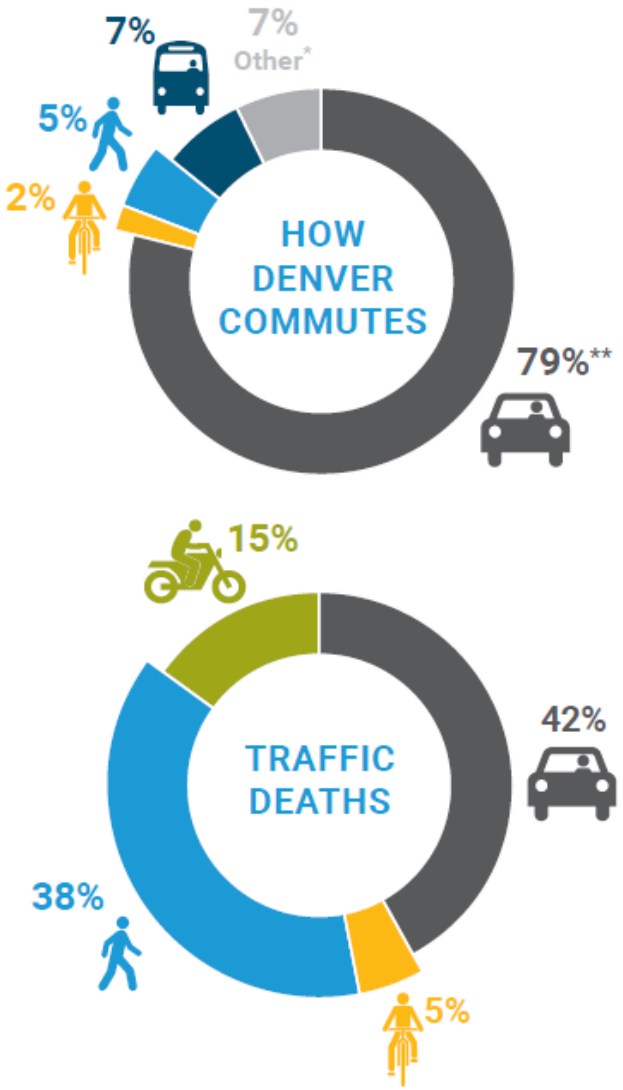
Reconfigure streets and intersections to improve safety and operations

Continue building the enhanced bikeway network and the amenities that support it (bicycle detection, parking), and phase implementation to ensure connectivity.

20 miles of bikeways/year

Graphic Source: City of Denver

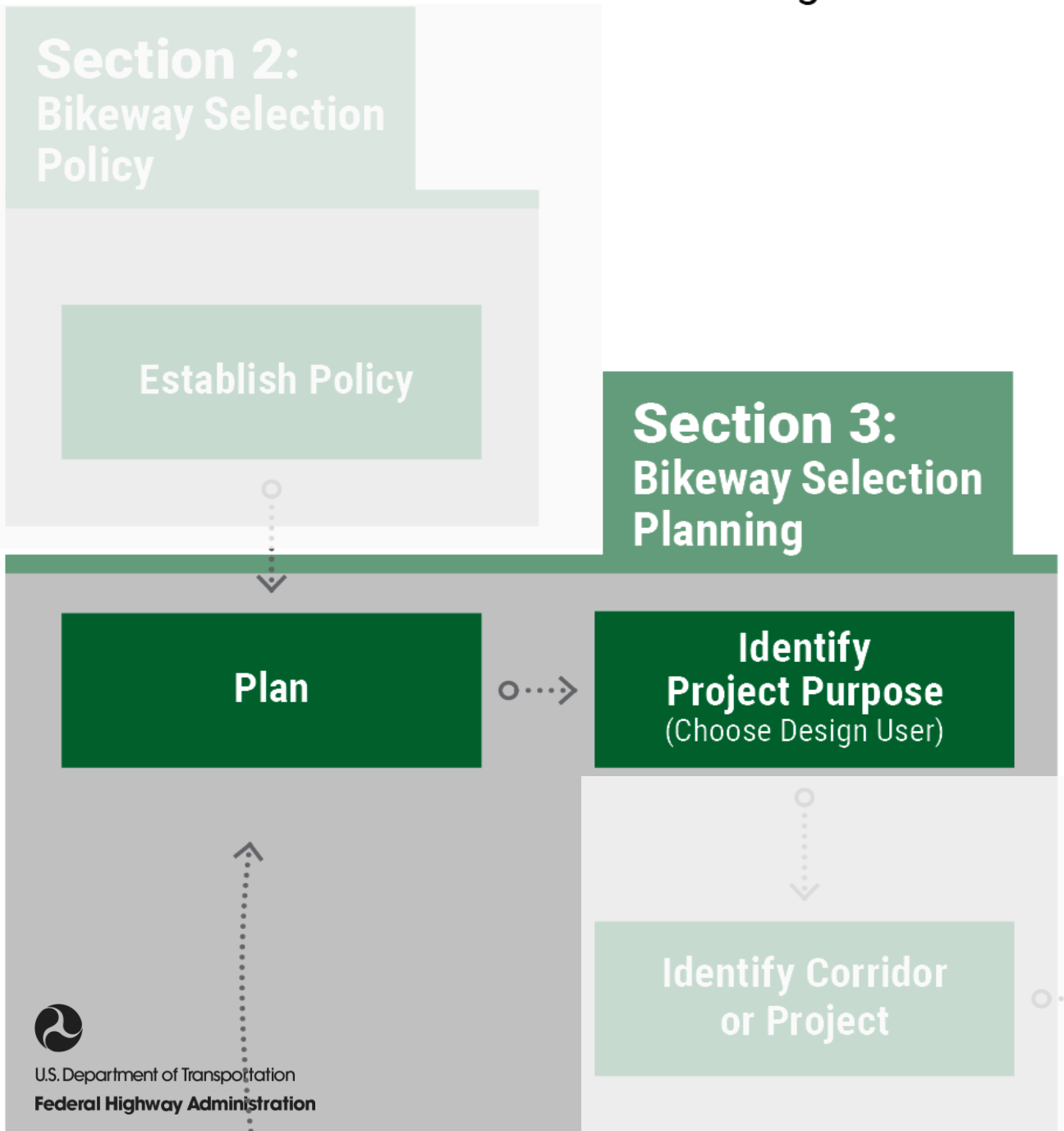
Figure 2: How Denver commutes versus Denver traffic deaths



* Includes motorcycle commuting
** Includes driving alone and carpooling

Source: U.S. Census Bureau (2011-2015); DPD (2011-2016)

Figure 1: **FHWA**



3. Bikeway Selection Planning

Bikeway type selection should not be done in isolation. The decision is part of a broader planning process that accounts for roadway and traffic characteristics of all modes, including freight, transit, personal vehicles, emergency access, bicyclists, and pedestrians. It includes community goals and priorities as well as public involvement and feedback from all parts of the community.

Vision

At the core of the planning process is a vision for a future bicycle network. The vision is developed through a planning process and is typically documented in a local, regional, or state plan. The vision describes desired future characteristics of and outcomes for bicycle transportation and typically defines, explicitly or implicitly, the target bicyclist design user type (as described on page 13).

The vision for the bike network can inform planning-related activities, such as decisions regarding where an agency chooses to pave shoulders and transportation recommendations in a small area plan. It should also be integrated into planning discussions about large scale transportation initiatives and plans for other types of networks, such as transit and freight.

To strengthen the vision, an agency may set it into policy. Agencies may consider adoption of the Safe Systems or Sustainable Safety policy, as described in the previous pages, which applies to all transportation decisions. In this case, the agency might prioritize the most vulnerable road users above other transportation objectives. These priorities inform the planned network and specific objectives for each transportation improvement project.

The Bicycle Network

A bicycle network is a seamless interconnected system of bikeways. The purpose and quality of the network depends on the assumptions, goals, and decisions made during the planning process. Networks should be thoughtfully planned to provide necessary and desired connections and access. The most successful bicycle networks enable people of all ages and abilities to safely and conveniently get where they want to go.

The bicycle network informs bikeway type selection by showing where higher quality facilities are needed the most. If a project is planned on a roadway that is a critical link in the bike network, including the appropriate bike infrastructure should be prioritized as a part of that project. A lower quality bikeway such as a regular bike lane on a busy suburban arterial road with high-speed traffic is a missed opportunity to build out a low-stress/high comfort bike network that serves a greater portion of the population. The opportunity to make a high-quality connection may not occur again for decades. While this bike lane may be an improvement over no bikeway facility, it will not be appealing for most people given the context.

Similarly, if a project is planned on a road that is not part of the bike network, a trade-off on the quality of the bike facility might be more acceptable (keeping in mind that bicyclists have a right to travel on all public roads, unless prohibited, whether or not a bicycle facility is present).

By influencing bikeway selection in this way, the planned bicycle network helps communities be strategic about investments and implementation, while also helping to balance competing network needs, such as for transit and freight. It helps agency staff and advocates set priorities by recognizing that every individual street or road does not serve the same role in the network and that some are more important than others. The network also helps to determine the extent to which a parallel route (described on page 34) is a feasible alternative.

Figure 3: Seven Principles of Bicycle Network Design

Chapter 3: Bikeway Selection Planning

Vision

The Bicycle Network

Target Design User

(Low-Stress Network)

Bikeway Types

Road Context

Project Type and Purpose

Bicycle Network Vision Statements

Massachusetts Department of Transportation Statewide Bike Plan Vision

Massachusetts' integrated and multimodal transportation system will provide a safe and well-connected bicycle network that will increase access for both transportation and recreational purposes. The Plan will advance bicycling statewide as a viable travel option - particularly for short trips of three miles or less - to the broadest base of users and free of geographic inequities.

Chapter 3:
The Bicycle Network

Seven Principles of Bicycle Network Design

Safety
The frequency and severity of crashes are minimized and conflicts with motor vehicles are limited

Comfort
Conditions do not deter bicycling due to stress, anxiety, or concerns over safety

Connectivity
All destinations can be accessed using the bicycling network and there are no gaps or missing links

Directness
Bicycling distances and trip times are minimized

Cohesion
Distances between parallel and intersecting bike routes are minimized

Attractiveness
Routes direct bicyclists through lively areas and personal safety is prioritized

Unbroken Flow
Stops, such as long waits at traffic lights, are limited and street lighting is consistent

Chapter 3:
The Bicycle Network - Design User

Key Principles

Safety
The frequency and severity of crashes are minimized and conflicts with motor vehicles are limited

Comfort
Conditions do not deter bicycling due to stress, anxiety, or concerns over safety

Connectivity
All destinations can be accessed using the bicycling network and there are no gaps or missing links

Directness
Bicycling distances and trip times are minimized

Cohesion
Distances between parallel and intersecting bike routes are minimized

Attractiveness
Routes direct bicyclists through lively areas and personal safety is prioritized

Unbroken Flow
Stops, such as long waits at traffic lights, are limited and street lighting is consistent

Chapter 3:
Bicycle Network – Design User

High Traffic Stress

Low Traffic Stress

Graphic Source: Toole Design

Interested but Concerned

51%-56% of the total population

Often not comfortable with bike lanes, may bike on sidewalks even if bike lanes are provided; prefer off-street or separated bicycle facilities or quiet or traffic-calmed residential roads. May not bike at all if bicycle facilities do not meet needs for perceived comfort.

Somewhat Confident

5-9% of the total population

Generally prefer more separated facilities, but are comfortable riding in bicycle lanes or on paved shoulders if need be.

Highly Confident

4-7% of the total population

Comfortable riding with traffic; will use roads without bike lanes.

LOW STRESS TOLERANCE

HIGH STRESS TOLERANCE

Target Design User

U.S. Department of Transportation
Federal Highway Administration

Source: Dill, J., McNeil, N. (2012). Four Types of Cyclists? Examining a Typology to Better Understand Bicycling Behavior and Potential.

Chapter 3:
The Bicycle Network - Form

Safety
The frequency and severity of crashes are minimized and conflicts with motor vehicles are limited

Comfort
Conditions do not deter bicycling due to stress, anxiety, or concerns over safety

Connectivity
All destinations can be accessed using the bicycling network and there are no gaps or missing links

Key Principles

Directness
Bicycling distances and trip times are minimized

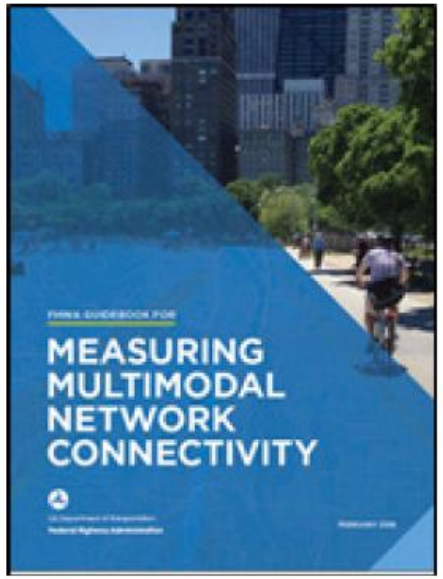
Cohesion
Distances between parallel and intersecting bike routes are minimized

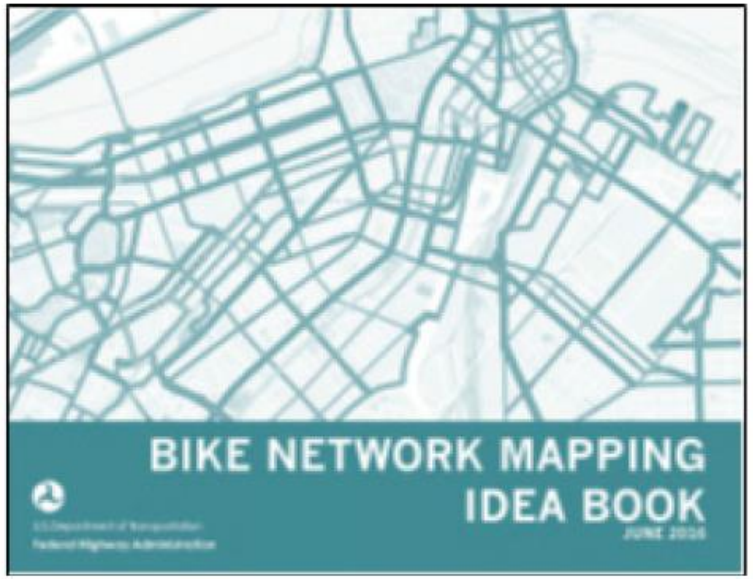
Attractiveness
Routes direct bicyclists through lively areas and personal safety is prioritized

