PBIC Webinar

How to Create a Bicycle Safety Action Plan: Off-Road Bicycle Facilities

Christopher Douwes, Federal Highway Administration

Bill Schultheiss, Vice President, Toole Design

Peter Lagerwey, Regional Director, Toole Design

Oct. 30, 2014, 2 pm

Today's Presentation

- **Introduction and housekeeping**
- **Audio issues?**
  Dial into the phone line instead of using "mic & speakers"
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- **Questions at the end**

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

- Incorporate safe and convenient walking and bicycling facilities into transportation projects.
- Every transportation agency has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems.
- Transportation agencies are encouraged to go beyond minimum standards to provide safe and convenient facilities for these modes.

U.S.Department of Transportation
Federal Highway Administration

Network Background and Context

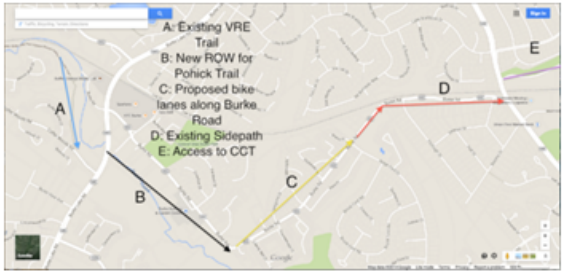
- Networks will include a combination of facility types and should provide seamless travel through intersections and across bridges and other potential barriers.
- Connected pedestrian and bicycle networks will include both on and off-road facilities.
- Connected networks will include seamless transitions between different facilities.

Greater Greater Washington
The Washington, DC area is great. But it could be **greater**.

New bike lanes will close a big trail gap in Burke

by Canaan Merchant • October 24, 2014

There's a big gap between two of Fairfax County's major bike trails. Burke Road, which connects them, has missing sidewalks, narrow stretches, and sharp curves that make riding on it intimidating for cyclists. Two new projects will help remedy the issue.



A map of proposed changes. Image from Google Maps with edits by the author.

The section of Burke Road we're looking at is about two miles long, and it provides the straight and flattest connection from the Cross County Trail to the Burke VRE Trail. The Cross County Trail extends 40 miles from north to south in Fairfax, and the county recently built the Burke VRE trail to add a sizable neighborhood trail system in the Burke area.

The first phase will extend the Pohick Creek Trail across Burke Lake Road, routing cyclists and pedestrians behind a busy commercial area whose multiple entrances are a hazard. The project received funding last year but has yet to really ramp up.

Examples: Projects that Improve Networks

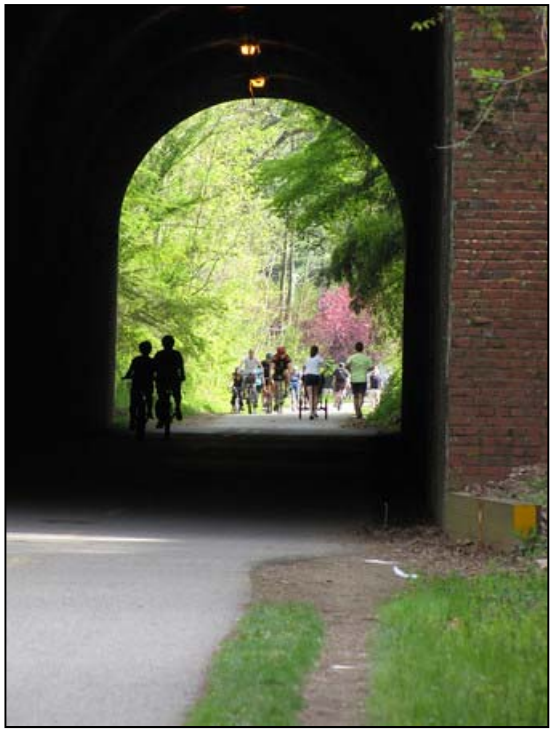
- A project adds bike lanes as part of a routine resurfacing process, linking other bike lanes and a shared use path.
- A community constructs a shared use path to connect a neighborhood to a school, shopping center, and health care facility.
- A community links together a combination of sidewalks and shared use paths to provide access between a school and a popular community park, allowing children to walk and bicycle safely.

Integrating Transportation and Recreation (It isn't either/or)

- We can and should integrate transportation and recreation infrastructure.
- Trails often are bicycle and pedestrian through routes: spines for nonmotorized networks.

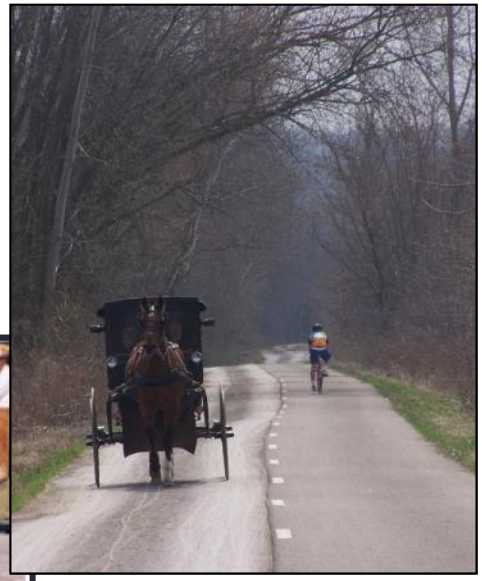
Bridges and Overpasses: Essential Links for Networks

Tunnels and Underpasses: Essential Links for Networks



Recreational Trails Used for Transportation

- Rail-trails and other shared use paths.
- No Federal law or regulation requires pavement, although accessibility requires “firm and stable”.
- No Federal law or regulation prohibits equestrian use.



Integrating Transportation and Recreation: Resources

- Shared Use Path presentation: www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/design_nonmotor/shared/
- Recreational Trail presentation: www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/design_nonmotor/recreation/

U.S. Department of Transportation
Federal Highway Administration

Pedestrian and Bicycle Information Center

Off-Road Bicycle Facilities

Planning for Safety

Presented by:

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and

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October 30, 2014

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Outcomes

At the end of this series, you will be able to…

- Recognize a bicycle-friendly network of roads and trails will increase cyclists' safety.
- Describe how planners and engineers develop bicycle plans that directly address safety.
- Recognize bicyclists are a diverse subset of travelers with wide ranging skill and tolerance of traffic stress.
- Identify good practices and effective Countermeasures to enhance bicycle safety and accessibility.


October
2014
SUNDAY
MONDAY
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY
1: Planning for Bicycle Safety
2: On-Road Bicycle Facilities
3: Off-Road Facilities
1
2
3
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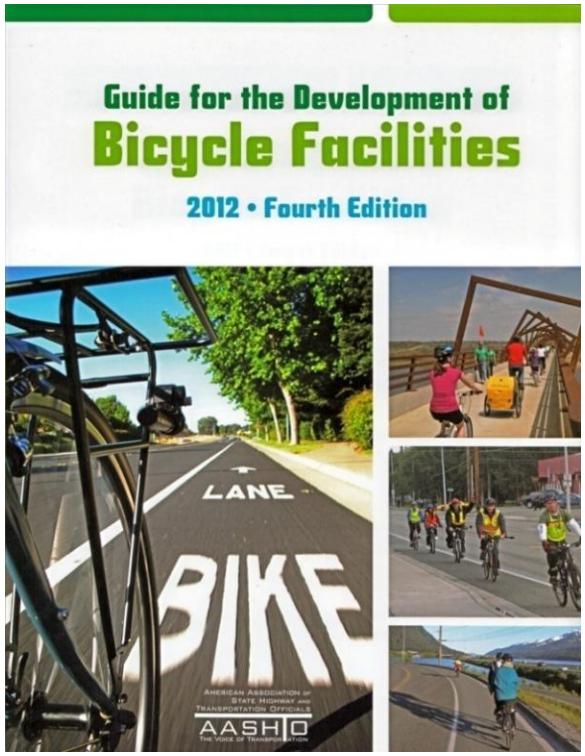
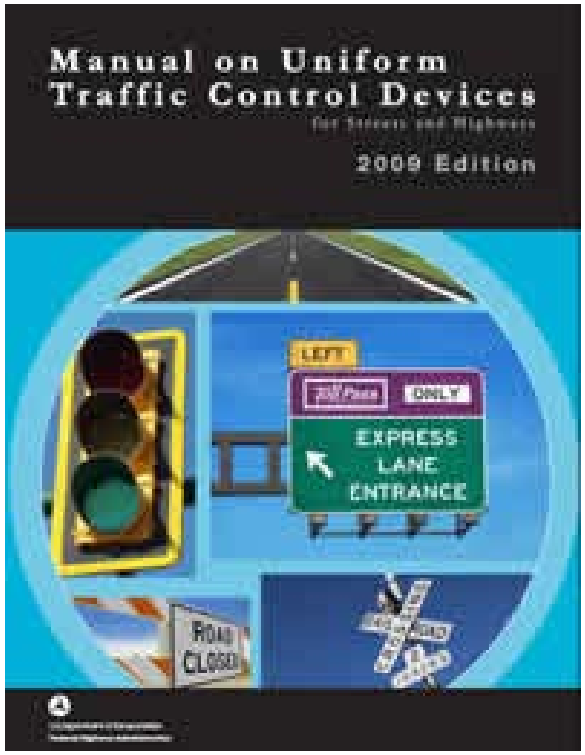
Section 1

