Implementing Complete Streets

Broward County MPO

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What is a Complete Street?

A Complete Street is comfortable, convenient & safe for travel via auto, foot, bicycle, & transit

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Isn't this the same as Context-Sensitive Design?

Context-sensitive design:

- Project-oriented
- Users adjoining the roadway

Complete streets:

- Process-oriented
- Users of the right-of-way

These approaches are complementary!

What's the difference with CSS?

"While Context-Sensitive Solutions involve stakeholders in considering a transportation facility in its entire social, environmental and aesthetic context,

Complete Streets policies are a reminder that providing for safe travel by users of all modes is the primary function of the corridor."

CSS Solutions for Urban Arterials

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What's the difference with CSS?

Bicyclists, pedestrians, and transit users are more than "context"

Illustration: AARP

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We know how to build good streets

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Yet many roads are still built like this

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Yet many roads are still built like this

Recently completed roadway expansion with destinations on both sides of the road.

Can you spot the pedestrian?

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What is a Complete Streets policy?

A complete streets policy ensures that the entire right-of-way is planned, designed & operated to provide safe access for all users.

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Complete Streets is NOT:

- A design prescription
- A mandate for immediate retrofit
- A silver bullet. Other initiatives, such as context sensitivity, are still needed!

Who benefits from Complete Streets?

Everybody

Why Complete Streets?

- About **one-third** of Americans don't drive:
  - ✓ 21% of Americans over 65
  - ✓ Children under 16
  - ✓ Disabled Americans
  - ✓ Those without cars
- Transit is growing faster than population or driving
- Most Americans would rather drive less & walk more

Congestion Benefits

Complete Streets are multimodal

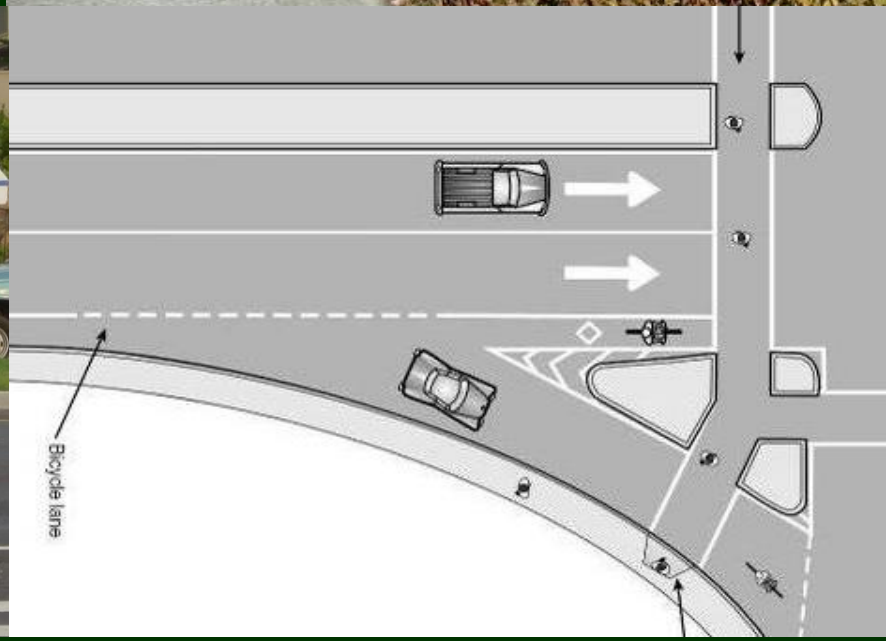
Trips in metro areas:

- 48% are less than 3 miles
- 28% are less than 1 mile
  - 65% of trips less than 1 mile are taken by car

These are all potential bicycle or walking trips

Benefits: Safety

- Sidewalks reduce pedestrian crashes 88%
- Medians reduce crashes 40%
- Road diets reduce crashes 29%
- Countdown signals reduce crashes 25%



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Benefits: People with disabilities

- Complete Streets improve mobility for disabled people and reduce the need for expensive paratransit service

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Benefits: Better use of transit funds

- One year of paratransit service for a daily commuter:
  - **$38,500**
- Permanent improvements to make a transit stop accessible:
  - **$7,000 - $58,000**

Source: Maryland Transit Administration

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Benefits: Health

- Americans move… without moving
- 60% of adults are at risk for diseases associated with inactivity:
  - Obesity
  - Diabetes
  - High blood pressure
  - Other chronic diseases

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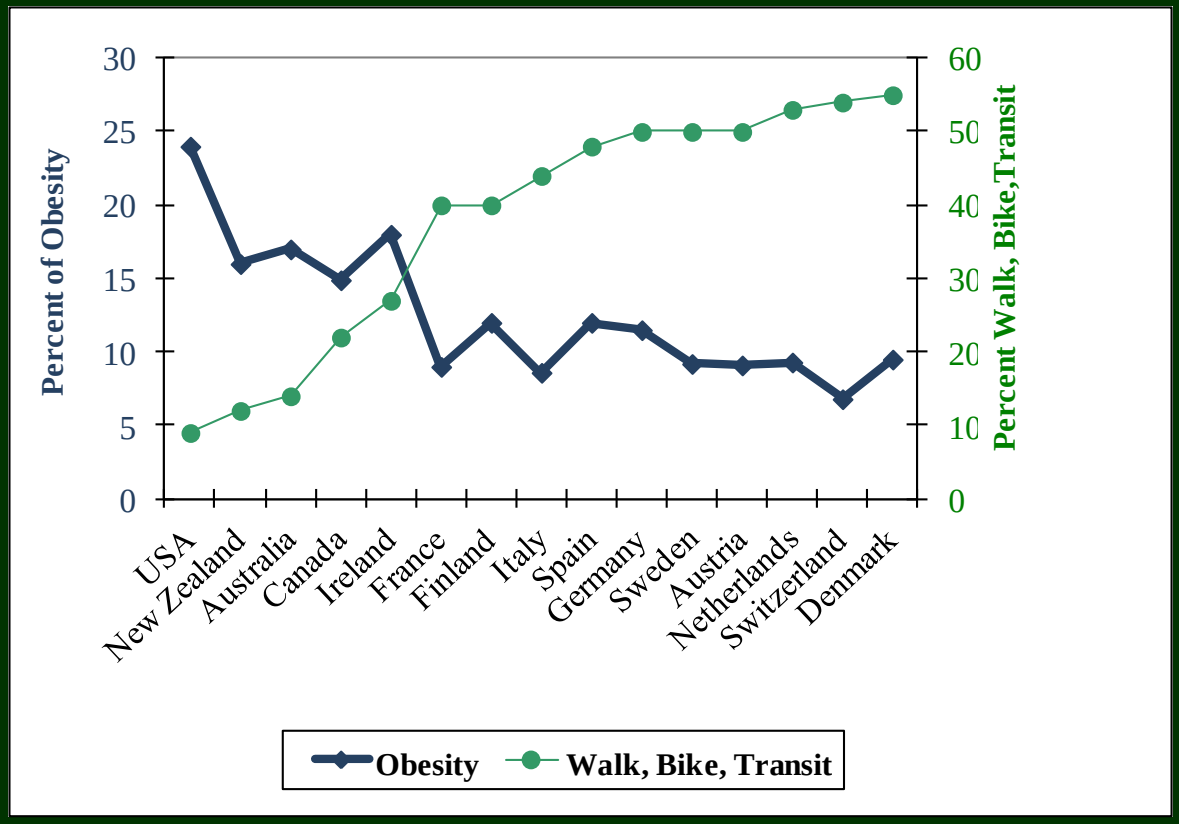
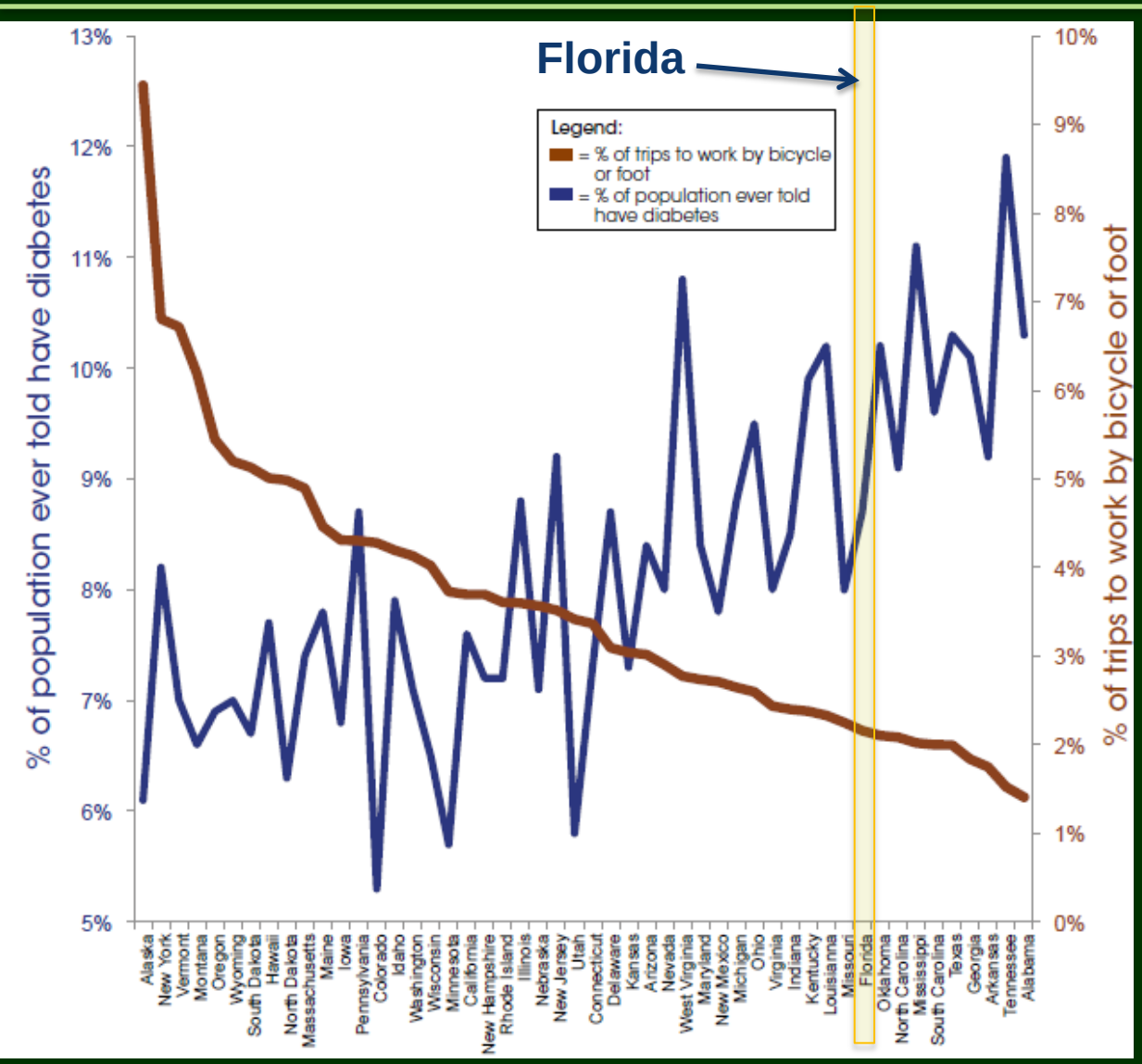
Health Benefits

- Obesity is lower in places where people use bicycles, public transportation, and their feet.



Pucher, "Walking and Cycling: Path to Improved Public Health," Fit City Conference, NYC, June 2009

Health Benefits



- States with the lowest levels of biking and walking have, on average, the highest rates of obesity, diabetes, and high blood pressure.

Benefits: Physical activity

- Residents are more likely to walk in a neighborhood with sidewalks.
- Cities with more bike lanes have higher levels of bicycle commuting

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CS changes intersection design

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CS changes intersection design

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CS changes bicycling

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CS changes bicycling

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CS changes transit

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CS changes transit

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CS changes accessibility

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CS changes accessibility

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Perceived Barriers to Achieving Complete Streets

- Conflicts with Federal highway standards and guidelines
- Slower speeds reduce mobility and increase costs for all vehicles
- Required to design to Level of Service C for the peak half hour 20 years hence
- Spending for peds and bikes is a luxury we cannot afford

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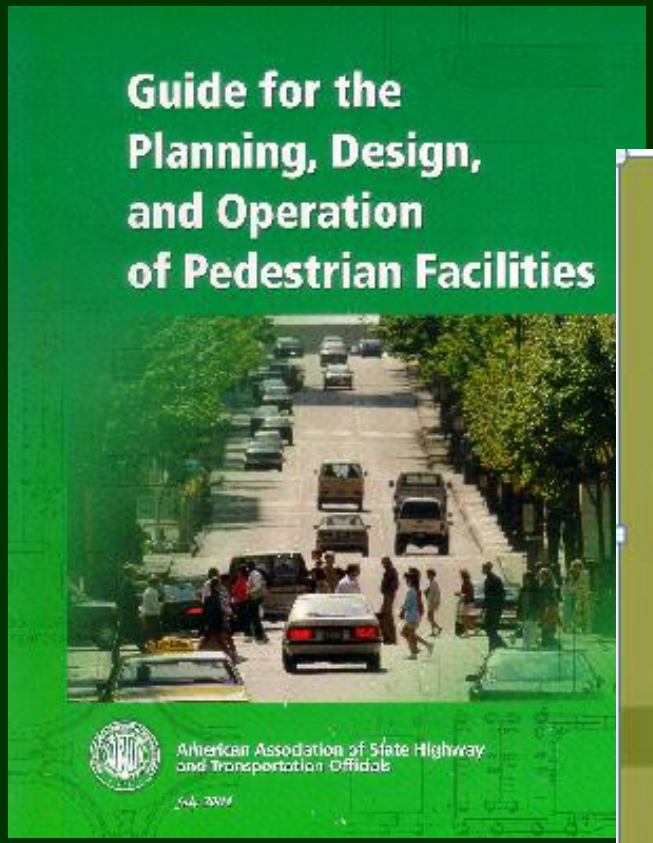
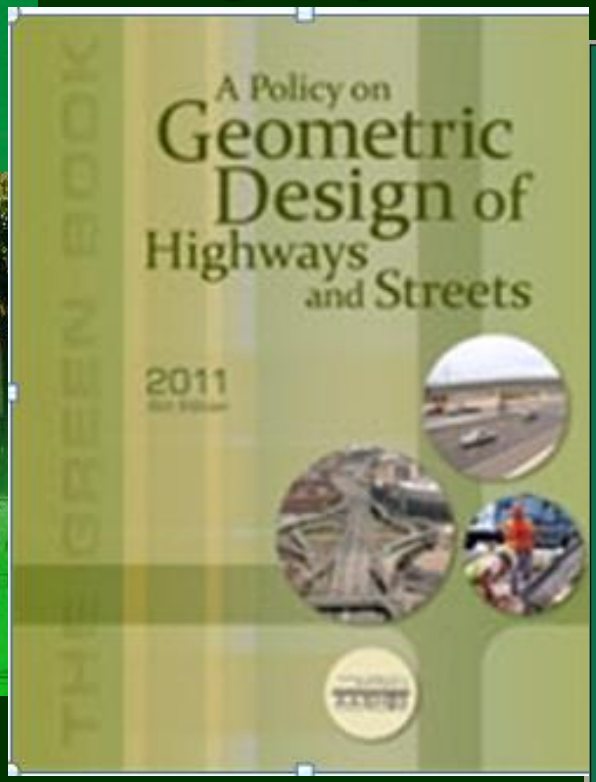
Nothing in Complete Streets Conflicts with National Guidelines

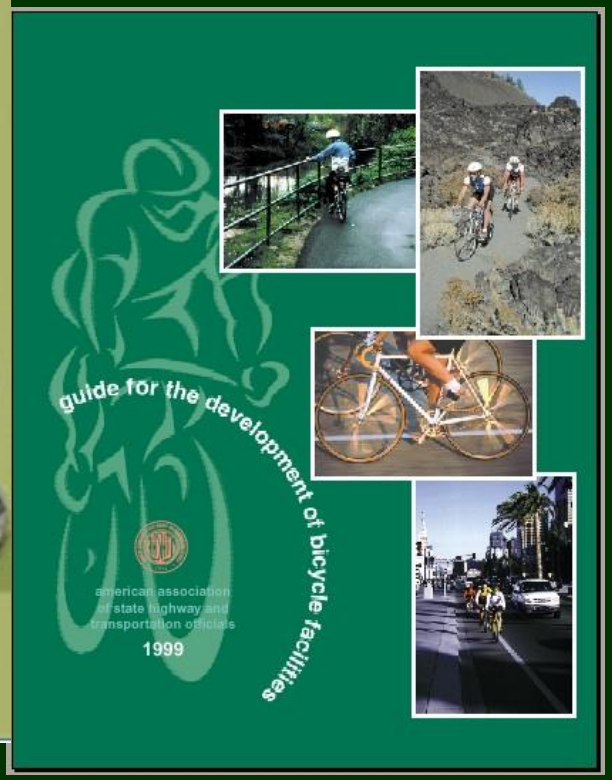


2004

AASHTO: American Association of State Highway and Transportation Officials



2011



1999 (Rev 2012)

Also US Access Board Public Rights-of-Way Accessibility Guidelines (PROWAG)