Unbroken Flow
Stops, such as long waits at traffic lights, are limited and street lighting is consistent

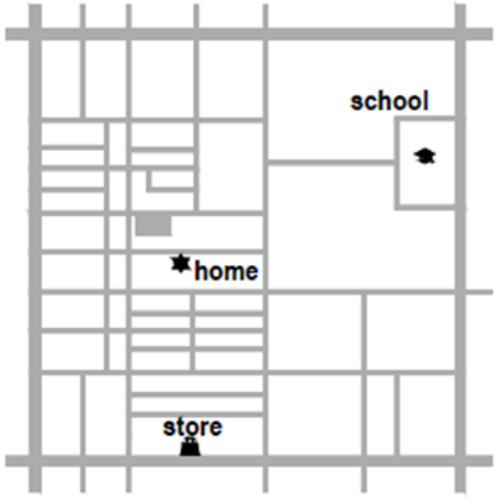
Chapter 3:
The Bicycle Network - Form

Figure 4: National Bike Network Resources

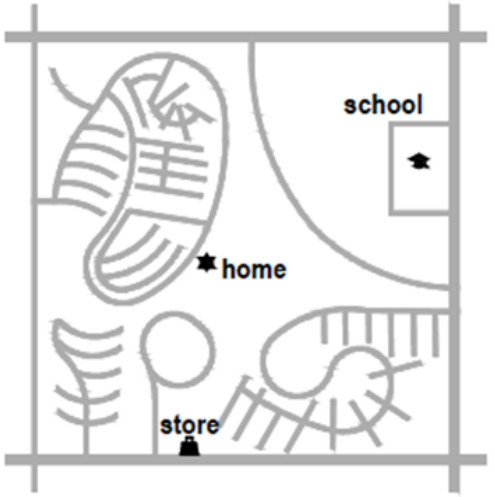




Source: Federal Highway Administration and Pedestrian and Bicycle Information Center



Good Road Network Connectivity



Poor Road Network Connectivity

Graphic Source:
Toole Design

Chapter 3:
Network Form and Target Design User

Graphic Source: Toole Design

Low-Stress Bicycle Network - is designed to be safe and comfortable for all users. These support All Ages and Abilities (≈ 72% of public)

Basic Bikeway Network - consist primarily of bicycle lanes and shoulders. These networks support Highly Confident Bicyclists and some Somewhat Confident Bicyclists (≈ 16%)

Traffic Tolerant Network - all roads and paths on which bicycling is legally allowed. These networks support Highly Confident Bicyclists (≈ 4%)

Example: Bike Plan

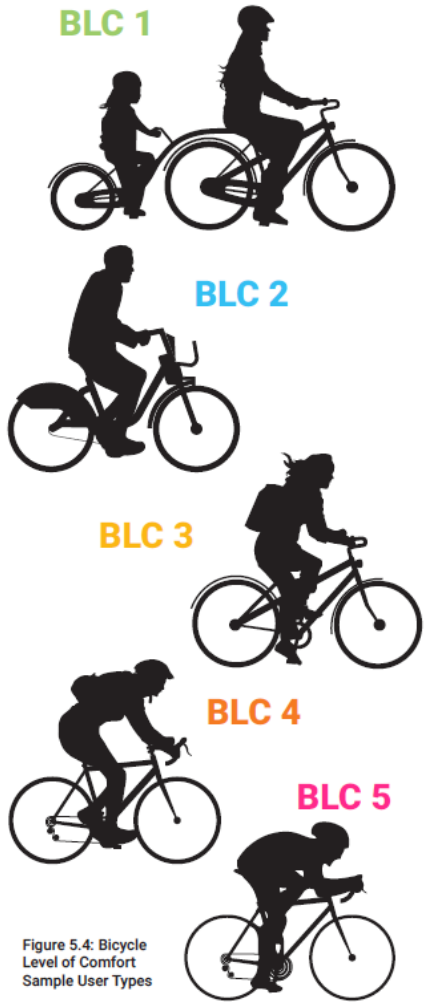


Figure 5.4: Bicycle Level of Comfort Sample User Types

Figure 5.5: Bicycle Level of Comfort Analysis: BLC 1-5

U.S. Department of Transportation
Federal Highway Administration

Graphic Source: City of Cambridge

Example: Bike Plan

LEGEND

bicycle accommodations

- off-street path
- separated bike facility
- lower volume and/or speed
- existing facility not in priority bicycle network

Goal: Low-Stress Bicycle Network

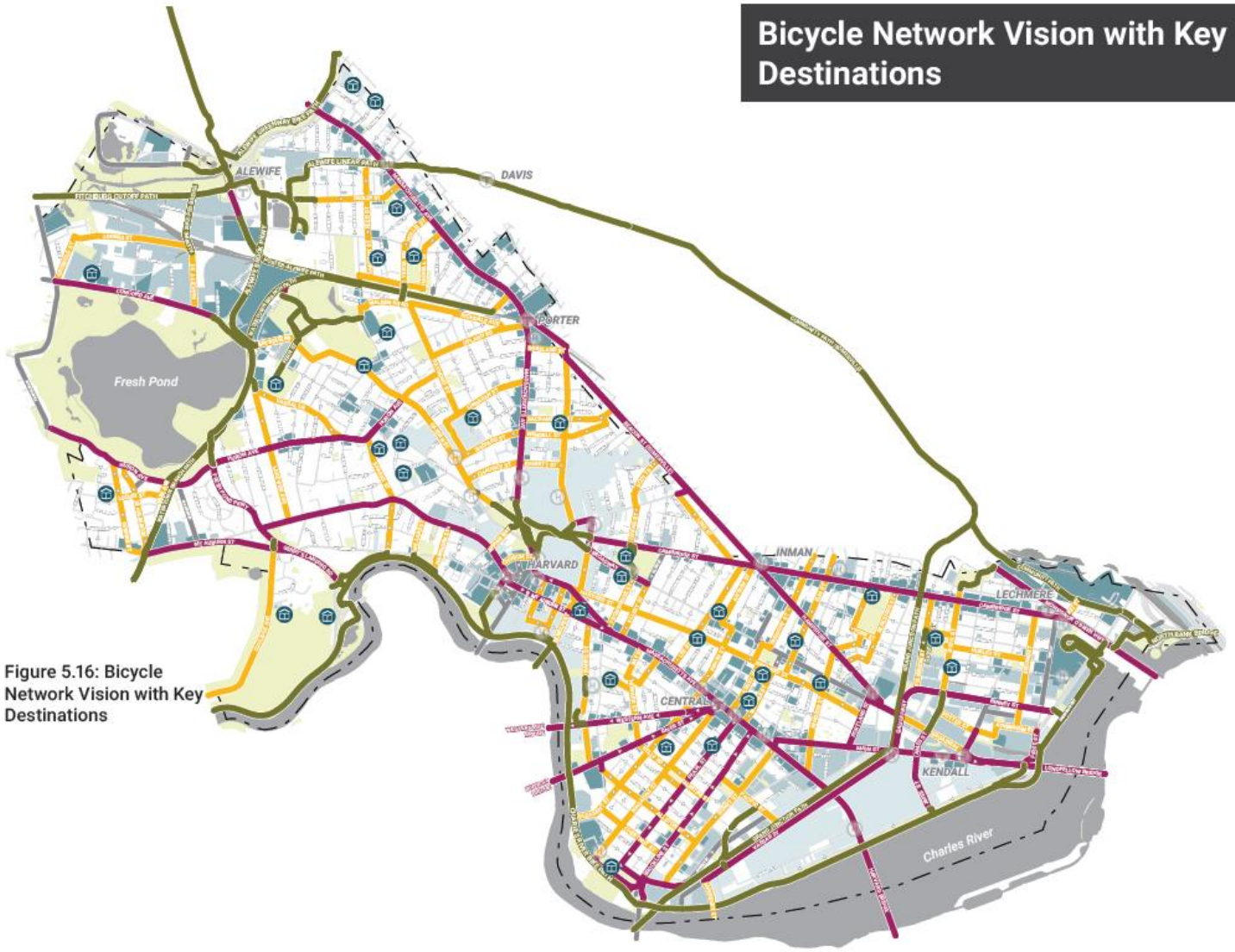


Figure 5.16: Bicycle Network Vision with Key Destinations

U.S. Department of Transportation
Federal Highway Administration

Graphic Source: City of Cambridge

Chapter 3: Bikeway Selection Considering Intersection Performance Characteristics

Literature Review:

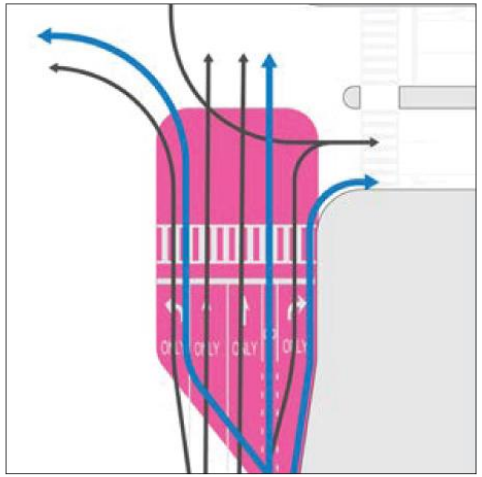
Resource Guide for Separating Bicyclists from Traffic

https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/fhwasa18030.pdf

Forgiveness (Safety) - Infrastructure can be designed to accommodate human error	Shared Lanes	Boulevards	Shoulders	Bike Lanes	One-Way Separated Bike Lanes with Mixing Zones	Separated Bike Lanes and Sidepaths with Protected Intersections
Relies upon perfect user (driver and bicyclist) behavior to avoid crashes	✓	✓	✓	✓		
Minimal: bicyclists operating in shared space with vehicles	✓					
Moderate: application of traffic calming treatments and lower operating speeds can improve safety		✓				
Moderate: bicyclists operate in separated space from vehicles, however vehicles can encroach into the facility at any location			✓	✓		
Moderate: bicyclists operate in separated space from vehicles except for defined entry point, followed by shared operating space					✓	
High: bicyclists operate in separated space from vehicles except for defined conflict point which can be designed to reduce motorist speed, but contraflow movement from two-way operation can increase risk						✓

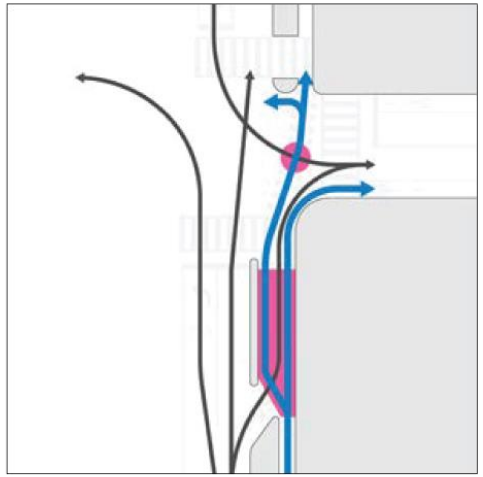
Chapter 3:
Bikeway Types – Traffic Stress/Conflicts/Forgiveness

Exposure Level:
High



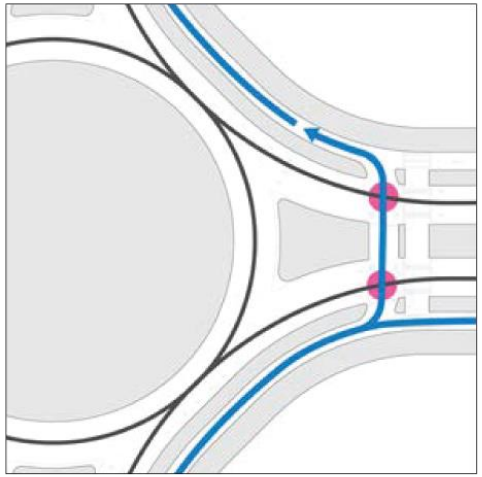
CONVENTIONAL BIKE LANES AND SHARED LANES

Exposure Level:
High to Medium



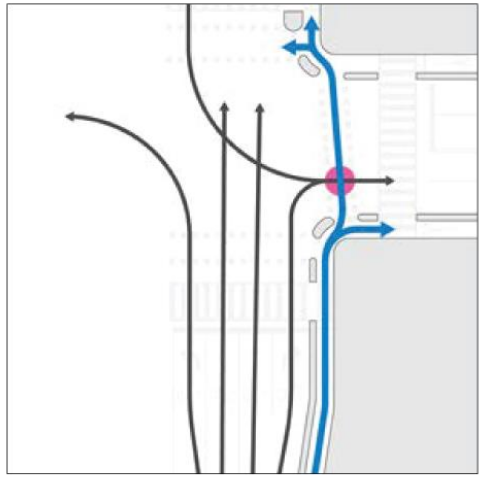
SEPARATED BIKE LANES WITH MIXING ZONES

Exposure Level:
Medium to Low



SEPARATED BIKE LANES THROUGH ROUNDABOUTS

Exposure Level:
Low



PROTECTED INTERSECTIONS

bicycle
motor vehicle
conflict area

Source: MassDOT Separated Bike Lane Planning & Design Guide

Chapter 3: Bikeway Selection Considering Intersection Performance Characteristics

Literature Review:

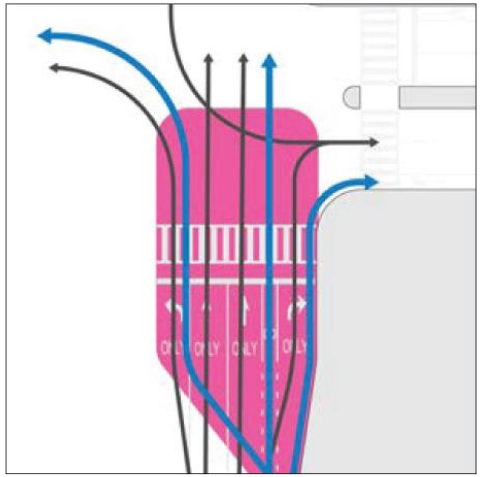
Resource Guide for Separating Bicyclists from Traffic

https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/fhwasa18030.pdf

Key Crash Types Associated with Bikeway Type	Shared Lanes	Boulevards	Shoulders	Bike Lanes	One-Way Separated Bike Lanes with Mixing Zones	Separated Bike Lanes and Sidepaths with Protected Intersections
Right and left hooks	✓	✓	✓	✓	✓	✓
Sideswipes	✓	✓	✓	✓		
Overtaking	✓	✓	✓	✓		
Hit from behind	✓	✓	✓	✓		
Merging	✓	✓	✓	✓	✓	
Failure to yield at conflict point	✓	✓	✓	✓	✓	✓

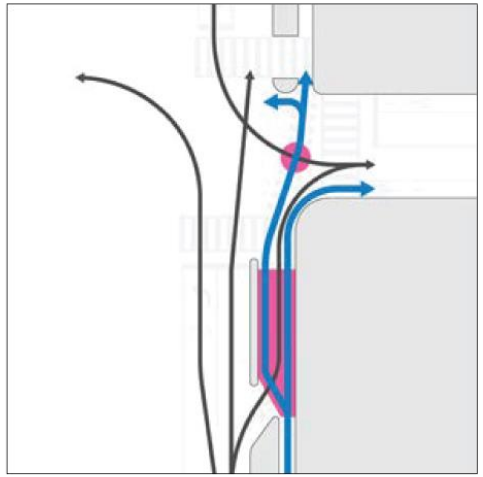
Chapter 3:
Bikeway Types – Traffic Stress/Conflicts/Forgiveness

Exposure Level:
High



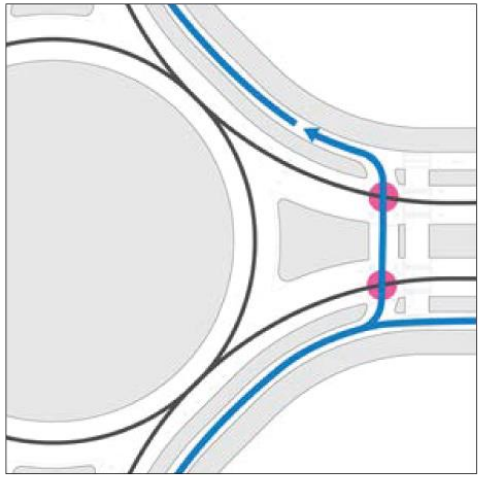
CONVENTIONAL BIKE LANES AND SHARED LANES

Exposure Level:
High to Medium



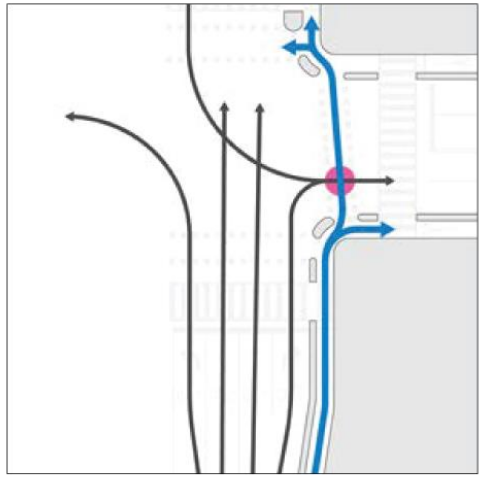
SEPARATED BIKE LANES WITH MIXING ZONES

Exposure Level:
Medium to Low



SEPARATED BIKE LANES THROUGH ROUNDABOUTS

Exposure Level:
Low



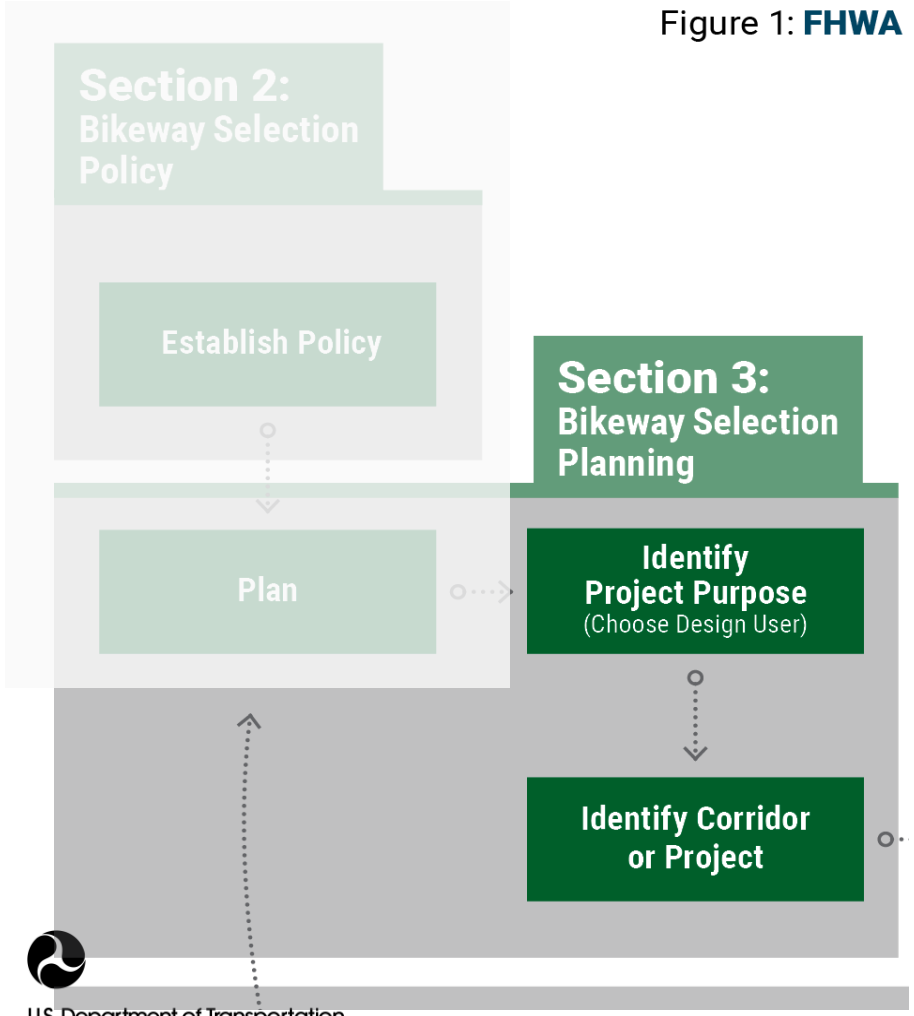
PROTECTED INTERSECTIONS

bicycle
motor vehicle
conflict area

Source: MassDOT Separated Bike Lane Planning & Design Guide

Chapter 3: Bikeway Selection at the Corridor Level

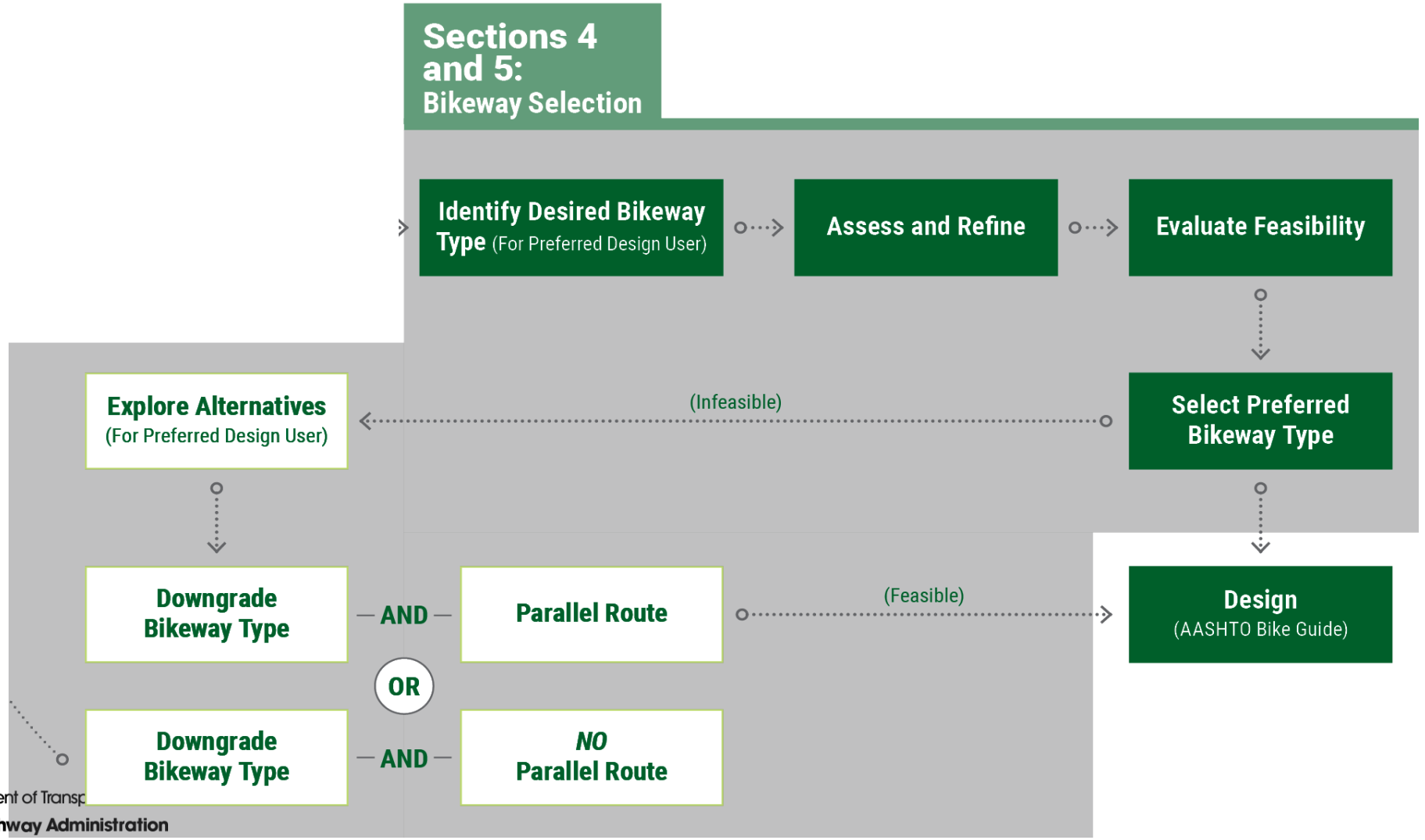
Figure 1: **FHWA**



Factors that can inform the identification of a specific project include:

- Project Limits
- **Project Type**
  - **New construction**
  - **Reconstruction (curb changes)**
  - **Resurfacing or striping (no curb changes)**
- Land Use Context
- **Bicyclist Type**
- Key Safety and Performance Criteria

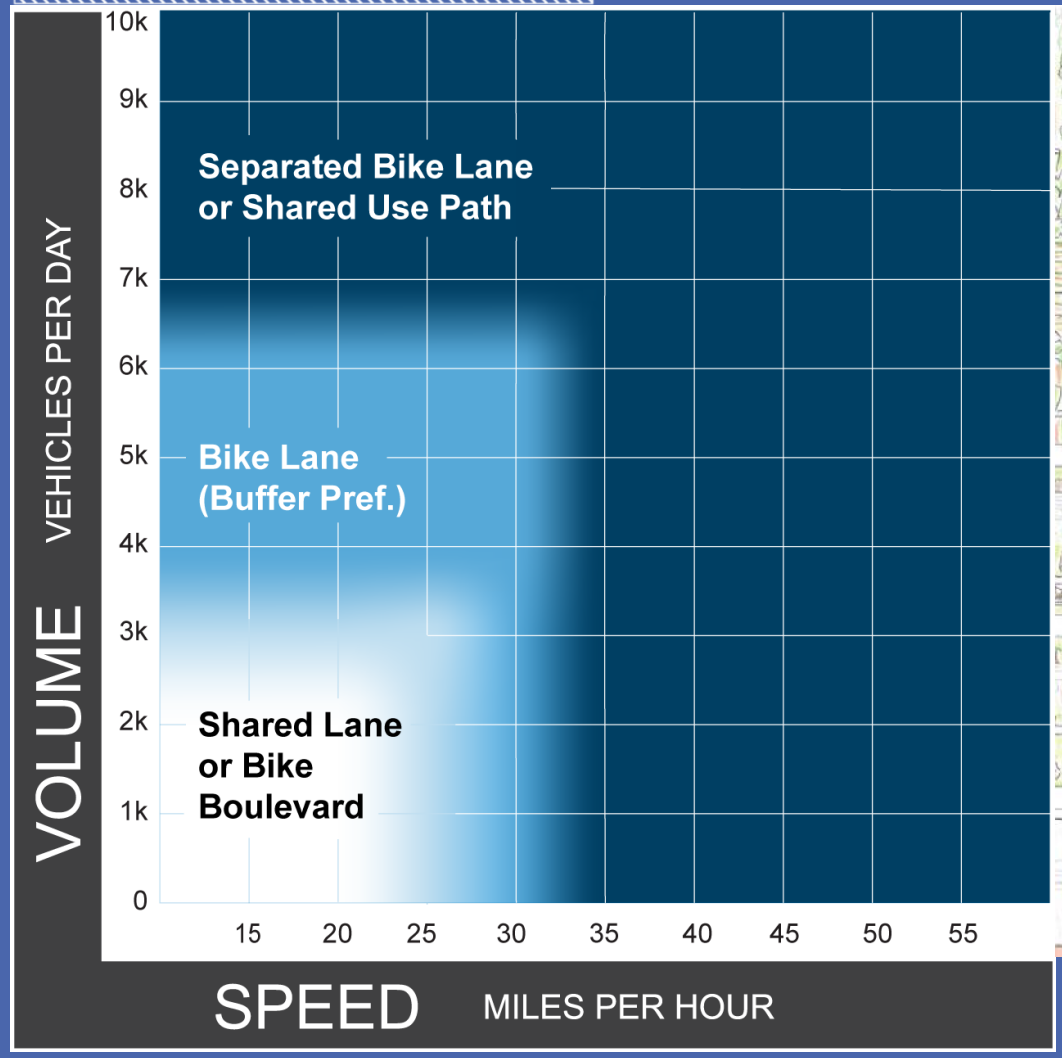
Chapter 4: Bikeway Selection
at the Corridor Level