Resources & Safety Analyses Approaches

National Design Resources

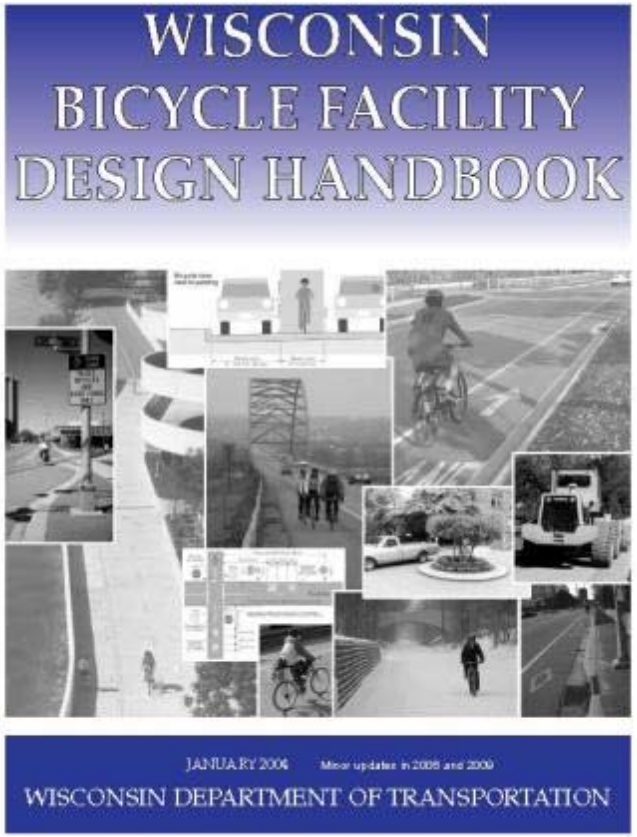


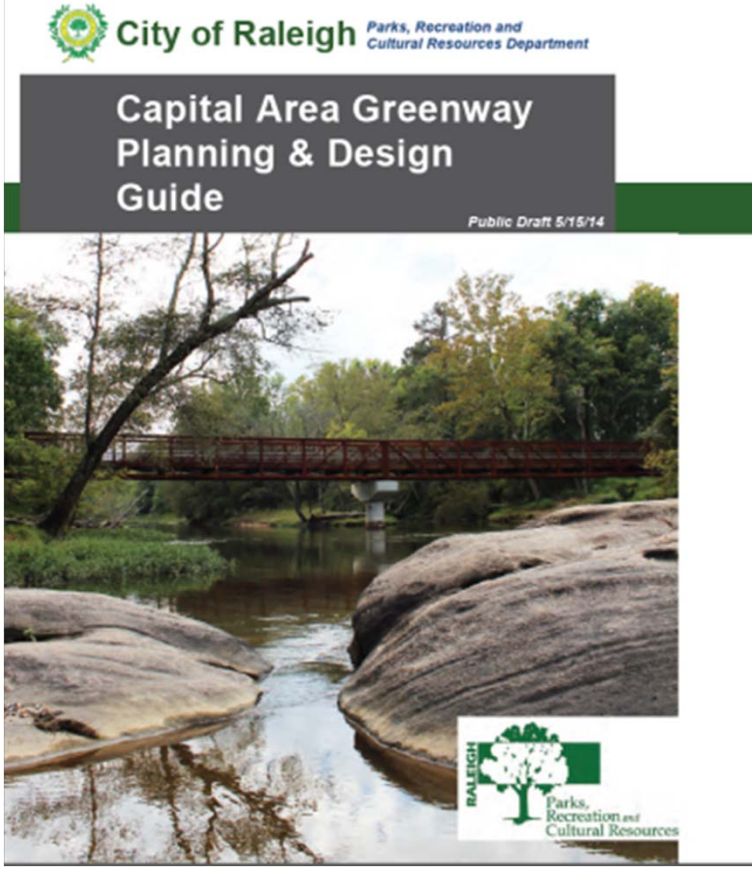


National Design Resources

http://www.access-board.gov/guidelines-and-standards/streets-sidewalks

Local Design Resources





Crash Context

Section 2

Overview of Bicycle Safety Problem

In 2012:

- 726 killed
- 49,000 injured
- Cyclist account for over 2% of all traffic deaths and injuries

...but are only 1% of all traffic

Common Crash Types

Mid-path

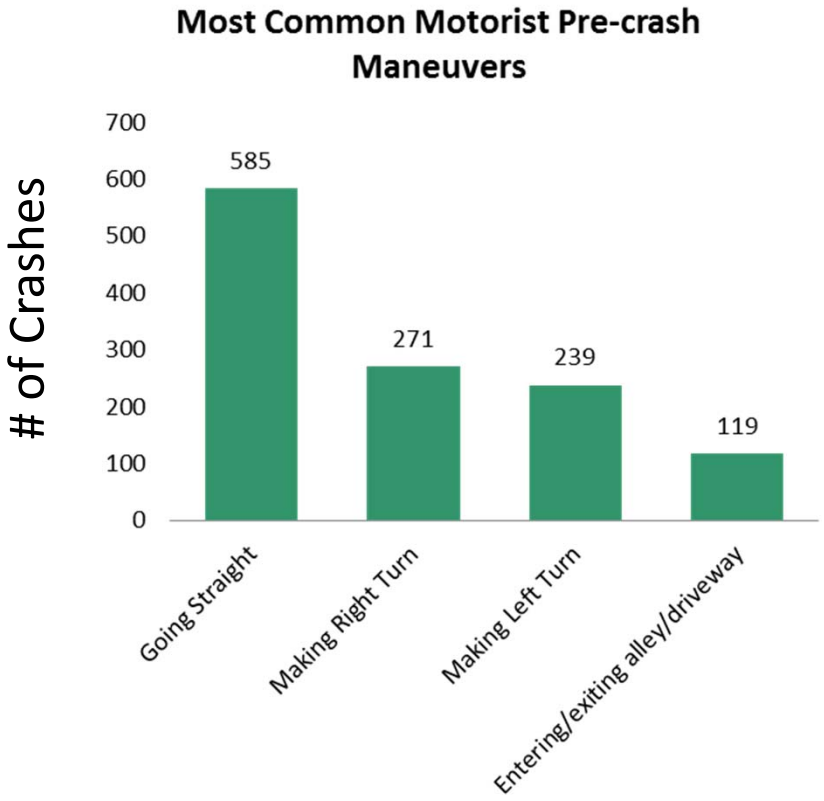
- Collisions with other users
- Collisions with fixed objects
- Falls
  - Inattention/user error
  - Surface defects

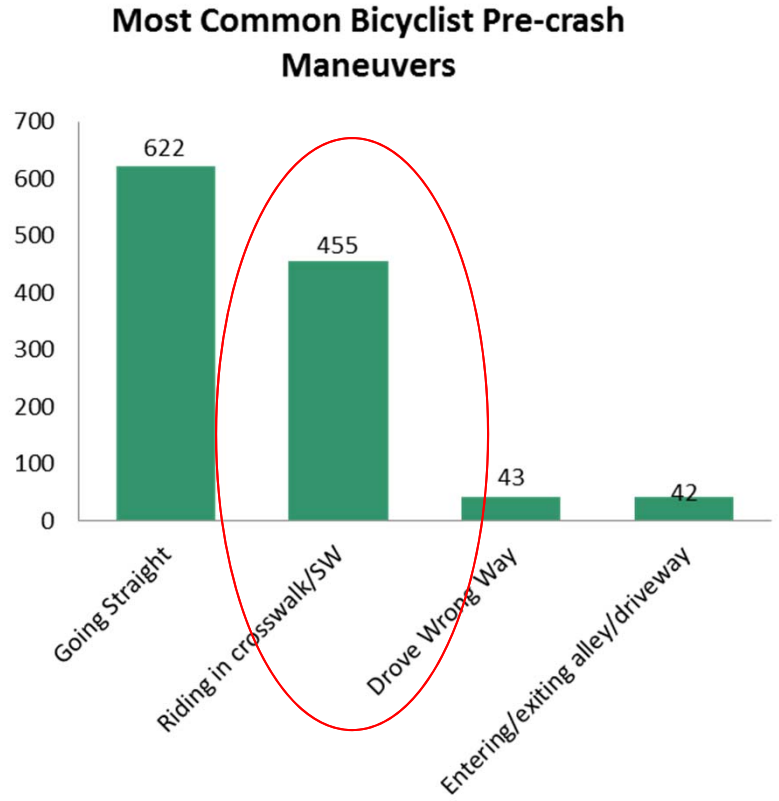
...mid-path collisions are typically not reported unless injury between users requires hospital treatment.