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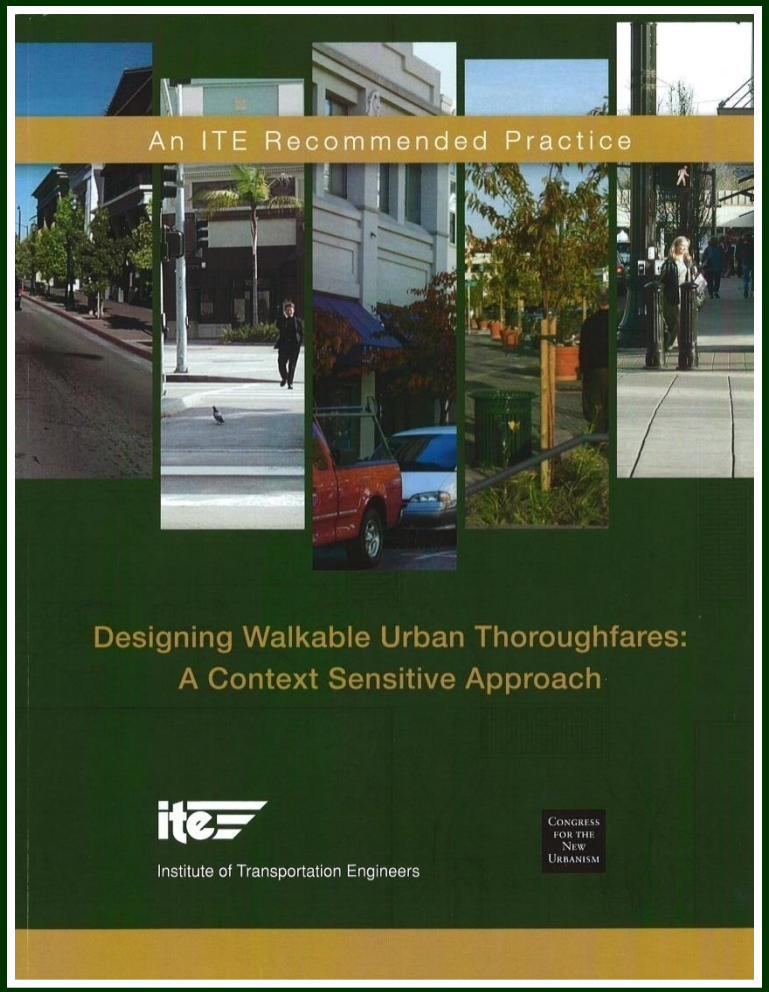
Designing Walkable Urban Thoroughfares: A Context Sensitive Approach



ITE New Recommended Practice

Sets **target speed** (desirable operating speed) as the most important design element

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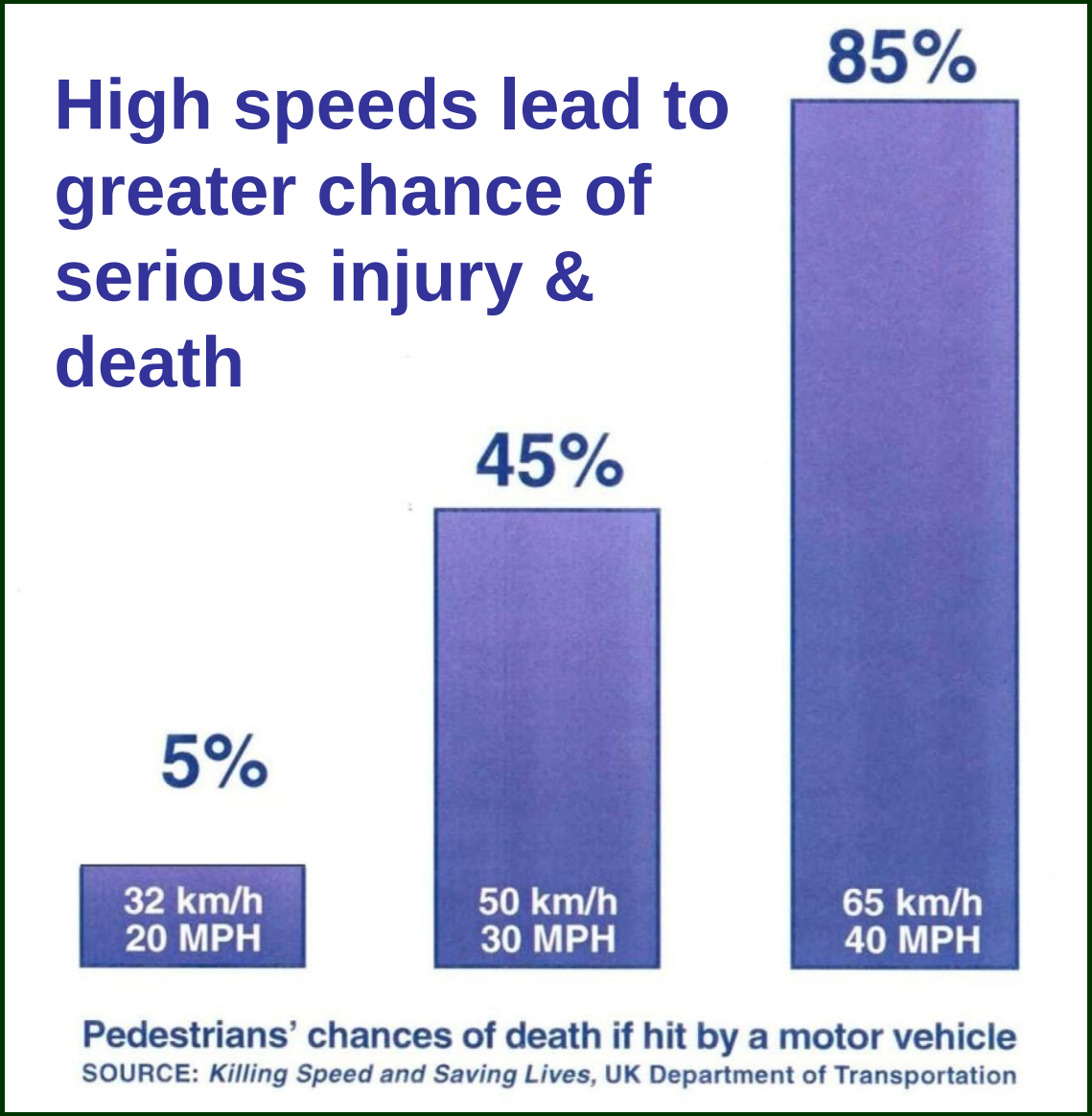
Why Speed Matters



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Child dart-out: speed is a factor!

150’

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First scenario: Speed 25 MPH

92’ = distance covered in 2.5 sec. perception/reaction time

Driver applies brakes

92’

150’

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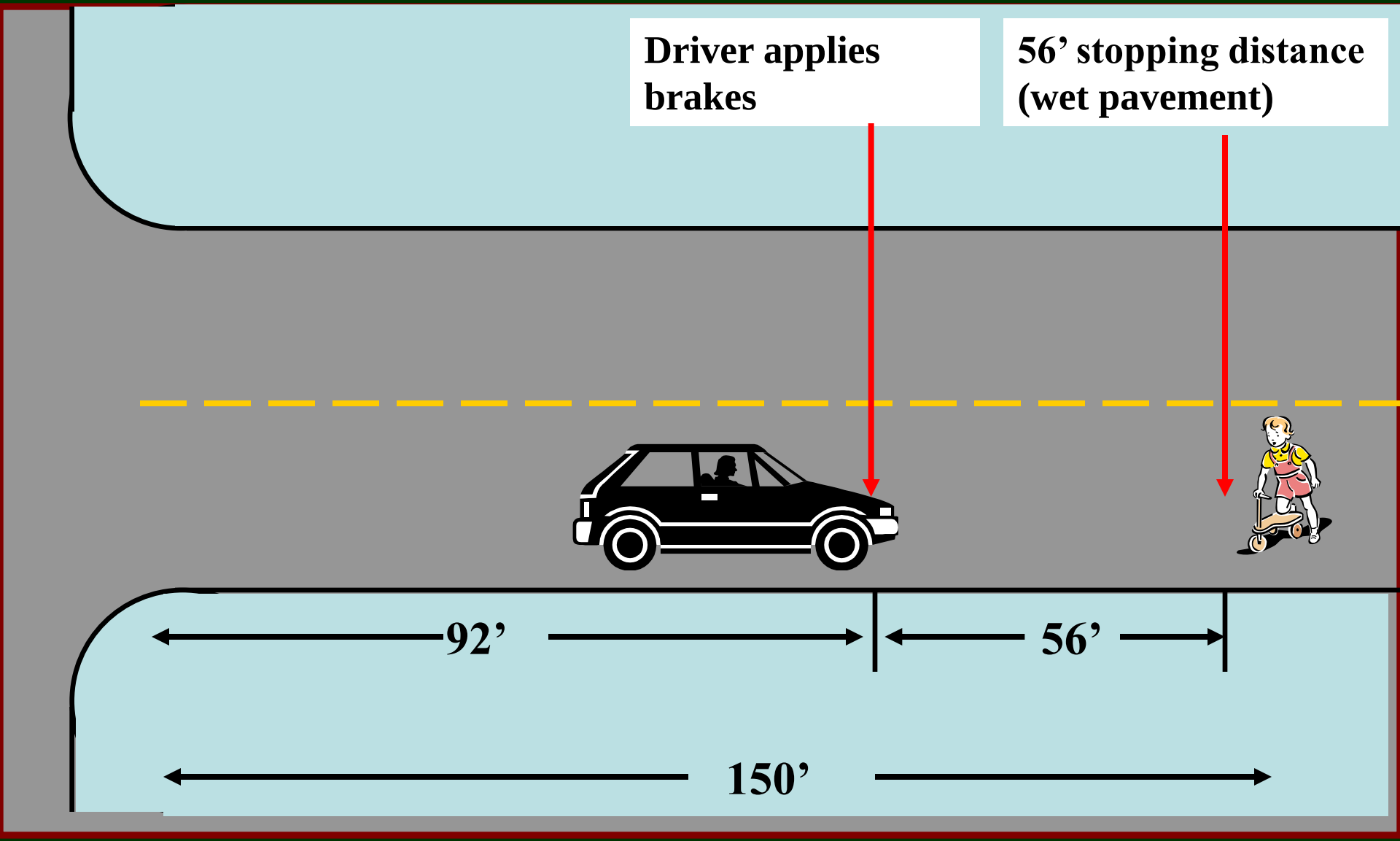
First scenario: Speed 25 MPH



First scenario: Speed 25 MPH

Result: Nothing happens beyond one scared child, driver & parent!

92’ 56’

148’ < 150’

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Second scenario: Speed 38MPH

142’ = distance covered in 2.5 sec. perception/reaction time

Driver applies brakes

142’

150’

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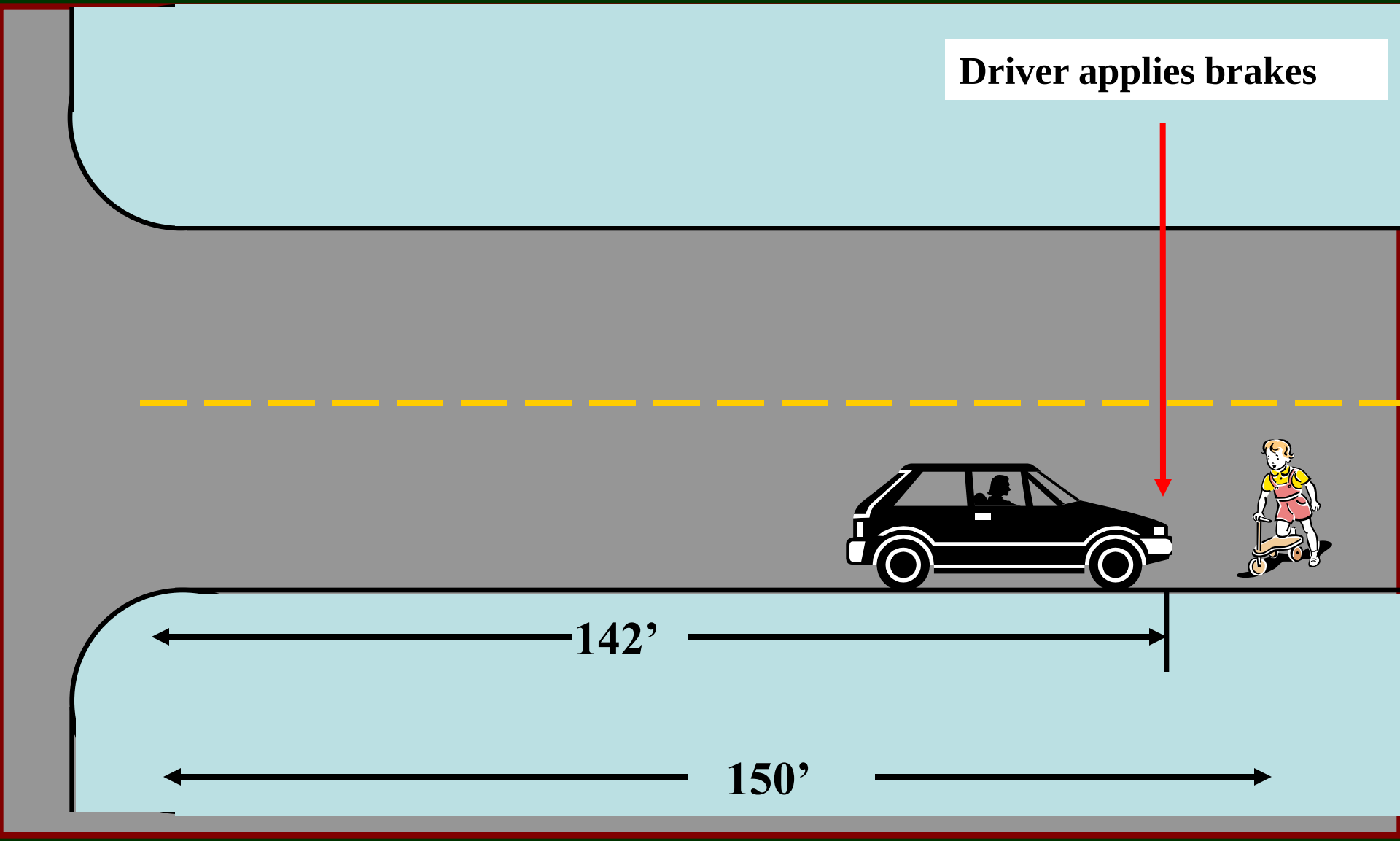
Second scenario: Speed 38MPH



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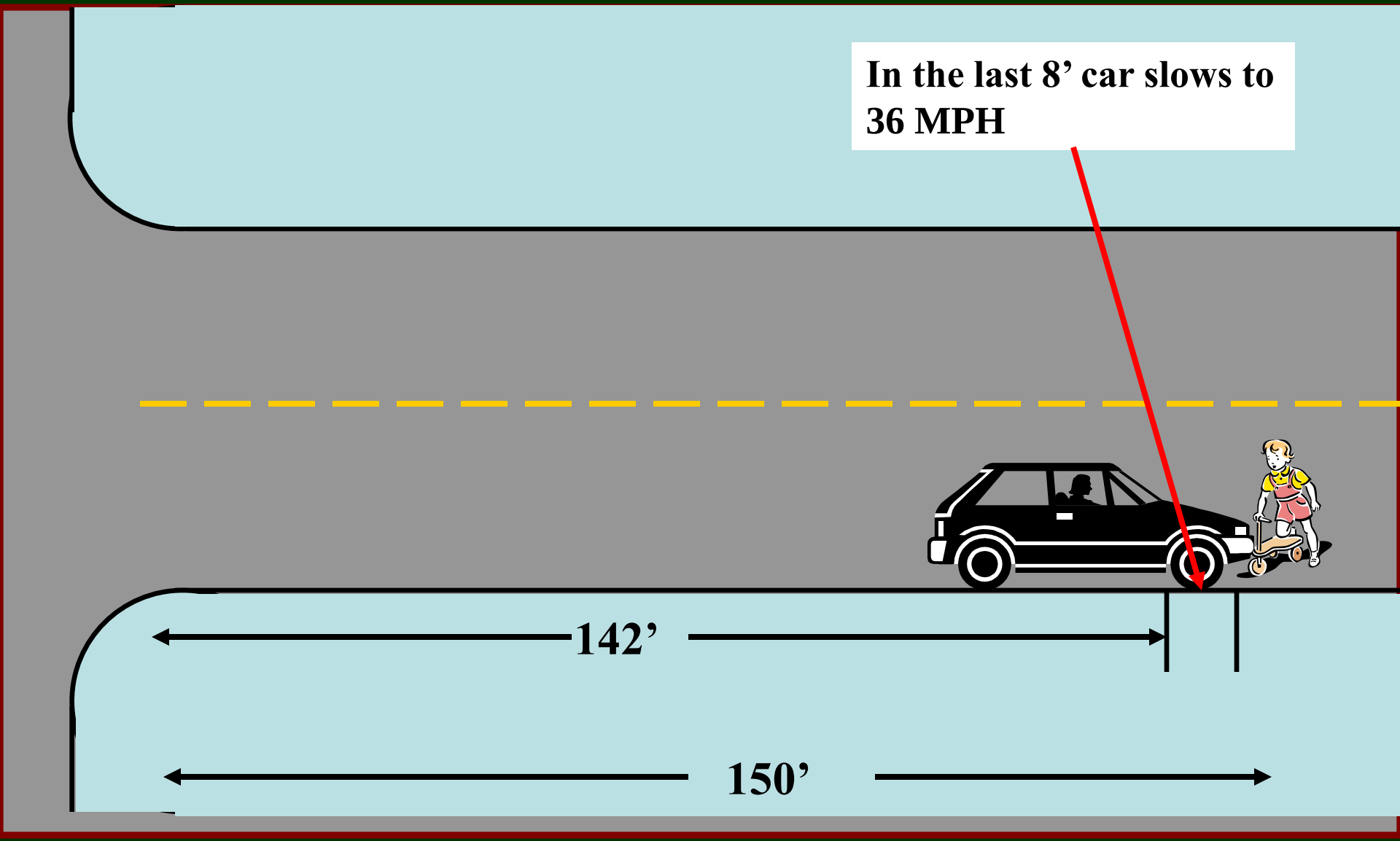
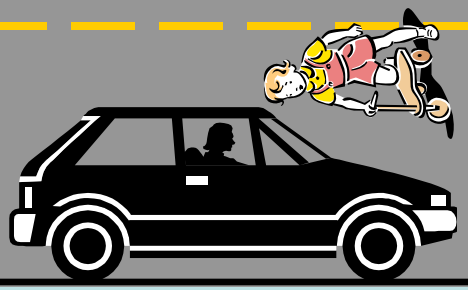
Second scenario: Speed 38MPH



