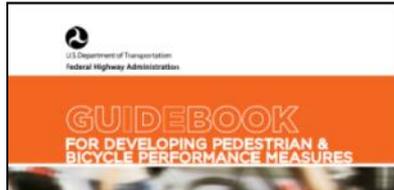


## Improving Multimodal Outcomes through Performance Measurement and Design Flexibility



Dan Goodman, [Federal Highway Administration](#)

Michelle Danila, [Toole Design Group](#)

Conor Semler, [Kittelson and Associates](#)

Carl Sundstrom, [UNC Highway Safety Research Center](#)

**November 14, 2016**



# Today's Presentation

---

- ⇒ **Introduction and housekeeping**
- ⇒ **Presentations**
- ⇒ **Questions at the end**



# Webinar Issues

---

## ⇒ Audio issues?

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.

# CM Credits and Email

## ⇒ Certificate of Attendance

You will receive a certificate of attendance by email from the UNC Highway Safety Research Center



Pedestrian and Bicycle Information Center

Dear James,

Thank you for registering for "A Resident's Guide for Creating Safer Communities for Walking and Biking".

The Federal Highway Administration just released "A Resident's Guide for Creating Safer Communities for Walking and Bicycling," a free guide offering step-by-step instructions for residents and community groups looking to improve pedestrian and bicyclist safety, access, and comfort. This webinar offers an overview of the guide and will review how two communities used the principles outlined within it to make their communities more walkable and bikeable.

Tamara Redmon, with FHWA's Office of Safety, will introduce the guide and discuss how it fits within the US Department of Transportation's Safer People, Safer Streets Initiative.

Laura Sandt, with the Pedestrian and Bicycle Information Center, will discuss the content of the new guide and how residents can use it.



# PBIC Webinars and News

⇒ Find PBIC webinars and webinar archives  
[pedbikeinfo.org/webinars](http://pedbikeinfo.org/webinars)

⇒ Next webinar: Ped Safety at  
Uncontrolled Locations (Nov 30)

⇒ Follow us on Facebook and Twitter for  
the latest PBIC News  
[facebook.com/pedbikeinfo](https://facebook.com/pedbikeinfo)  
[twitter.com/pedbikeinfo](https://twitter.com/pedbikeinfo)

⇒ Join our mailing list  
[pedbikeinfo.org/signup](http://pedbikeinfo.org/signup)

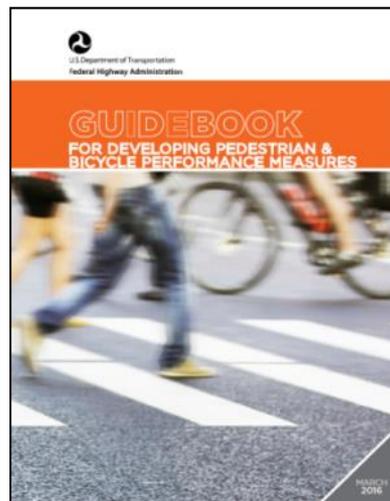
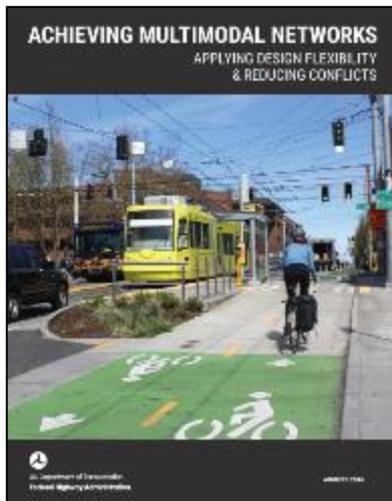
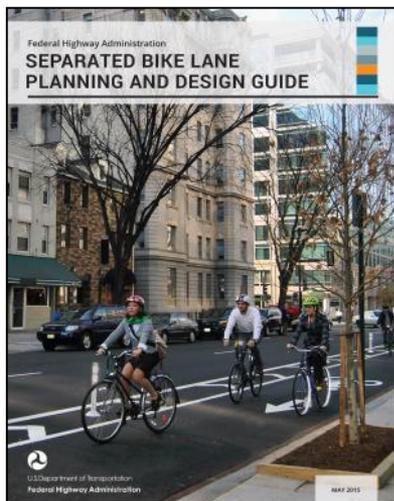
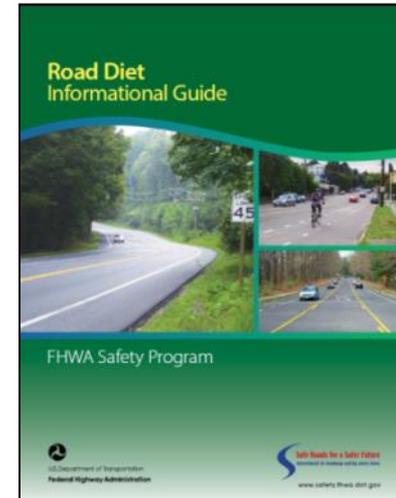
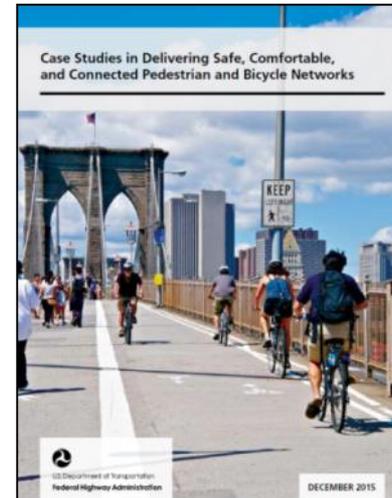
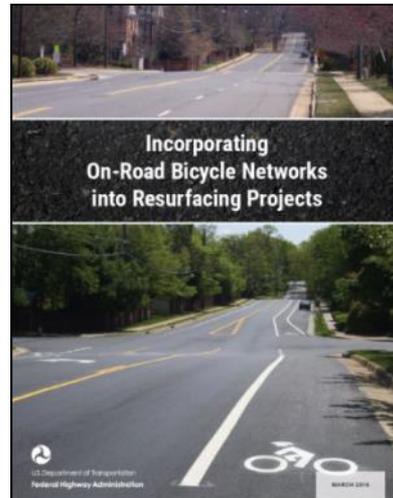
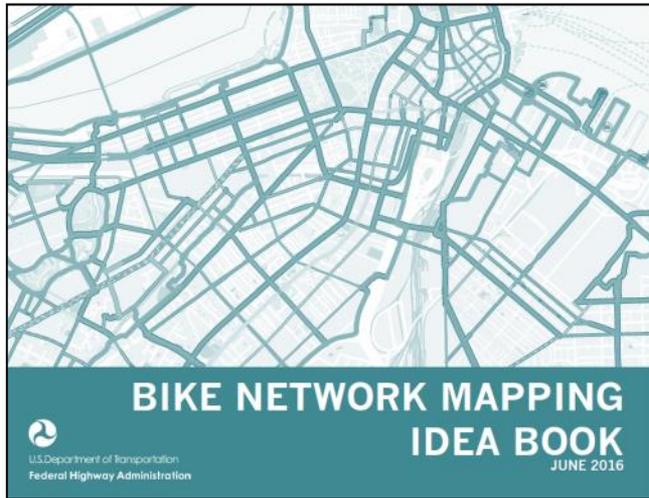


The screenshot shows the PBIC website's 'Webinars' section. The header includes the PBIC logo and navigation links: Data & Resources, Community Support, Planning & Design, Training & Events, and Programs & Campaigns. The main content area is titled 'Webinars' and lists upcoming and recent webinars. The first entry is dated 11/30/2014 and is titled 'Ped Safety at Uncontrolled Locations'. The second entry is dated 11/19/2014 and is titled 'Bicycle Safety Guide and Countermeasures Detection Systems (BILCSM11 Webinar)'. The third entry is dated 11/10/2014 and is titled 'A Resident's Guide for Creating Safer Communities for Walking and Biking Webinars'. The fourth entry is dated 11/5/2014 and is titled 'Active Team Safety Tools: A Model Methodology for Prioritizing Pedestrian and Bicycle Improvements on Existing Roads'.



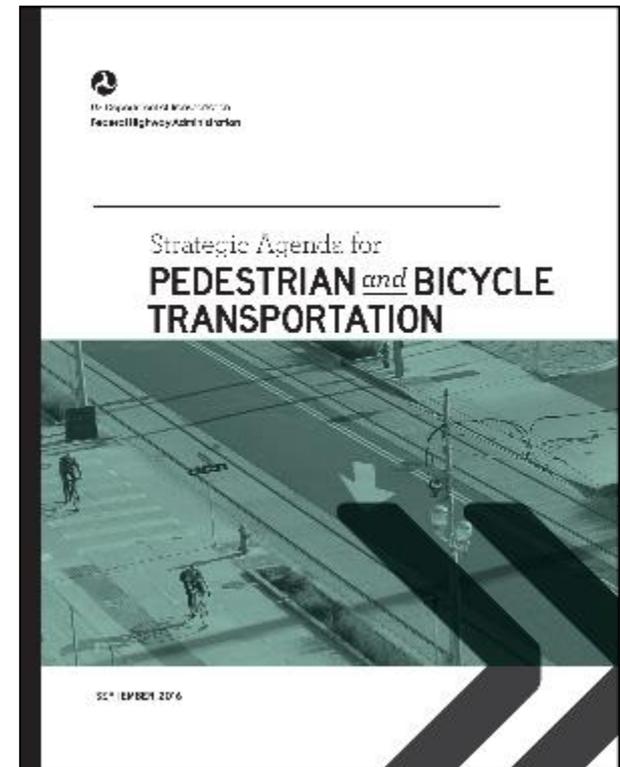
The screenshot shows the PBIC Facebook page. The header includes the PBIC logo and the text 'Pedestrian and Bicycle Information Center'. Below the header is a navigation bar with links for Timeline, About, Photos, Likes, and More. The main content area shows a post from the PBIC page with a video player and a text description. The text describes the PBIC's role in supporting the National Center for Safe Routes to School and its efforts to improve the quality of life in communities through the increase in safe walking and bicycling as a viable means of transportation. The post also includes a map of the United States and a link to the PBIC website.