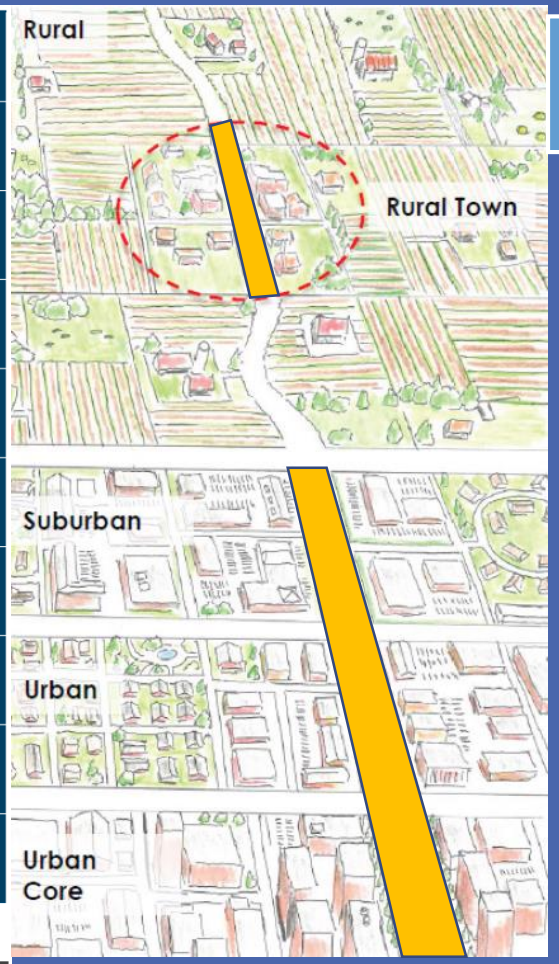


U.S. Department of Transp
Federal Highway Administration

Preferred Bikeway Type

Urban, Urban Core, Suburban, and Rural Town Contexts





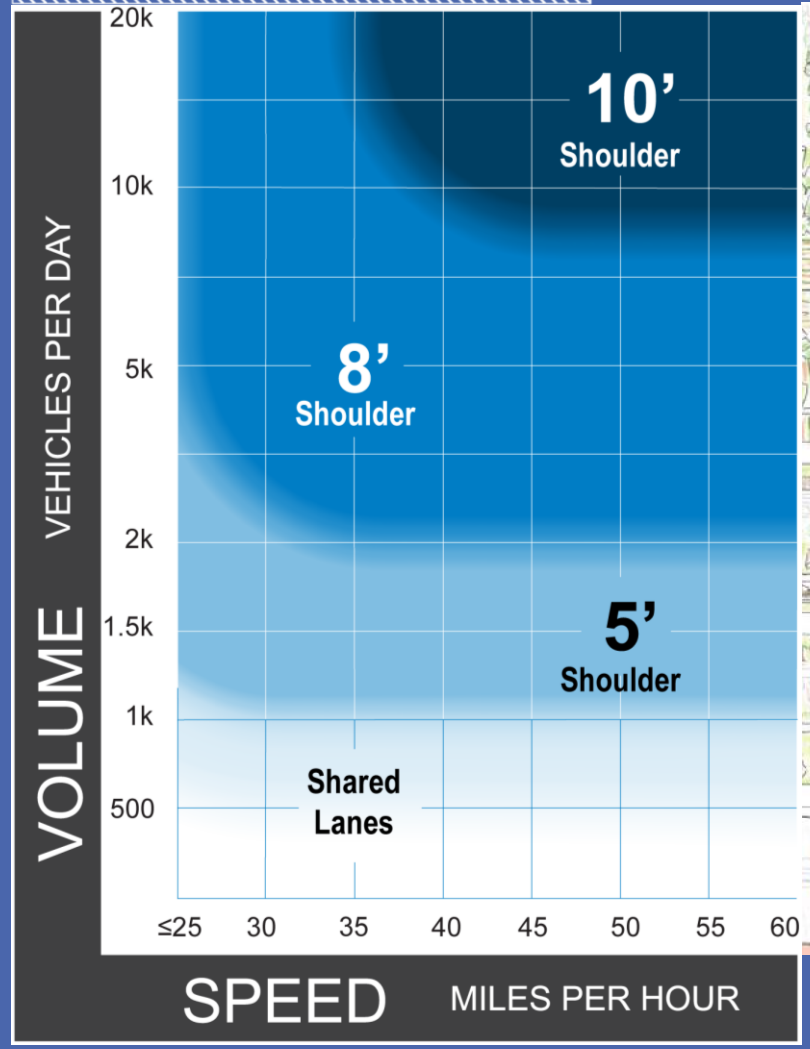
Design User Assumption = Interested But Concerned Bicyclist

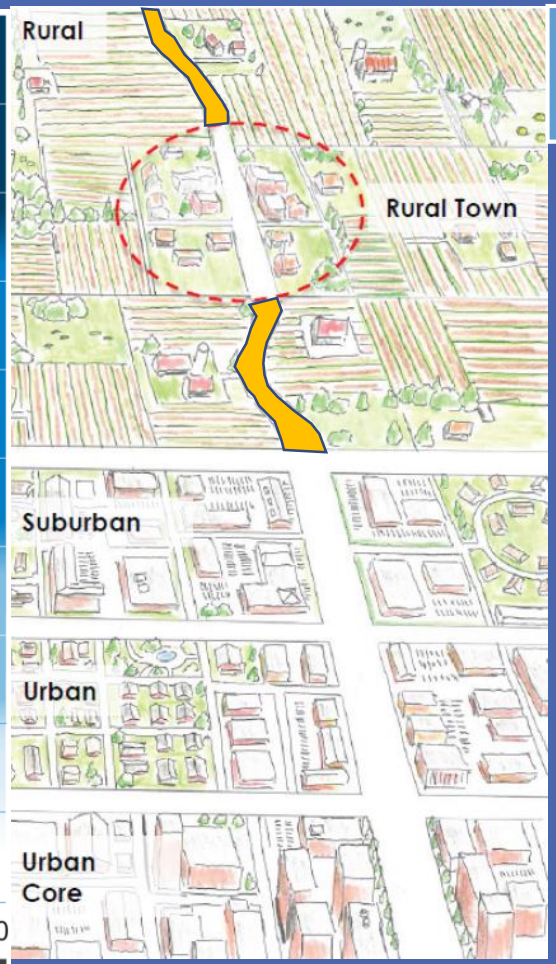
Notes

1. *Chart assumes operating speeds are similar to posted speeds. If they differ, use operating speed rather than posted speed.*
2. *Advisory bike lanes may be an option where traffic volume is <3K ADT.*
3. *See Section 4.4 for a discussion of alternatives if the preferred bikeway type is not feasible.*

Graphic Source: NCHRP 855

Preferred Bikeway Type
Rural Context





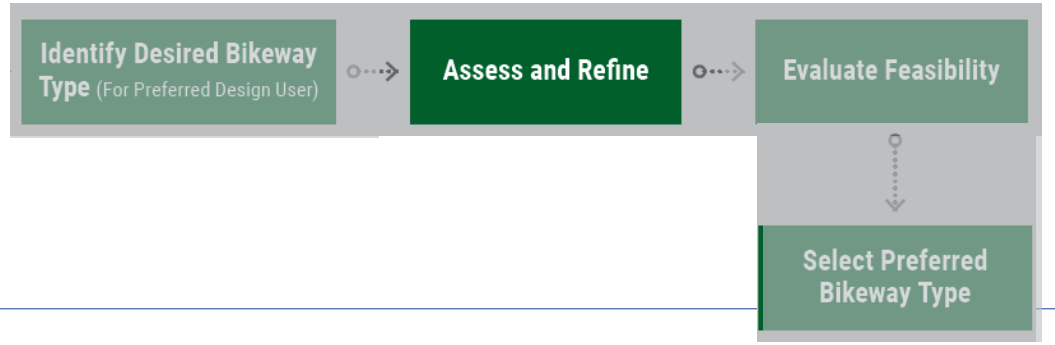
Design User Assumption = Confident Bicyclists

Notes

1. *This chart assumes the project involves reconstruction or retrofit in constrained conditions. For new construction, follow recommended shoulder widths in the AASHTO Green Book.*
2. *A separated shared use pathway is a suitable alternative to providing paved shoulders.*
3. *Chart assumes operating speeds are similar to posted speeds. If they differ, use operating speed rather than posted speed.*
4. *If the percentage of heavy vehicles is greater than 10%, consider providing a wider shoulder or a separated pathway.*

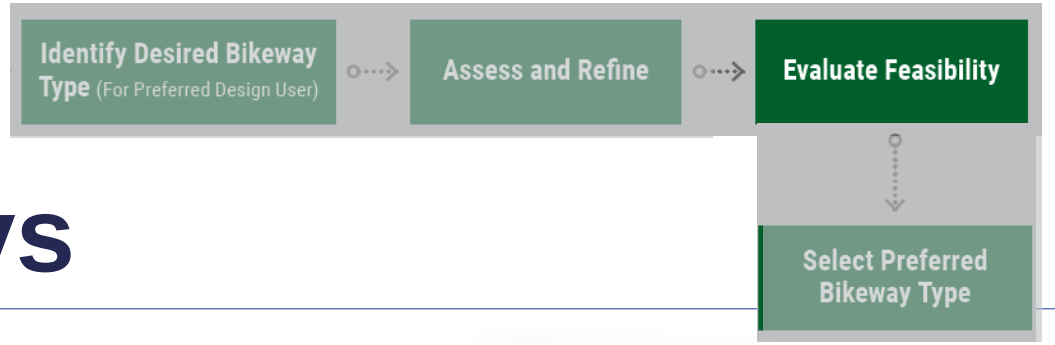
Graphic Source: NCHRP 855

Assessing and Refining the Desired Bikeway Type



- Motor Vehicle Peak Hour Volumes
- Traffic Vehicle Mix
- Curbside Activity (e.g. deliveries and parking turnover)
- Driveway and Intersection Frequency
- Direction of Operation
- Vulnerable Populations and Equity Considerations
- Network Connectivity Gaps
- Transit Considerations (first- and last-mile connections)

Evaluating Feasibility
Finding Space for Bikeways

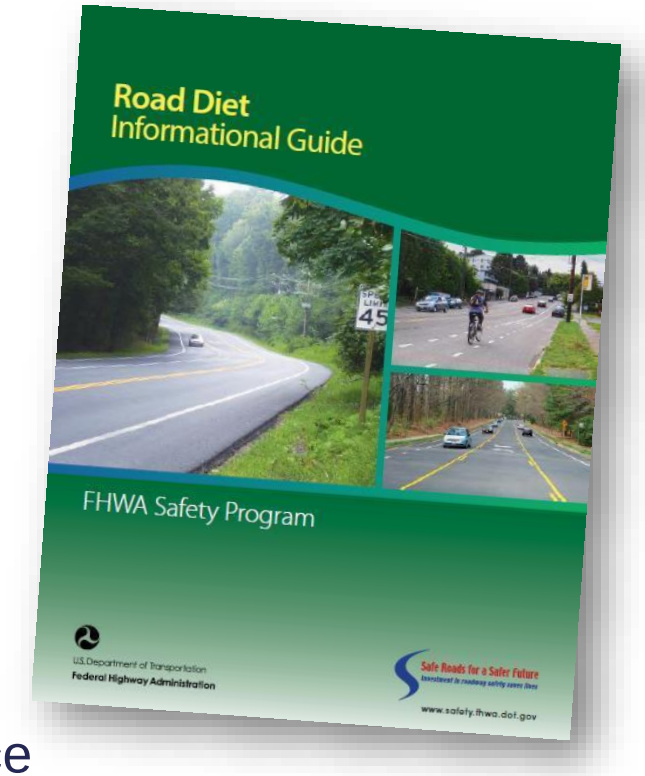


Project Type

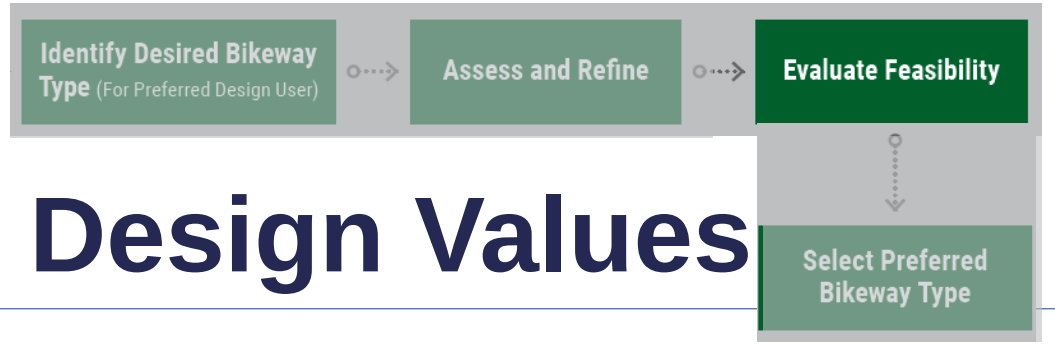
- New construction
- **Reconstruction (curb changes)**
- **Resurfacing or striping (no curb changes)**