Intersections

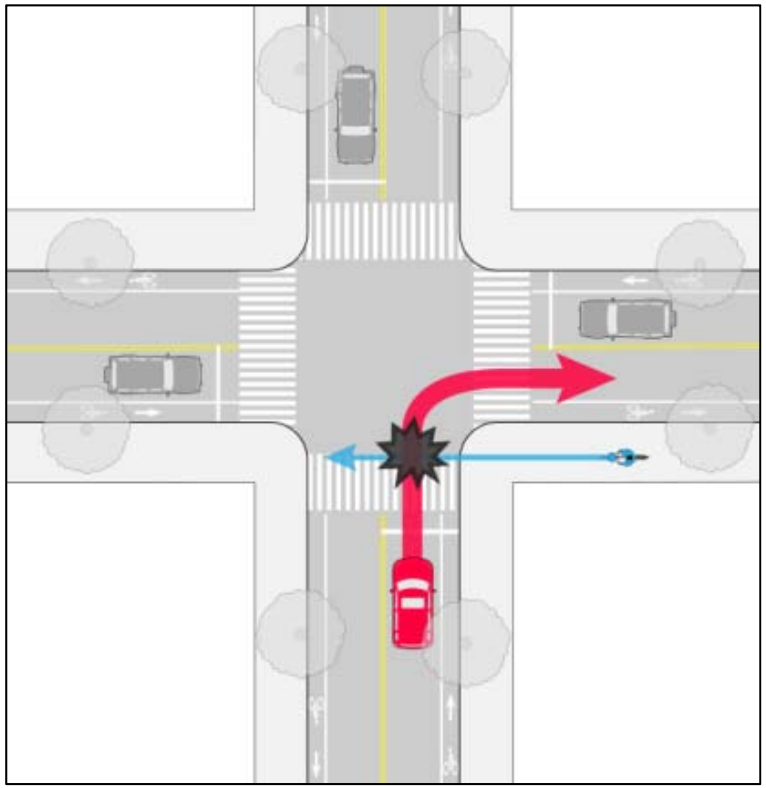
- Collisions with left or right turning vehicles
- Broadside collisions with through vehicles
  - Multiple threat
  - Single lane

Pre-crash Maneuvers

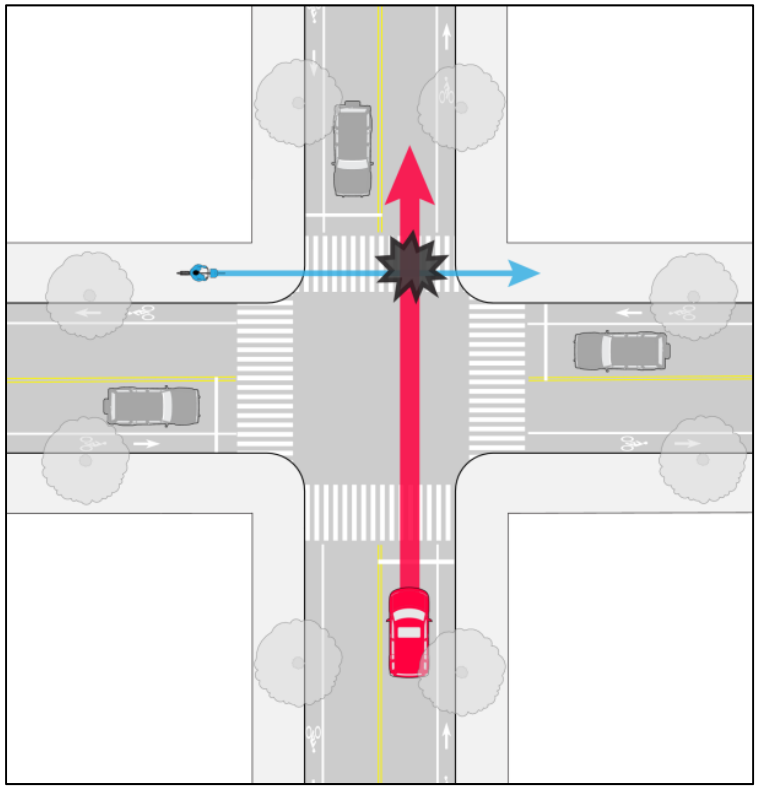




Source: City of Denver Bicycle Crash Study



Right Hook into
“wrong way”
bicyclists on sidepath



Broadside into
“wrong way”
bicyclists on sidepath

Shared Use Path Users

- **Bicyclists**
  - *Upright adults, children*
  - *Recumbent bicyclists*
  - *Bicyclists pulling trailer/bikes*
  - *Tandem bicyclists*
- **Pedestrians**
  - *Walkers, Runners*
  - *People with disabilities*
  - *People with strollers*
  - *People walking dogs*
- **Inline/roller skaters**
- **Kick scooter users**

Shared Use Path Users

Table 2: One-way Observations of Path Users by Type

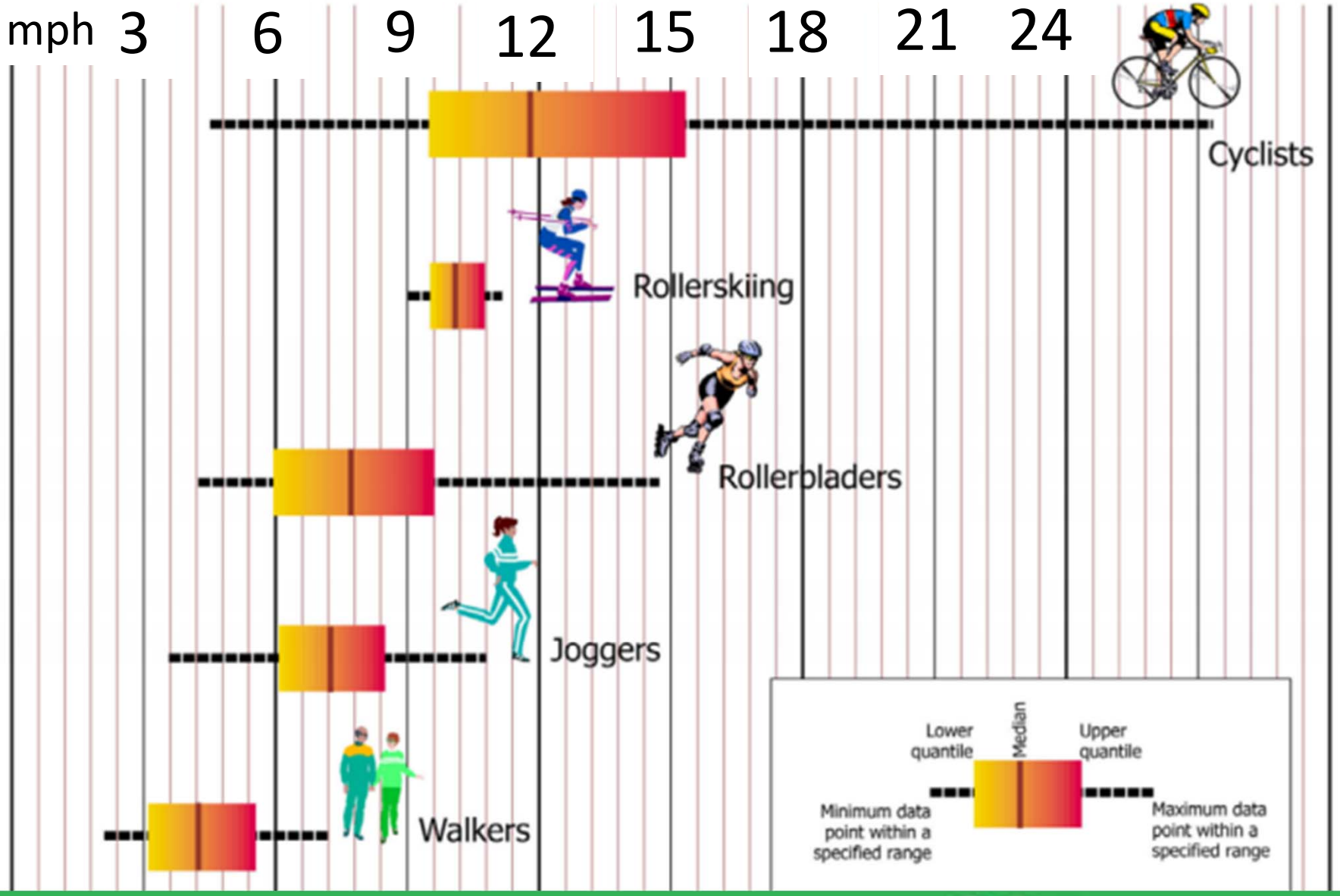
Type	Farmington River 1	Heritage Canal Greenway	Farmington River 2
Walkers	44.9%	25.0%	22.7%
Walkers with Strollers	3.2%	1.8%	3.1%
Runners	6.7%	3.2%	4.9%
Wheelchairs	0%	0%	0.6%
Skaters	6.0%	23.7%	9.8%
Scooters	1.3%	0.1%	0%
Skateboarders	0.4%	0%	0%
Cyclists	37.6%	45.5%	55.2%
Horse riding	0%	0%	0%
Dogs	N/A	0.6%	3.7%