# Recent FHWA Pedestrian and Bicycle Resources

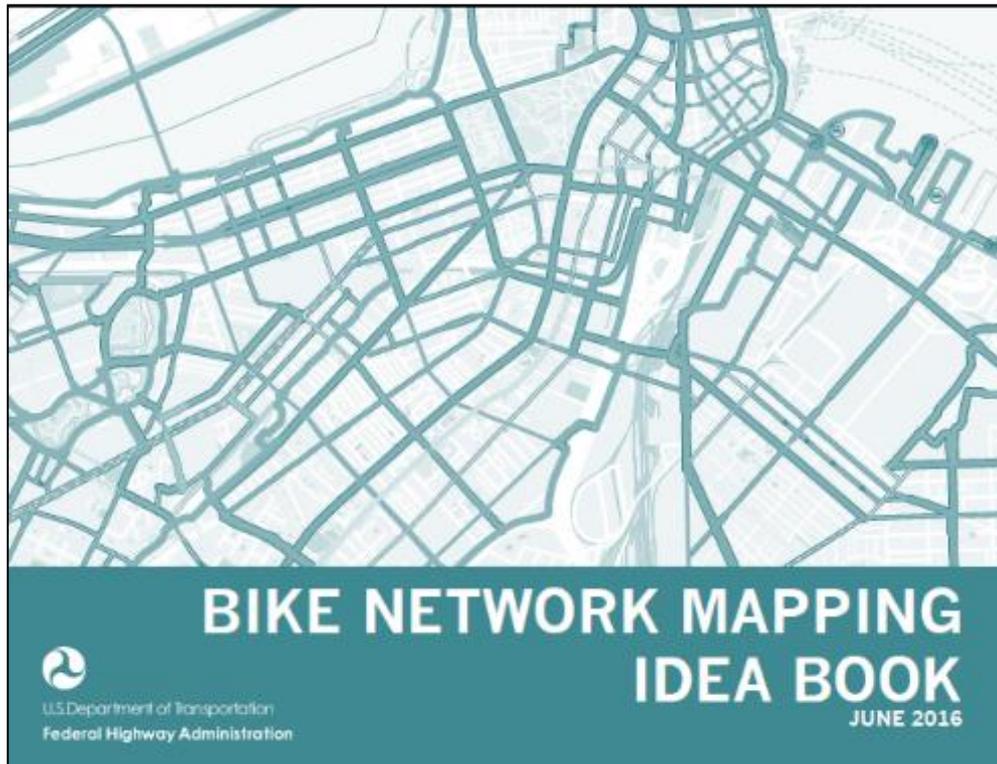


# Strategic Agenda for Pedestrian and Bicycle Transportation

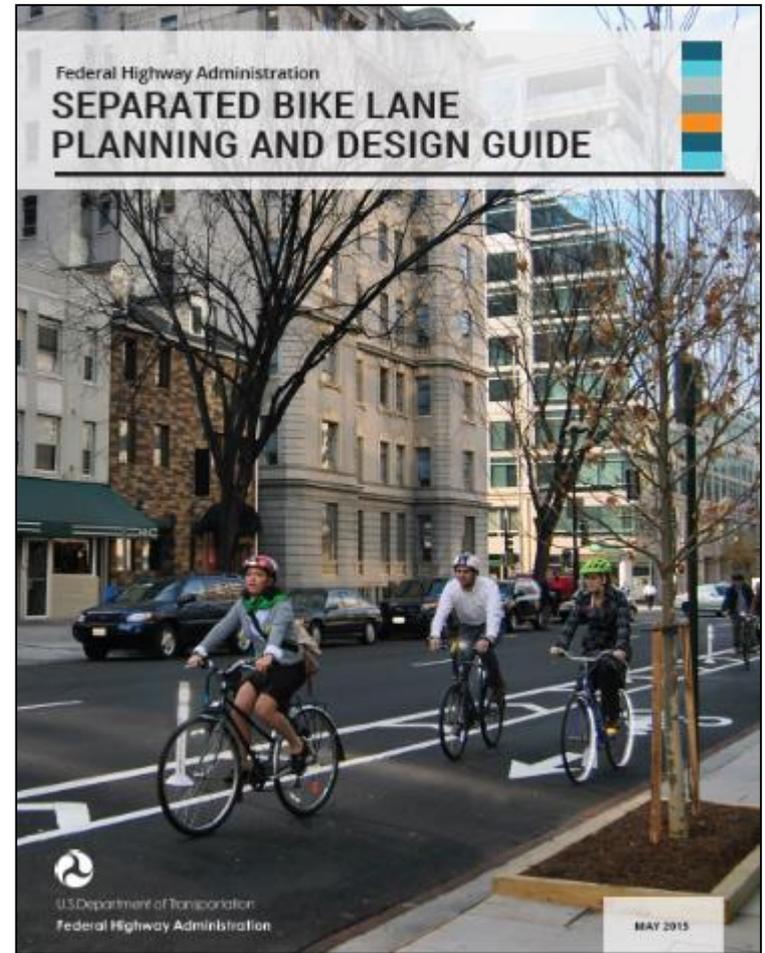
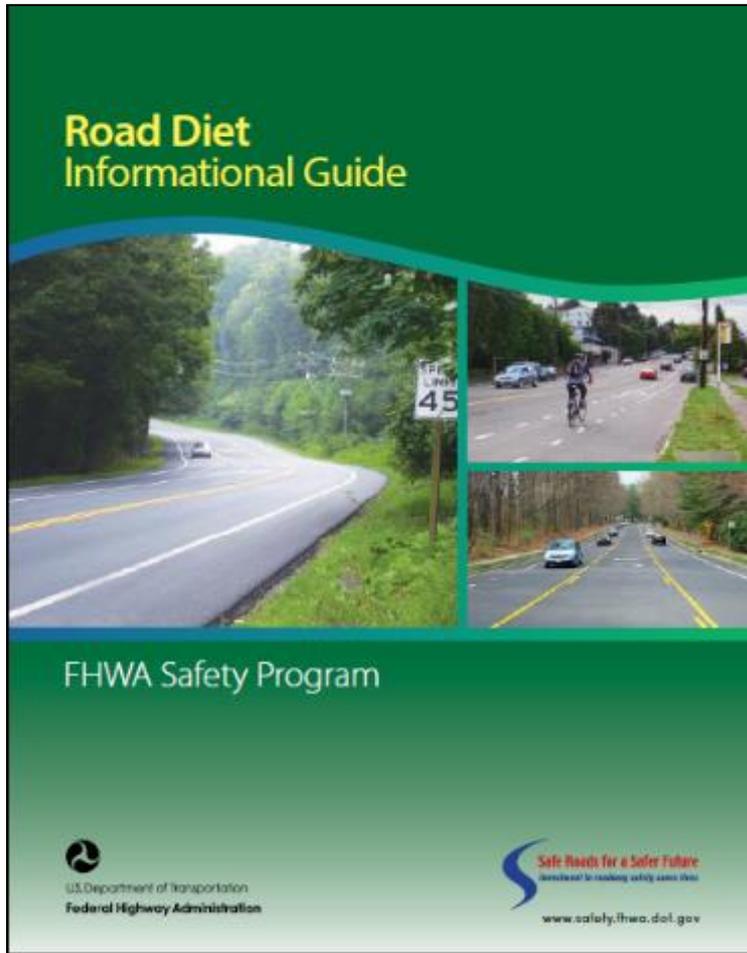
- Provides a framework for organizing existing and planned pedestrian and bicycle activities
- Emphasizes collaboration and partnerships
- Assumes a 3-5 year time horizon
- Builds on the [policy statement on bicycle and pedestrian accommodations](#)
- Demonstrates FHWA's ongoing national leadership on multimodal transportation and represents the agency's commitment to institutionalize and mainstream these issues moving forward



# Linkages Between Resources



# Linkages Between Resources



# Design Resource Index



## Pedestrian and Bicycle Information Center

Data & Resources

Community Support

Planning & Design

Training & Events

Programs & Campaigns

### PLANNING & DESIGN

#### Planning & Data Collection Tools

Crash Data

Counts

Surveys

Inventories

Audits

Secondary Data Sources

#### Performance & Analysis

Level & Quality of Service

Intersection Safety Indices

## Design Resource Index

The Design Resource Index identifies the specific location of information in key national design manuals for various pedestrian and bicycle design treatments. The Design Resource Index will help practitioners quickly access the right resources and should reduce the amount of time it takes to search through multiple design guides to find the information they need.

- For the navigable Excel version, [click here](#)
- For a printable 11x17 version, [click here](#)

As you use this document, we encourage you to share your observations and feedback. For example, we would like to get input on existing gaps in design guidance, research needs, and additional tools and resources that would help you navigate between various design resources. Please email this feedback to [daniel.goodman@dot.gov](mailto:daniel.goodman@dot.gov).

# Design Resource Index

## On-Street Bicycle Facility Design Treatments

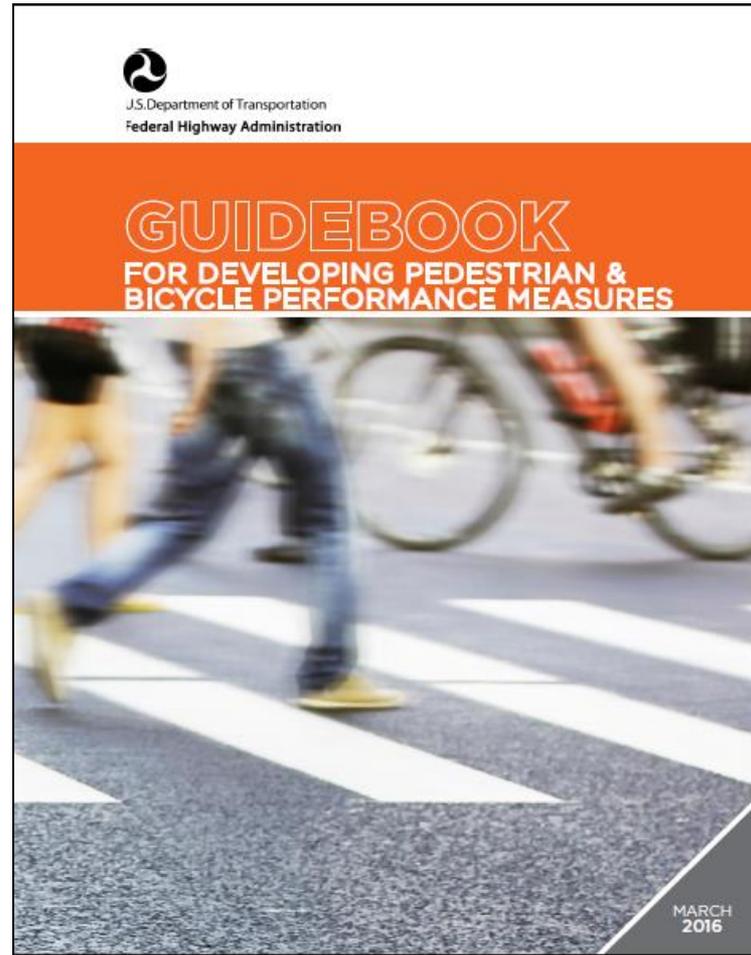
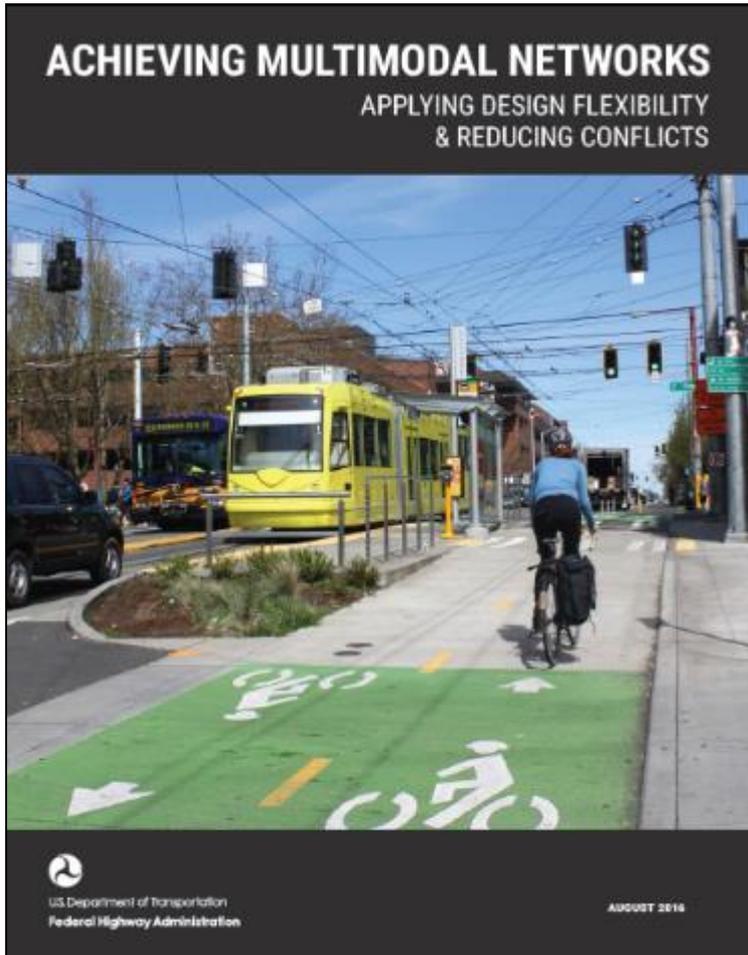
5/14/15

Key	Color
Design Treatment Addressed	
Interim Approval	
Experimental Status	

Roadside Design Guide (2011)	A Policy on Geometric Design of Highways and Streets (2011)	Guide for the Development of Bicycle Facilities (2012)
AASHTO	AASHTO	AASHTO

A. Bicycle Facility Selection			
A1	Guidance of appropriate use/ typical application of bicycle facilities		Section 2.5.2
B. General Roadway Design			
B1	Paved shoulders	Sections 2.7, 4.4	Section 4.5
B2	Bicycle route signs		Section 2.5.3
B3	Shared lane markings		Section 4.4
B4	Shared lane signage		Section 4.3
B5	Bicycle boulevards/neighborhood greenways		Section 4.10
B6	Bicycle accommodations related to traffic calming		Sections 4.12.6, 4.12.7
B7	Bicycle accommodations on bridges/tunnels	Sections 4.10.3, 4.16.4	Section 4.12.3
B8	Bicycle treatments at railroad crossings		Section 4.12.1
B9	Bicycle-safe drainage grate design	Section 2.7, 4.7.2	Section 4.12.8
B10	Rumble strips (bicycle guidance)	Section 4.5	Section 4.5.2
B11	Colored bicycle facilities		Section 4.7.2
C. Bicycle Lanes			

# Linkages Between Resources



# Achieving Multimodal Networks: Introduction

Interconnected pedestrian and bicycle infrastructure makes *walking and bicycling a viable transportation choice* for everyone and this contributes to the health, equity, and quality of life of our communities.