Options for reallocating roadway space

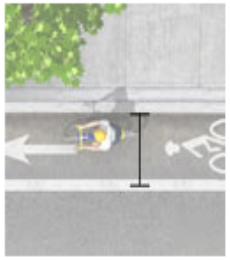
- Narrowing travel lanes
- Removing travel lanes
- One-way streets
- Reorganizing street space
- Changing street parking



Evaluating Feasibility
Assess Desirable Bikeway Design Values



Example for standard bicycle lanes from NACTO Urban Bikeway Guide:



The desirable bike lane width adjacent to a curbface is 6 feet. The desirable ridable surface adjacent to a street edge or longitudinal joint is 4 feet, with a minimum width of 3 feet. In cities where illegal parking in bike lanes is an concern, 5 foot wide bike lanes may be preferred. Read More+

Against Curb:

Desirable = 6’

Minimum = 4’

When placed adjacent to a parking lane, the desirable reach from the curb face to the edge of the bike lane (including the parking lane, bike lane, and optional buffer between them) is 14.5 feet; the absolute minimum reach is 12 feet. A bike lane next to a parking lane shall be at least 5 feet wide, unless there is a marked buffer between them. Wherever possible, minimize parking lane width in favor of increased bike lane width. Read More+

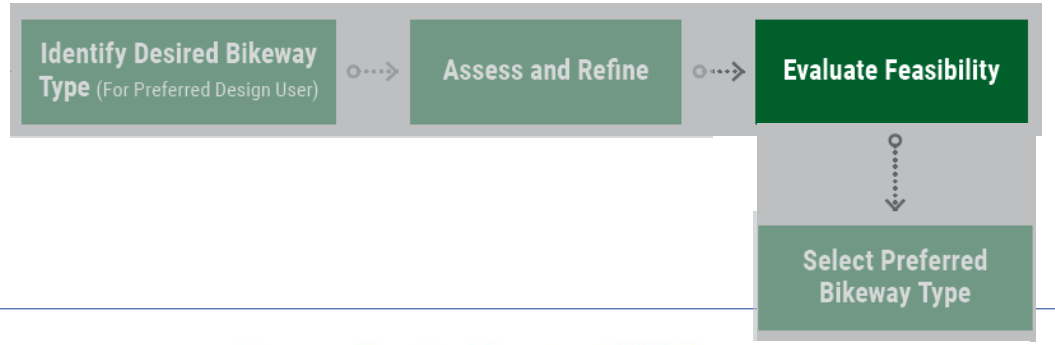
Against Parking:

Desirable = 7.5’

Minimum = 5’

Graphic Source: NACTO

Evaluating Feasibility
Constrained Bikeways



"the use of minimum width bikeways should be **limited to constrained roadways where** desirable or preferred bikeway widths cannot be achieved after **all other travel lanes have been narrowed to minimum widths** appropriate for the context of the roadway."

Preferred Bikeway Type is Feasible with Preferred Design Values

If an existing space reallocation strategy results in sufficient space for the preferred bikeway to be installed with preferred design values, the bikeway can be installed. There is no need to consider other bikeway types or parallel routes.

Preferred Bikeway Type is Not Feasible with Preferred Design Values

If sufficient space is not available to provide the preferred bikeway type at the preferred design values, it will be necessary to consider other options, several of which are highlighted below.

Reducing Bicycle Facility Widths

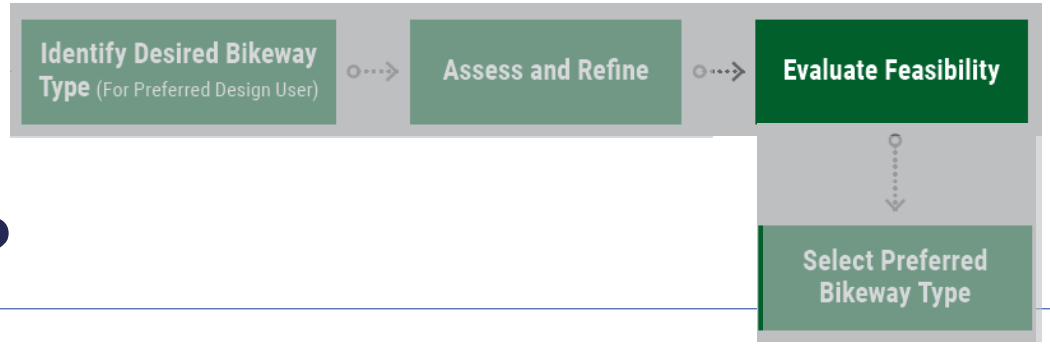
Where preferred design values cannot be achieved, reduced or minimum widths can be used to preserve the preferred bikeway type in the design. However, the use of minimum width bikeways should be limited to constrained roadways where desirable or preferred bikeway widths cannot be achieved after all other travel lanes have been narrowed to minimum widths appropriate for the context of the roadway. Where it is necessary to go below minimum widths, the preferred bikeway is infeasible and it will be necessary to select another bikeway type.

Wide Outside Lane or Bike Lane?

In some instances, it may be necessary to choose between the

Figure 14: Roadway Reconfiguration Opportunities

Source: Longview, TX Bicycle and Pedestrian Plan



Evaluating Feasibility
Wide Outside Lane or Bike Lane?

15 – 16’ Wide Outside Lane

10’ – 11’ Lane with 5’-6’ bike lane

Source: Longview, TX Bicycle and Pedestrian Plan

Wide lanes:

- Do not improve bicycling comfort
- Encourage faster traffic
- Shared lanes have higher bike crash risk

Narrow lanes with bike lanes:

- Improve bicycling comfort
- Encourage slower traffic
- Have lower bike crash risk
- Generally do not increase motorists crash rates if on 45 mph or less roadways

Evaluating Feasibility
Door Zone Bike Lane or No Bike Lane?

15 – 16’ Wide Outside Lane adjacent to parking

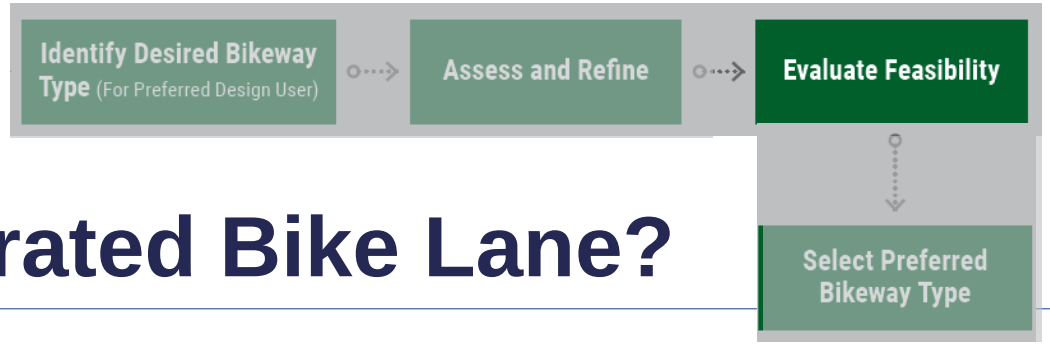
10’ – 11’ Lane with 5’-6’ bike lane adjacent to parking

Wide lanes:

- Do not improve bicycling comfort
- Encourage faster traffic
- Shared lanes have higher bike crash risk
- Parking increases bike crash risk

Narrow lanes with bike lanes:

- Improve bicycling comfort
- Encourage slower traffic
- May lower bike crash risks compared to wide lanes



Evaluating Feasibility
Narrow Bike Lane or 2-Way Separated Bike Lane?

Narrow Bike Lane

Narrow Bike Lanes:

- Improve bicycling comfort for Confident bicyclists
- Do not accommodate Interested but Concerned bicyclists

Two-Way Separated Bike Lane

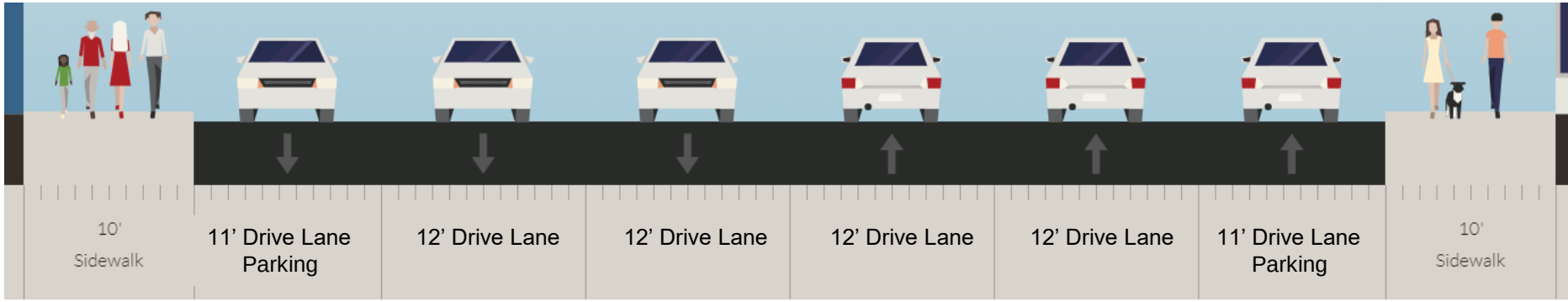
2-Way Separated Bike Lanes:

- Improve bicycling comfort for all bicyclists increasing use
- Has higher rate of bicycle crashes compared to 1-way separated bike lanes due to contra-flow movement

U.S. Department of Transportation
Federal Highway Administration

Existing Shared Lanes
2005 - 2009:

- 30 bicyclists/hour
- Average 5 crashes/year
- Crash Risk ~
  20 crashes/million cyclists



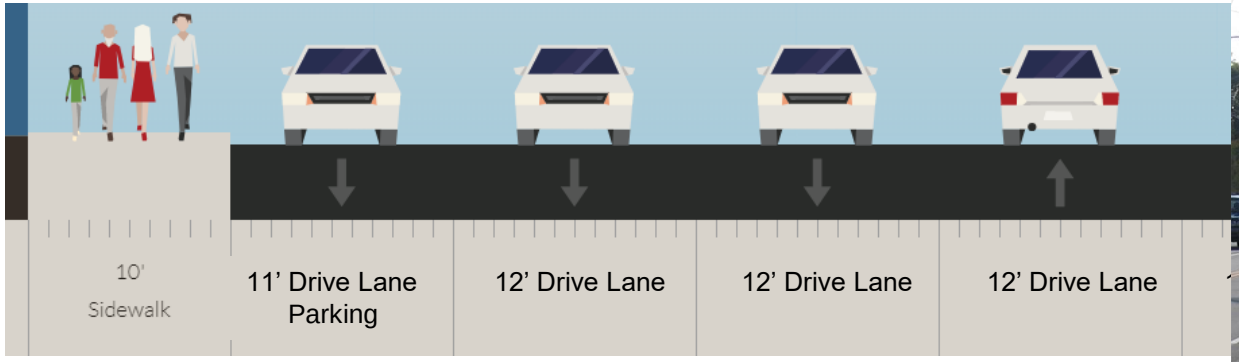
Case Study: 15th Street, NW. Washington DC

Data Sources: District Department of Transportation/Streetmix

U.S. Department of Transportation
Federal Highway Administration

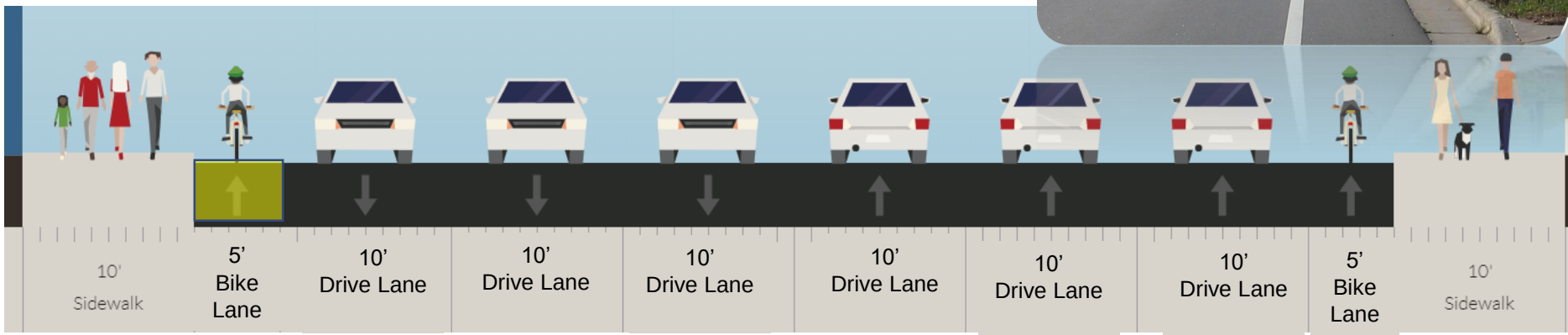
Existing Shared Lanes
2005 - 2009:

- 30 bicyclists/hour
- Average 5 crashes/year
- Crash Risk ~
  20 crashes/million cyclists



Option 1
Bike Lane

Not Chosen



U.S. Department of Transportation
Federal Highway Administration

Case Study: 15th Street, NW. Washington DC

Data Sources: District Department of Transportation/Streetmix

Existing Shared Lanes
2005 - 2009:

- 30 bicyclists/hour
- Average 5 crashes/year
- Crash Risk ~
  20 crashes/million cyclists