Second scenario: Speed 38MPH

Result: a high speed crash

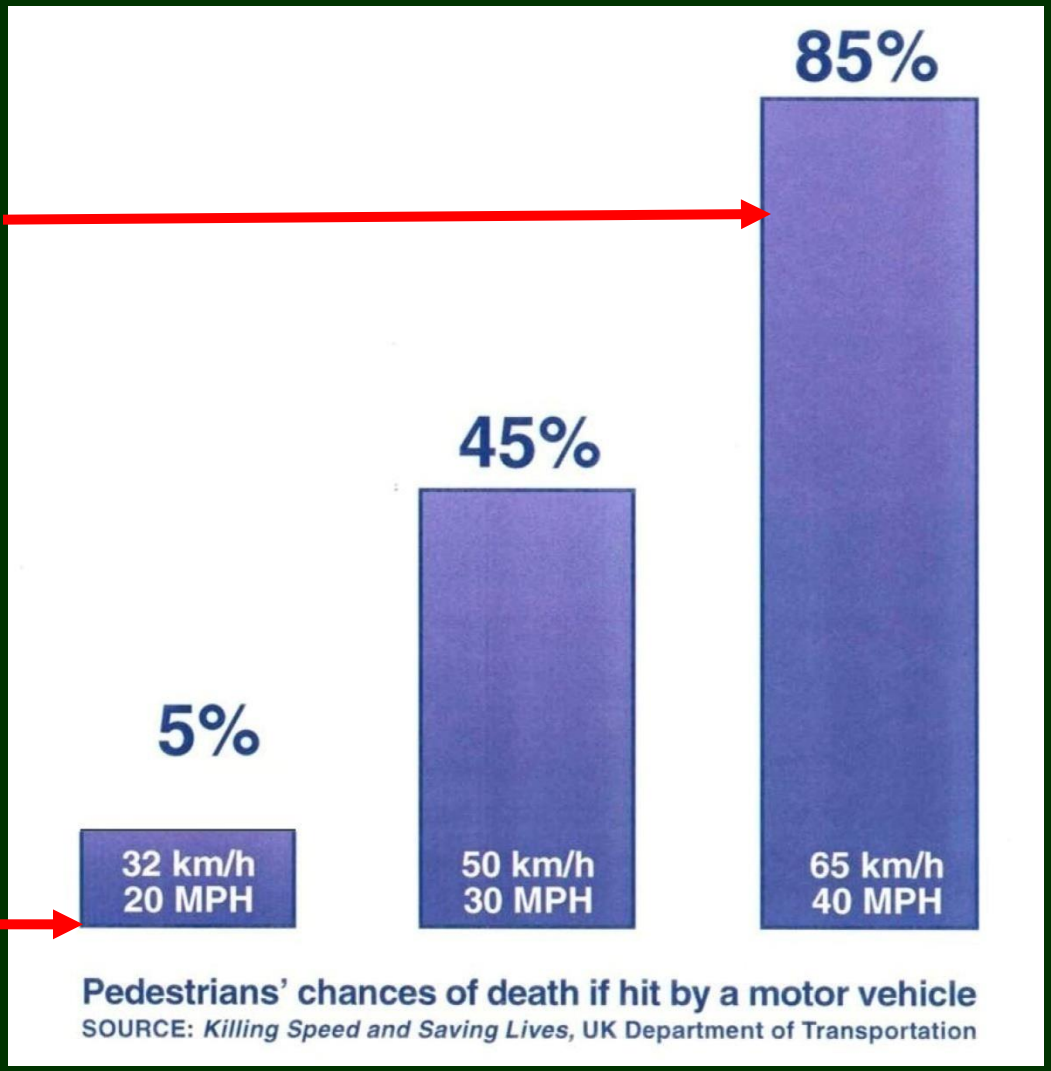


150’

Where do these two scenarios lie on the pedestrian fatality risk scale?

Second scenario:
Crash speed 36 MPH

First scenario:
no crash



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Defining Mobility

- Typical experience:
  - 45 mph speed
  - 2 min wait at signal

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Defining Mobility

- Viable alternative:
  - 2-way progression set for 30 mph

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Benefit/Cost Analysis

- Reducing speed from 45 mph to 30 mph
  - For a 5-mile trip, a 3.33-minute delay
  - Assume 30,000 ADT and $20/hr driver cost
  - $12.154 million in loss to economy, right?
- Wrong!
  - Delay for each person is still 3.33 minutes
  - Less time than their daily stop for Starbucks
- Community benefit
  - Slower operating speeds
  - Safer and more comfortable ped crossings

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Perceived Barriers to Achieving Complete Streets

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Roadway Capacity Analysis

- Designing to LOS C for peak hour means:
  - Unnecessary pavement, waste of tax dollars
  - Increased ped crossing times, thus reducing vehicular movement times
  - Increased operating speeds for other 22 hours

- ALWAYS design urban roadways to LOS D

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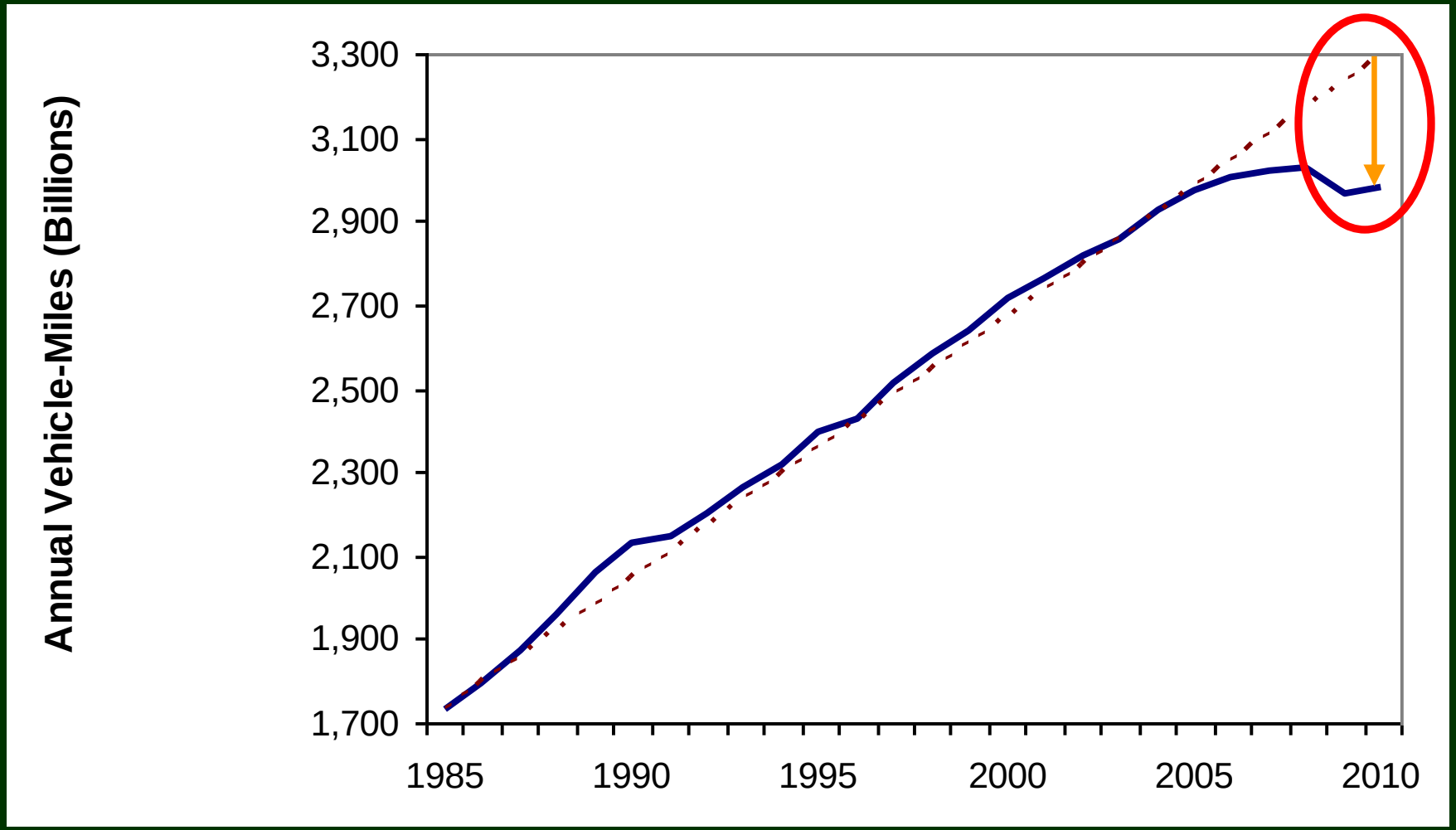
Will traffic volumes always increase? Maybe not



Since 2005 US VMT has been flat

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Multimodal Level of Service

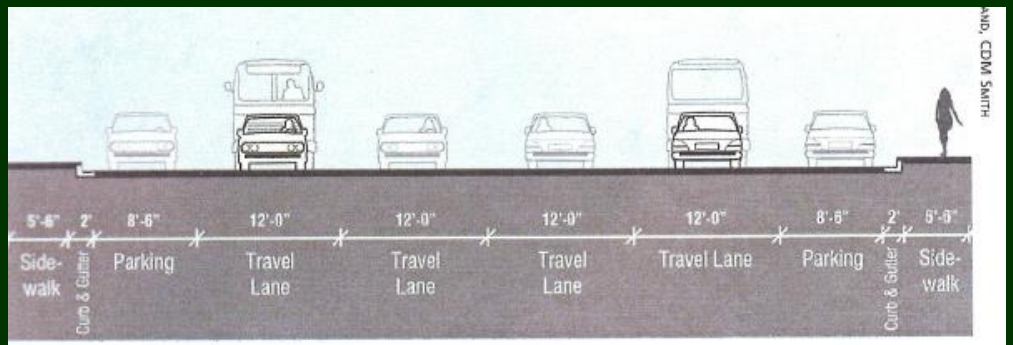

FIGURE 1 Existing 80-ft right-of-way: four lanes with parking.

	Before	After
Automobile	D	E
Bicycle	E	C
Pedestrian	C	B
Transit	D	D

Midblock LOS

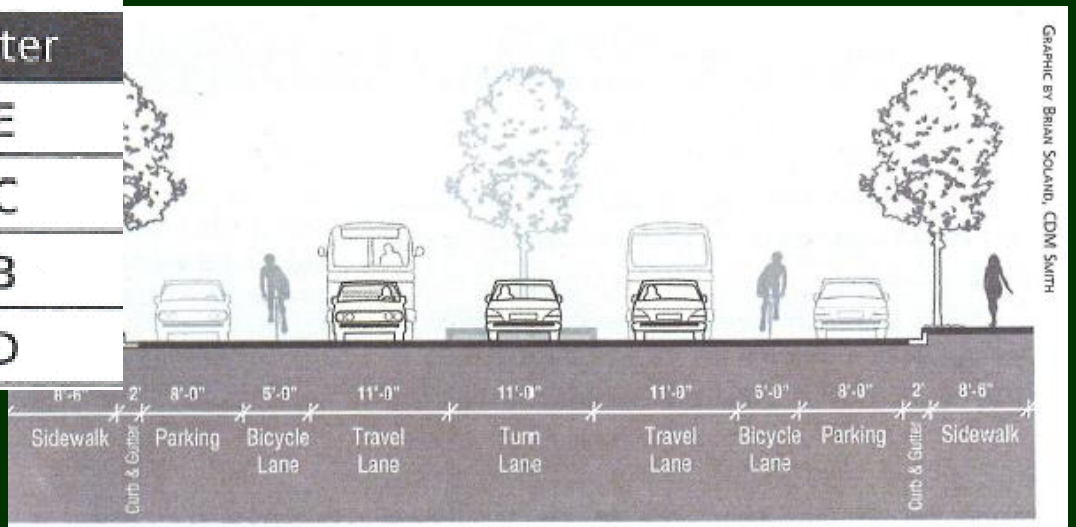

FIGURE 2 Two lanes with median–turn lane, bicycle lanes, and parking.

Source: Highway Capacity Manual, 2010

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Costs of Retrofitting Urban Arterials to Complete Streets

- Requires arterial traffic calming/taming:
  1. Controlling operating speeds
  2. Ped-friendly street crossings
- Requires facilities for nonmotorized users:
  1. Pedestrians
  2. Bicycles
  3. Transit

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Costs to Control Operating Speeds

- Design to D LOS
- Signal progression
- Narrower travel lanes
- Road diets
- Raised medians and landscaping
- Retain curb parking

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Costs to Control Operating Speeds

- Design to D LOS – Less pavement = less cost

Costs to Control Operating Speeds

- Design to D LOS – Less pavement = less cost
- Signal progression – Cost to interconnect

Narrower Travel Lanes

- 70 mph lane widths not needed to handle 30 mph traffic

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Narrower Travel Lanes

News Flash! 10 and 11-foot lanes are <u>just as safe</u> as 12-foot lanes on urban arterials with posted speeds less than 45 mph

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Costs to Control Operating Speeds

- Design to D LOS – Less pavement = less cost
- Signal progression – Cost to interconnect
- Narrower travel lanes – Less pavement = less cost

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Effect of Converting 4-Lane Roads to 3-Lane and TWLTL

“Classic Road Diet”