## ACHIEVING MULTIMODAL NETWORKS

APPLYING DESIGN FLEXIBILITY  
& REDUCING CONFLICTS



U.S. Department of Transportation  
Federal Highway Administration

APRIL 2016

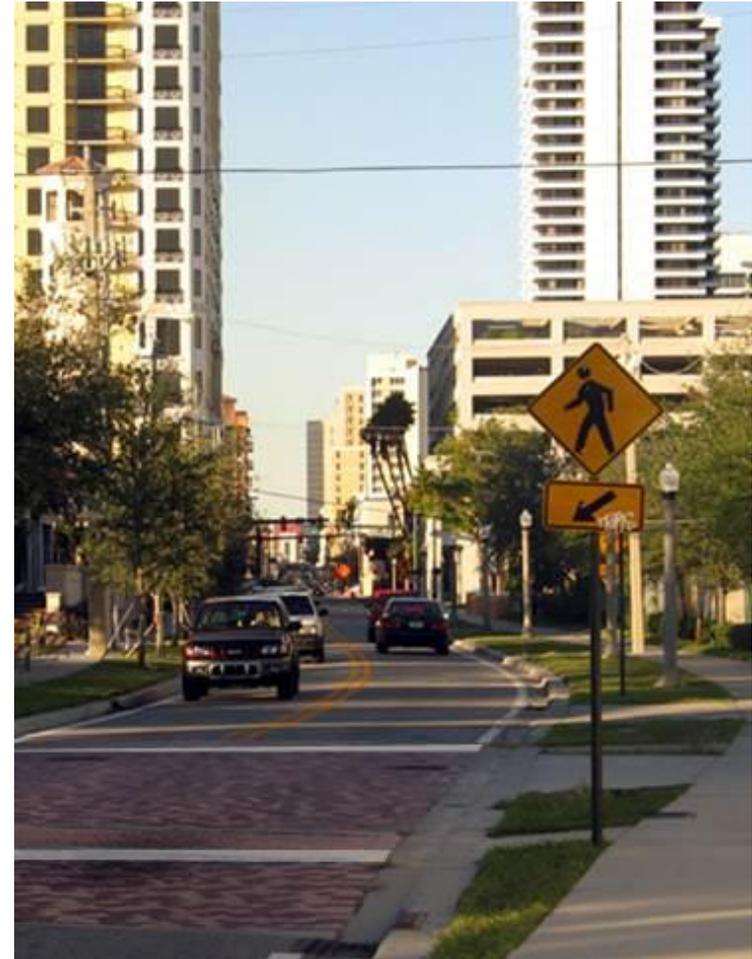
# Achieving Multimodal Networks: Objectives

Equip planners, designers, and policy makers with information, so that:

1. walking is a viable transportation choice for everyone, and
2. bicycling is a viable transportation choice for all ages and abilities.

*Address common concerns and perceived barriers*

*Direct planners and designers to existing national guidelines*



*Olive Avenue, Complete Street, West Palm Beach, FL*

# Achieving Multimodal Networks: Applying Design Flexibility

These documents state the need for flexibility and encourage engineering judgement:

- MUTCD
- AASHTO Green Book
- Highway Capacity Manual

“The intent of this policy is to provide guidance to the designer by referencing a recommended range of values for critical dimensions. ***Good highway design involves balancing safety, mobility, and preservation of scenic, aesthetic, historic, cultural, and environmental resources.*** This policy is therefore not intended to be a detailed design manual that could supersede the need for the application of sound principles by the knowledgeable design professional. ***Sufficient flexibility is permitted*** to encourage independent designs tailored to particular situations.”

– AASHTO Green Book

# Achieving Multimodal Networks: Applying Design Flexibility

- Engineering Judgement

“This Manual should not be considered a substitute for engineering judgment.”

– MUTCD

- Documentation

“With reliance on complete and sound documentation, tort liability concerns need not be an impediment to achieving good road design.”

- *The Maine Department of Transportation’s Highway Design Guide,  
Chapter 15: Flexible Design Practices*

- Experimentation

Liability concerns should not limit innovations, experimentation and versatile applications of existing design treatments

# Achieving Multimodal Networks: Reducing Conflicts

## Guiding Principles

1. Safety
2. Accommodation and Comfort
3. Coherence and Predictability
4. Context-Sensitivity
5. Experimentation



*Capital City Trail, Madison, WI*

# Achieving Multimodal Networks: Design Topics

## PART 1: APPLYING DESIGN FLEXIBILITY

DESIGN CRITERIA AND LANE WIDTH

INTERSECTION GEOMETRY

TRAFFIC CALMING AND DESIGN SPEED

TRANSITIONS TO MAIN STREETS

ROAD DIETS AND TRAFFIC ANALYSIS

ENHANCED CROSSING TREATMENTS

SIGNALIZED INTERSECTIONS

PAVED SHOULDERS

SEPARATED BIKE LANES

BUS STOPS

BRIDGE DESIGN

SLOW STREETS

## PART 2: REDUCING CONFLICTS

NETWORK CONNECTIVITY

SCHOOL ACCESS

MULTIMODAL ACCESS TO EXISTING TRANSIT STATIONS

MULTIMODAL ACCESS TO NEW TRANSIT STATIONS

TRANSIT CONFLICTS

FREIGHT INTERACTION

ACCESSIBILITY

TURNING VEHICLES

SEPARATED BIKE LANES AT INTERSECTIONS

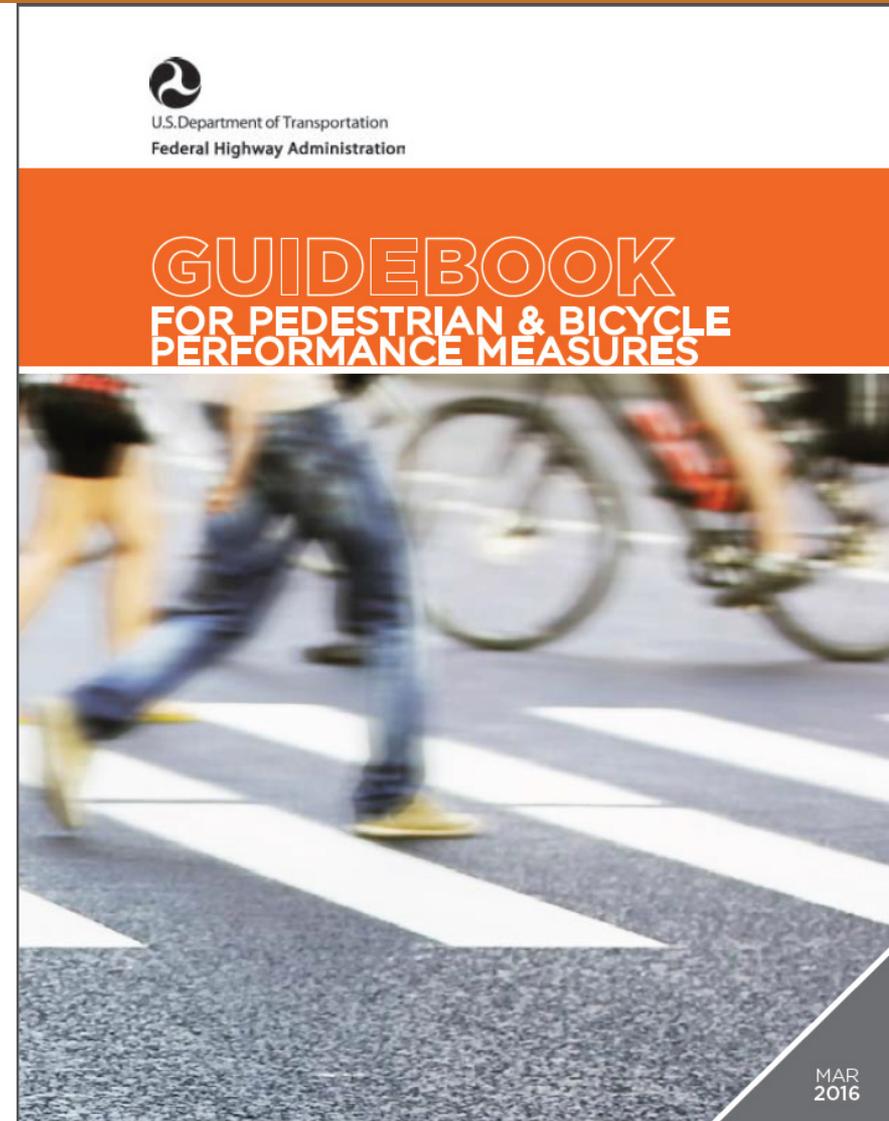
SHARED USE PATHS

MIDBLOCK PATH INTERSECTIONS

SHARED STREETS

# Performance Measures: Introduction

Transportation investment decisions are based on measurement and analysis. *Improving outcomes for walking and bicycling* requires measuring performance comprehensively.



# Performance Measures: Core Challenges

- Measuring performance with data available
- How to balance competing needs and impacts?
- Which measures “matter” in determining investment outcomes?
- How to differentiate “community goals” and “transportation measures?”

# Performance Measures: Goals and Transportation Measures

COMMUNITY GOALS CATEGORIES	TRANSPORTATION MEASURES CATEGORIES					
	ACCESSIBILITY	COMPLIANCE	DEMAND	INFRASTRUCTURE	MOBILITY	RELIABILITY
CONNECTIVITY	High			High	High	Low
ECONOMY	High			Low	High	High
ENVIRONMENT	High		High		Low	Low
EQUITY	High	Low	Low	High	High	Low
HEALTH	High	Low	High	High	Low	Low
LIVABILITY	High	Low	Low	High	Low	High
SAFETY	Low	High		High	Low	Low

# Performance Measures: Applications

How will performance measures be used?

- Evaluate planning scenarios
- Long-term benchmarking
- Comparing alternatives
- Project prioritization
- Near-term standard

AGENCY/APPLICATION	COMMON PERFORMANCE MEASURE APPLICATIONS				
	PLANNING SCENARIO EVALUATION	LONG-TERM BENCHMARK	ALTERNATIVES COMPARISON	PROJECT NEED/PRIORITIZATION	NEAR-TERM STANDARD
<b>LOCAL JURISDICTION (COUNTY, CITY)</b>					
SYSTEM/NETWORK PLANNING	X	X		X	
CORRIDOR OR PROJECT PLANNING	X		X	X	X
DEVELOPMENT REVIEW/ CODE COMPLIANCE	X		X		X
<b>REGIONAL PLANNING AGENCY (MPO)</b>					
SYSTEM/NETWORK PLANNING	X	X		X	
REGIONAL POLICY DEVELOPMENT		X			X
FUNDING ALLOCATION				X	
<b>STATE AGENCY (DOT)</b>					
STATEWIDE SYSTEM/ NETWORK PLANNING	X		X	X	
STATEWIDE POLICY DEVELOPMENT		X			X
FUNDING ALLOCATION				X	
CODE COMPLIANCE					X

# Performance Measures: Guidebook

- Establish performance measurement program
- Desktop reference tool

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## PERFORMANCE MEASURE

# NETWORK COMPLETENESS

The portion of the transportation network that is usable for people walking or bicycling, and represents the minimum accommodations needed for a facility to be considered part of the walking or bicycling network.

### GOALS

- CONNECTIVITY
- ECONOMIC
- ENVIRONMENT
- EQUITY
- HEALTH
- LIVABILITY
- SAFETY

### RELATED MEASURES

- "Connectivity Index"
- "Miles of Pedestrian/Bicycle Facilities"
- "Pedestrian Space"
- "Route Directness"

### CONTEXT

#### PERFORMANCE MEASURE APPLICATION

##### PROJECT PRIORITIZATION

A measure of network completeness can be used to prioritize projects that fill crucial gaps or meet unaddressed needs for walkers and bicyclists.

##### ALTERNATIVES COMPARISON

When comparing design options, an agency may consider how two or more possible configurations contribute to a more complete transportation network for those walking or biking.

##### SCENARIO EVALUATION (POSSIBLE)

Network Completeness can be applied in evaluating future scenarios of potential transportation investments and land use changes.

##### BENCHMARKING

An agency can report change over time through regular updates to inventories of intersection treatments, bicycle facilities, and sidewalks.

##### STANDARD

A performance baseline related to network completeness may call for a given percentage of the network to be completed each year or for a given percentage of sidewalks to meet ADA standards by a given year.

GEOGRAPHY	PREFERRED	POSSIBLE
STATE	<input checked="" type="checkbox"/>	<input type="checkbox"/>
REGION	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LOCAL	<input checked="" type="checkbox"/>	<input type="checkbox"/>
LAND USE CONTEXT	PREFERRED	POSSIBLE
URBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SUBURBAN	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RURAL	<input type="checkbox"/>	<input checked="" type="checkbox"/>

## HOW TO TRACK

In some cases, agencies set a threshold for what qualifies as complete based on the context of the street (e.g., wider sidewalks in commercial areas or separated bike lanes in higher traffic conditions).

System completeness can be defined and measured in a variety of ways:

- Percent of roadway miles with complete sidewalks or bicycle facilities on both sides.
- Percent of planned pedestrian or bicycle network that is constructed.
- Percent of pedestrian or bicycle or roadway system that serves pedestrian and bicycle users ages 8 to 80.
- Percent of signalized intersections that have complete pedestrian and bicycle facilities, such as detection, push buttons or pedestrian-recall, striped crossings.
- Percent of sidewalk facilities accessible to users of all abilities.
- Percent of arterial and collector roadways with crossing opportunities every XX miles.