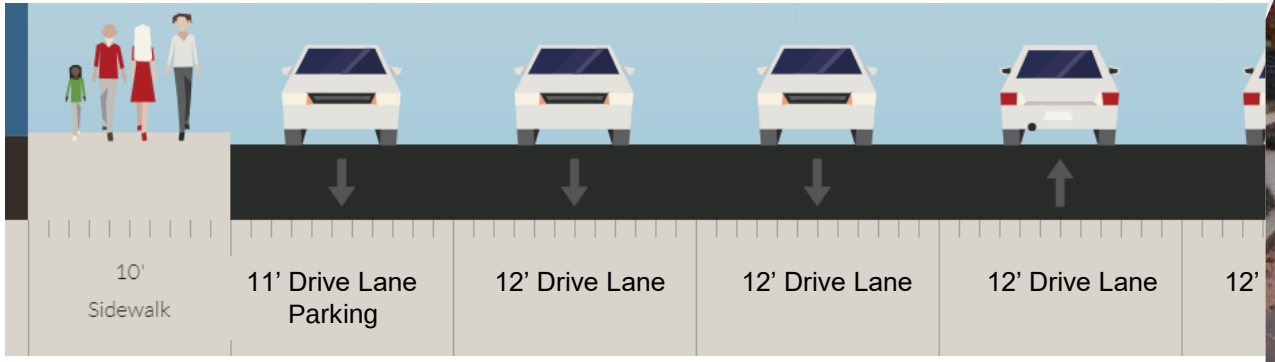
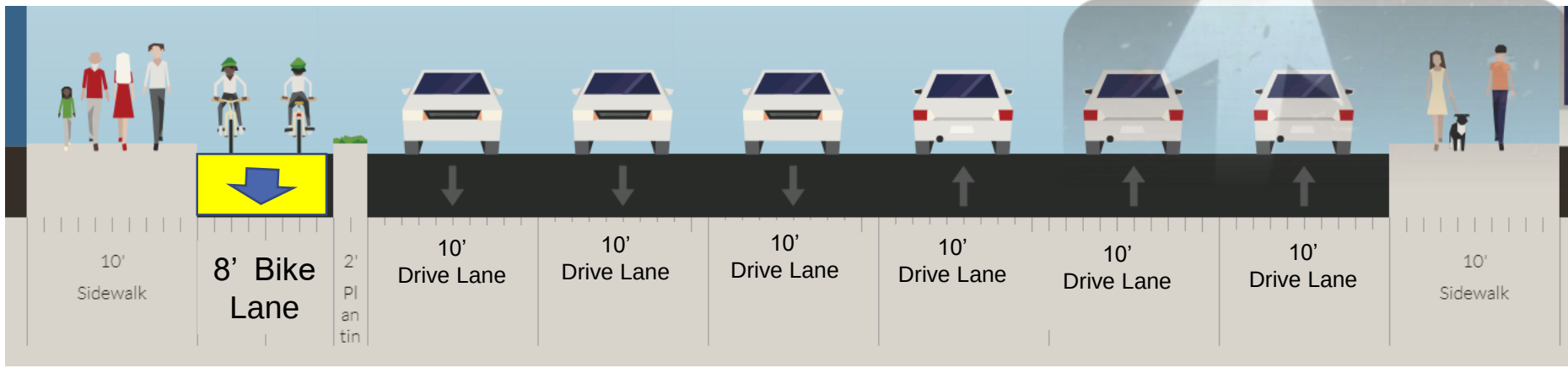


Image: Toole Design

Option 2
1-Way Separated Bike Lane
2009 - 2011

- 100 bicyclists/hour
- 15-20% wrong way riding (northbound)



Case Study: 15th Street, NW. Washington DC

Data Sources: District Department of Transportation/Streetmix

U.S. Department of Transportation
Federal Highway Administration

Existing Shared Lanes
2005 - 2009:

- 30 bicyclists/hour
- Average 5 crashes/year
- Crash Risk ~
  20 crashes/million cyclists

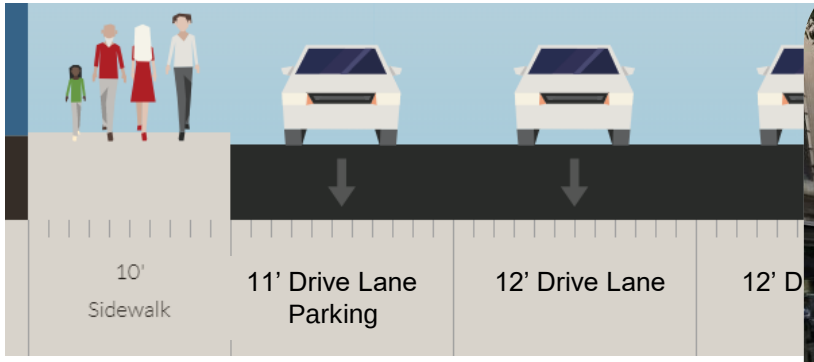
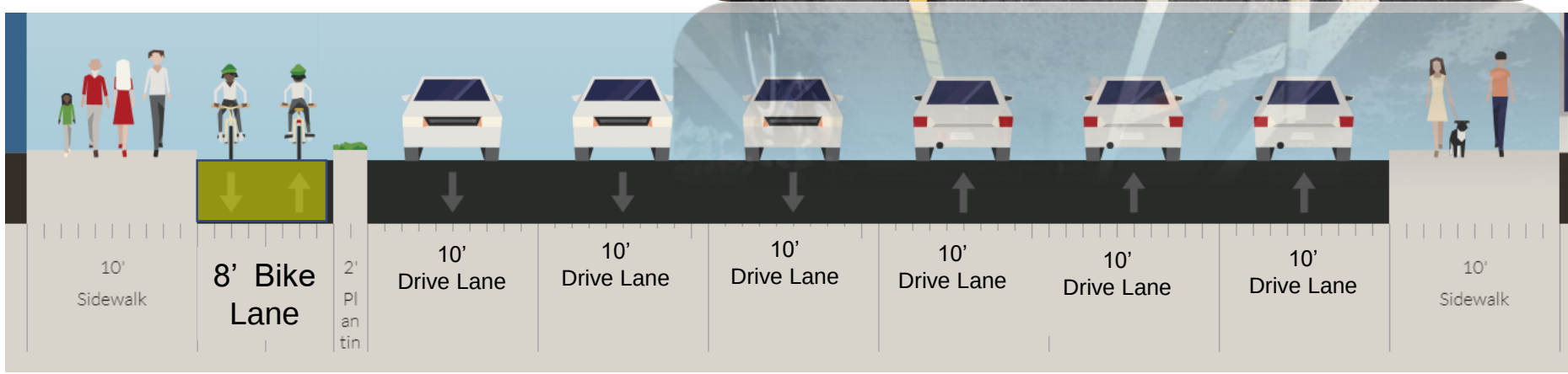


Image: Toole Design

Option 3
2-Way Separated Bike Lane
2011 - present:

- 400 bicyclists/hour
- Average 20 crashes/year
- Crash Risk ~
  6 crashes/million cyclists

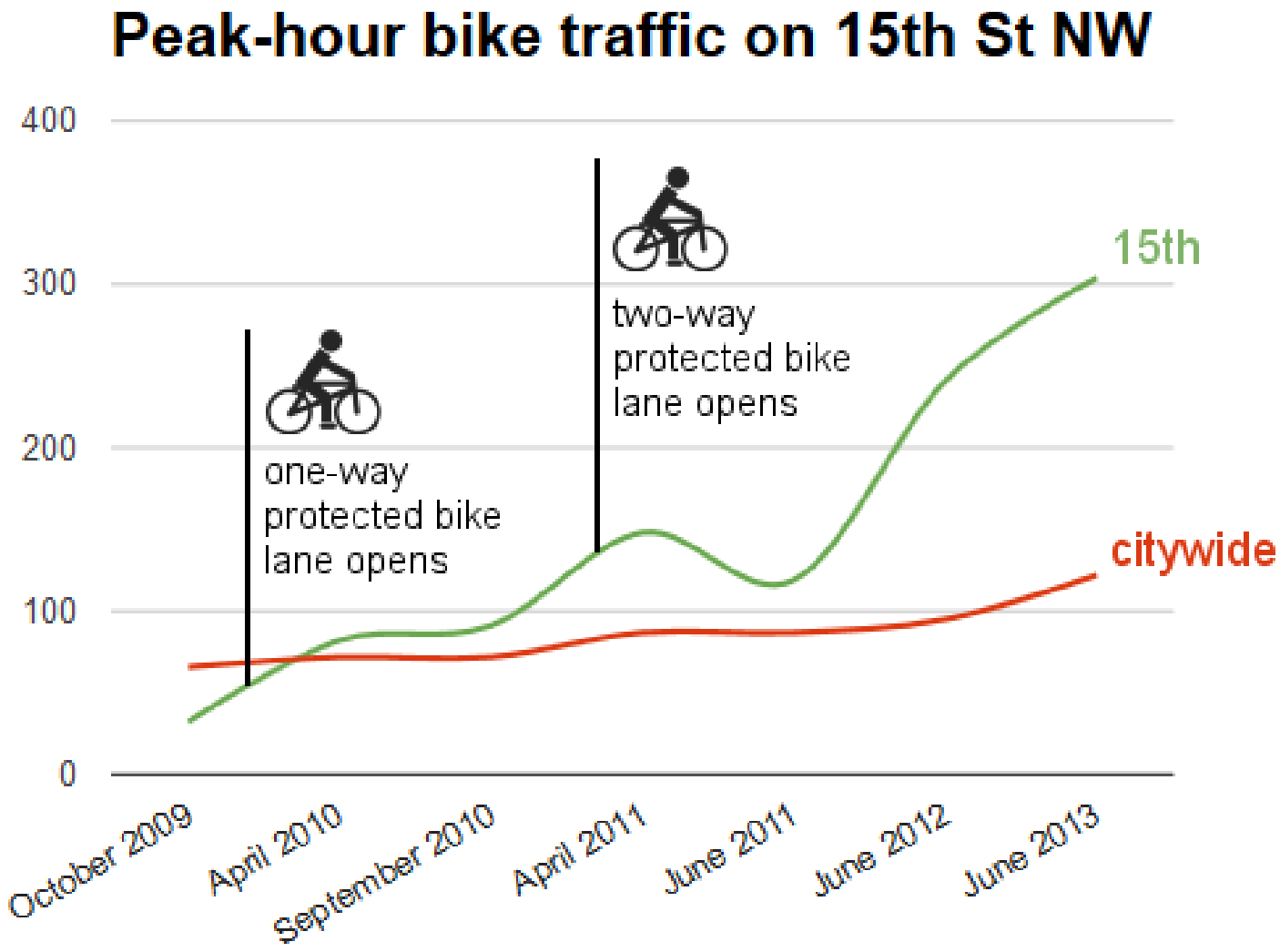


Case Study: 15th Street, NW. Washington DC

Data Sources: District Department of Transportation/Streetmix

U.S. Department of Transportation
Federal Highway Administration

2009 Shared Lanes
Crash Risk ~
20 crashes/million
cyclists



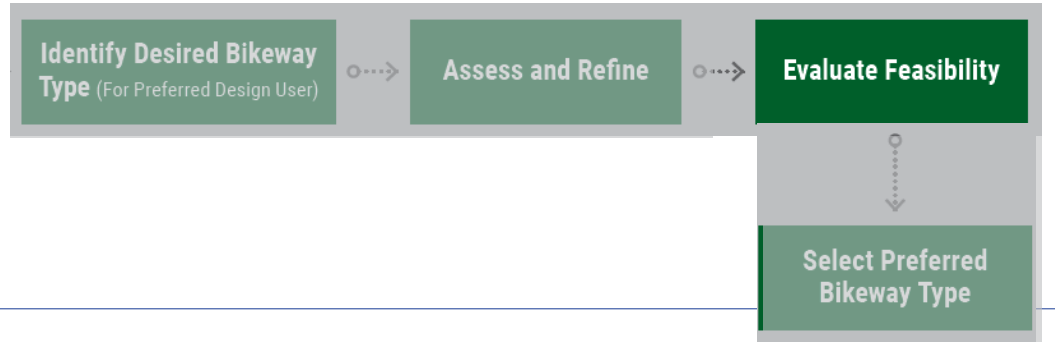
2011 Two-Way SBL
Crash Risk ~
6 crashes/million
cyclists

Case Study: 15th Street, NW. Washington DC

Data Sources: District Department of Transportation/Streetmix

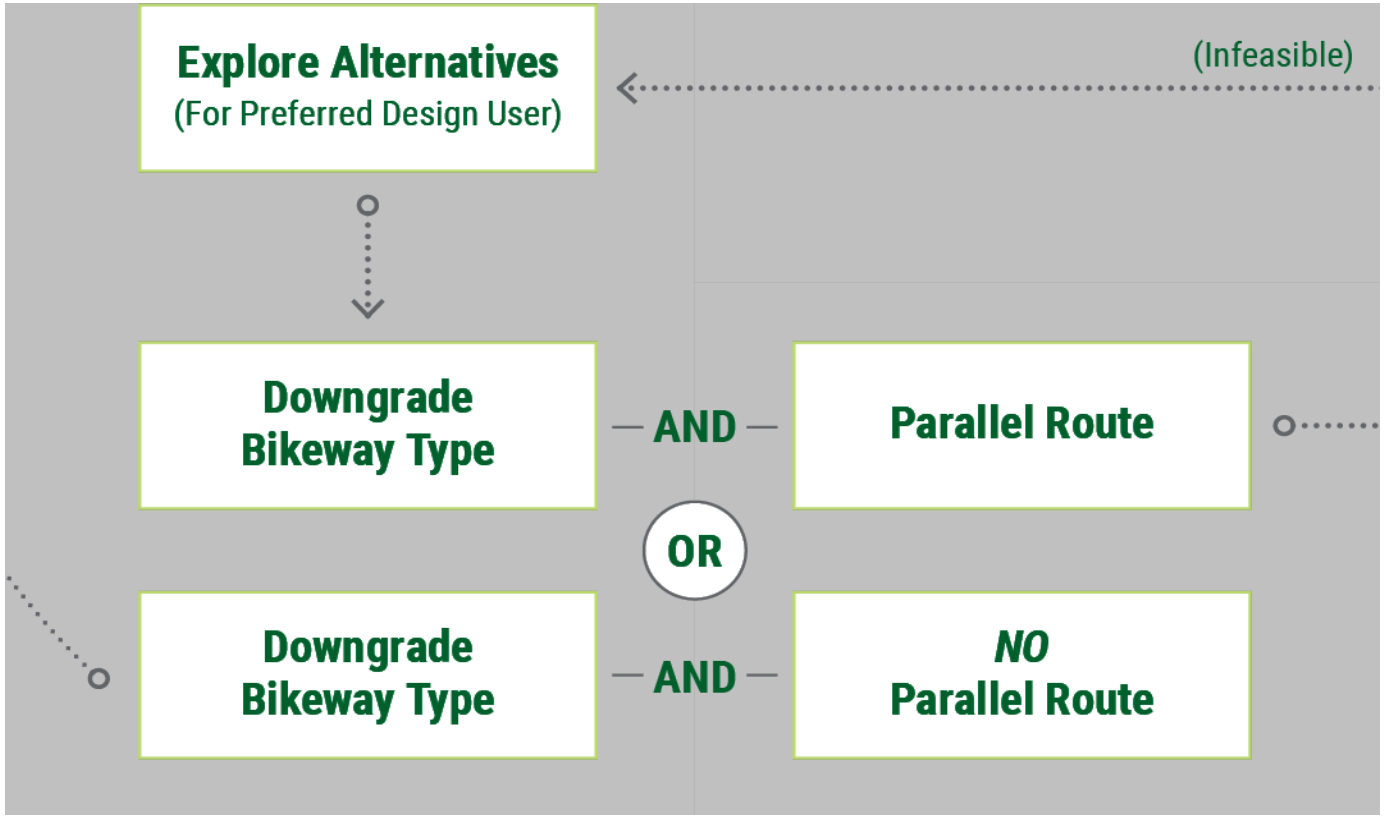
U.S. Department of Transportation
Federal Highway Administration

Evaluating Feasibility
Other Options Discussed



- Shared Use Path or Separated Bike Lane?
- Narrow Shoulder or No Shoulder?
- One-Way Separated Bike Lane on Both Sides or Two-Way Separated Bike Lane?