Source: UCONN Trail Safety Study
http://www.cti.uconn.edu/pdfs/jhr04-297_02-2.pdf

Users

- Motorized vehicles not recommended
  - Exceptions: wheel chair users, maintenance vehicles, snow mobiles
- Can accommodate horses with an adjacent bridle trail

Diagram 2 - Speeds of various modes on paths at Westerfolds Park, Melbourne (Shepherd 1994)



User Design Implications

- **Approach** speeds determined by **fastest**:
  - Bicyclists (12-30mph)
  - Motorists (15-80mph)
- **Departure** speed determined by **slowest**:
  - Pedestrians 3.0 – 3.5 feet/second

AASHTO Guide: Recommends Marked Crosswalks for all Path Crossings

- Legal Crossings
  - Mid-block: marked crosswalks required to create a legal crossing
  - Sidepath: crosswalks exists regardless of marking
- Consider state laws
  - How are bicyclists treated? (bicyclist = pedestrian in x-walk?)

Path Safety Audits – Potential Prompt Questions

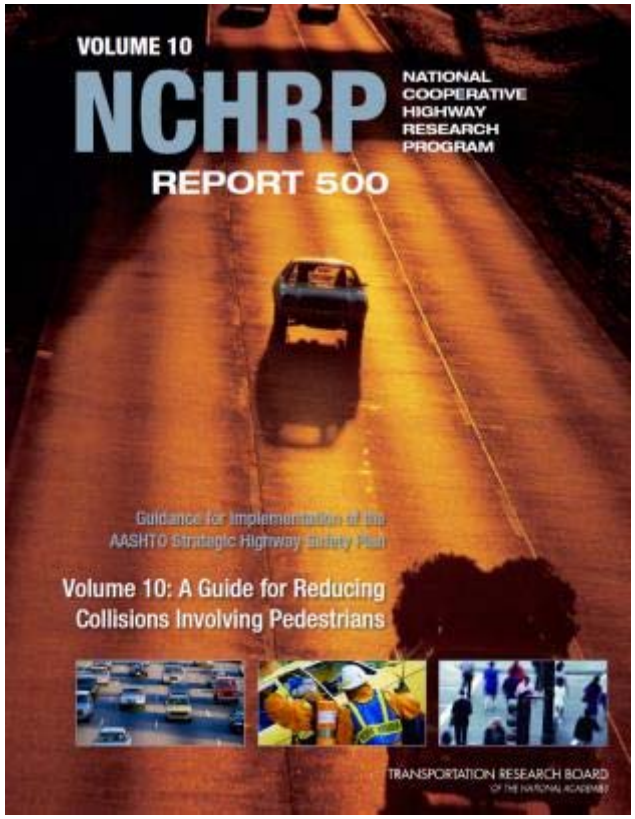
Observations

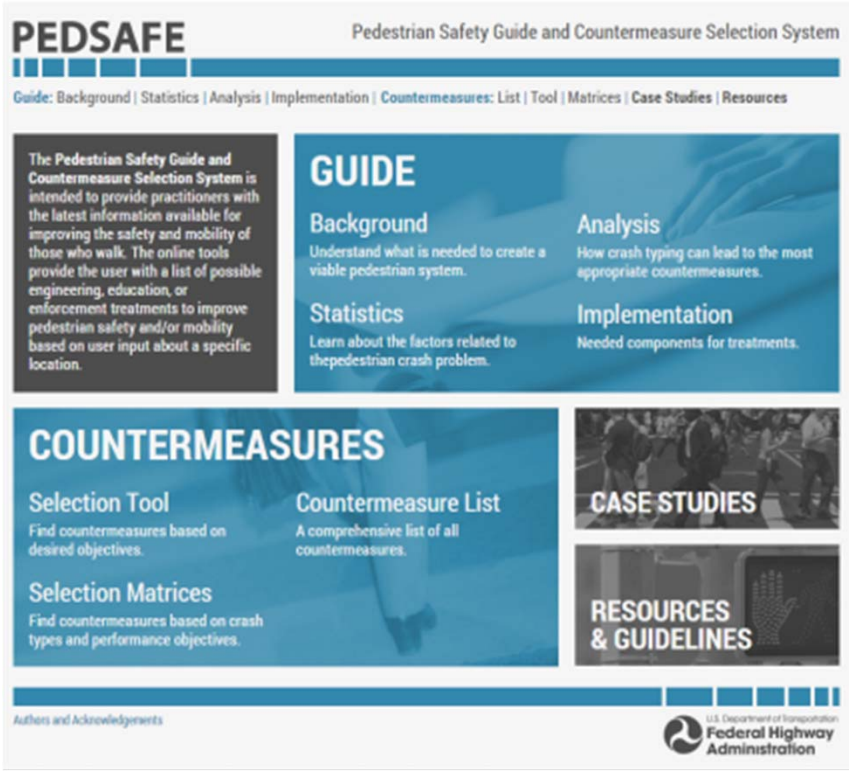
- Path volumes, user mix?
- User speeds?
- Path width?
- User behaviors?
- Obstacles?
- Surface conditions?
- Sign inventory

Design Checks

- Sight Distance
- Curve radius
- Intersection controls
- Sign conformance with MUTCD
- Custom sign design

Crash Countermeasure Resources





http://www.pedbikesafe.org/PEDSAFE/

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v10.pdf

Crash Countermeasure CMF

- Crash Modification Factors (CMF) are limited for bikes
  - Limited before/after data
  - Insufficient bike counts
- Use CMF's for pedestrians
- Countermeasure research available on PEDSAFE