System completeness and inventory information can be reported as an aggregate measure (e.g., total miles of bike lanes) or stored in a GIS database.

## DATA NEEDS & SOURCES

Inventory data for:

- Roadways.
- Sidewalks.
- Bike facilities.
- Pavement markings.
- Signs.
- Signals.

## PEERS TRACKING THE MEASURE

- Most agencies maintain an inventory of sidewalk, crosswalk, and/or bicycle lane infrastructure.
- A number of agencies, including the City of Oakland (California), the City of Boulder (Colorado), Montgomery County (Maryland), and Delaware DOT measure network connectivity using the Level of Traffic Stress method.<sup>48</sup> LTS is an effective measure for assessing the completeness of a network, particularly because it highlights all streets that are appropriate for the "interested but concerned" bicycling demographic. LTS also highlights areas of concern where the network is not complete and uncomfortable for less experienced bicyclists.

## NOTES

Completeness can be a subjective term and should be explicitly defined. For example, a minimum width of a sidewalk should be identified to qualify as part of a complete system.

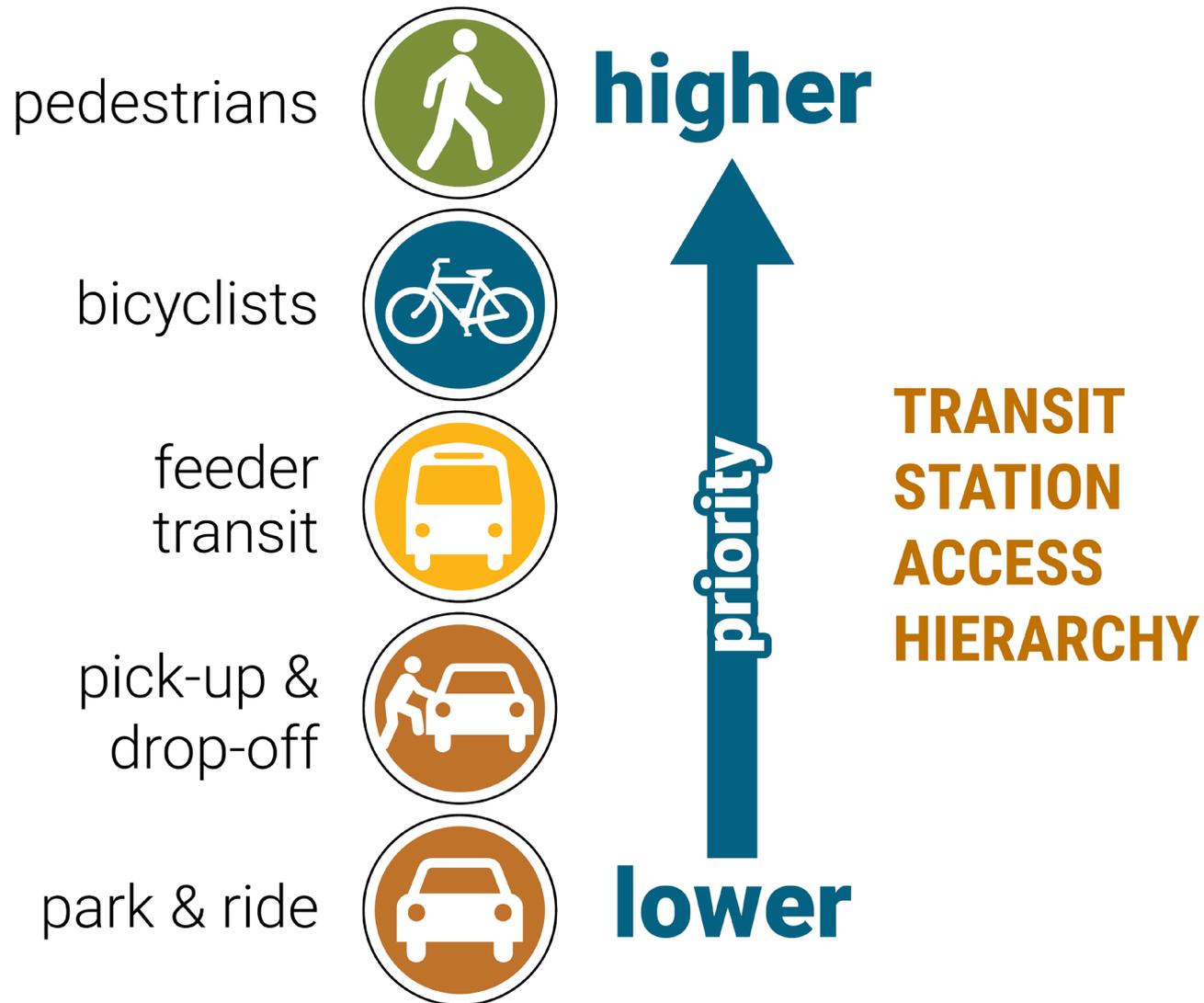
Collecting inventory data can be time consuming and expensive, and some agencies lack documentation on pedestrian and bicycle infrastructure. With ever improving photographic inventories such as third party aerial photography and street-level photo inventories, agencies may be able to collect bulk information much more easily.

Network Completeness can be tied in with agencies' ADA Transition Plans, which require DOTs and other agencies to identify barriers to access for persons with disabilities.

# Access and Equity

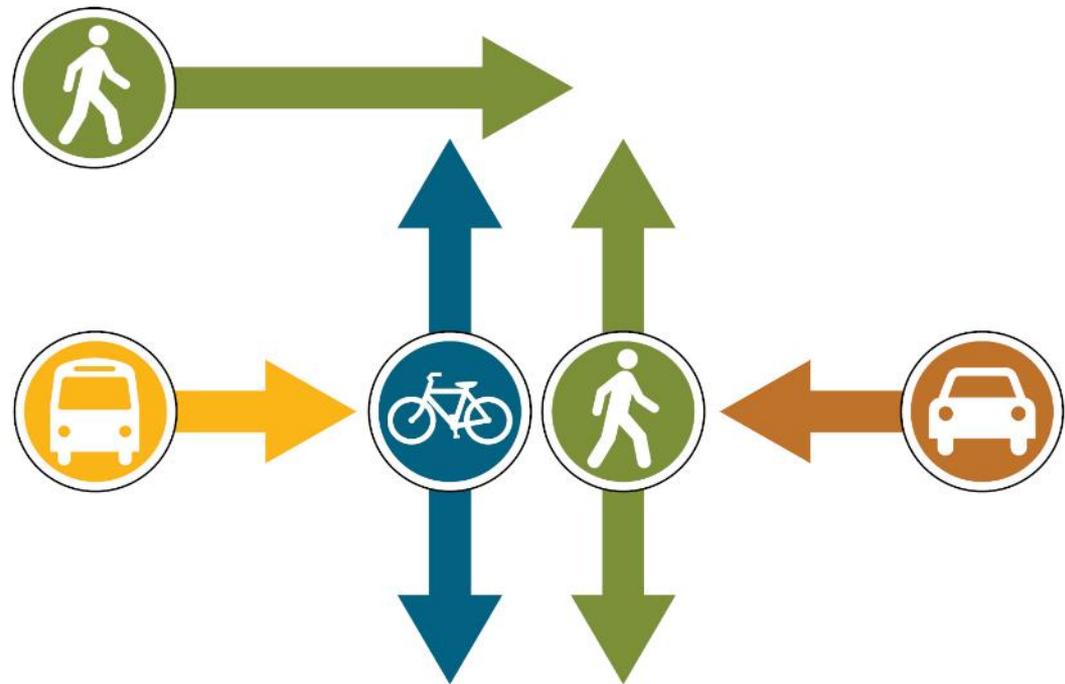
The background features a large, abstract geometric shape on the left side, divided into two horizontal sections. The top section is a dark olive green, and the bottom section is a lighter, muted green. The right side of the image is plain white.

# Achieving Multimodal Networks: Multimodal Access to Transit Stations



# Achieving Multimodal Networks: Multimodal Access to Transit Stations

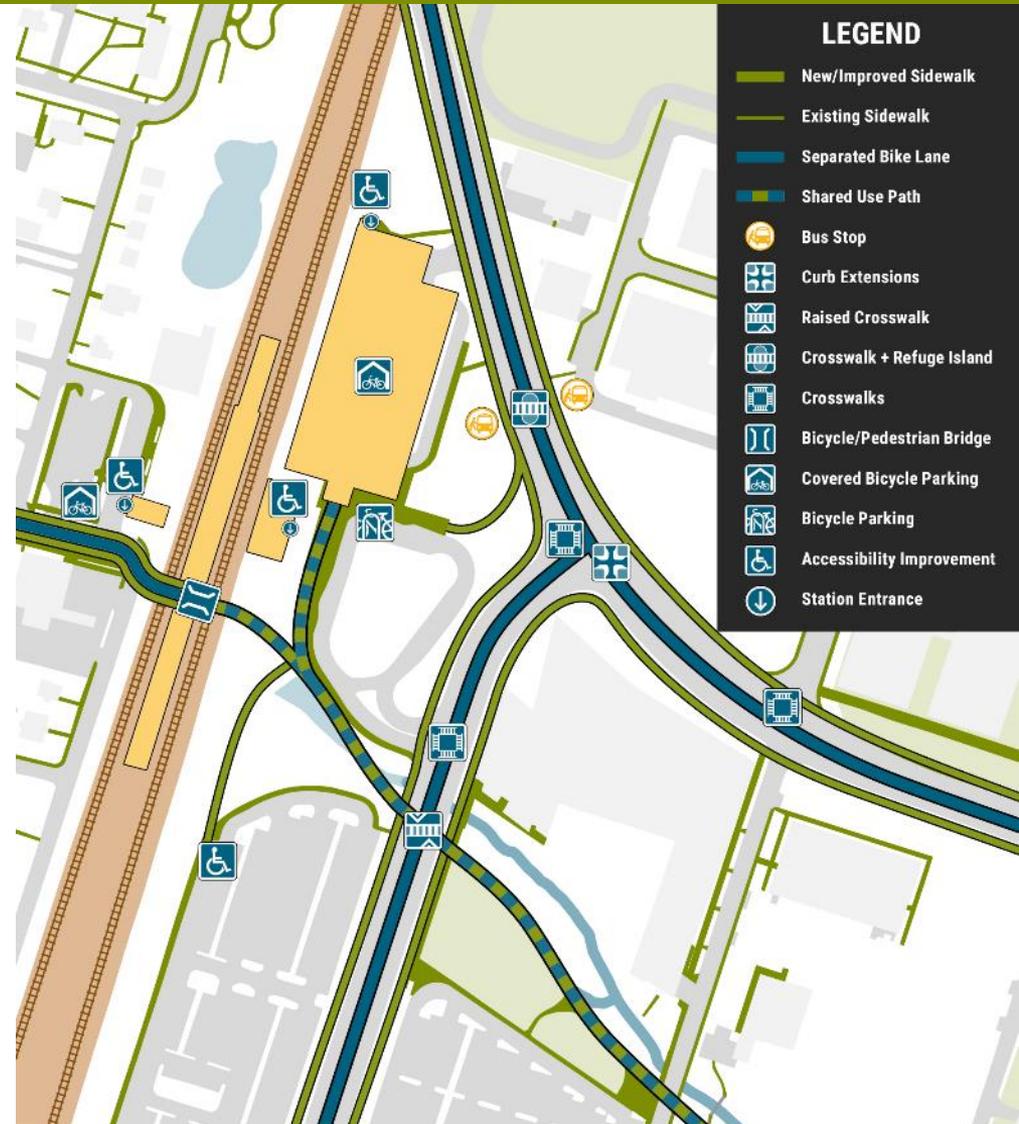
Poor site planning at transit stations can contribute to crashes between various modes accessing the station.