29% reduction in total crashes/mile

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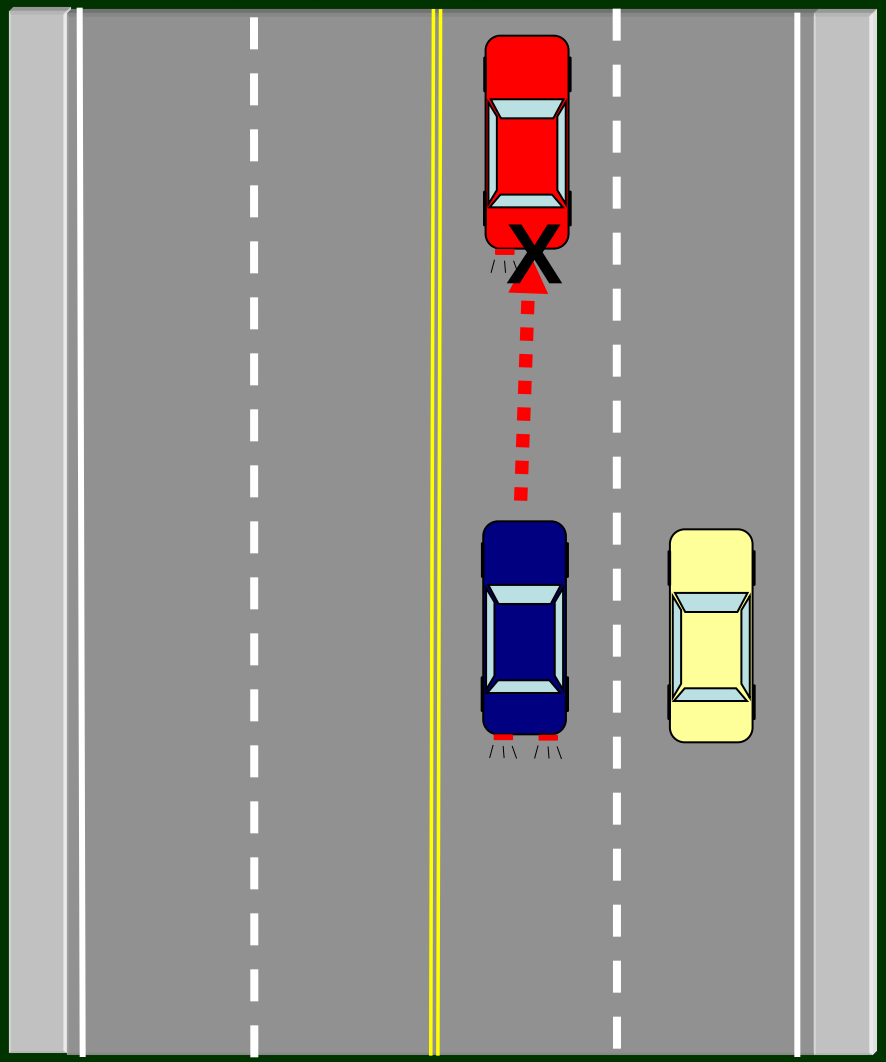
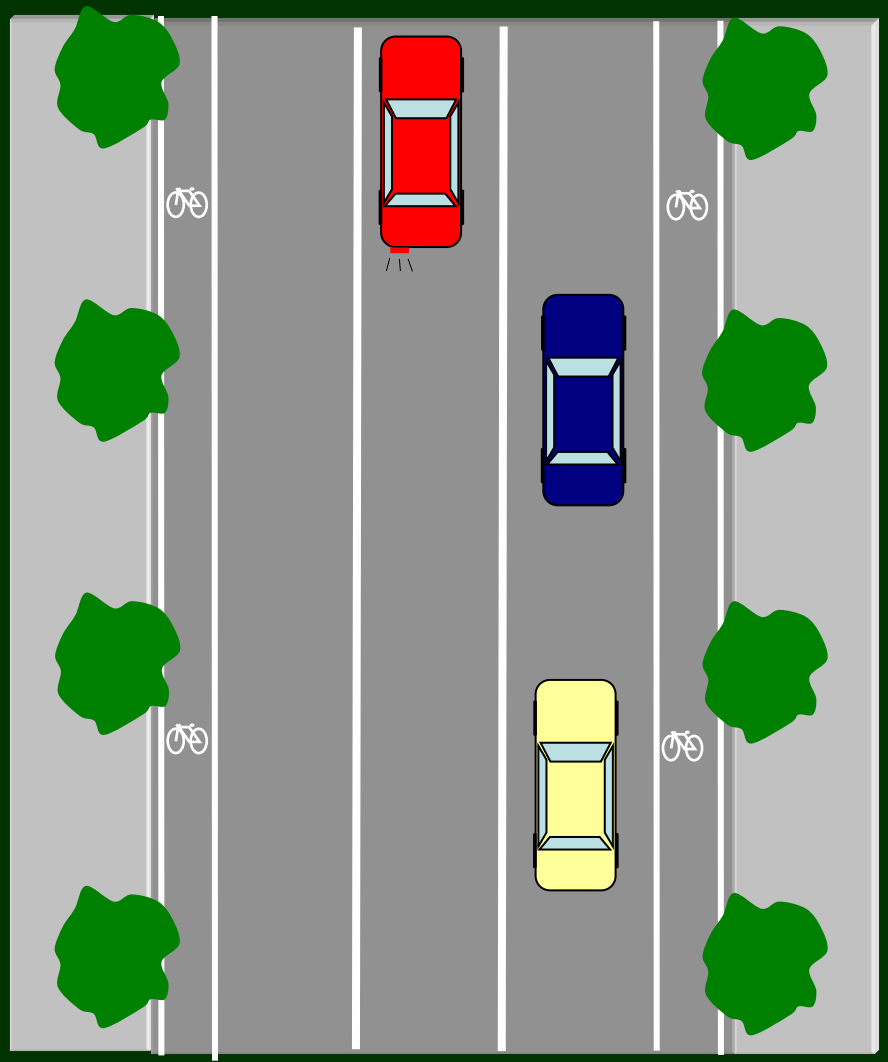
Three crash types can be reduced by going from 4 to 3 lanes





1. Rear enders

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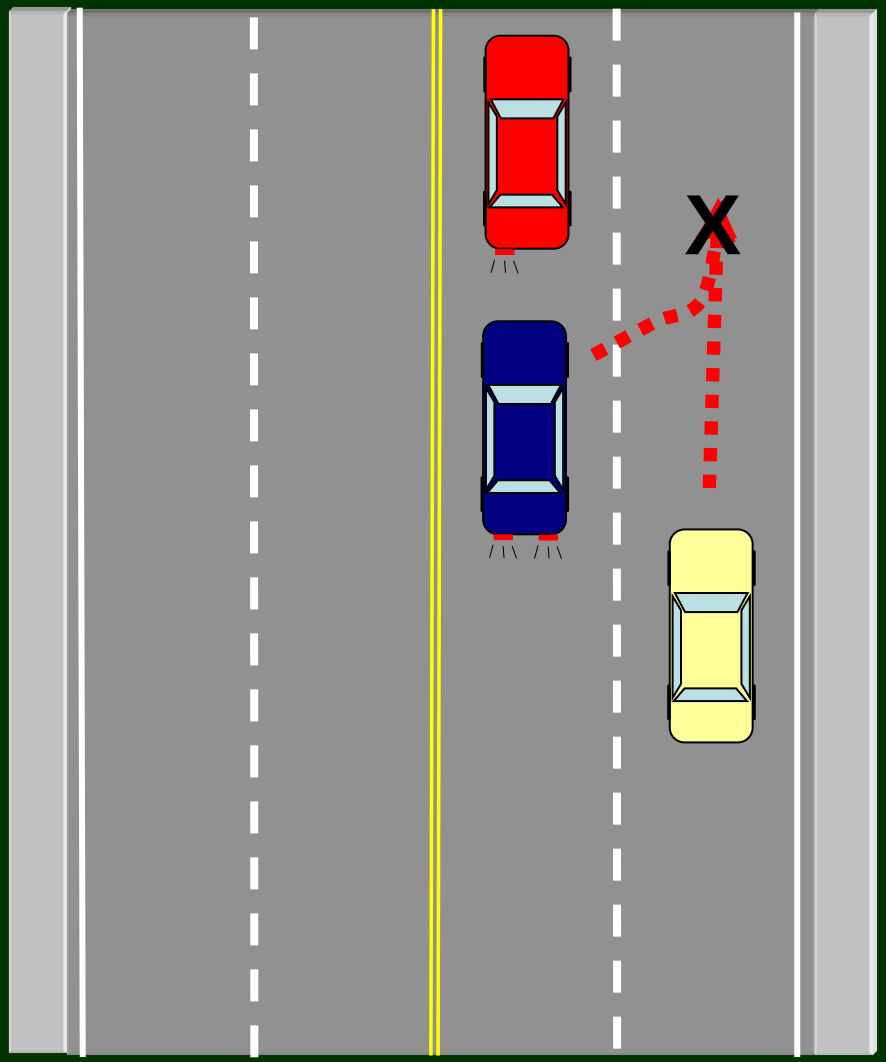
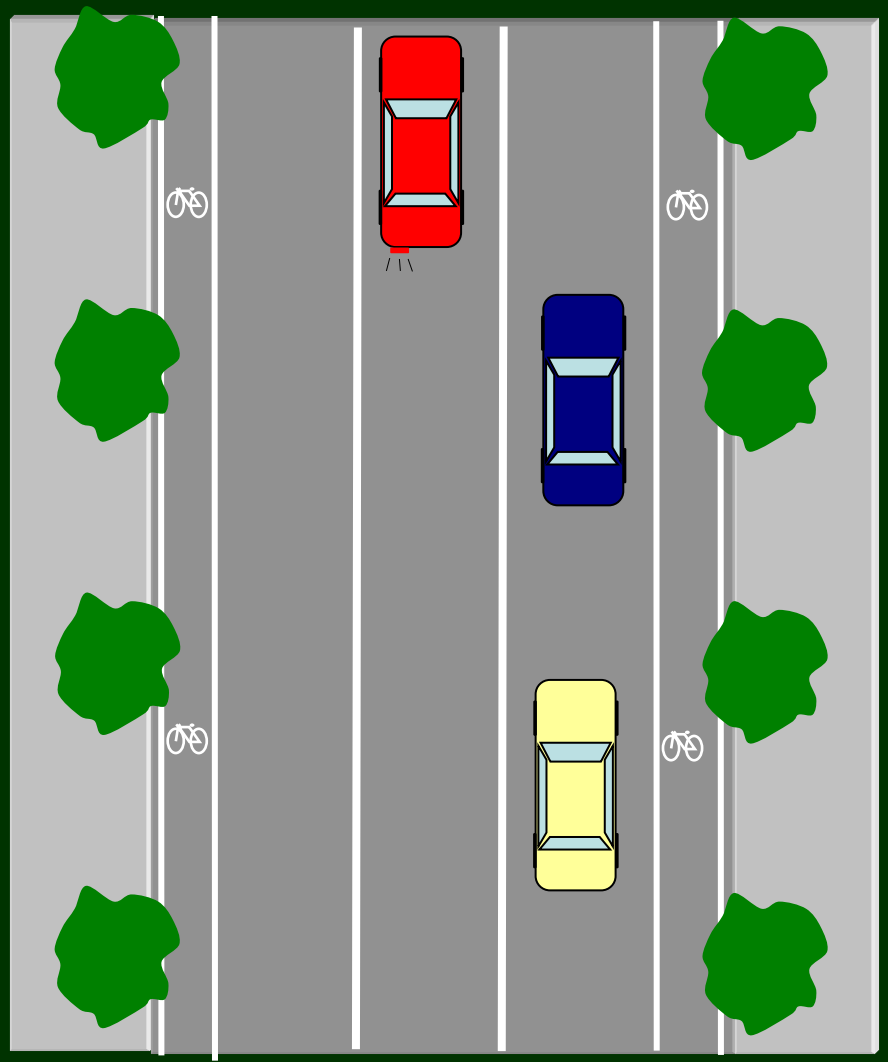
Three crash types can be reduced by going from 4 to 3 lanes





2. Side swipes

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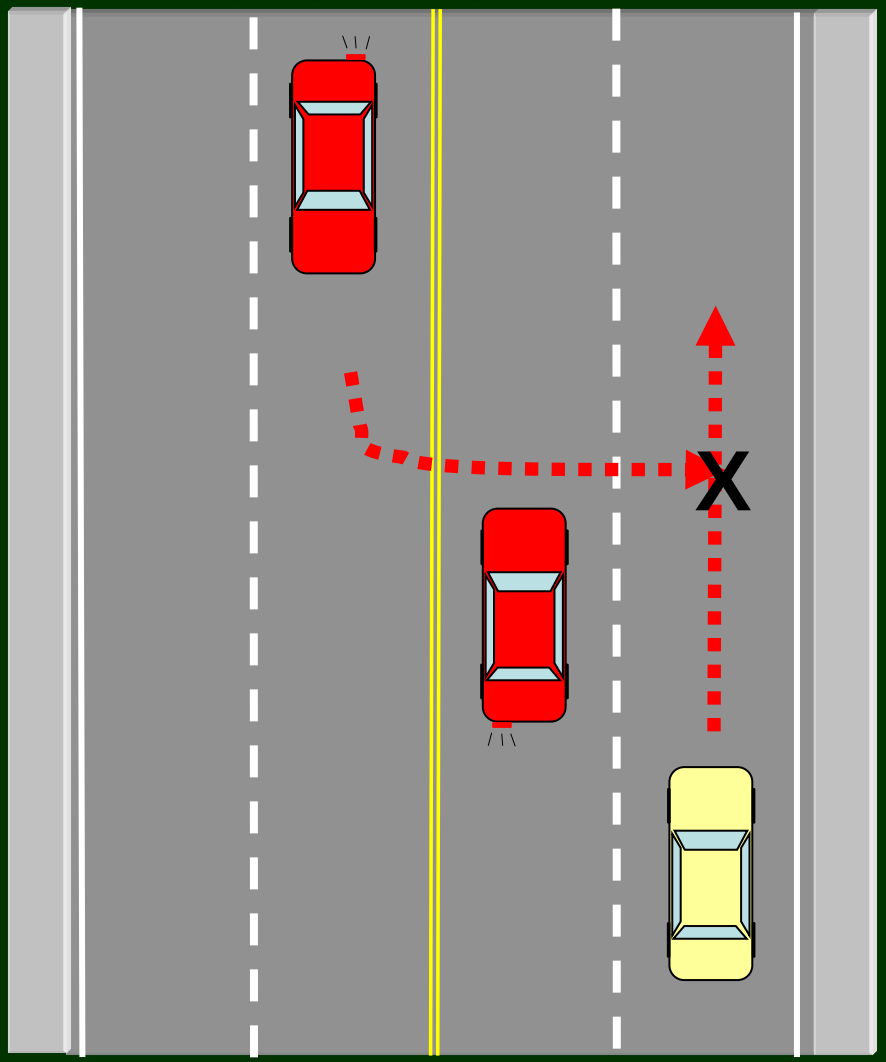
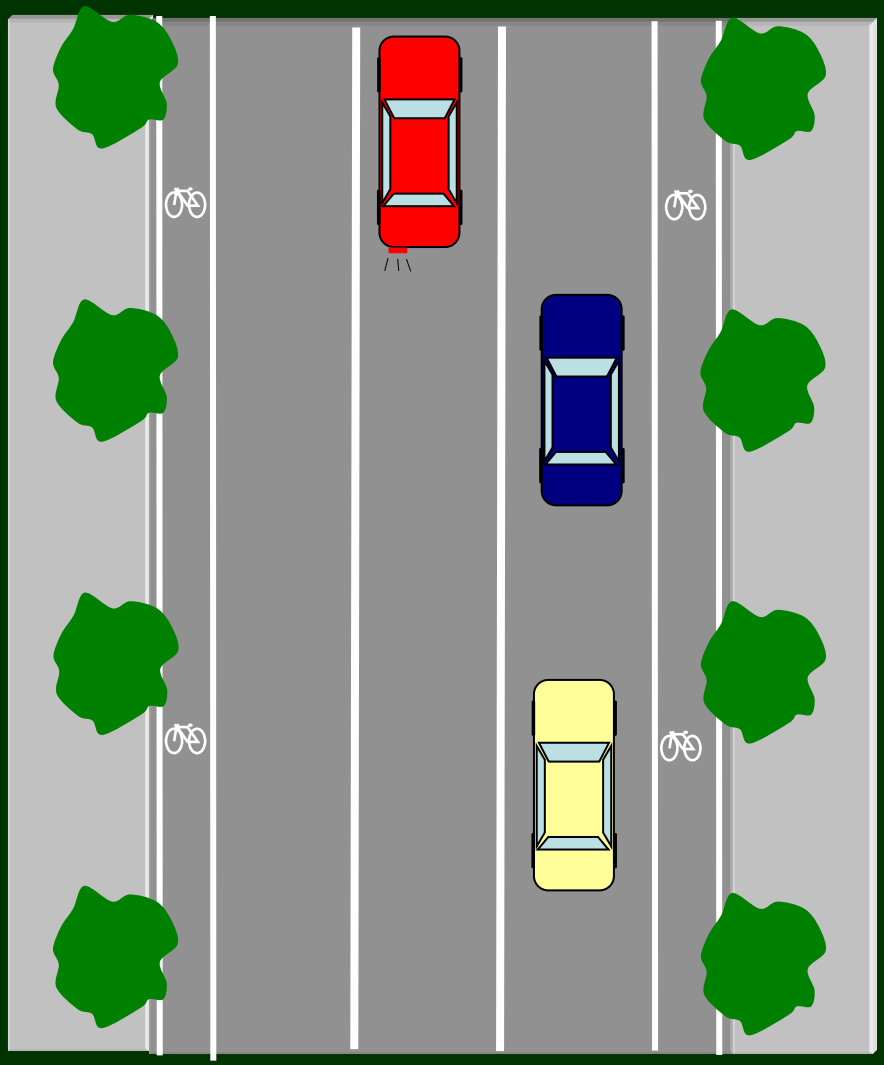
Three crash types can be reduced by going from 4 to 3 lanes





3. Left turn/broadside

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Handles 20,000 ADT

Mission District, San Francisco
North-South ADT

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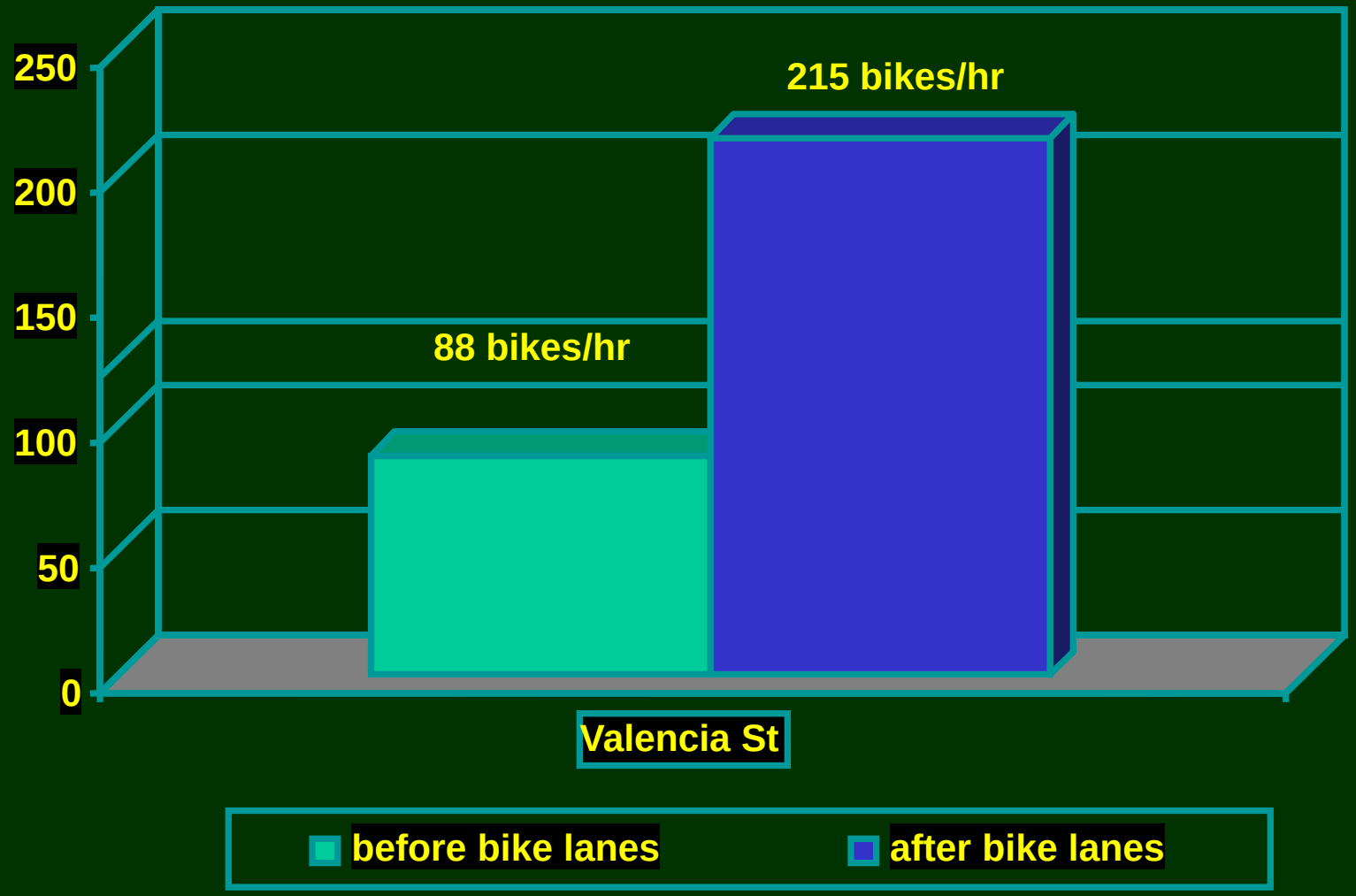
Valencia Street Bicycle Volumes
PM peak hour counts



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- Which road carries more traffic?
- Which road produces higher speed?
  - ✓ **4-lane: Faster driver can pass others**
  - ✓ **2-lane: Slower driver sets speed**
- Which road produces higher crash rate?
- Which is better for bicyclists? Peds? Businesses?