Off-Road Bicycling Infrastructure Crash Reduction Countermeasures Mid-Path

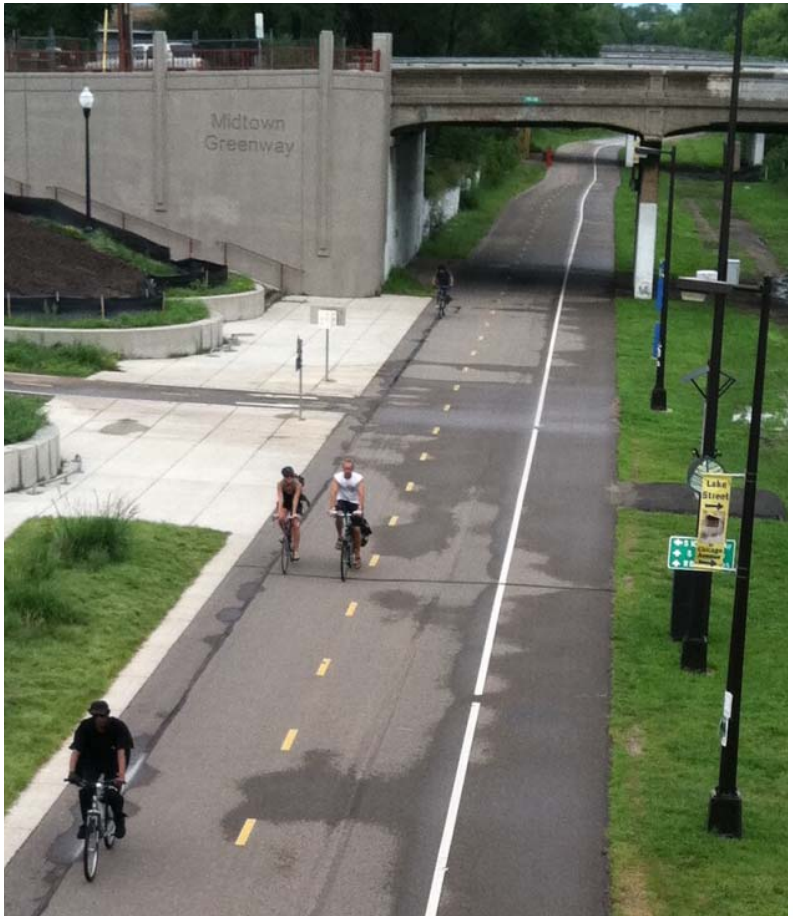
Section 4

Crashes Due to User Conflicts

Countermeasure:
Widen Shared Use Path

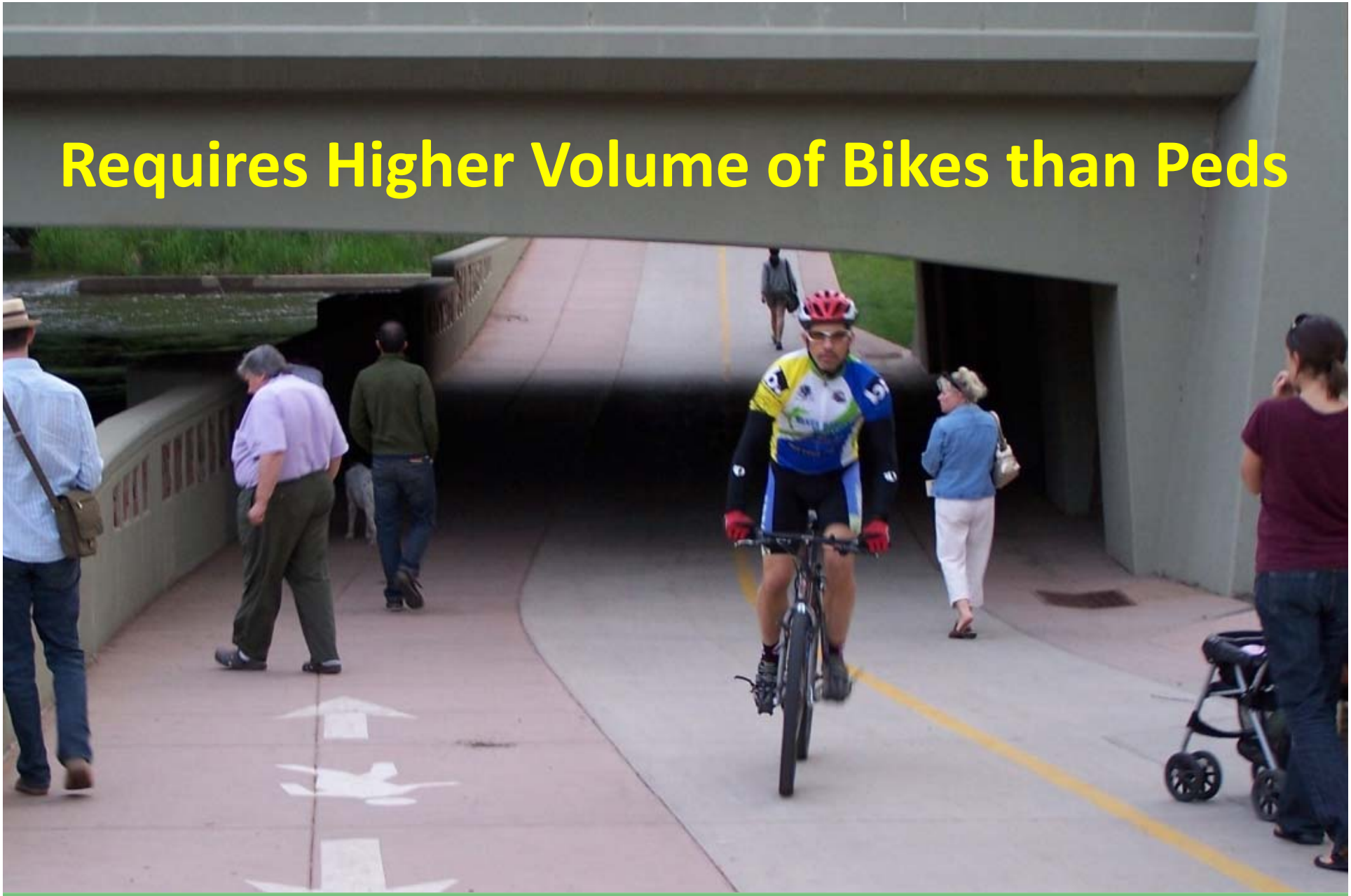
- Use Shared Use Path LOS Calculator to design width for volume:
  - Pedestrians
  - Bicyclists
- AASHTO Guide:
  - 10 ft = minimum width
  - 11 ft is needed for passing
  - 10-14 ft width is typical
  - 8 ft = constrained minimum

Countermeasure:
Separate Bikes/Peds Horizontally



- Striping, color differentiation, or barriers
- Bi-directional walking lane for pedestrians
  - 5 ft min width for pedestrians
- Uni-directional lanes for cyclists
  - At least 5 feet for bicyclists

Requires Higher Volume of Bikes than Peds



Countermeasure:
Separate Bikes/Peds Vertically

Countermeasure:
Separate Bikes/Peds Barriers

Countermeasure: Provide clear sight lines at path intersections with other paths

Countermeasure: Lighting

- Where nighttime use is permitted
- Pedestrian scale fixtures
- Consider 0.5 to 2 foot candles
- Higher illumination at crossings

Crashes Due to Maintenance

Countermeasure:

Proactive Maintenance – Sweeping/Plowing

Countermeasure:

Proactive Maintenance – Spot Repair

Fixed Object Crashes

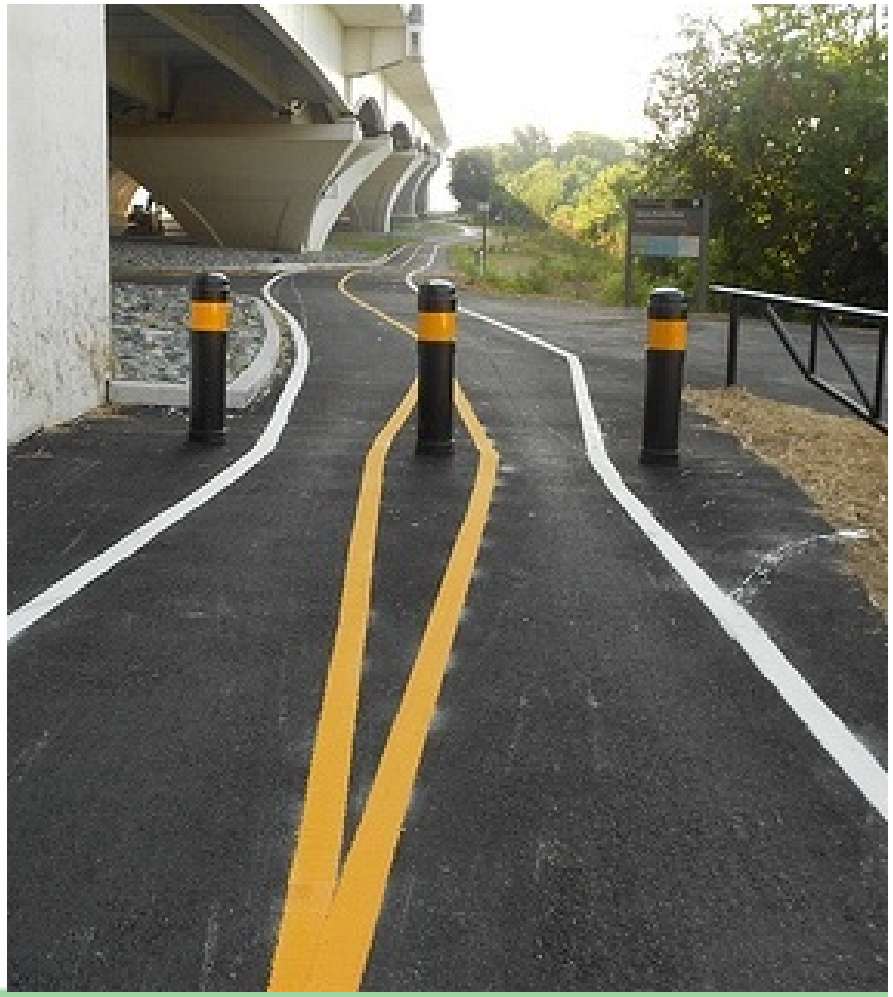
"Barriers such as bollards, fences, or other similar devices create permanent obstacles…and can cause serious injury." - AASHTO