# Achieving Multimodal Networks: Multimodal Access to Transit Stations

## Design strategies:

- Street crossings
- Reduce crossing distances & curb radii
- Desire lines
  - Walk & bike shed analysis
  - Assessments



# Achieving Multimodal Networks:

## Case Study: MBTA Bicycle Parking, Boston, MA

- High-quality bicycle parking facilities at stations
- Station inventory
- Site-specific design treatments
  - Access
  - Circulation
  - Safety
  - Visibility
  - Number of spaces
- Pedal & Park facilities

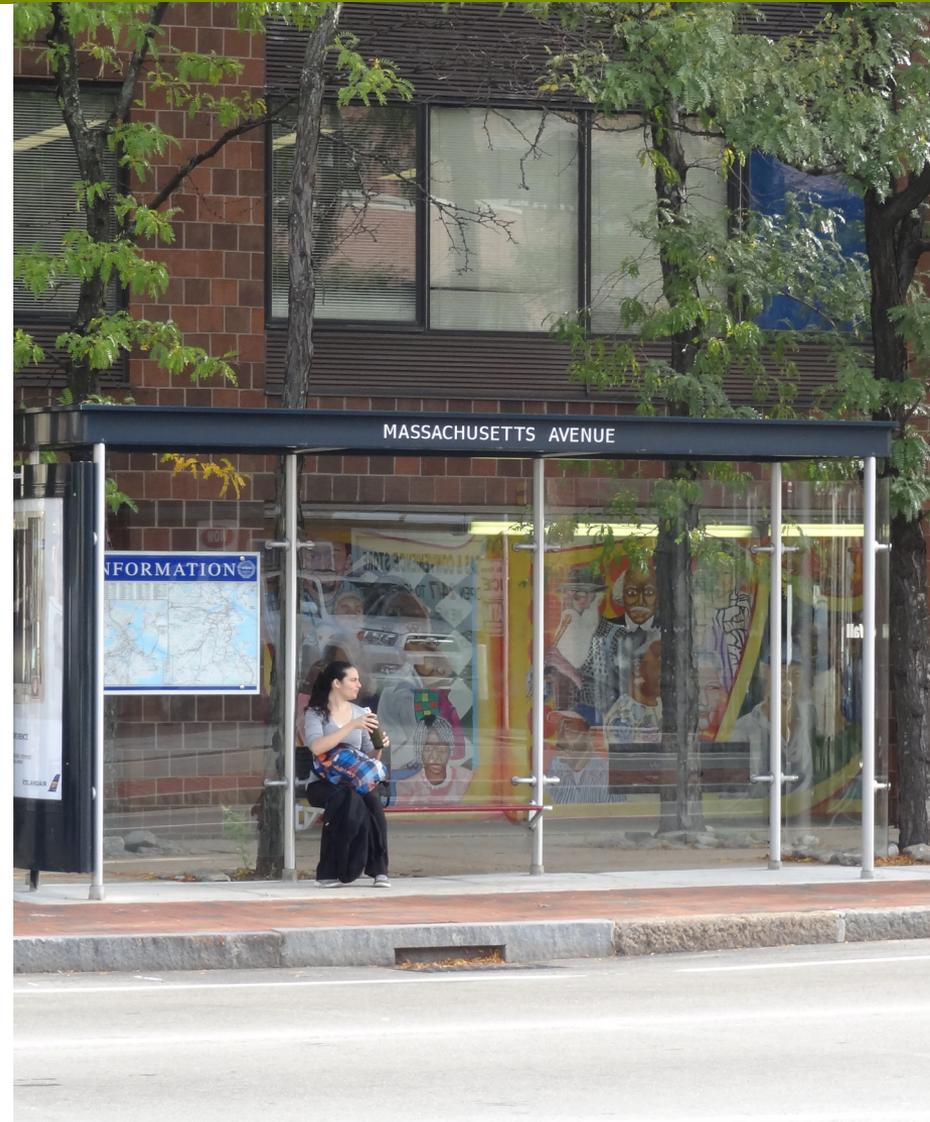


# Achieving Multimodal Networks: Transit Conflicts

## Bus Stop Placement

### Considerations:

- Bus stop spacing
- Pedestrian & bike connectivity
- Placement at intersections





# Performance Measure: Access to Community Destinations

## How to Track

Common access to destinations measures include:

- Proportion of destinations within walk/bike distance
- Proportion of comfortable infrastructure within walk/bike distance
- Percent of network complete within walk/bike distance
- Number of destinations accessible within walk/bike distance

## DATA NEEDS & SOURCES

- Local parcel data.
- GIS data on schools, parks, healthcare centers, and other daily destinations.
- NAICS coded employment data, available from the U.S. Bureau of Labor Statistics.
- GIS data on transportation network for all modes.
- Optional: Demographic data from the U.S. Census Bureau.

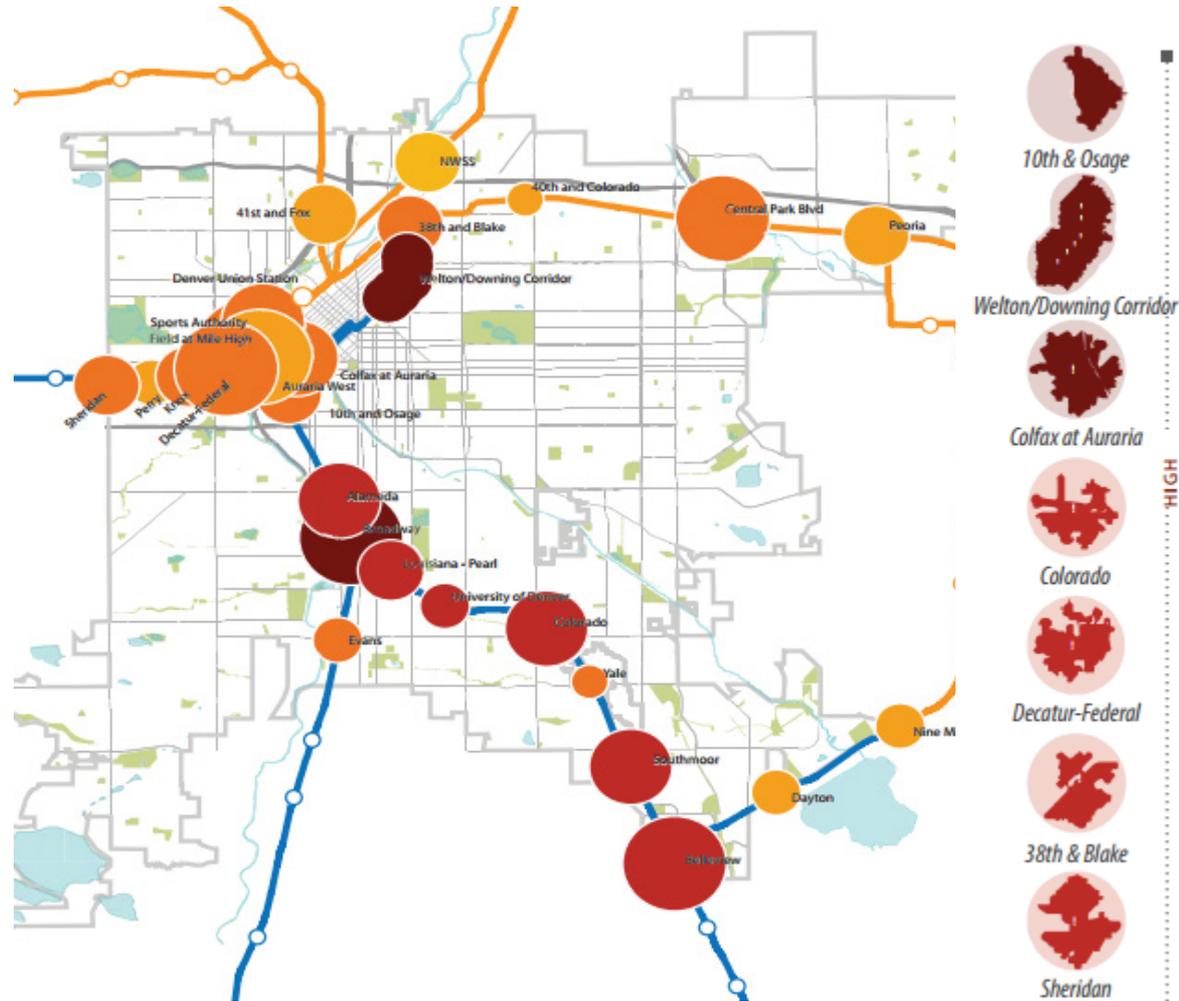
# Performance Measure: Population Served by Walk/Bike/Transit

## Definition

*The proximity of pedestrian, bicycle, and transit infrastructure and services (e.g., travel time, distance) to residential populations.*

## Application

- *Project Prioritization*
- *Alternatives Comparison*
- *Scenario Evaluation*
- *Benchmarking*
- *Standard*



# Performance Measure: Population Served by Walk/Bike/Transit

## How to Track

Common methods to evaluate access to walk/bike/transit facilities include:

- Percent of population within 1/2-mile walk or 2-mile bike to transit station
- Percent of population within 1/4-mile distance to sidewalk, trail, or bike facility
- Percent of transit stops that are accessible

## DATA NEEDS & SOURCES

- U.S. Census demographic data.
- GIS transportation network for all modes.

# Performance Measure: Transportation-Disadvantaged Population Served

## Definition

*The proportion of low income, minority, senior, and disabled populations with access to pedestrian, bicycle, and transit infrastructure and services.*

## Application

- *Project Prioritization*
- *Alternatives Comparison*
- *Scenario Evaluation*
- *Benchmarking*
- *Standard*

### THE FIVE E'S FRAMEWORK

Improving bicycle and pedestrian connectivity and safety is a significant component of the Plan, but creating a Bike and Walk Friendly Community takes more than just new trails, bike lanes and sidewalks. In order to create significant and lasting change, the Plan utilizes the Five E's framework to establish bicycling and walking as comfortable, safe and convenient transportation choices for people of all ages and abilities. Initially developed by the League of American Bicyclists, the Five E's framework consists of education, encouragement, enforcement, engineering and evaluation tactics to support active transportation. This unique, holistic approach to community transformation addresses the physical, social, and policy environments

that influence transportation decisions and behaviors, creating meaningful opportunities to build a culture that values and supports walking and bicycling.

An additional E - equity - is often grouped with the Five E's to address access and opportunity for disadvantaged and low income populations within the community. There is, however, an important distinction between equity and the Five E's: equity is a guiding principle and desired outcome, whereas the Five E's are tools used to achieve the vision and goals of the Plan. The graphic below shows how equity is incorporated into the planning framework as an overarching principle that guides planning process and is integrated into all plan recommendations.

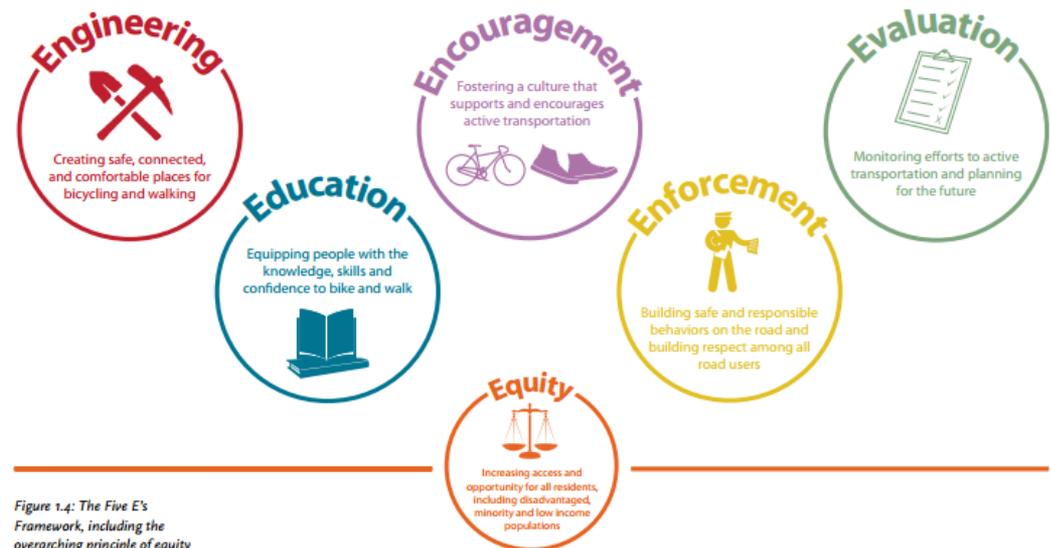


Figure 1.4: The Five E's Framework, including the overarching principle of equity

# Performance Measure:

## Transportation-Disadvantaged Population Served

### How to Track

Evaluate the transportation system effectiveness in providing access to sidewalks, bicycle facilities, and transit stops for transportation-disadvantaged populations.