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Costs to Control Operating Speeds

- Design to D LOS – Less pavement = less cost
- Signal progression – Cost to interconnect
- Narrower travel lanes – Less pavement = less cost
- Road diets – Install with resurfacing, no additional cost

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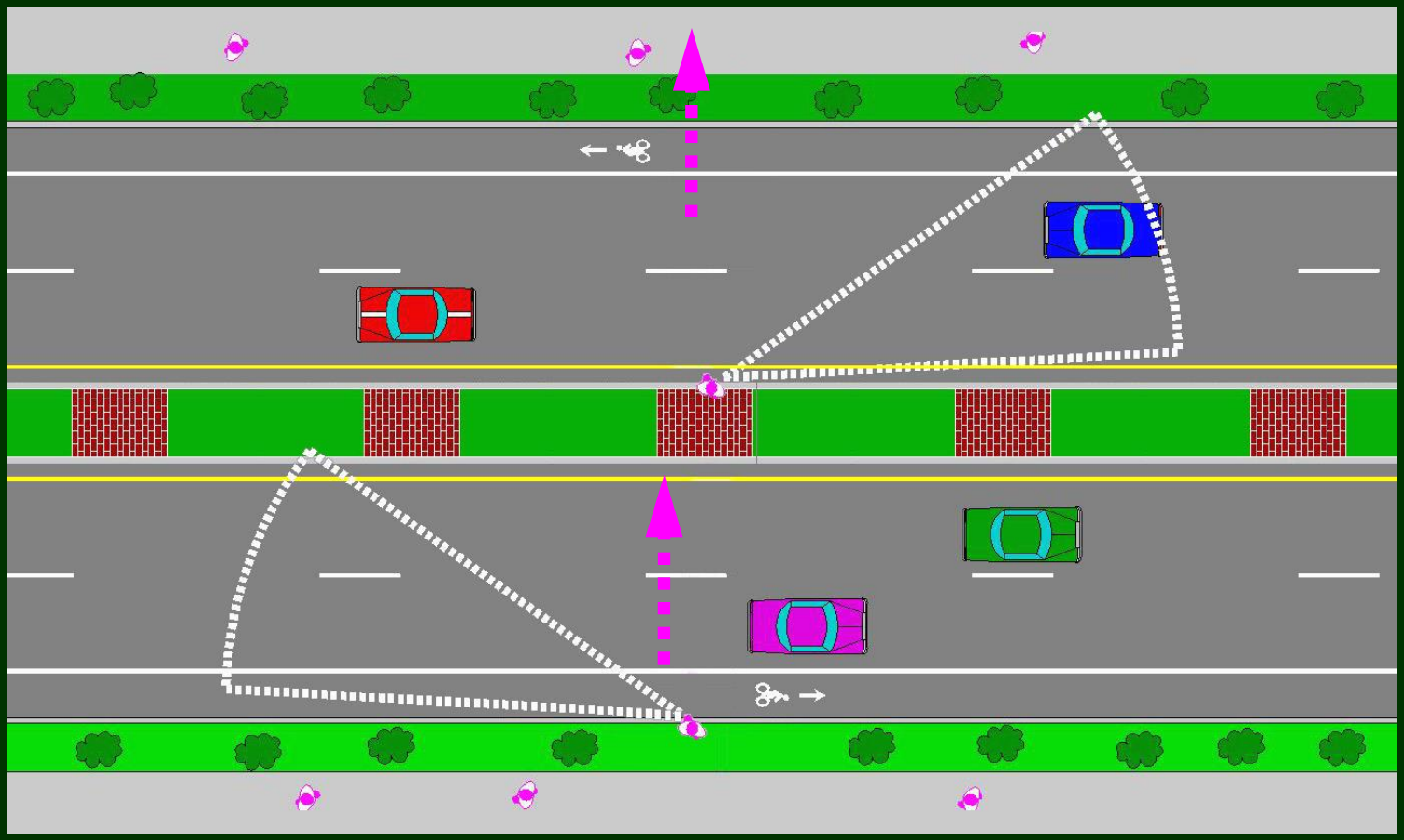
Raised Medians



Continuous raised median

40% reduction in pedestrian crashes

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Raised Medians

Flush median is not a refuge

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Raised Medians

Add a raised island

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Median/Parkway Landscaping

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Costs to Control Operating Speeds

- Design to D LOS – Less pavement = less cost
- Signal progression – Cost to interconnect
- Narrower travel lanes – Less pavement = less cost
- Road diets – Install with resurfacing, no additional cost
- Raised medians and landscaping – With roadway reconstruction

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Retain Curb Parking

Eliminating on-street parking encourages cars to go faster and discourages neighborhood business

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Costs to Control Operating Speeds

- Design to D LOS – Less pavement = less cost
- Signal progression – Cost to interconnect
- Narrower travel lanes – Less pavement = less cost
- Road diets – Install with resurfacing, no additional cost
- Raised medians and landscaping – With roadway reconstruction
- Retain curb parking – No cost, parking meter revenue

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Retrofitting Urban Arterials to Complete Streets

- Requires arterial traffic calming/taming:
  1. Controlling operating speeds
  2. **Ped-friendly street crossings**
     - ✓ Geometric issues
     - ✓ Signal considerations
- Requires facilities for nonmotorized users:
  1. Pedestrians
  2. Bicycles
  3. Transit

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Costs for Ped-Friendly Geometrics

- Tighten corner curb radii
- Corner “pork chop” islands
- Eliminate free flow right turn lanes
- Accessible curb ramps
- Curb bulb-outs

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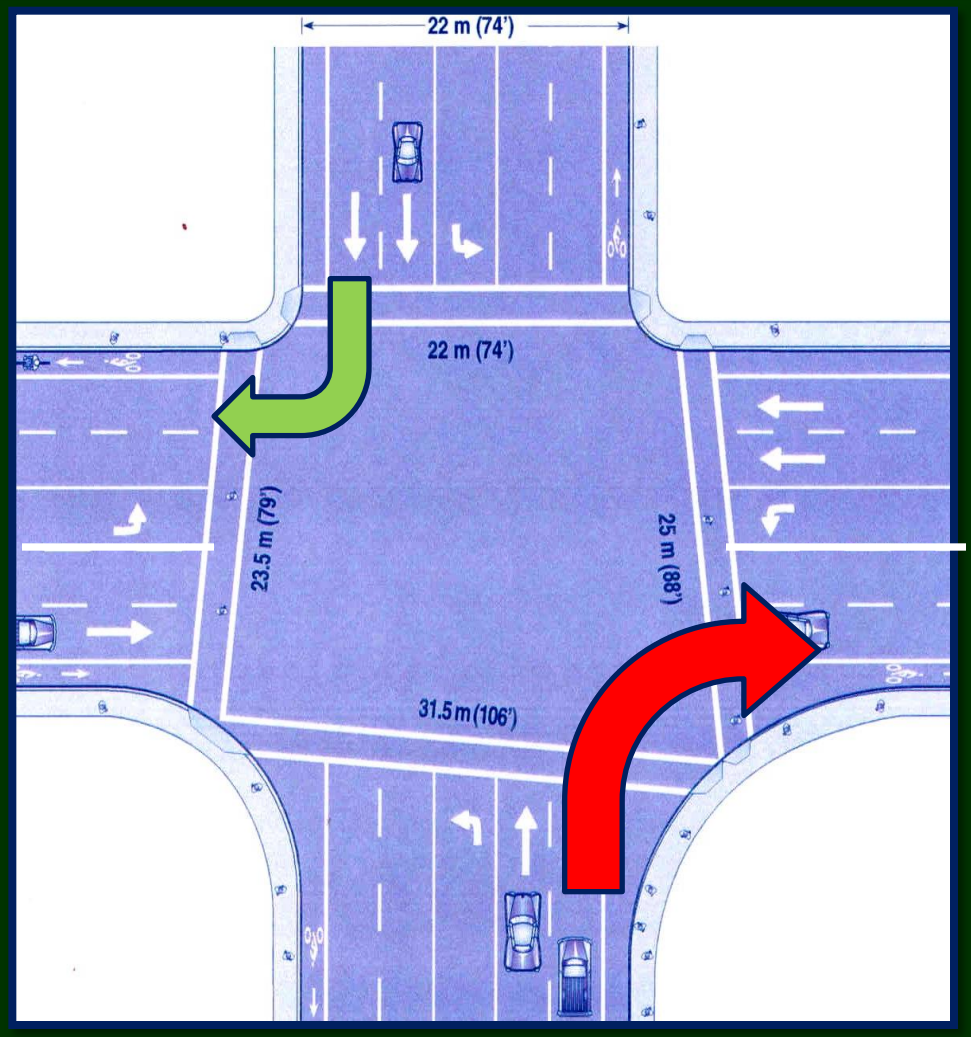
Effect of large radius on drivers

Tighten Corner Curb Radii

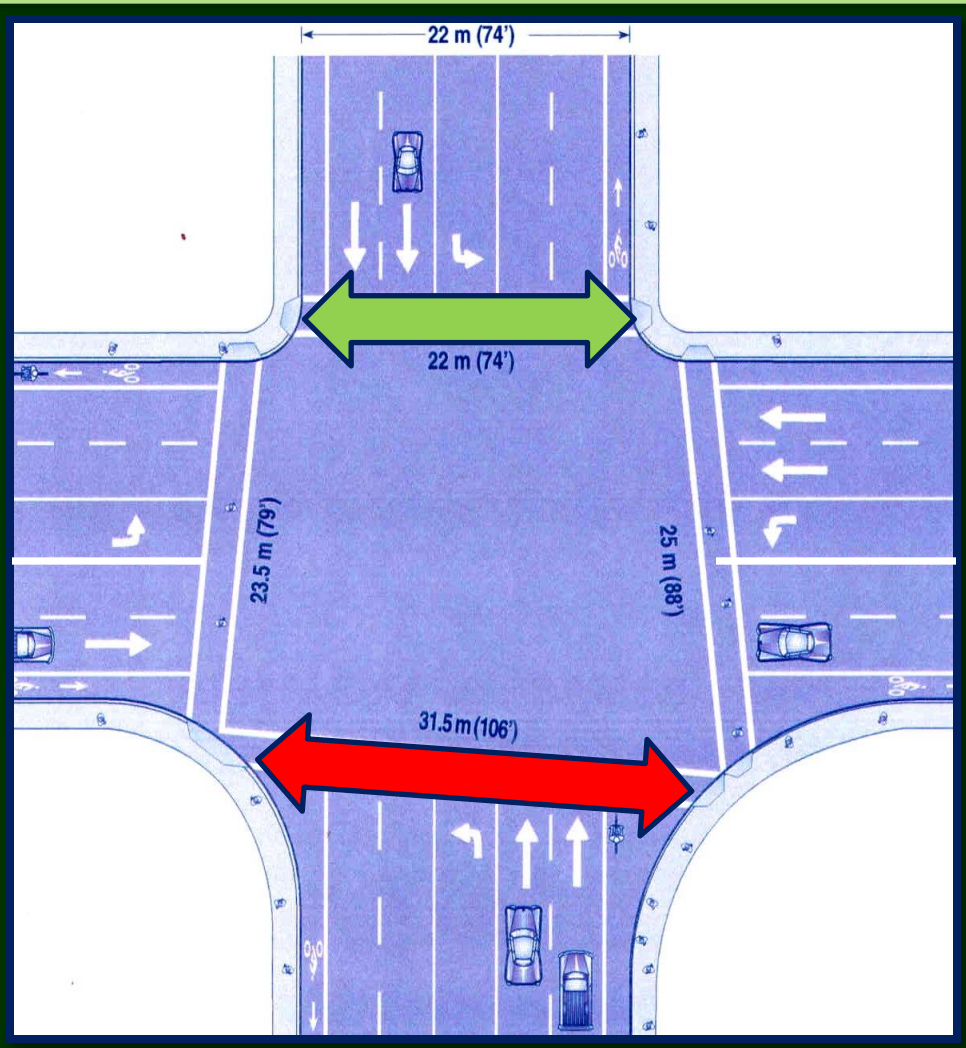
Large corner radii:

- Allow high-speed turns by cars
  - Less likely to yield
  - Injury severity is higher at higher speeds



Tighten Corner Curb Radii

- Large corner radii:
  - Increase crossing distance
  - Longer crosswalk means more pedestrian signal time, reducing roadway capacity for vehicles



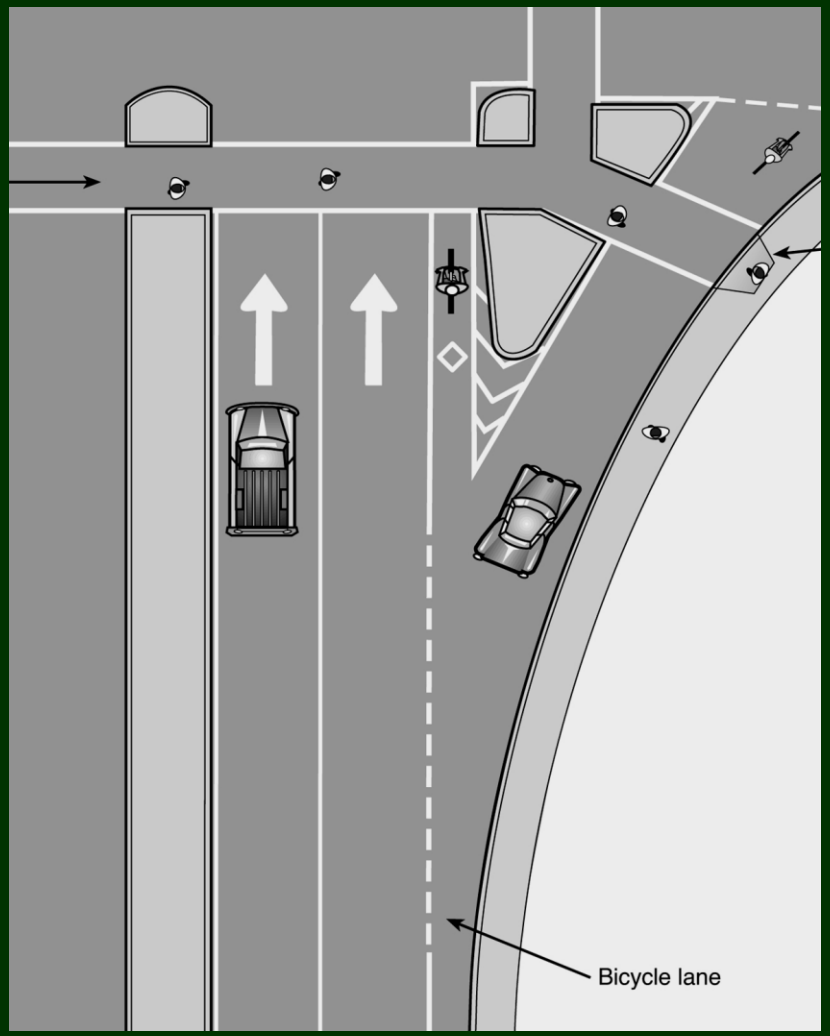
Costs for Ped-Friendly Geometrics

- Tighten corner curb radii – With roadway reconstruction

Corner “Pork Chop” Islands

Benefits:

- Separate conflicts & decision points
- Reduce crossing distance
- Improve signal timing
- Reduce ped crashes (29%)



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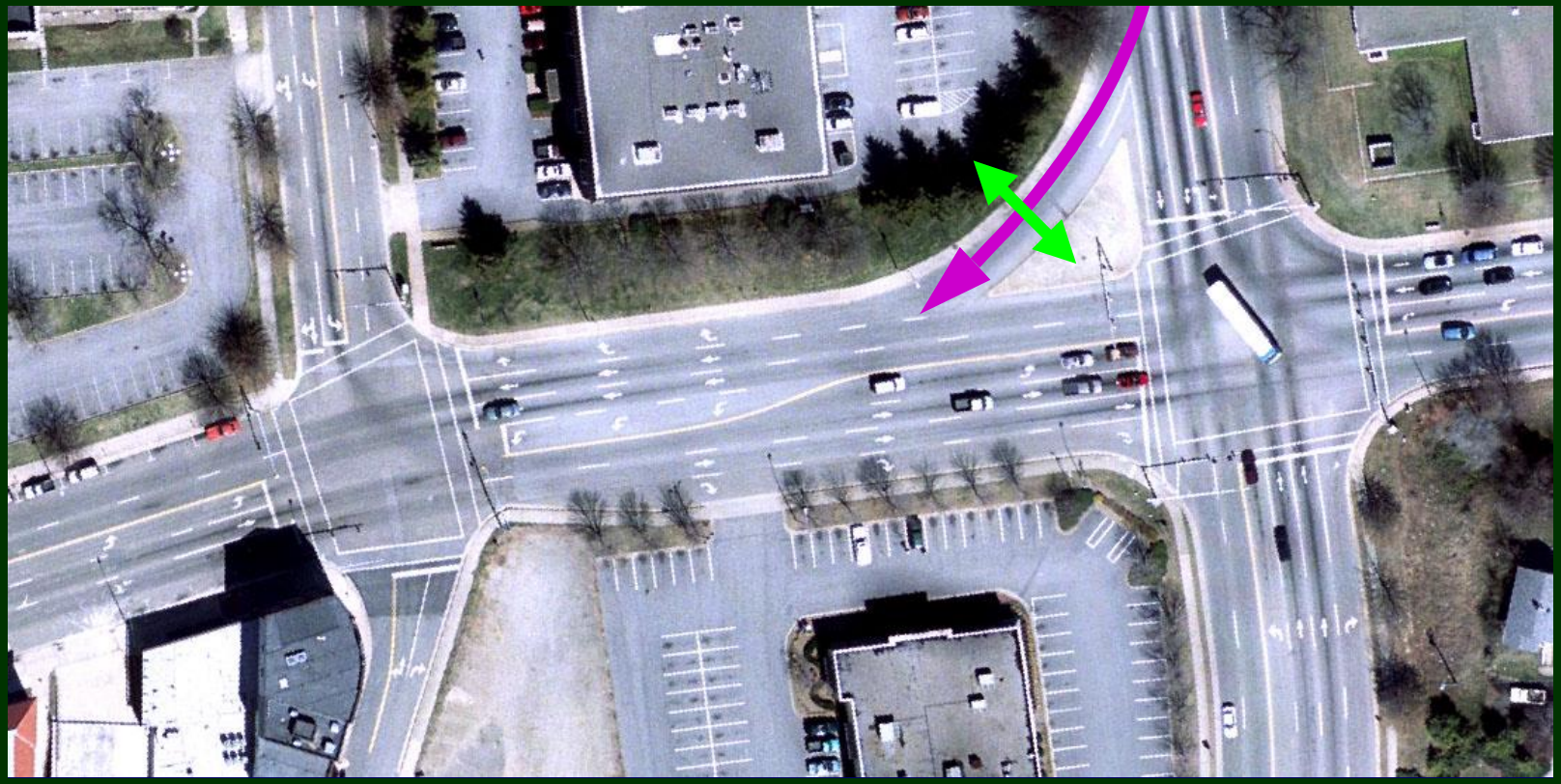
Costs for Ped-Friendly Geometrics

- Tighten corner curb radii – With roadway reconstruction
- Corner “pork chop” islands – With roadway reconstruction

Free Flow Right Turn Lanes



Eliminate free flow turns across crosswalks/bikeways

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Free Flow Right Turn Lanes

Eliminate free flow turns across crosswalks/bikeways

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Costs for Ped-Friendly Geometrics

- Tighten corner curb radii – With roadway reconstruction
- Corner “pork chop” islands – With roadway reconstruction
- Eliminate free flow right turn lanes – With ramp reconstruction

Accessible Curb Ramps

Eliminate movement barriers

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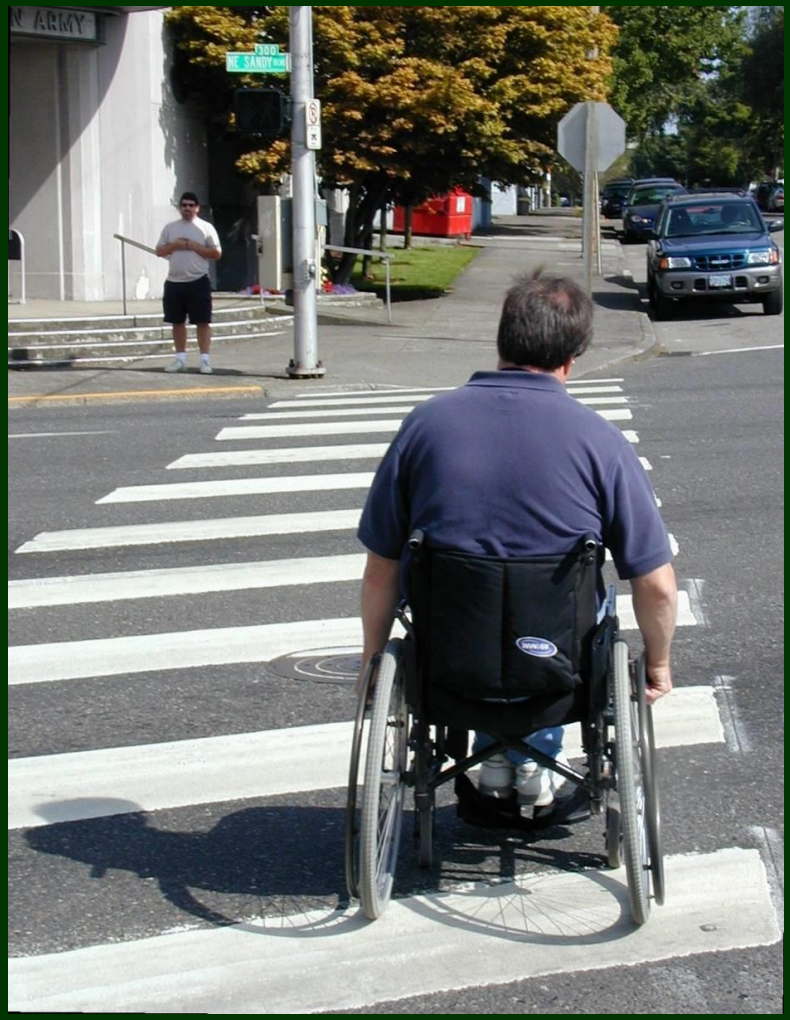
Accessible Curb Ramps



Complete the Streets

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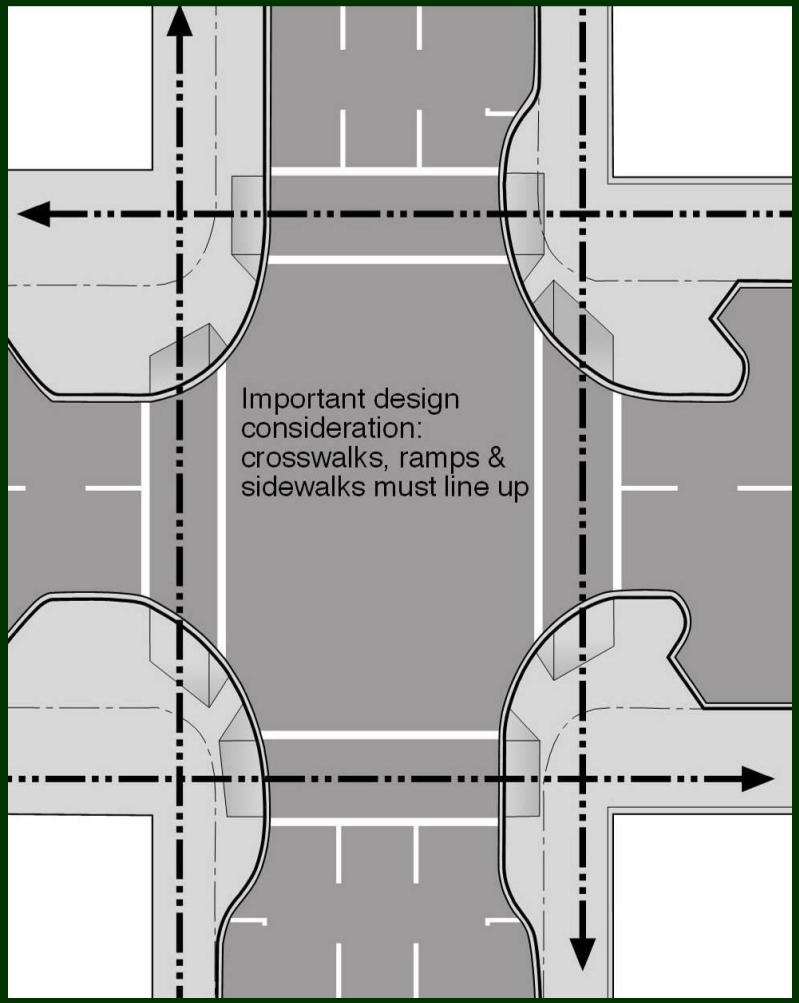
Accessible Ramp Design

Important design consideration: crosswalks, ramps & sidewalks should line up



Complete the Streets

TY LIN INTERNATIONAL

Costs for Ped-Friendly Geometrics

- Tighten corner curb radii – With roadway reconstruction
- Corner “pork chop” islands – With roadway reconstruction
- Eliminate free flow right turn lanes – With ramp reconstruction
- Accessible curb ramps – As part of your Transition Plan

Complete the Streets

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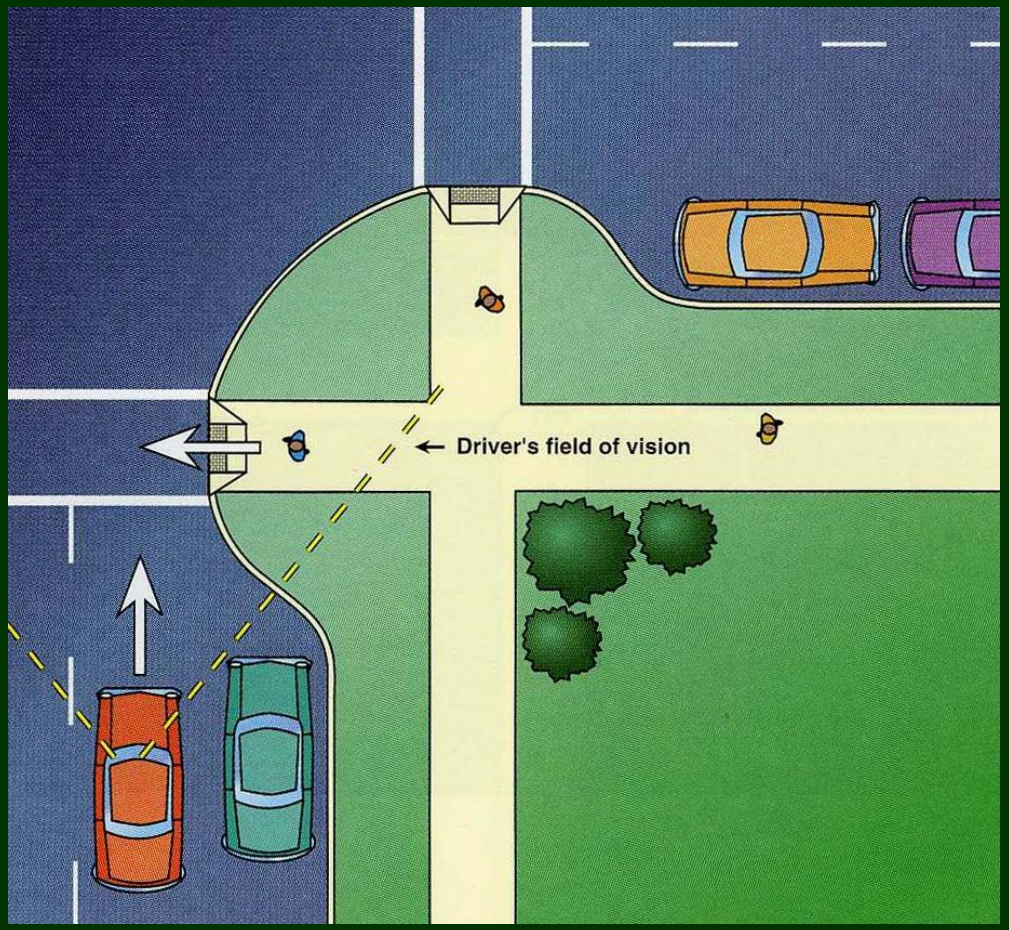
Curb Bulb-outs

- Reduce crossing distance
- Improve sight distance and sight lines
- Prevent encroachment by parked cars
- Create space for curb ramps and landings



Complete the Streets

TY LIN INTERNATIONAL

Costs for Ped-Friendly Geometrics

- Tighten corner curb radii – With roadway reconstruction
- Corner “pork chop” islands – With roadway reconstruction
- Eliminate free flow right turn lanes – With ramp reconstruction
- Accessible curb ramps – As part of your Transition Plan
- Curb bulb-outs – With roadway reconstruction and on-street parking

Complete the Streets

T·Y·LIN INTERNATIONAL

Retrofitting Urban Arterials to Complete Streets

- Requires arterial traffic calming/taming:
  1. Controlling operating speeds
  2. **Ped-friendly street crossings**
     - ✓ Geometric issues
     - ✓ Signal considerations
- Requires facilities for nonmotorized users:
  1. Pedestrians
  2. Bicycles
  3. Transit

Complete the Streets

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Pedestrian Signal Costs

- Time signals for 3.5 ft/sec walking speed
- Countdown clocks
- Ped actuated HAWK signals
- Rectangular Rapid Flash Beacon

Complete the Streets

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Pedestrian signal timing

- Recent studies found that previous 4.0 fps walking speed based on average walking speeds (not 15th percentile)
- 2009 MUTCD now recommends using a pedestrian walking speed of 3.5 fps for FDW and 3.0 fps for overall WALK phase

Complete the Streets

T·Y·LIN INTERNATIONAL

Pedestrian Signal Costs

- Time signals for 3.5 ft/sec walking speed
  - Signal maintenance

Effective Communications

50% of pedestrians in the U.S. do not understand that “Flashing Don’t Walk” really means it is OK to continue walking

So we put signs like this to “correct” the problem

Complete the Streets

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Countdown Clocks

Pedestrian count-down signal tells pedestrians how much crossing time is left

Complete the Streets

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Countdown Clocks

Results from San Francisco:

25% Crash Reduction Factor after countdown signals installed

Complete the Streets

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Pedestrian Signal Costs

- Time signals for 3.5 ft/sec walking speed – Signal maintenance
- Countdown clocks – Can be added for roughly $2,000/intersection

HAWK Pedestrian Hybrid Signal

HAWK (High Intensity Activated Crosswalk)