Chapter 4: Bikeway Selection
preferred bikeway is “infeasible”



Downgrading Bikeway has potential impacts:

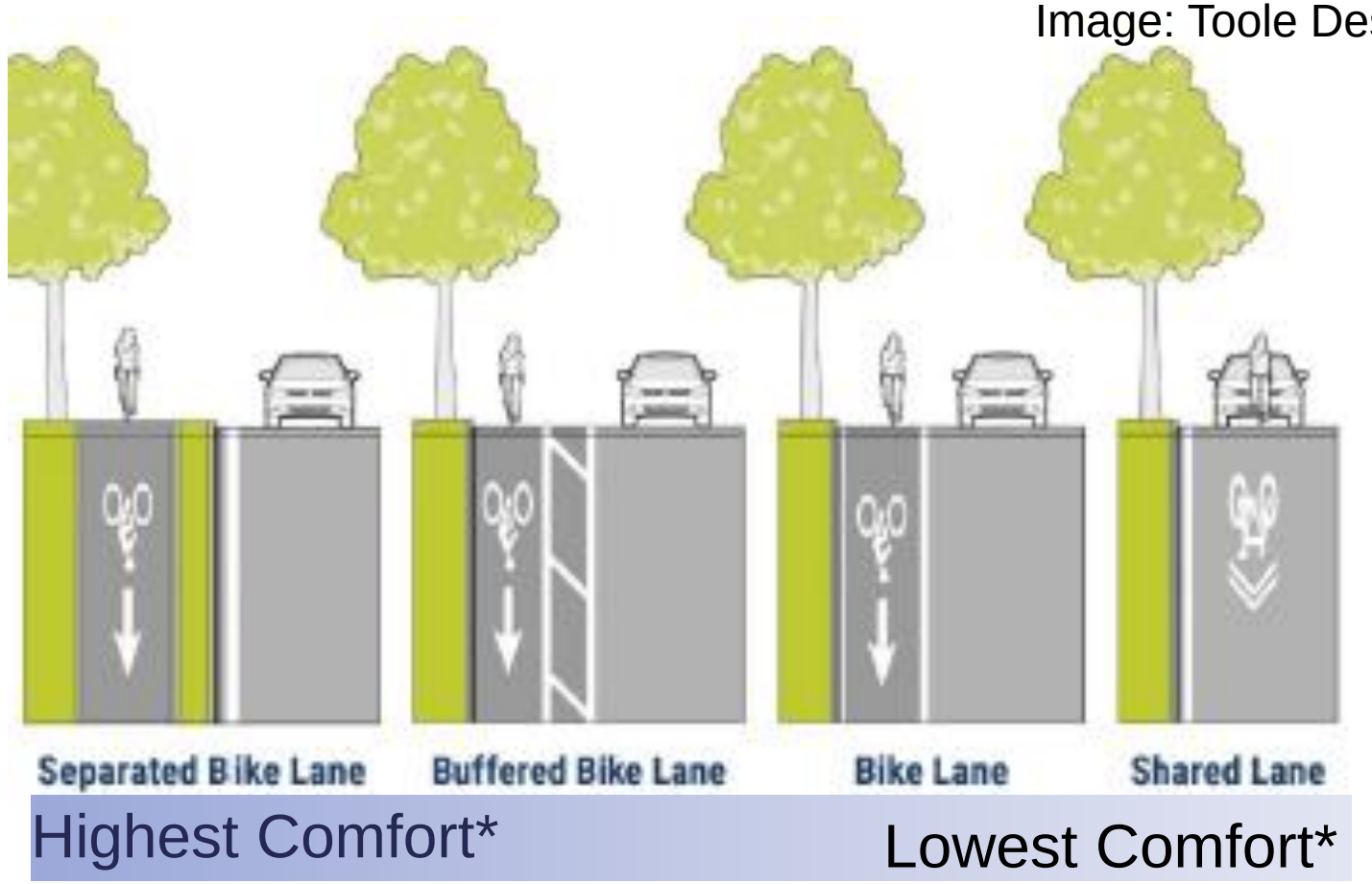
- Suppressed bicycling
- Reduced safety from:
  - Sidewalk bicycling
  - Shared lane or constrained bikeway dimensions

Chapter 4: Bikeway Selection

preferred bikeway is “infeasible” – downgrade bikeway

If the preferred bikeway is infeasible on the main route, select “the next best facility” for it as a short term measure.

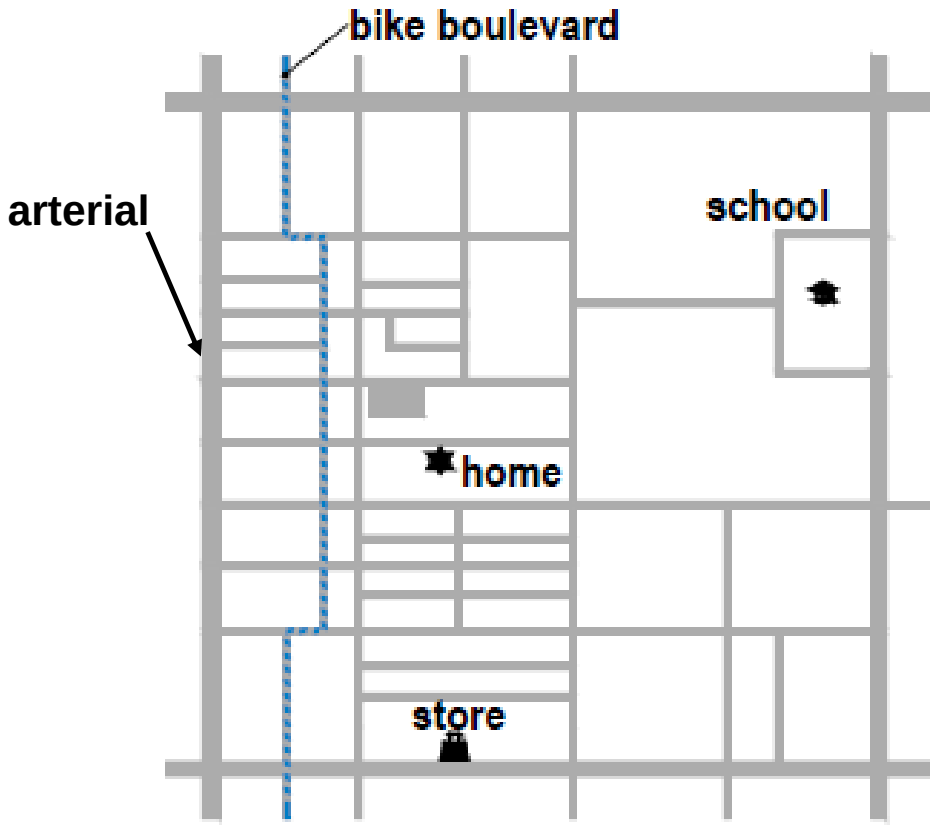
Image: Toole Design



*Assumption is high volume roadway with speeds > 30mph with sidepath bicyclists comfort contingent upon pedestrian volume

Graphic Source: Toole Design

Chapter 4: Bikeway Selection
preferred bikeway is “infeasible” – parallel route



Graphic Source: Toole Design

Parallel routes can accommodate the Interested but Concerned if:

- It is designed for their comfort
- Detour is less than 30% in length*
- Bike boulevards may require assessments of major street crossings

*Broach, J., Dill, J., and J., Gliebe. Where Do Cyclists Ride? A Route Choice Model Developed with Revealed Preference GPS Data. *Transportation Research Part A: Policy and Practice*, Vol. 46, No. 10, 2012, pp. 1730-1740.

Chapter 5.
Bikeway Selection in Practice

Example Case Studies to Apply the Guide Include:

- **Rural Context, 2-Lane Roadway**
- Small Town Context, 2-Lane Roadway
- Suburban, 4-Lane Roadway
- **Suburban, 6-Lane Roadway**

High-Speed 2-Lane Roadway (Base Condition)

- rural, two-way, 22-foot-wide undivided road
- popular state bicycle route connecting two small towns
- Average Daily Traffic (ADT) is 1,500 (4% trucks)
- operating speed is 45 mph
- public right-of-way extends to 10 feet on either side of the roadway
- motorists can easily change lanes to pass; however, there are locations with limited sight lines
- pedestrian volumes are expected to be low

Who is Our Design User?

- popular state bicycle route connecting two small towns
  - Confident Bicyclists?
  - Interested But Concerned?
  - Both are uncomfortable due to 45+ mph speeds
- pedestrian volumes are expected to be low

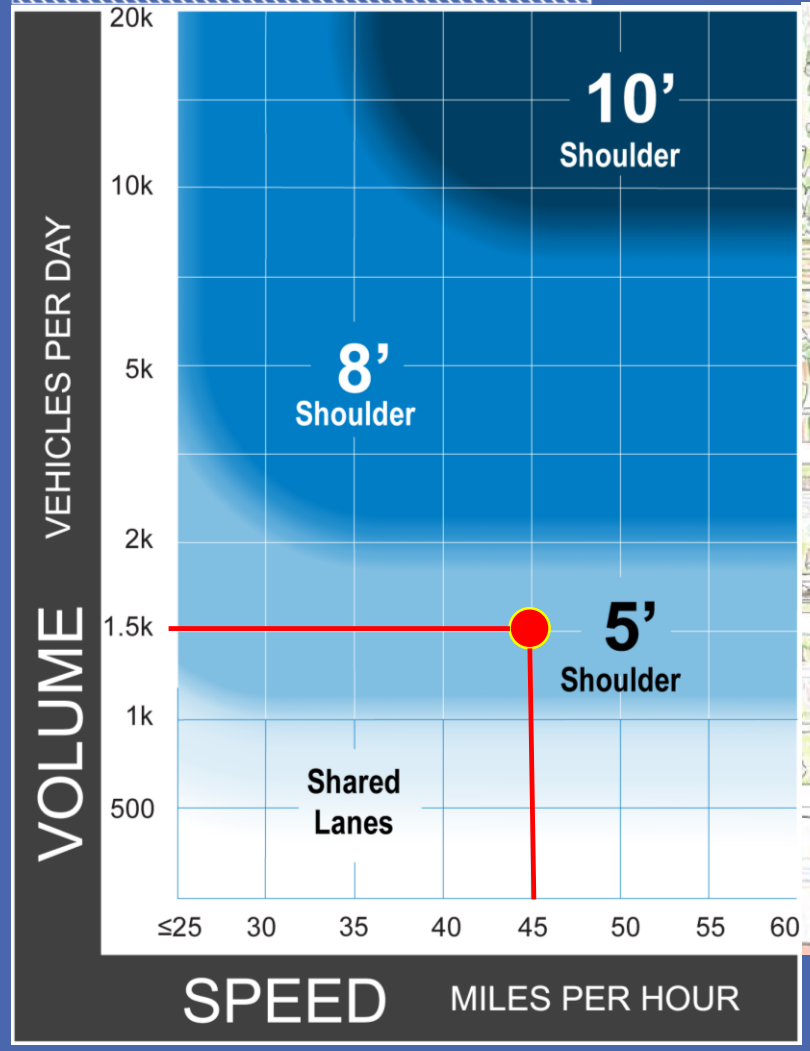
Who is Our Design User?