- Proportion of destinations within walk/bike distance
- Proportion of comfortable infrastructure within walk/bike distance
- Percent of network complete within walk/bike distance
- Number of destinations accessible within walk/bike distance

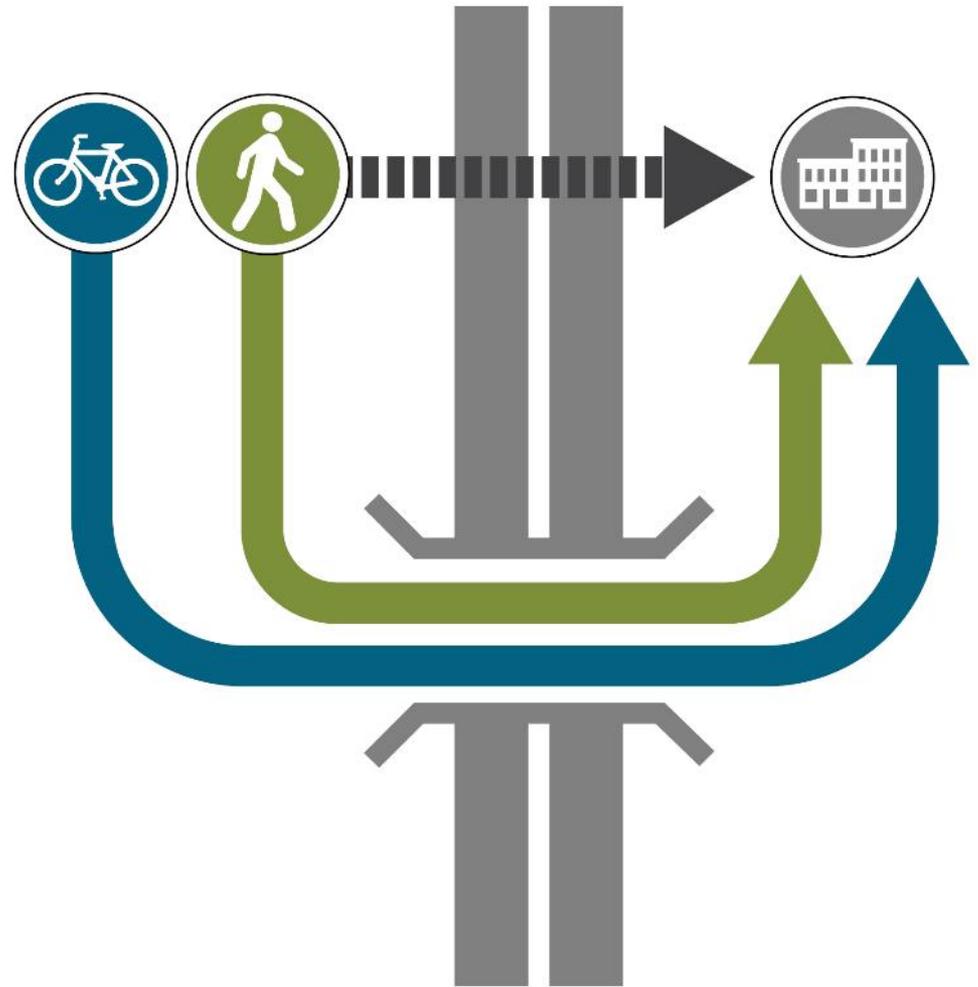
### DATA NEEDS & SOURCES

- U.S. Census demographic data, including income, levels of poverty, zero-car households, seniors, children.
- GIS transportation network for all modes, including existing and proposed pedestrian and bicycle infrastructure. This data is usually found in local GIS Clearinghouses and/or from relevant local, regional, and State agencies.

# Physical Characteristics

# Achieving Multimodal Networks: Network Connectivity

A well-connected network of pedestrian and bicycle facilities reduces conflicts by providing access where desired.



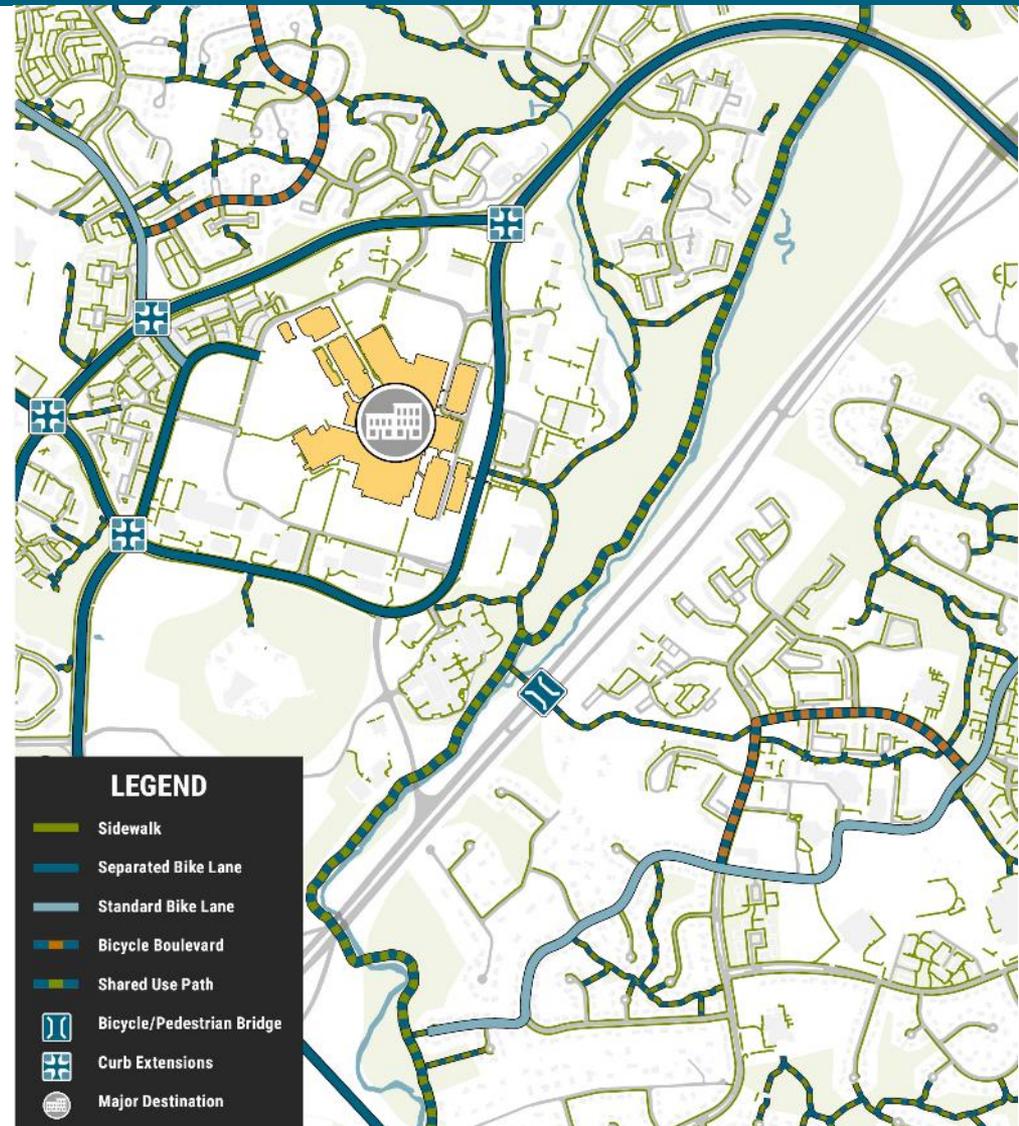
# Achieving Multimodal Networks: Network Connectivity

## Network challenges:

- Disconnected street networks
- Barriers

## Considerations:

- Pedestrian facilities
- Bicycles facilities
- Shared use paths



# Achieving Multimodal Networks: Intersection Geometry

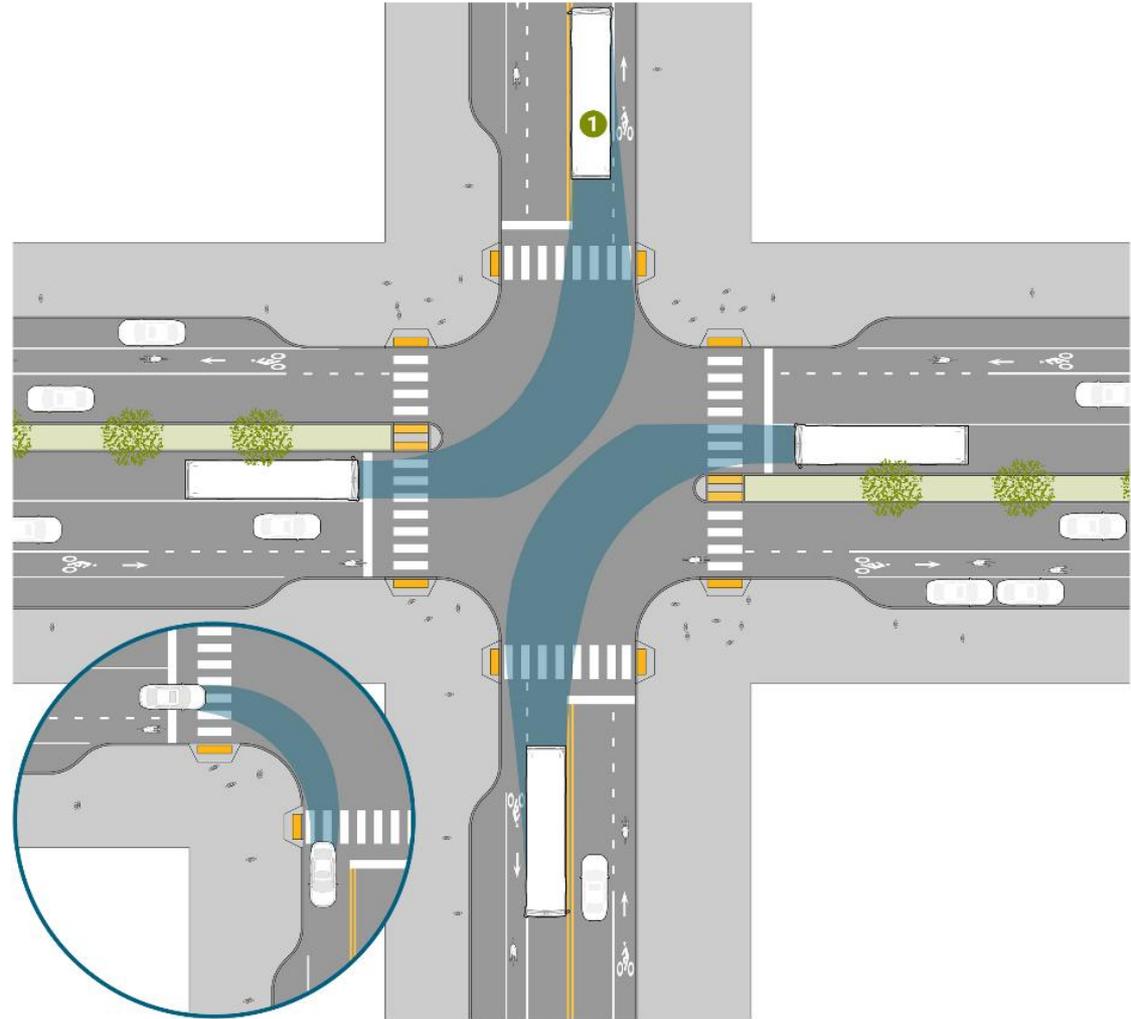
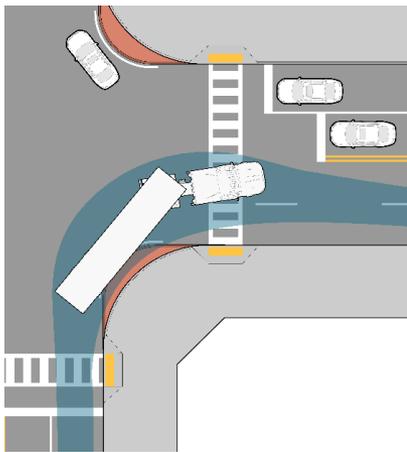
*“If turning traffic is nearly all passenger vehicles, it may not be cost-effective or pedestrian friendly to design for large trucks. However, the design should allow for an occasional large truck to turn by swinging wide and encroaching on other traffic lanes without disrupting traffic significantly.”*

**AASHTO Green Book 2011, p. 9-80**



# Achieving Multimodal Networks: Intersection Geometry

- Layout
- Curb radii
- Curb extension
- Design vehicle
- Truck aprons



# Achieving Multimodal Networks: Bridge Design

*"Integrating bicycle and pedestrian accommodation on new, rehabilitated, and limited-access bridges: DOT encourages bicycle and pedestrian accommodation on bridge projects including facilities on limited-access bridges with connections to streets or paths."*