Also in 2009 MUTCD

Complete the Streets

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Drivers see Beacon

Peds see Pedhead

Complete the Streets

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Hybrid Beacon Sequence

1

Blank for drivers

2

Flashing yellow

3

Steady yellow

4

Steady red

5

Wig-Wag

Return to 1

Complete the Streets

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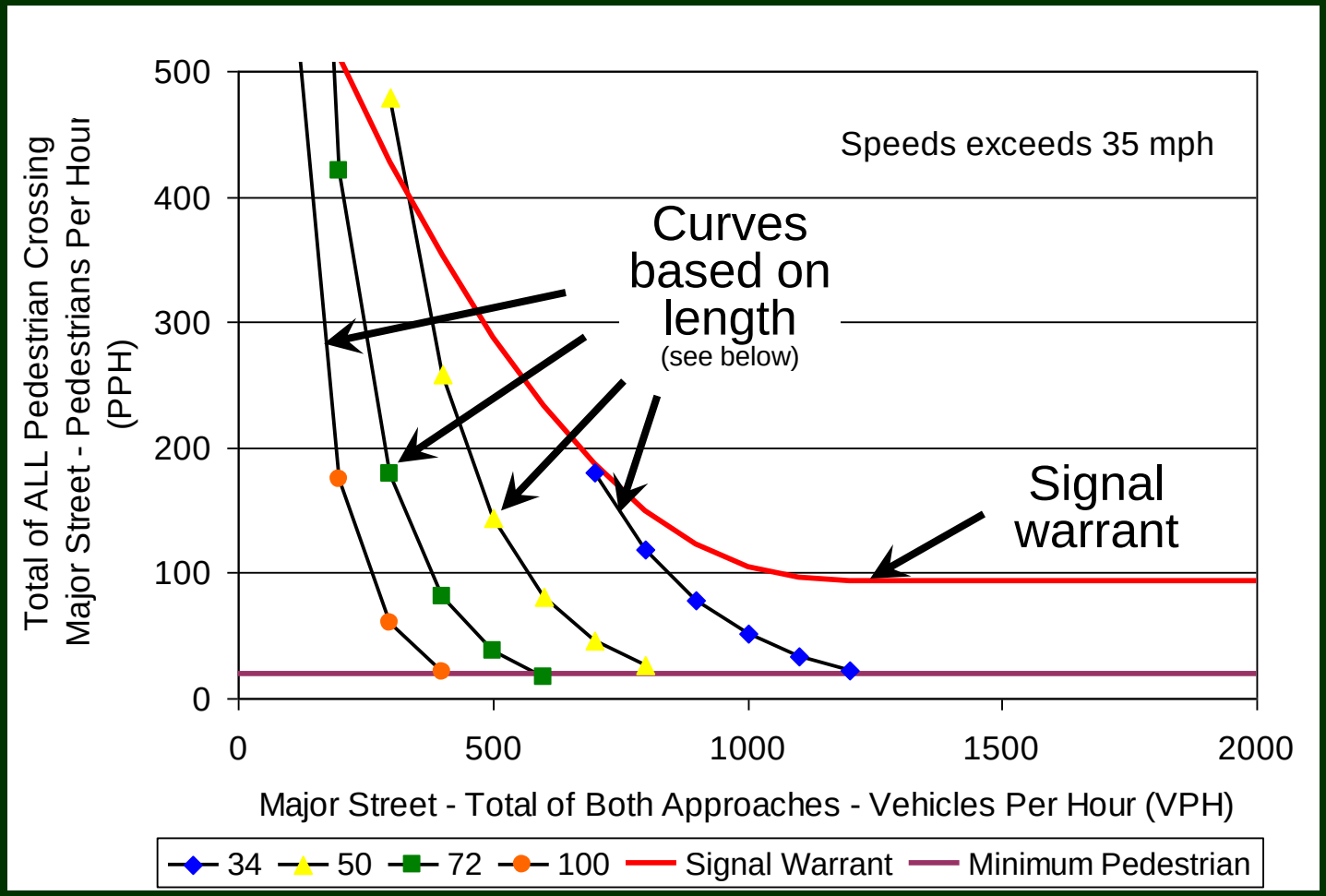
Pedestrian Hybrid Beacon (HAWK)



2009 MUTCD Chapter 4F

Complete the Streets

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Pedestrian Signal Costs

- Time signals for 3.5 ft/sec walking speed – Signal maintenance
- Countdown clocks – Can be added for roughly $2,000/intersection
- Ped actuated HAWK signals – Half the cost of standard ped signal; lower warrant

Complete the Streets

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Rectangular Rapid Flash LED Beacon

- Beacon is yellow, rectangular, and has a rapid “stutter” flash
- Beacon located between the warning sign and the arrow plaque
- Must be pedestrian activated (pushbutton or passive)
- Studies indicate motorist yielding rates increased from **18.2% to 81.2%** for 2 beacons and to **87.8%** for 4 beacons
- Interim approval from FHWA in July 2008

Complete the Streets

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Pedestrian Signal Costs

- Time signals for 3.5 ft/sec walking speed – Signal maintenance
- Countdown clocks – Can be added for roughly $2,000/intersection
- Ped actuated HAWK signals – Half the cost of standard ped signal; lower warrant
- Rectangular Rapid Flash Beacon - $20K and no specific warrant

Complete the Streets

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Costs for Facilities for Nonmotorized Users

1. **Pedestrians**
2. Bicycles
3. Transit

Pedestrians can get by without sidewalks on quiet streets

Complete the Streets

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Shoulders serve pedestrians in rural areas

Complete the Streets

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Rural Environments: Paved Shoulders

Crash Reduction of 70%

Complete the Streets

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Urban/Suburban Environments: Sidewalks

Crash Reduction of 88%

Complete the Streets

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Buffer sidewalks with planter strip/furniture zone:

- Space for trees and street furniture
- Easy to meet ADA at driveways and curb ramps
- More pleasant to walk on

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Narrow curbside sidewalks are inadequate in commercial areas

Complete the Streets

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Sidewalk Design

Set triggers for future sidewalks

- ✓Development densities
- ✓Developer requirements
- ✓Going from open to closed drainage

Complete the Streets

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Costs for Facilities for Nonmotorized Users

1. Pedestrians – Create gap infill program funded by developers, new roadway construction, program small amount each year
2. Bicycles
3. Transit

Complete the Streets

T·Y·LIN INTERNATIONAL

Costs for Facilities for Nonmotorized Users

1. Pedestrians – Create gap infill program funded by developers, new roadway construction, program small amount each year
2. **Bicycles**
3. Transit

Bikes Belong

"All highways, except those where bicyclists are legally prohibited, should be designed and constructed under the assumption that they will be used by cyclists."
AASHTO

Bikes Belong

"Therefore, bicycles should be considered in all phases of transportation planning, new roadway design, roadway construction and capacity improvement projects, and transit projects." AASHTO

Typical Bicyclists

Complete the Streets

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Typical Bicyclists

Bicyclist Characteristics

Four Bicyclist Types*

Strong & Fearless <1%

Enthused & Confident 7%

Interested but Concerned 60%
(Includes children)

No Way, No How 33%

* Roger Geller, Portland, OR

Sidewalks are Low Stress

It’s okay for young kids to ride on sidewalks

Complete the Streets

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An adult bicyclist on a sidewalk is not a good sign

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A cyclist on a sidewalk interferes with pedestrians

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A cyclist on a sidewalk places himself at risk

Complete the Streets

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Especially when riding against traffic!

Complete the Streets

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RELATIVE DANGER INDEX
of various types of facilities

Major Streets w/o bike lanes	1.28
Minor Streets w/o bike lanes	1.04*
Streets with bike lanes	0.5
Mixed-use paths	0.67
Sidewalks	5.32

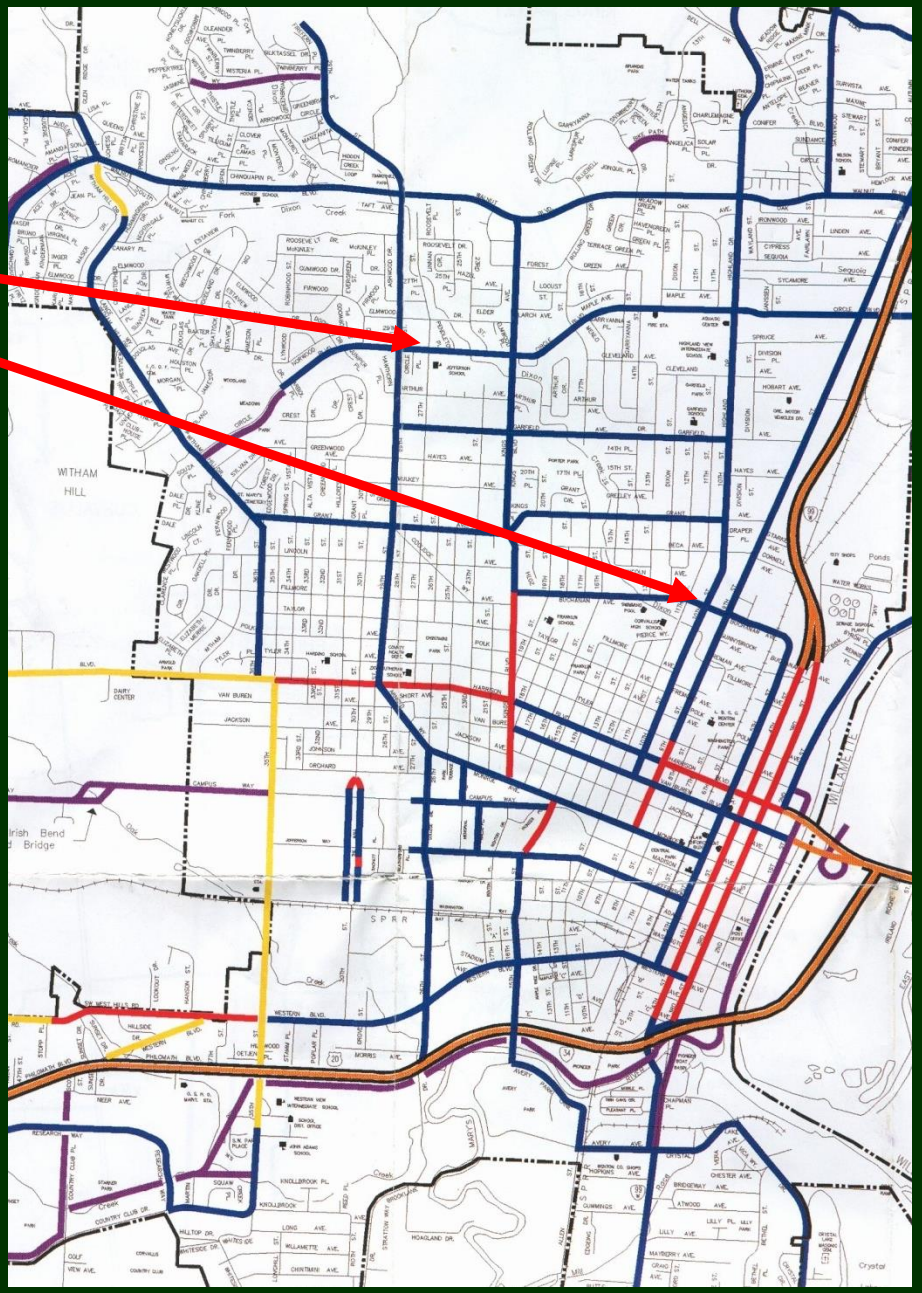
(* = shared roadway)

1.00 = median

Source: William Moritz, U.W. - “Accident Rates for Various Bicycle Facilities” - based on 2374 riders, 4.4 million miles

Provide space on streets …

- Bike lanes most appropriate on urban thoroughfares
- They get you from one part of town to another efficiently
- Intersections stop or signal controlled
- No point in striping local streets with bike lanes



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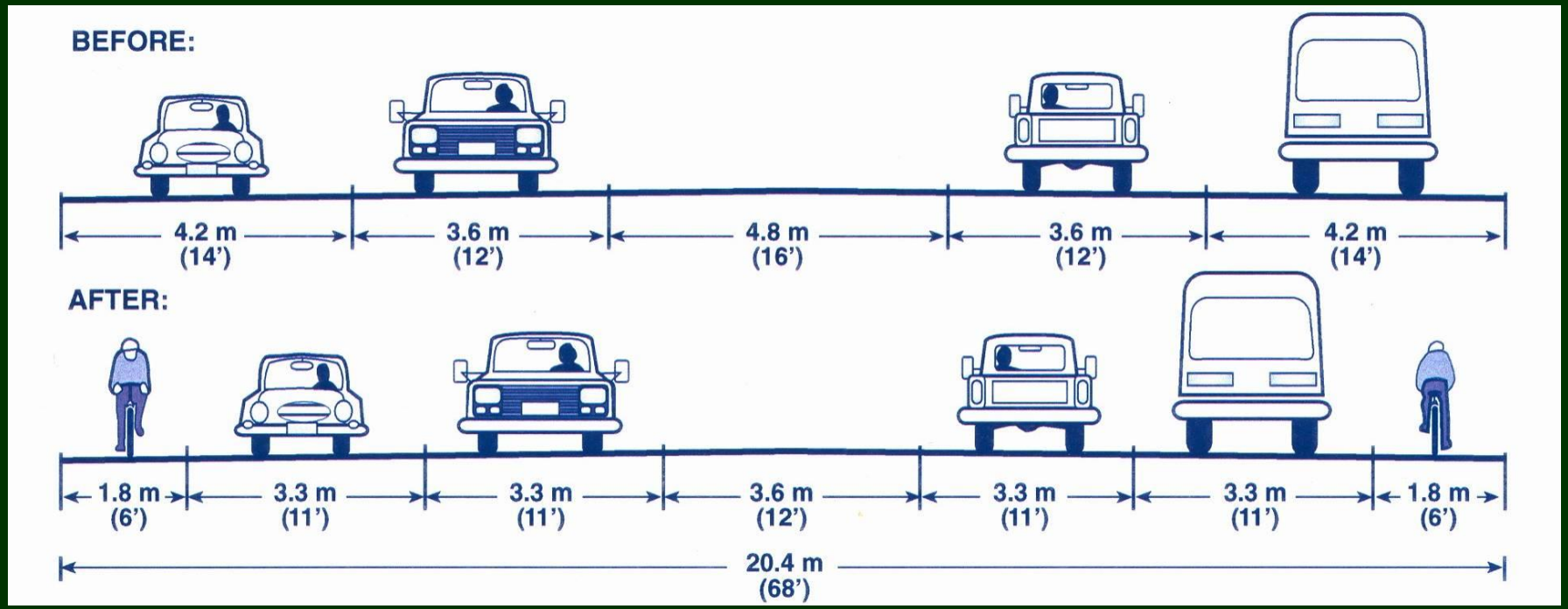
Facility Selection

- Bicycle Lanes
  - OK to reduce travel lane



10 and 11-foot lanes are just as safe as 12-foot lanes on urban arterials with posted speeds less than 45 mph

Complete the Streets

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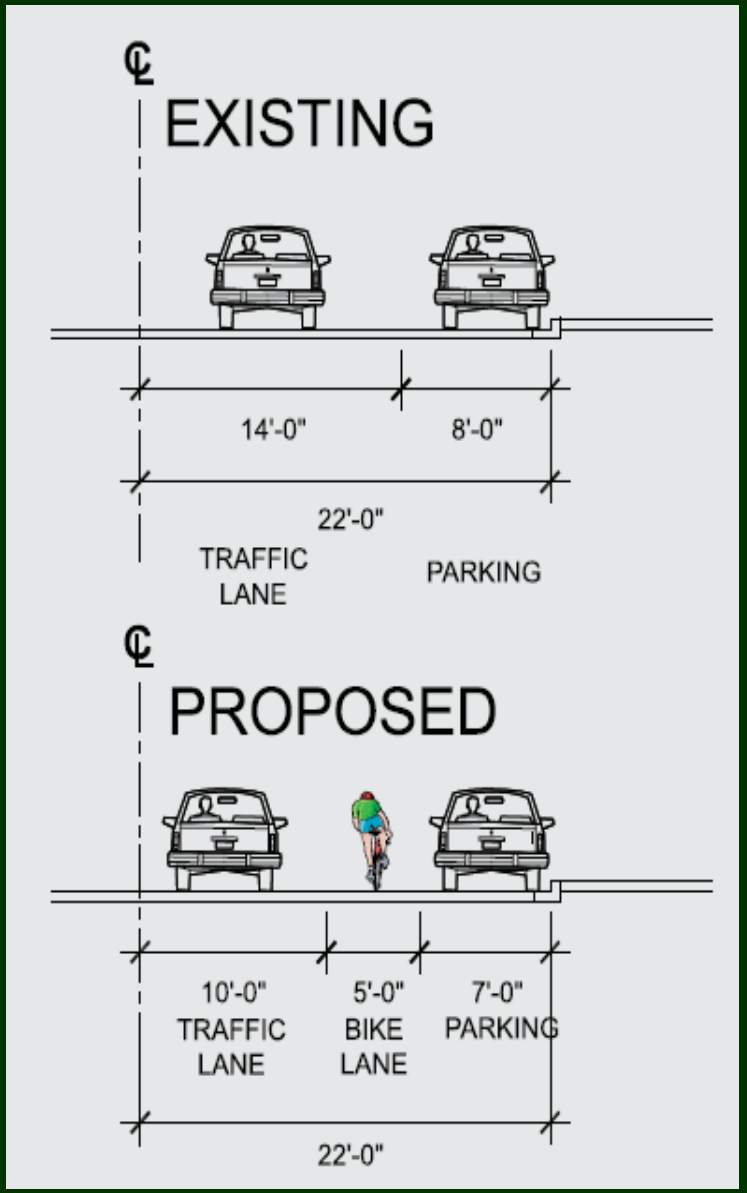
10-5-7 Retrofit

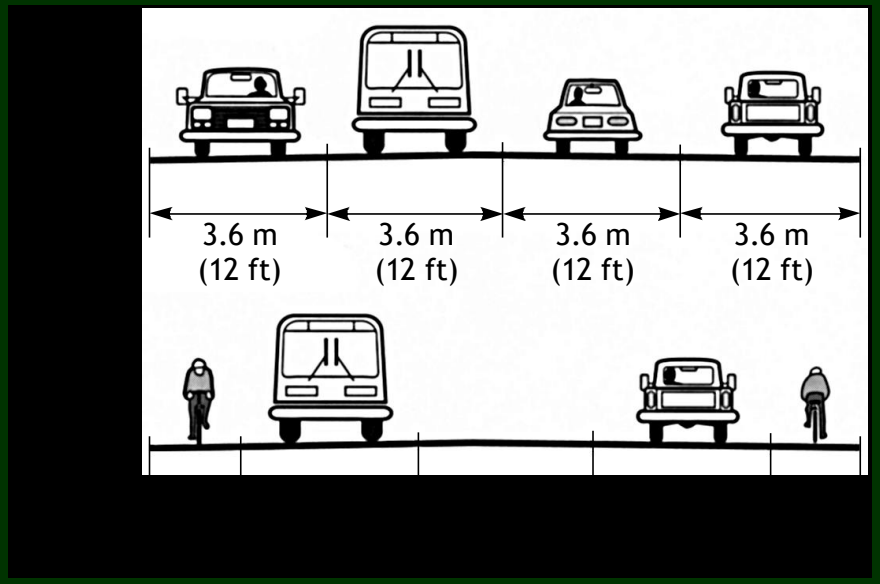
- Option when:
  - Current lane 22 ft (6.7 m) with parking
  - Vehicle speeds 30 mph
- How to implement:
  - Reduce width of travel and parking lanes
- Accepted by AASHTO
- Implemented in Chicago