Countermeasure:
Restricting motor vehicle access

Countermeasure: Bollard considerations

If bollards must be used:

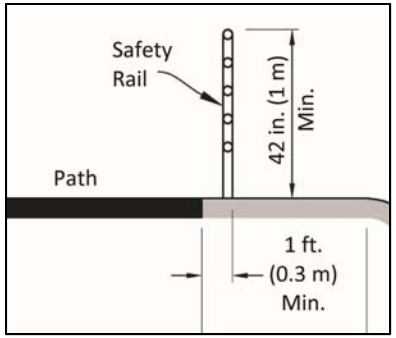
- Retroreflectorized
- Bikes can pass w/o dismounting
- Provide adequate sight distance
- Stripe an envelope at approach
- Use flexible delineators
- Vehicles should not be able to pass
- Use an odd number of bollards
- Set back min, 30 ft from road
- Flush hardware in ground



Countermeasure: Provide Shy Distance

Provide clearance to fences, guard rails, railings, walls

- 2 ft desirable
- 1 ft minimum if "smooth"

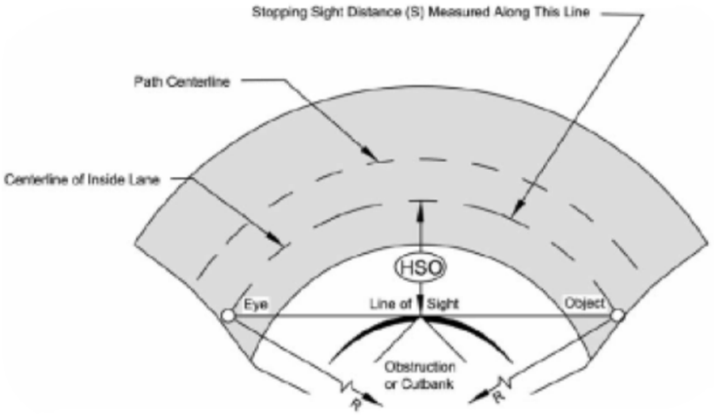


Crashes Due to Curves/Speed

Countermeasure: Horizontal Curve Design/Widening

Follow AASHTO Guidance:

- Actual user speeds?
- Design speed?
- Stopping sight distance?



US Customary

$$HSO = R\left[1 - \cos\left(\frac{28.65S}{R}\right)\right]$$

$$S = \frac{R}{28.65}\left[\cos^{-1}\left(\frac{R - HSO}{R}\right)\right]$$

where:

S	=	stopping sight distance (ft)
R	=	radius of centerline of lane (ft)
HSO	=	horizontal sightline offset, distance from centerline of lane to obstruction (ft)
Note:		-angle is expressed in degrees -line of sight is 2.3 ft above centerline of inside lane at point of obstruction

Countermeasure: Superelevation of Unpaved Paths

U.S. Customary

$$R = \frac{V^2}{15\left(\frac{e}{100} + f\right)}$$

where:

R	=	minimum radius of curvature (ft)
V	=	design speed (mph)
e	=	rate of bikeway superelevation (percent)
f	=	coefficient of friction

Off-Road Bicycling Infrastructure Crash Reduction Countermeasures Path - Roadway Intersections

Section 5

Understand the Path Crossing Types

1. Mid-block roadway crossings
   - Outside the functional area of an adjacent intersection
   - Can be considered a four-leg intersection
2. Sidepath roadway crossings
   - Within functional area of intersection
3. Grade-separated

Midblock Crossings

Outside functional area of adjacent intersection

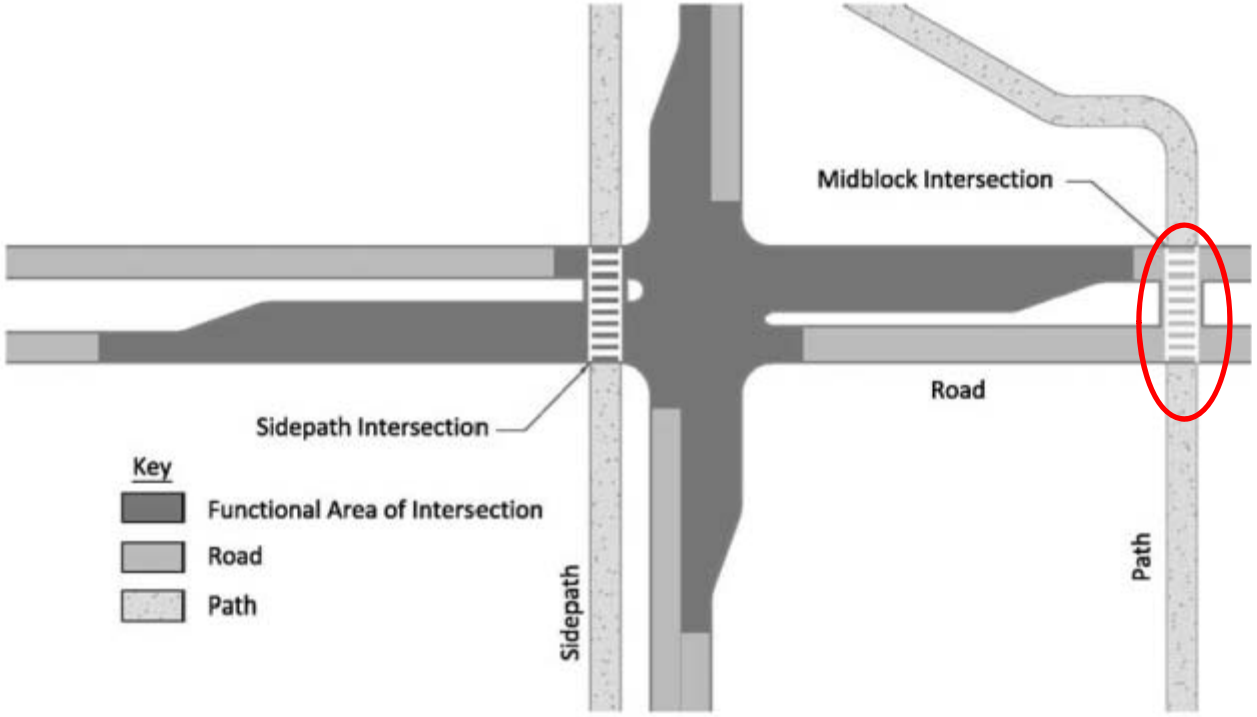


Figure 5-13. Mid-Block and Sidepath Crossings Relative to Intersection Functional Area

Side Path Crossing Types

Within functional area of adjacent intersection

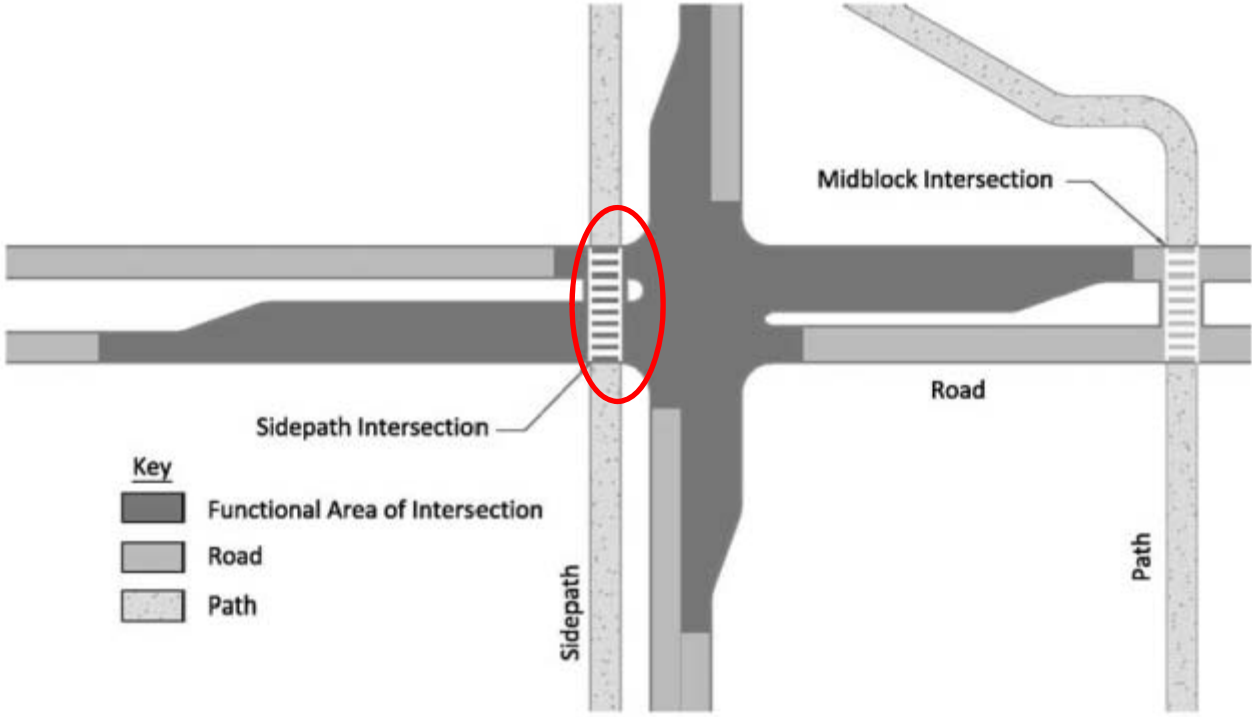


Figure 5-13. Mid-Block and Sidepath Crossings Relative to Intersection Functional Area