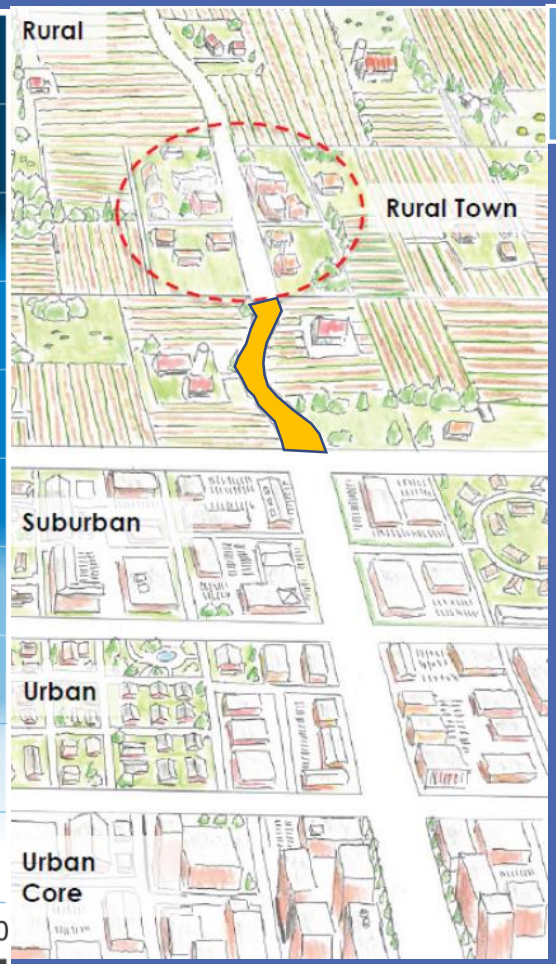
- popular state bicycle route connecting two small towns
  - Confident Bicyclists?
  - Interested But Concerned?
  - Both are uncomfortable due to 45+ mph speeds
- pedestrian volumes are expected to be low

Confident Bicyclists Chosen for this Example

Preferred Bikeway Type

Rural Context





Design User Assumption = Confident Bicyclists

- **Average Daily Traffic (ADT) is 1,500 (4% trucks)**
- **operating speed is 45 mph.**

Graphic Source: NCHRP 855

5’ Shoulder Option

- Confident cyclists are comfortable (BLOS = “”B”)
- Relatively inexpensive option
- No room for rumble strips
- Interested but Concerned cyclists are uncomfortable due to 45 mph and no protection (potential suppressed bike volume)
- Pedestrians may walk in shoulder, but will not feel safe

Wide Shoulder Option

- Confident cyclists are very comfortable (BLOS = ‘”A”)
- Relatively more expensive option
- Room for rumble strips
- Interested but Concerned cyclists are uncomfortable due to 45 mph and no protection (potential suppressed bike volume)
- Pedestrians may walk in shoulder, but will not feel safe

Shared Use Path Option

- Confident cyclists are very comfortable (BLOS = ‘”A”)
- Most expensive option
- Room for rumble strips
- Interested but Concerned cyclists are comfortable due with protection
- Pedestrians are comfortable and will feel safe, while low volume will not result in conflicts with bikes

4-Lane Suburban Roadway (Base Condition)

- 4-lane, 50-foot-wide street
- various large business and retail parcels with busy driveways
- Average Daily Traffic (ADT) is 9,000 (2% trucks/buses)
- operating speed is 35 mph
- public right-of-way extends to 10 feet on either side of the roadway with continuous sidewalks that have trees and utility poles located within them.
- Expected peak hour volumes:
  - 25-50 pedestrians
  - 200-250 bicyclists
- Built environment is a challenge

Who is Our Design User?

- Important retail corridor for the area with lots of destinations for work and shopping
  - Confident Bicyclists?
  - Interested But Concerned?
  - Both are uncomfortable due to 35+ mph speeds and 9,000 ADT
- pedestrian volumes are moderate due to businesses

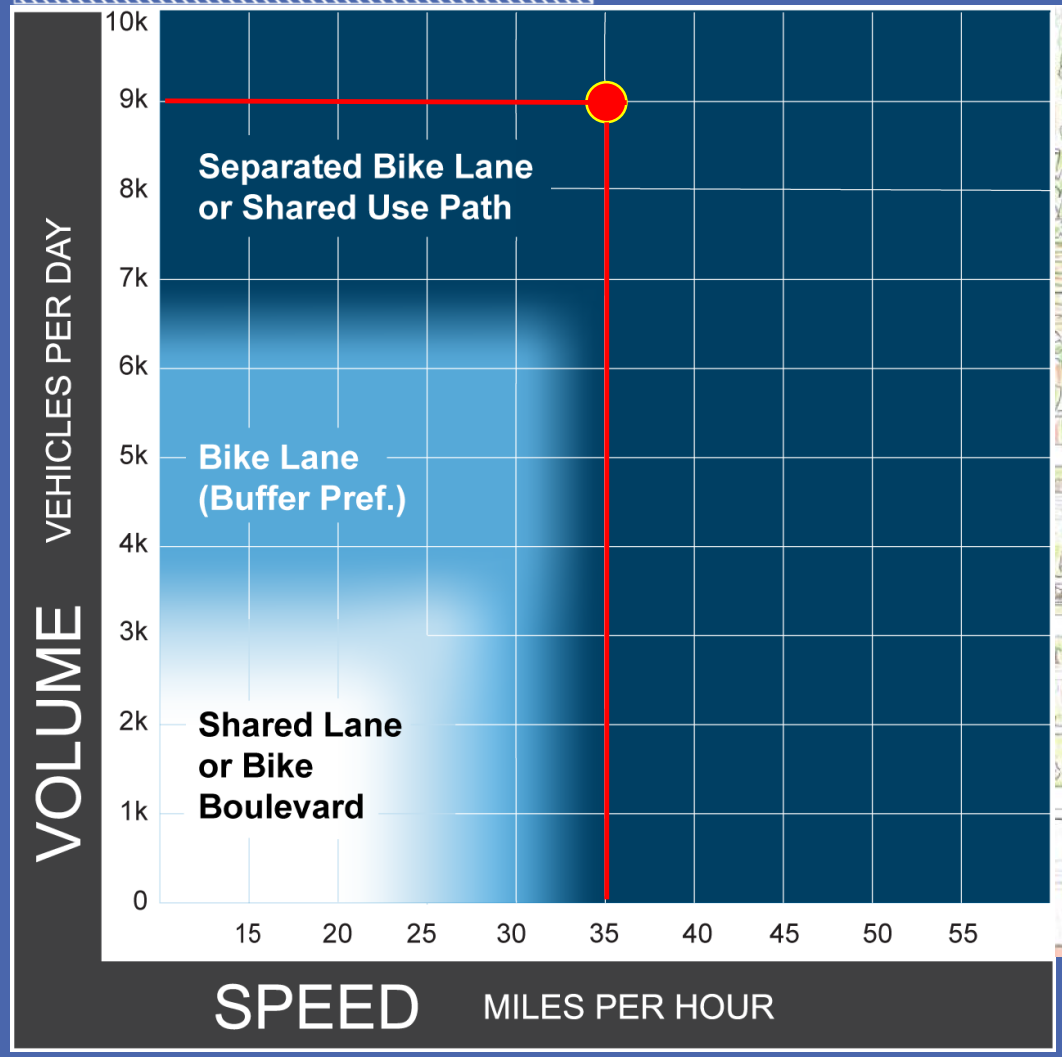
Who is Our Design User?

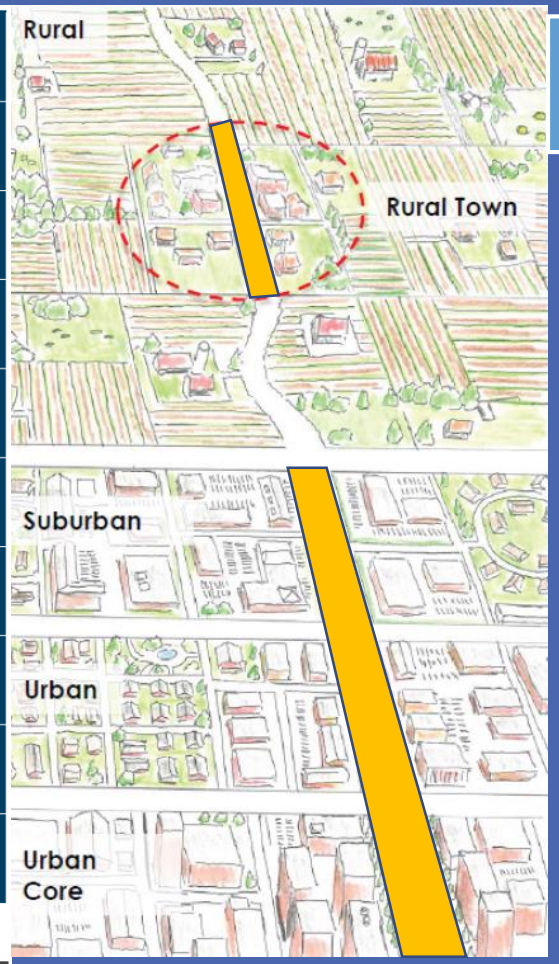
- Important retail corridor for the area with lots of destinations for work and shopping
  - Confident Bicyclists?
  - Interested But Concerned?
  - Both are uncomfortable due to 35+ mph speeds and 9,000 ADT
- pedestrian volumes are moderate due to businesses

Interested But Concerned Bicyclists Chosen for this Example

Preferred Bikeway Type

Urban, Urban Core, Suburban, and Rural Town Contexts





Design User Assumption = Interested But Concerned Bicyclist

- Average Daily Traffic (ADT) is 9,000
- 2% trucks/buses
- operating speed is 35 mph

Graphic Source: NCHRP 855

Bike Lane Option

- Road Diet gains 12’ of space for 6’ bike lane
- Confident cyclists are comfortable (BLOS = “”B”)
- Relatively inexpensive option
- No room for rumble strips
- Interested but Concerned cyclists are uncomfortable due to 45 mph and no protection (potential suppressed bike volume)
- Pedestrians may walk in shoulder, but will not feel safe

Separated Bike Lane Option

- Road Diet gains 12’ of space for 4’ bike lane with 2’ buffer
- Relatively inexpensive option
- Interested but Concerned cyclists are comfortable (LTS 1) due to separation
- Confident cyclists are comfortable (BLOS = “A”)
- Pedestrians remain on sidewalk with increased separation from traffic

Shared Use Path Option

- Road Diet gains 12’ of space from road to create 6’- 12’ buffer
- Most expensive option
- Utilities relocate to buffer and sidewalk widened to 12’ - 14’
- Interested but Concerned cyclists are comfortable (LTS 1) due to separation
- Confident cyclists may prefer the road due to pedestrians on the path
- If bicycle volumes increase beyond 200/hour, or pedestrians exceed 30% of users, the path can begin to conflicts between pedestrians and bicyclists may result

Workshops

Workshops May Be Available through March 2021

*Priority given to workshops scheduled through Summer 2019

Full Day Workshop May Include:

- Deeper Dive into Bikeway Selection Guide
- Application to local or example scenarios
- Hands-on Activity

Considerations when Requesting a Workshop

- What are your goals and objectives for the workshop?
- Invite a broad set of participants (20-30 total is preferred).
- Local host is responsible for securing a meeting space, promoting the workshop, and coordinating logistics (i.e. parking, accommodations) with participants.

Technical Assistance

Technical Assistance Available Through March 2021

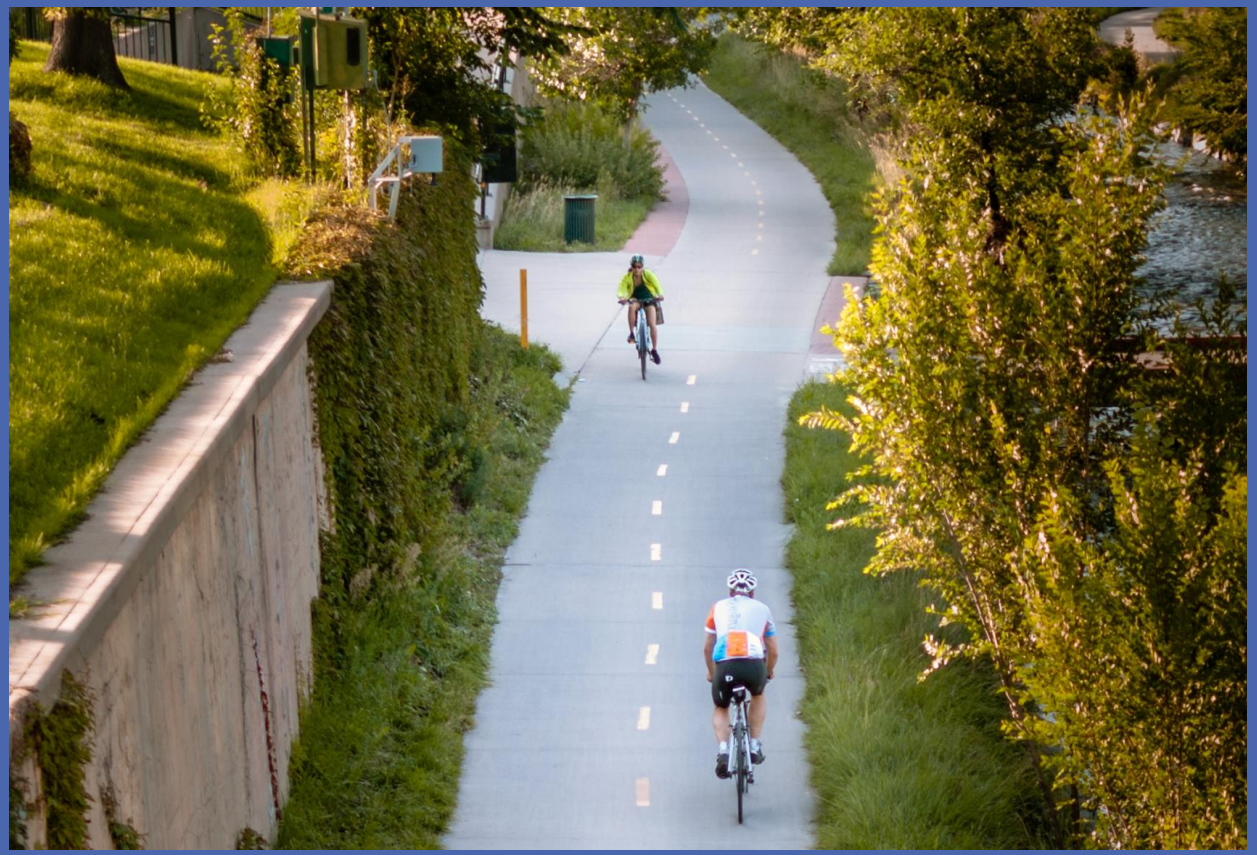
- Webinar training for local agencies or State DOT partners
- Partial-day workshops
- Inquiries about elements of the Guide
- Questions when applying the Guide

Request a Workshop or Technical Assistance:

Tamara Redmon at tamara.redmon@dot.gov *or*

Lauren Blackburn at lblackburn@vhb.com

Questions?



Tamara Redmon
tamara.redmon@dot.gov

Bill Schultheiss
wschultheiss@tooledesign.com

Lauren Blackburn
lblackburn@vhb.com