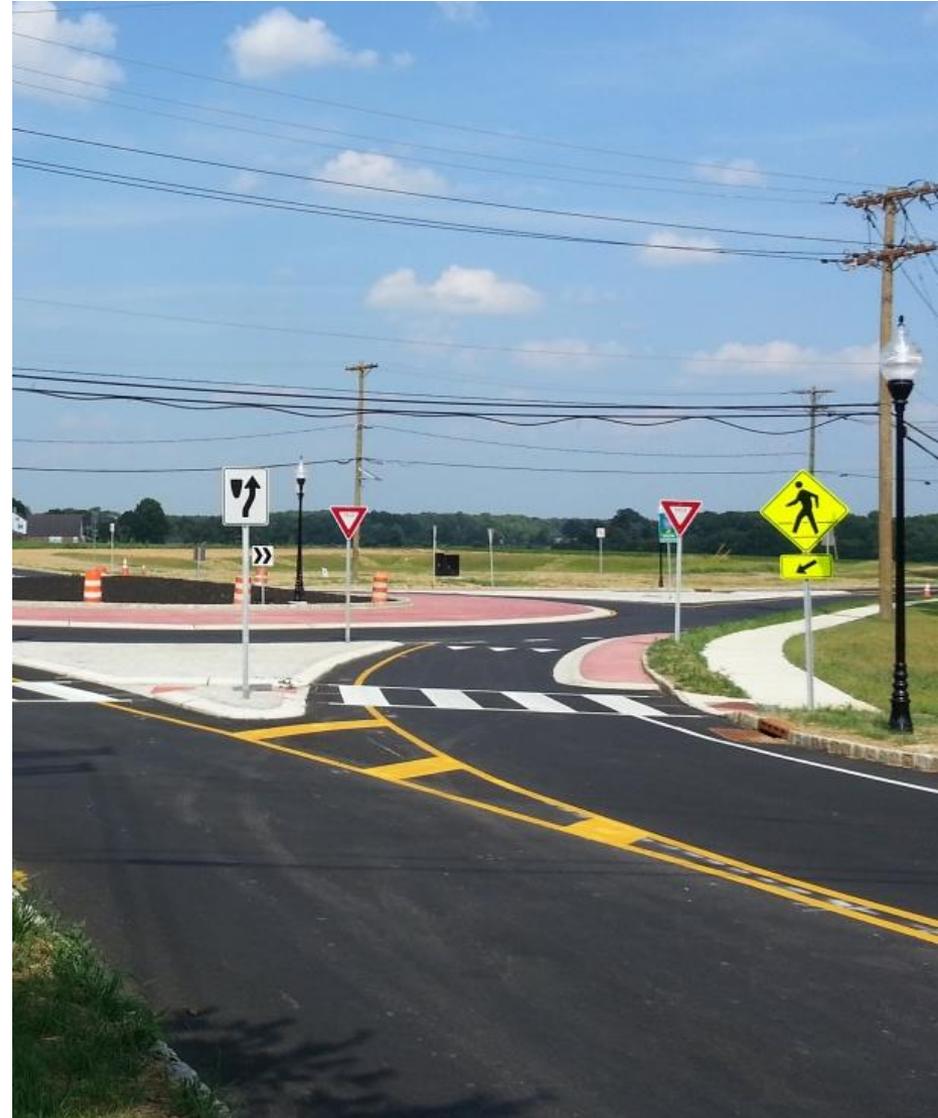
**U.S. DOT Policy Statement on  
Bicycle and Pedestrian  
Accommodation Regulations  
and Recommendations 2010**



# Achieving Multimodal Networks:

## Case Study: Truck Aprons, Burlington County, NJ

- Two-way stop control replaced with modern roundabout
- Maintains desired entering car speed
- Accommodates tractor trailers (WB-67)
- Mountable curb with minimum 3" reveal
- Stamped red concrete



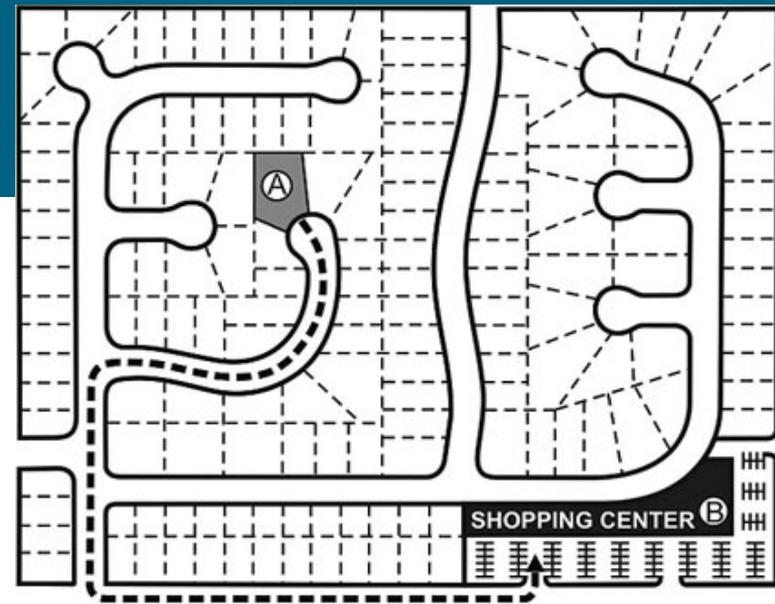
# Performance Measure: Connectivity Index

## Definition

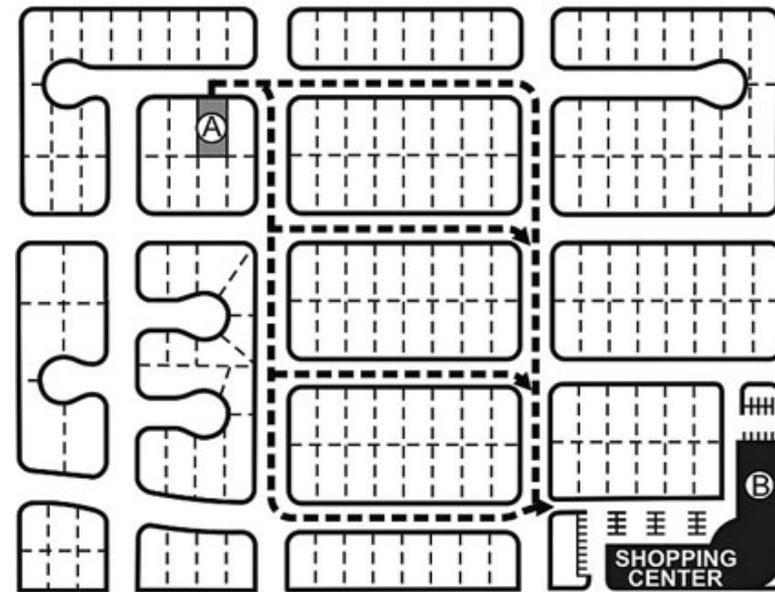
*Connectivity is a representation of the number and directness of travel routes and options available to a user, while a connectivity index represents a number of specific measures used to assess walking and biking connectivity in a specific area*

## Application

- *Project Prioritization*
- *Alternatives Comparison*
- *Scenario Evaluation*
- *Benchmarking*
- *Standard*



(A) Conventional suburban hierarchical network.



(B) Traditional urban connected network.

Source: ITE

# Performance Measure: Connectivity Index

## How to Track

A variety of metrics can be used as connectivity indices:

- Intersection Density
- Intersections per Linear Mile
- Network Density
- Connected Node Ratio
- Link-to-Node Ratio
- Polygon Density

## DATA NEEDS & SOURCES

- GIS transportation networks for each mode to be evaluated are needed to apply a connectivity index measure to an area larger than a few blocks.
- Aerial imagery or static maps can be used to manually calculate connectivity for small areas.
- Long range plans.
- STIP/TIPs.

# Performance Measure: Network Completeness

## Definition

*The portion of the transportation network that is usable for people walking or bicycling, and represents the minimum accommodations needed for a facility to be considered part of the walking or bicycling network*

## Application

- *Project Prioritization*
- *Scenario Evaluation*
- *Benchmarking*
- *Standard*



# Performance Measure: Network Completeness

## How to Track

Some of the common measures are % of:

- Roadway miles with complete facilities
- Planned network that is constructed
- Signalized intersections that have complete facilities
- Sidewalk facilities accessible to users of all abilities
- Bus stops with accessible boarding and alighting areas

## DATA NEEDS & SOURCES

Inventory data for:

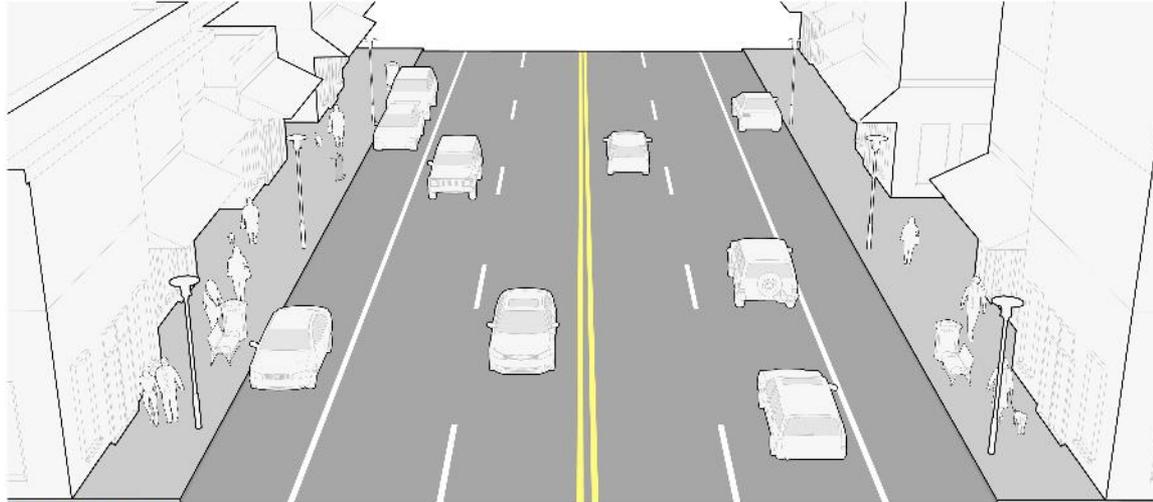
- Roadways.
- Sidewalks.
- Bike facilities.
- Pavement markings.
- Signs.
- Signals.

# Safety and Behavior

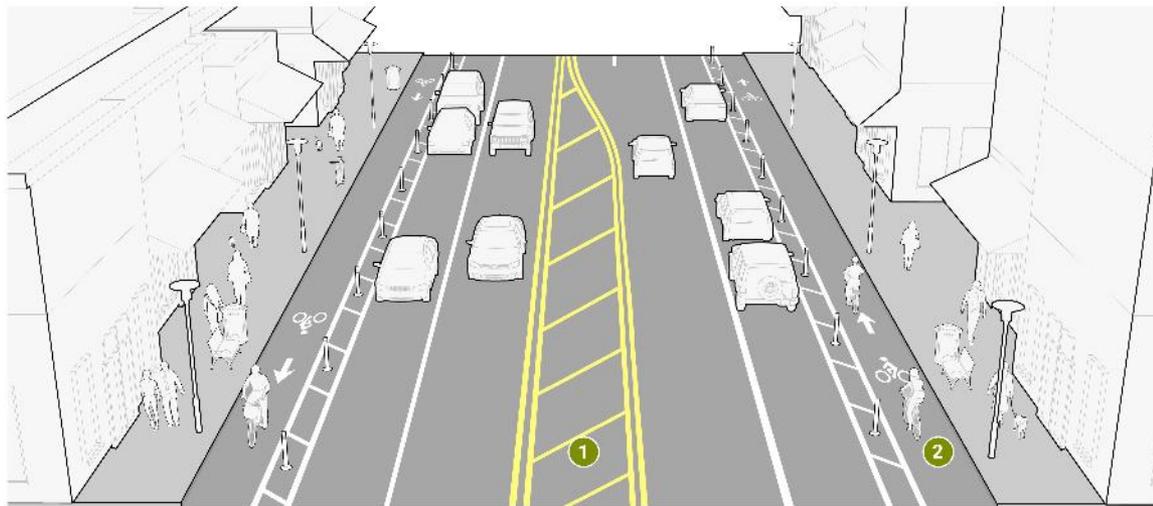
# Achieving Multimodal Networks: Road Diets and Traffic Analysis

## Safety benefits

- Crash reduction
- Reduced pedestrian crossing distance
- Space for standard or separated bike lanes



BEFORE ROAD DIET



AFTER ROAD DIET

# Achieving Multimodal Networks: Road Diets and Traffic Analysis

*"Analysts and decision-makers should always be mindful that neither LOS [Level of Service] or any other single performance measure tells the full story of roadway performance."*