Shared Use Path – Motorist Conflict Types

Straight-on

Turning and Straight-on

Traffic Control Non-Compliance

"Apply the least restriction that is effective." - AASHTO

Countermeasure: Choose the least restrictive – but effective – control

- Unwarranted controls will be ignored by users
- Consider relative volumes, speeds, and system hierarchy
  - Local street vs. regional trail
  - Low volume road vs. high volume trail

Countermeasure: Integrate Sidepath Crossings Controls at Signalized Intersections

Conveying clear message?…

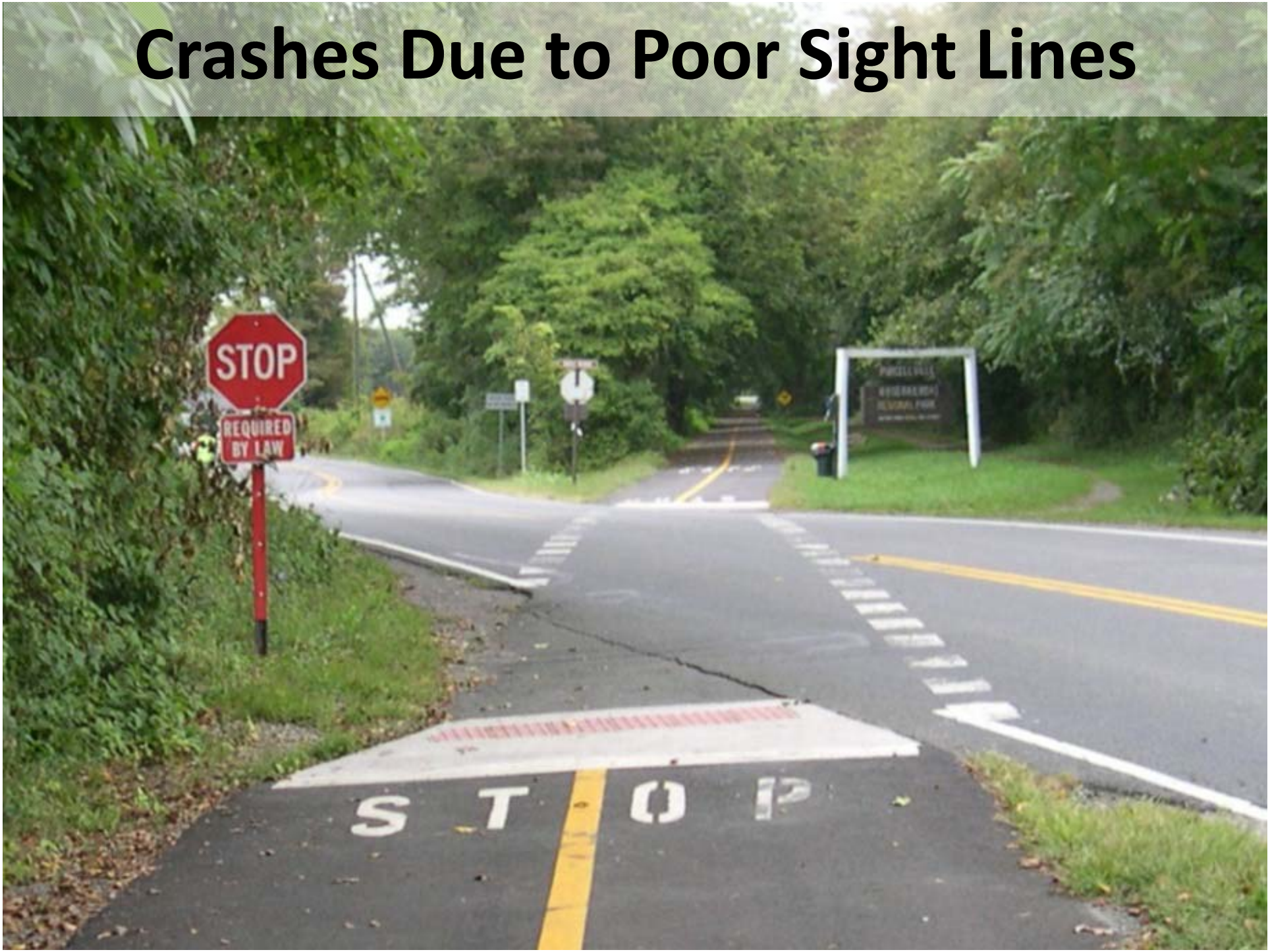
Countermeasure: Integrate Sidepath Crossings Controls at Signalized Intersections

Integrate path with street traffic controls…

Countermeasure: Integrate Sidepath Crossings Controls at Signalized Intersections

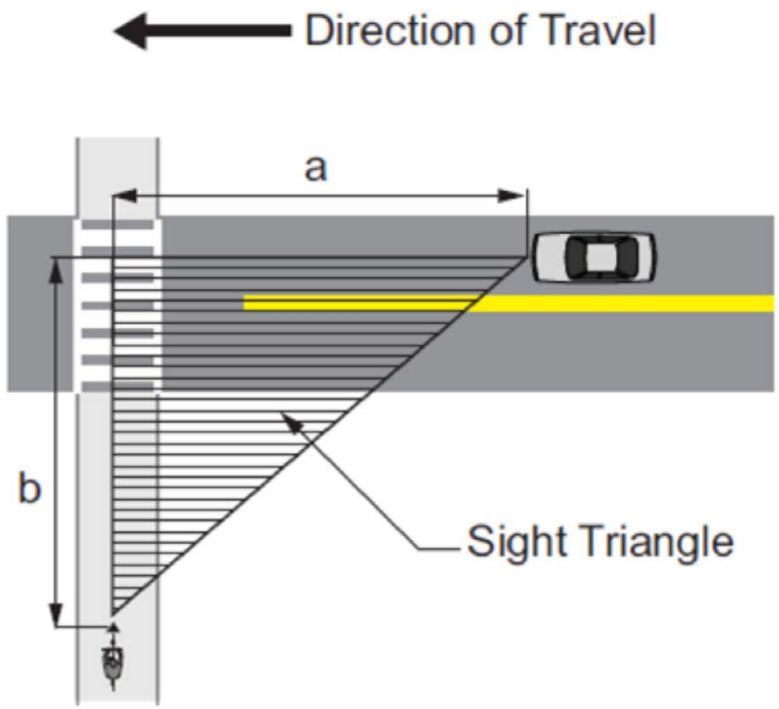
- Bicycle signals issued interim approval by FHWA
- Research shows increased bike compliance
- Next edition of MUTCD will add guidance for use

Crashes Due to Poor Sight Lines

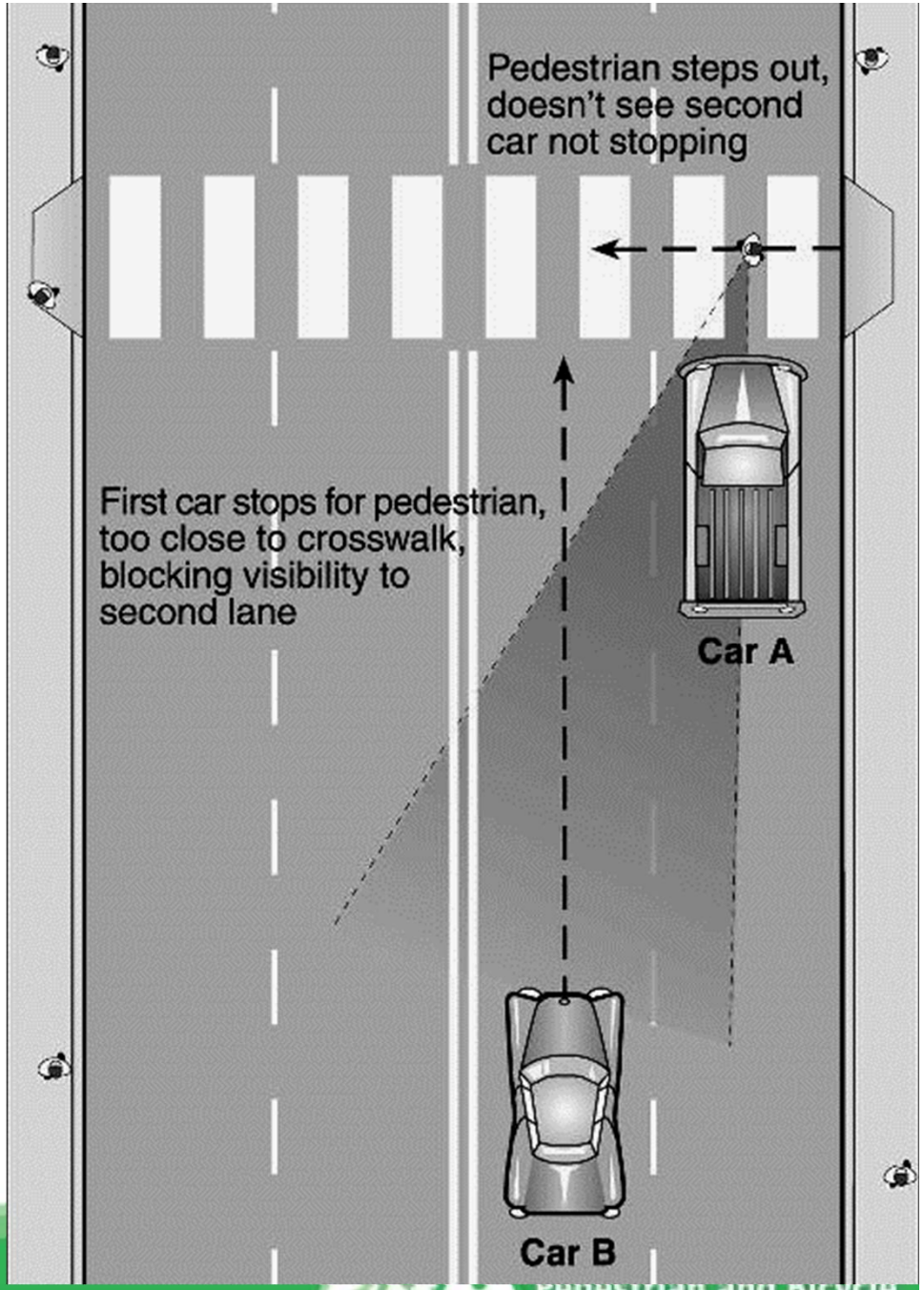


Provide Adequate Sight Lines

- Approach speeds determined by fastest users:
  - Bicyclists (12-30mph)
  - Motorists (15-80mph)
- Departure speed determined by slowest users (typically pedestrian):
  - 3.0 – 3.5 feet/second

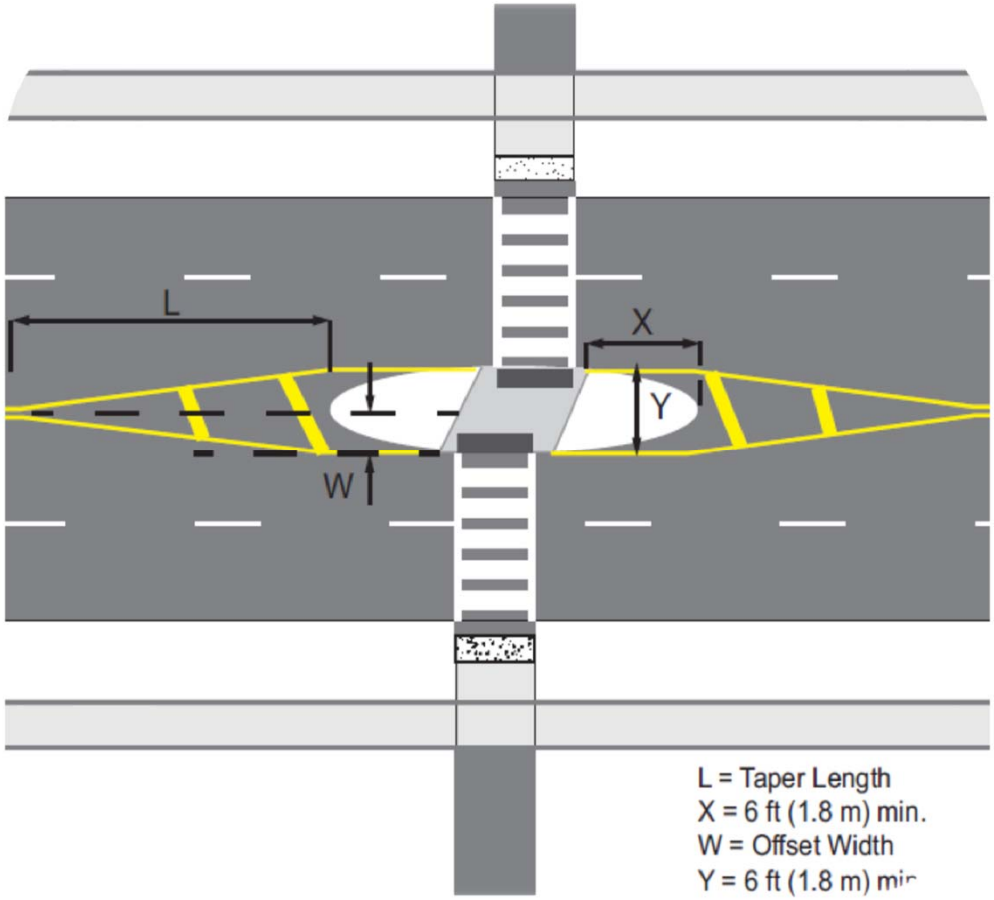


Multiple Threat Crashes



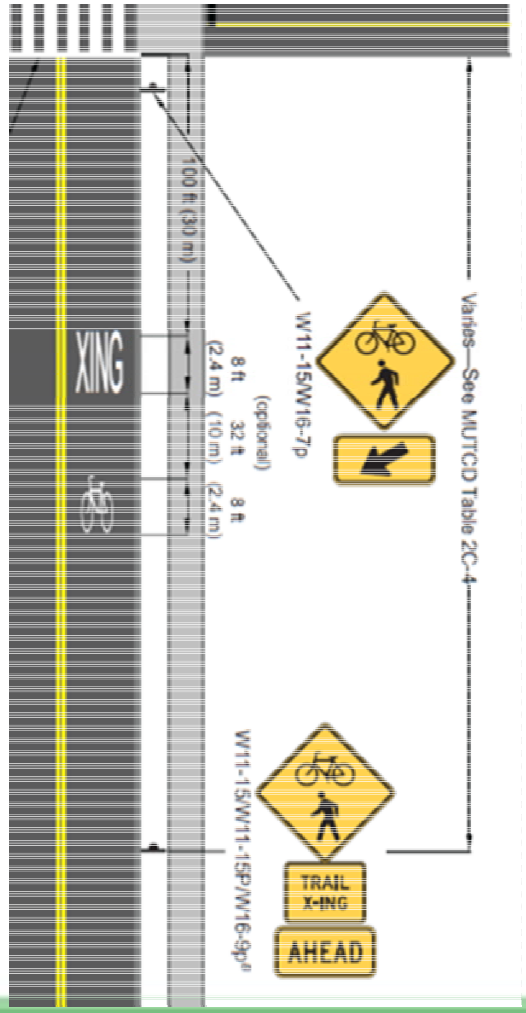
Countermeasure: Crossing islands

- Lower crash rates
- Beneficial at:
  - High roadway volumes
  - Wide crossings
  - Crossing 3 or more lanes
- Widths
  - Minimum width: 6 feet
  - Preferred width: 10 feet
    - consider platoons



Countermeasure:
Advance stop or yield lines

Countermeasure:
Advance warning signs and markings



Should not use where roadway is stop, signal, or yield controlled

Countermeasure:
Rectangular Rapid Flashing Beacons

Countermeasure Takeaways

- Shared use path countermeasures require pedestrian countermeasures
- Comfort and safety have a relationship
- Land use, terrain, and traffic character influence use and safety
- Education & Enforcement strategies are also very important
- Our industry needs more count data for CMF's

Questions?

Thank You!

- **Archive at www.pedbikeinfo.org/webinars**
  - Downloadable and streaming recording, transcript, presentation slides
- **Questions?**
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