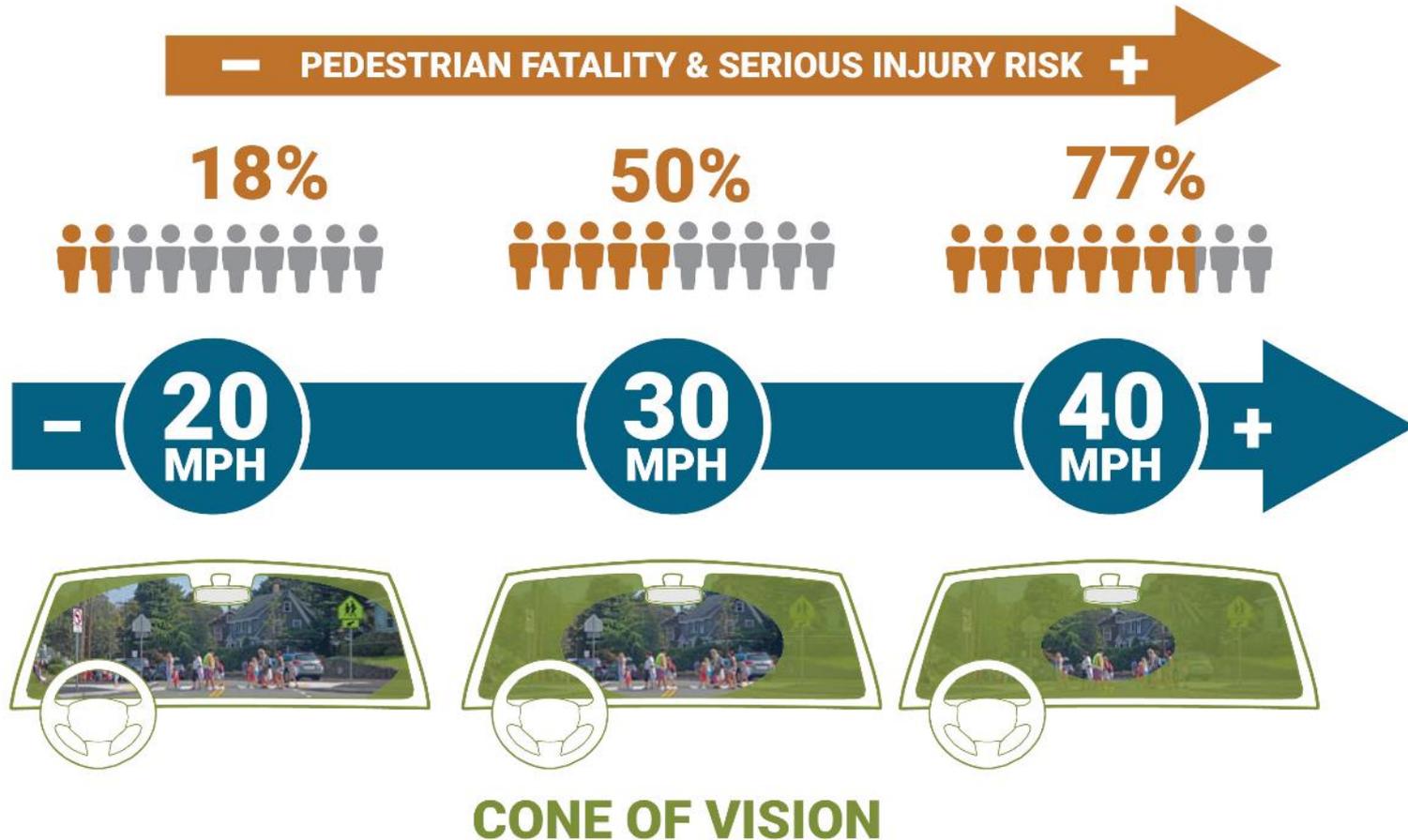
**TRB Highway Capacity Manual 2010, p. 8-11**

*"As always, engineering judgment should be applied to any recommendations resulting from HCM (or alternative tool) analyses."*

**TRB Highway Capacity Manual 2010, p. 8-20**

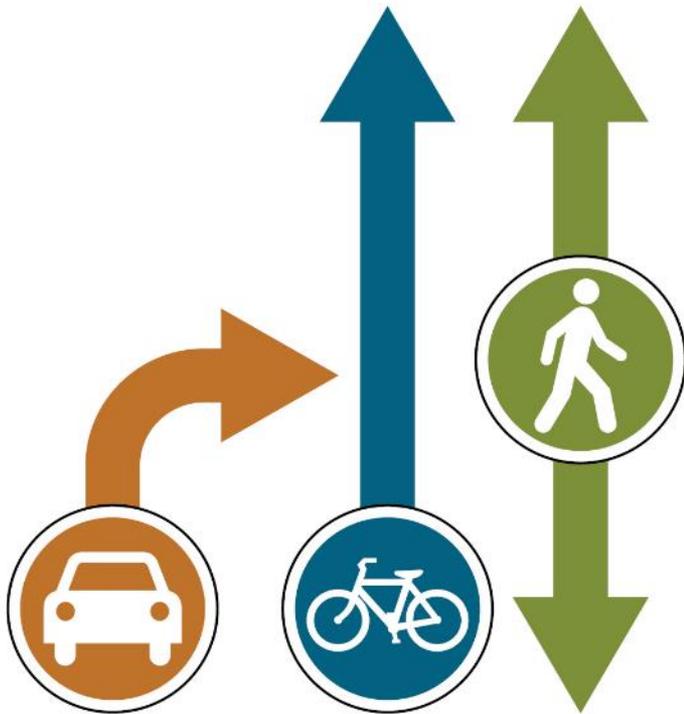


# Achieving Multimodal Networks: Design Speed

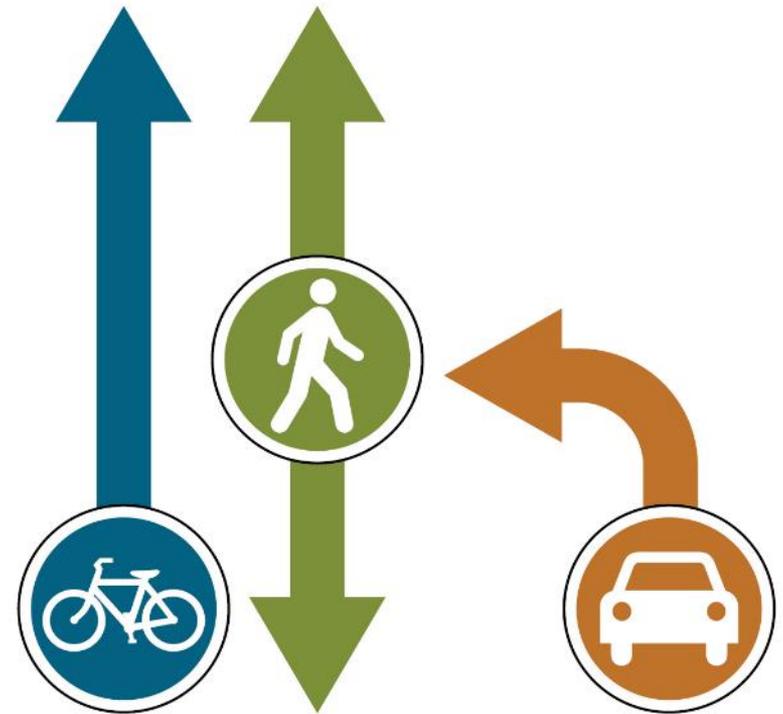


*"The severity of pedestrian crashes, a significant concern in urban areas, is greatly increased as speeds increase."*

# Achieving Multimodal Networks: Turning Vehicles



**Right-turning vehicles crossing through bicyclists or pedestrians is known as a “right hook” crash**

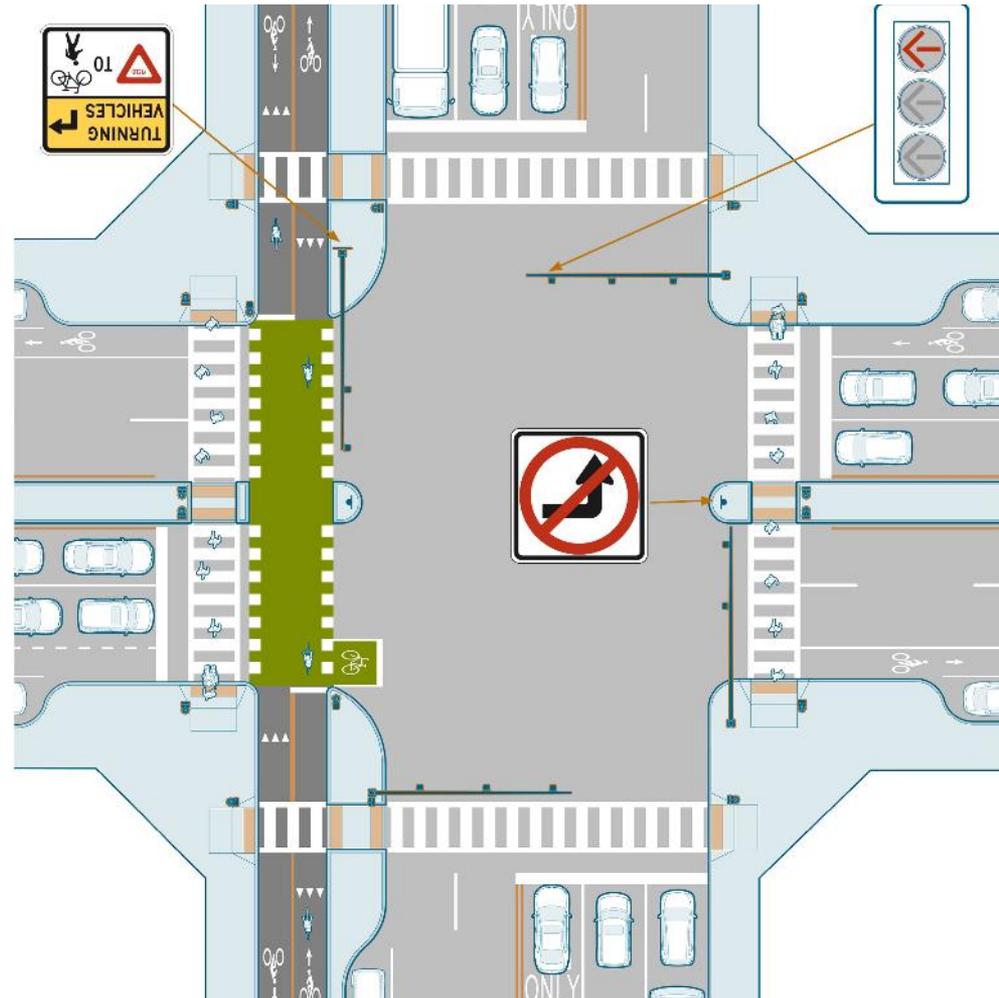


**“Left hooks” are similar, where left-turning vehicles come into conflict with opposing traffic traveling straight**

# Achieving Multimodal Networks: Turning Vehicles

## Design strategies:

- Signalized intersections
- Crossings
- Pavement markings
- Separated bike lanes
- Signs
- Intersection geometry



# Achieving Multimodal Networks:

## Case Study: Lawyers Road, Reston, VA

- Two mile Road Diet
- 4-lane roadway reduced to one travel lane each direction, continuous center turn lane
- Added 5 ft bike lanes in each direction
- Travel speeds over 50 mi/h fell from 13 to 1 percent of daily traffic



# Performance Measure: Crashes

## Definition

*The measured number of crashes or rate of crashes over a period of time, typically separated into modes and severity*

## Application

- *Project Prioritization*
- *Alternatives Comparison*
- *Benchmarking*

**ILLINOIS TRAFFIC CRASH REPORT** **TEM**

**DIE CUT AREA**

TYPE OF FIRST CRASH (COLL)		PED/PEDAL LOCATION (PPL)																																																			
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**CRASH DATA SAVES LIVES!**

# Performance Measure: Crashes

## How to Track

Some of the common measures are:

- Number of bicycle-involved and/or pedestrian-involved crashes over 5 years.
- Number of fatal or serious injuries of bicyclists and/or pedestrians over 5 years.
- Crashes per volume of bicyclists and/or pedestrians over 5 years (crash rates).

## DATA NEEDS & SOURCES

- Local or State crash report database.
- State reported data.
- Fatality Analysis Reporting System (*FARS*).
- Potentially: emergency room visit data.
- Pedestrian and bicycle counts (volumes).
- Demographic information.
- Facility inventories.
- *Highway Safety Improvement Program Online Reporting Tool*.
- Highway Performance Monitoring System (HPMS).
- State Highway Safety Plan (HSP) and the State Strategic Highway Safety Plan (SHSP).

# Questions?

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- ⇒ **Archive at [www.pedbikeinfo.org/webinars](http://www.pedbikeinfo.org/webinars)**  
Download a video recording and presentation slides
- ⇒ **Questions?**
  - ⇒ **Dan Goodman [daniel.goodman@dot.gov](mailto:daniel.goodman@dot.gov)**
  - ⇒ **Michelle Danila [mdanila@tooledesign.com](mailto:mdanila@tooledesign.com)**
  - ⇒ **Carl Sundstrom [sundstrom@hsrc.unc.edu](mailto:sundstrom@hsrc.unc.edu)**
  - ⇒ **Conor Semler [csemler@kittelson.com](mailto:csemler@kittelson.com)**
  - ⇒ **General Inquiries [pbic@pedbikeinfo.org](mailto:pbic@pedbikeinfo.org)**

# Coming Soon!

- Provides a bridge between existing guidance on bicycle and pedestrian design and rural practice.
- Encourages innovation in development of safe and appealing networks for bicycling and walking in small towns and rural areas.
- Provide examples of peer communities and project implementation that is appropriate for rural communities.



DECEMBER 2016

## Small Town & Rural Multimodal Networks



U.S. Department of Transportation  
Federal Highway Administration

**DRAFT**  
**SEPTEMBER 2016**  
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