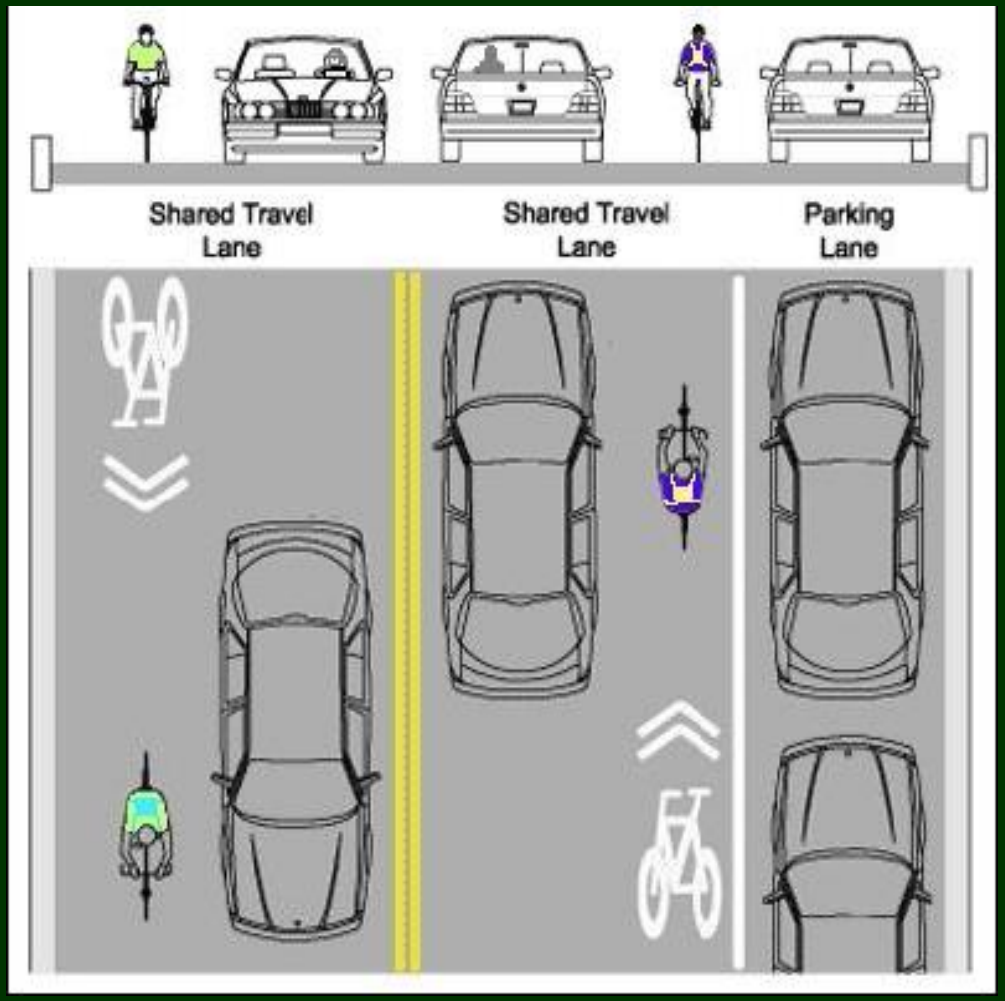
Retrofitting for Bike Lanes

- Reduce travel lane widths
- Reduce number of travel lanes
- Remove, narrow, or reconfigure parking
- Other design options

Typical "Road Diet"

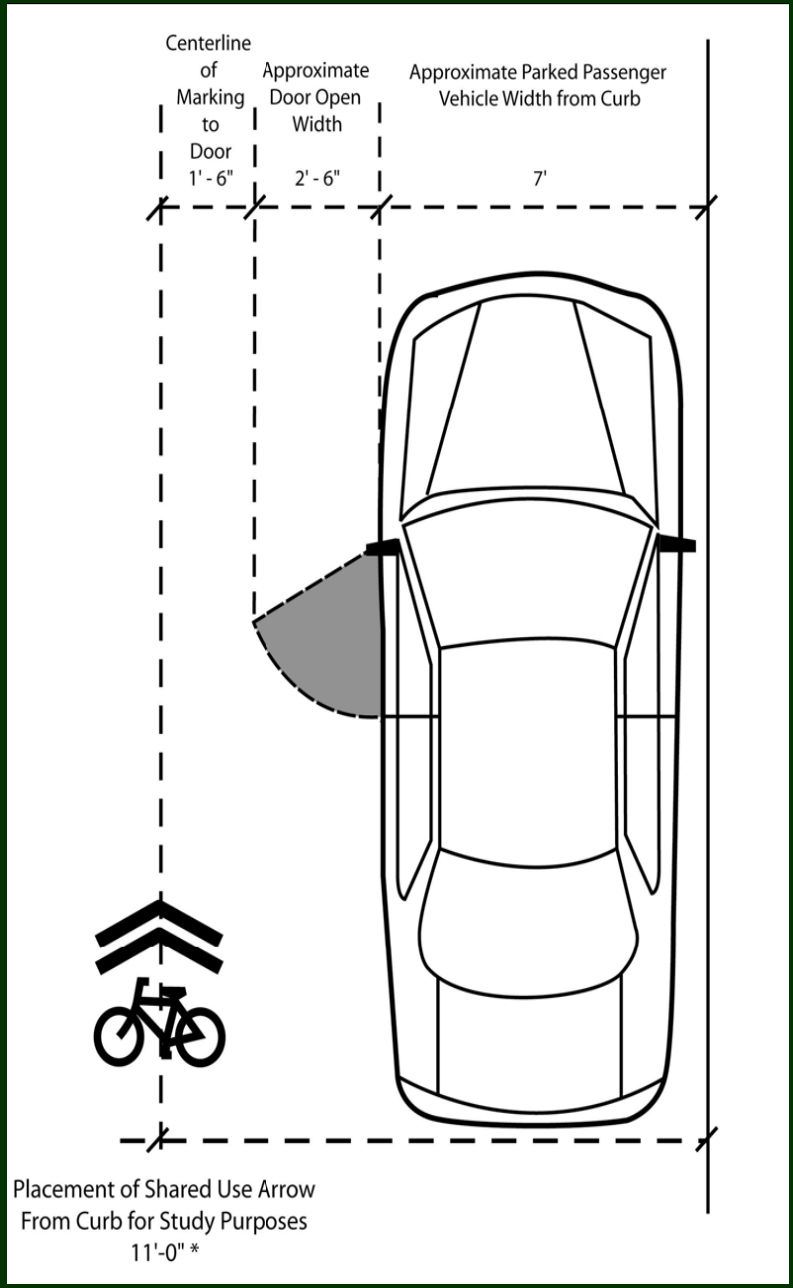


Shared Lane Markings



Shared Lane Markings

- "Sharrow"
  - Reinforces shared lane concept
  - Keeps bikes away from door zone
- Where to use:
  - Narrow shared use road where bicyclists tend to ride too close to parked cars or curb
  - Low roadway speeds with high parking turnover



Signing of Shared Roadways

D11-1

D11-1c

- Generic “Bike Route” signs not recommended
- Routes should be designated with a name or number.

Complete the Streets

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Signing of Shared Roadways

Route Signage

- Distance
- Direction
- Destination

Directional and destination signs are now in the 2009 MUTCD (Section 2B-20)

Complete the Streets

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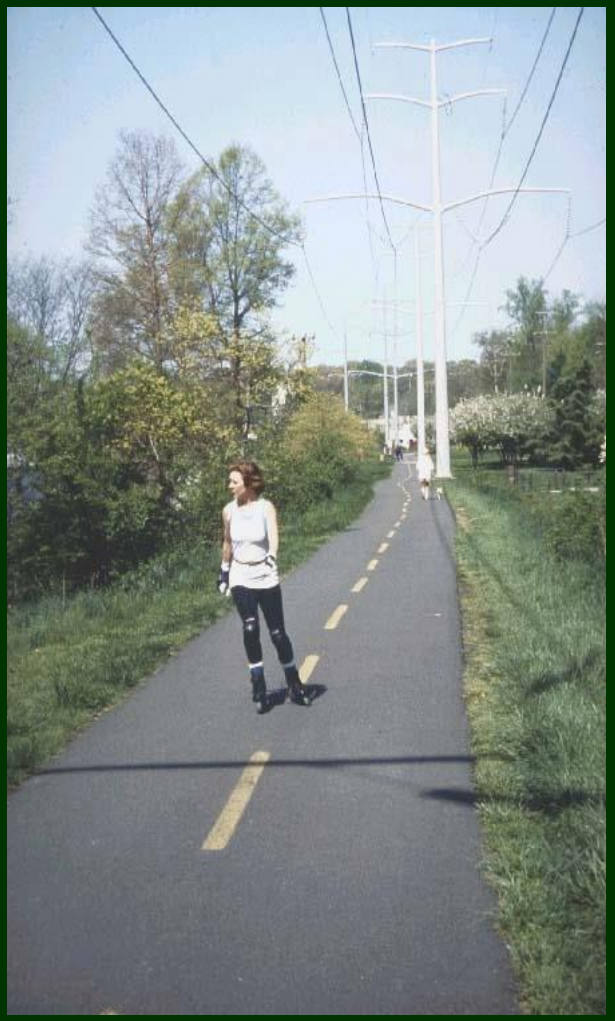
Shared Use Paths

- Bike facilities that are separated from the roadway
- Typically located on exclusive ROW
  - No fixed objects
  - Minimal cross-flow by motor vehicles

Shared Use Paths

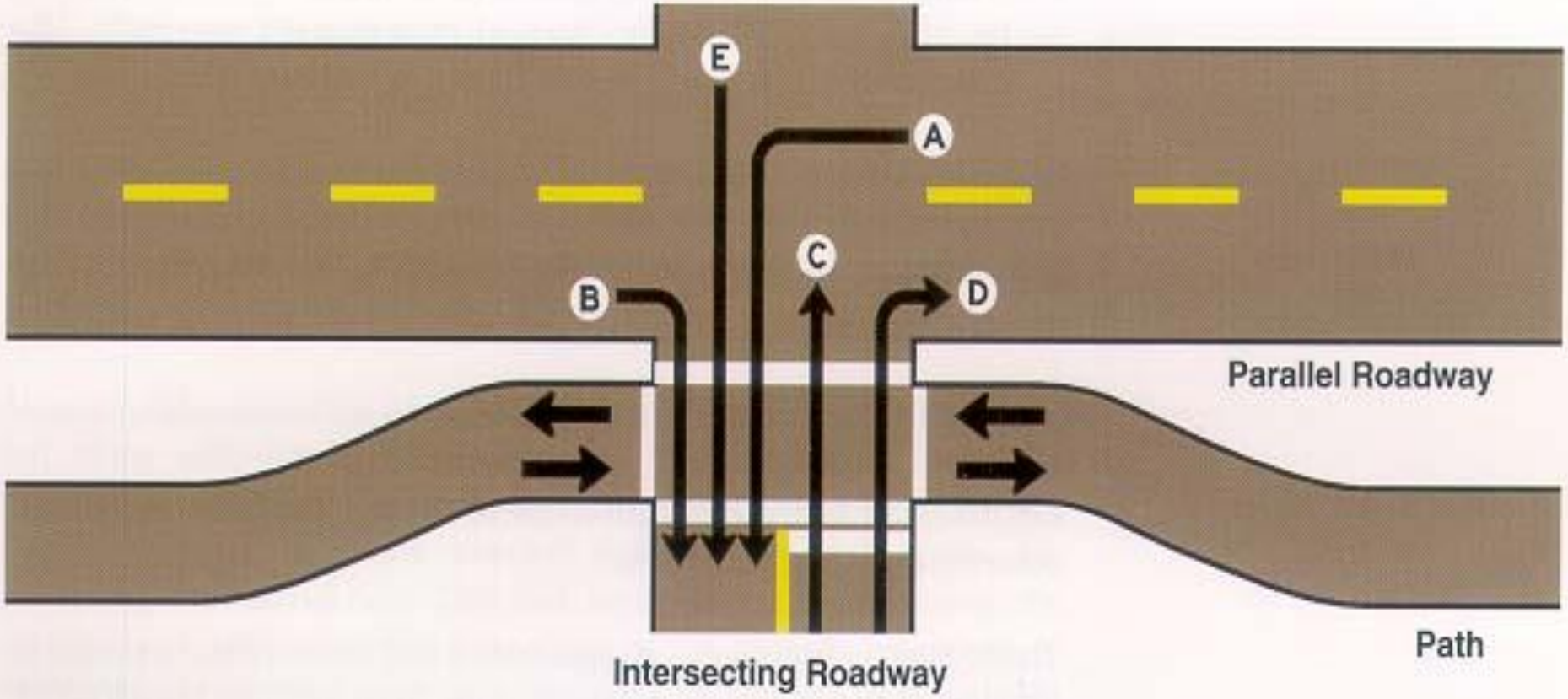
- Users include:
  - Bicyclists
  - Skaters
  - Wheelchairs
  - Pedestrians
  - Joggers/runners,
  - People with baby strollers
  - Dogs with people



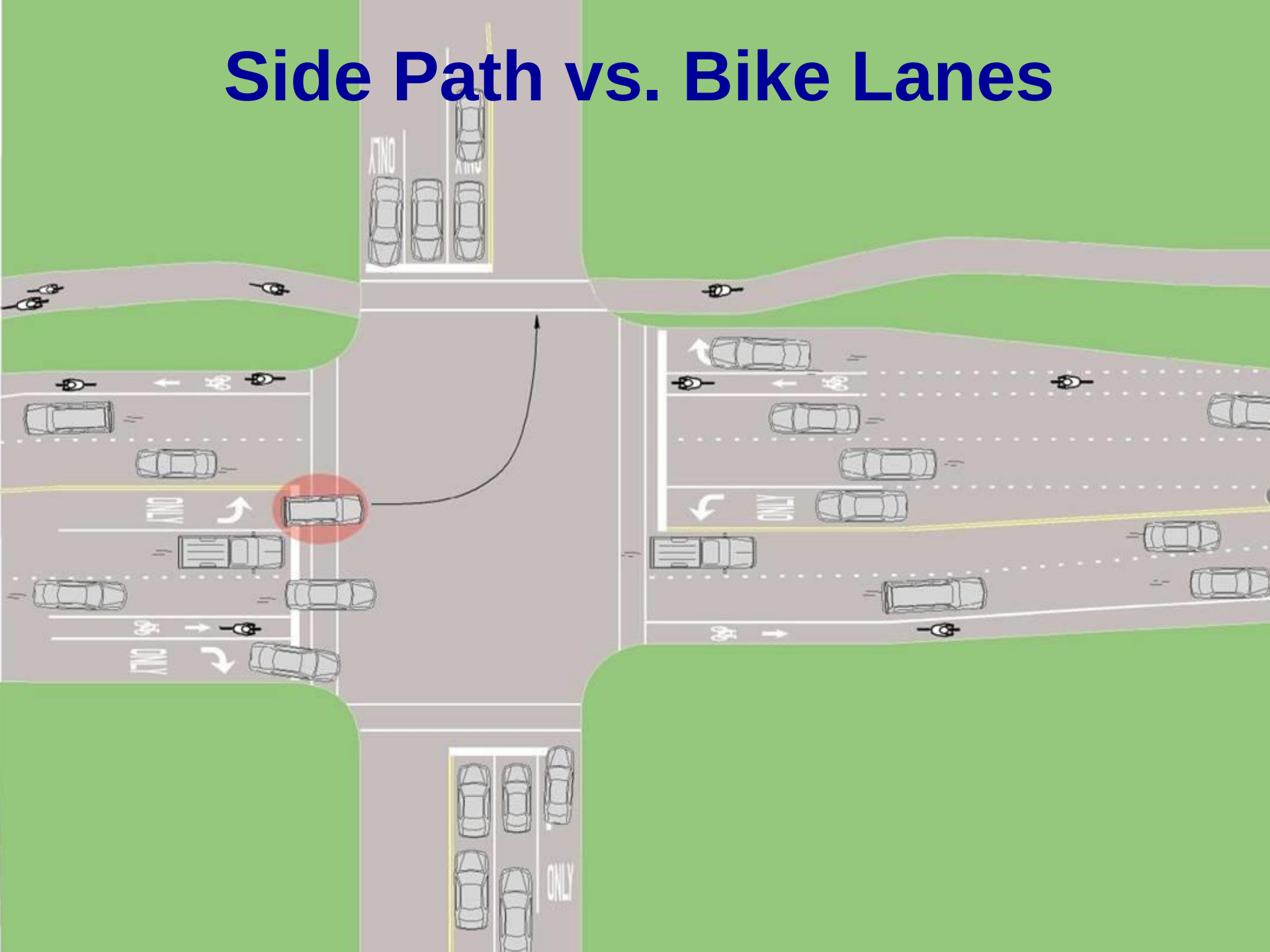
Paths Next to Roads

- Recommended minimum separation – 5 ft

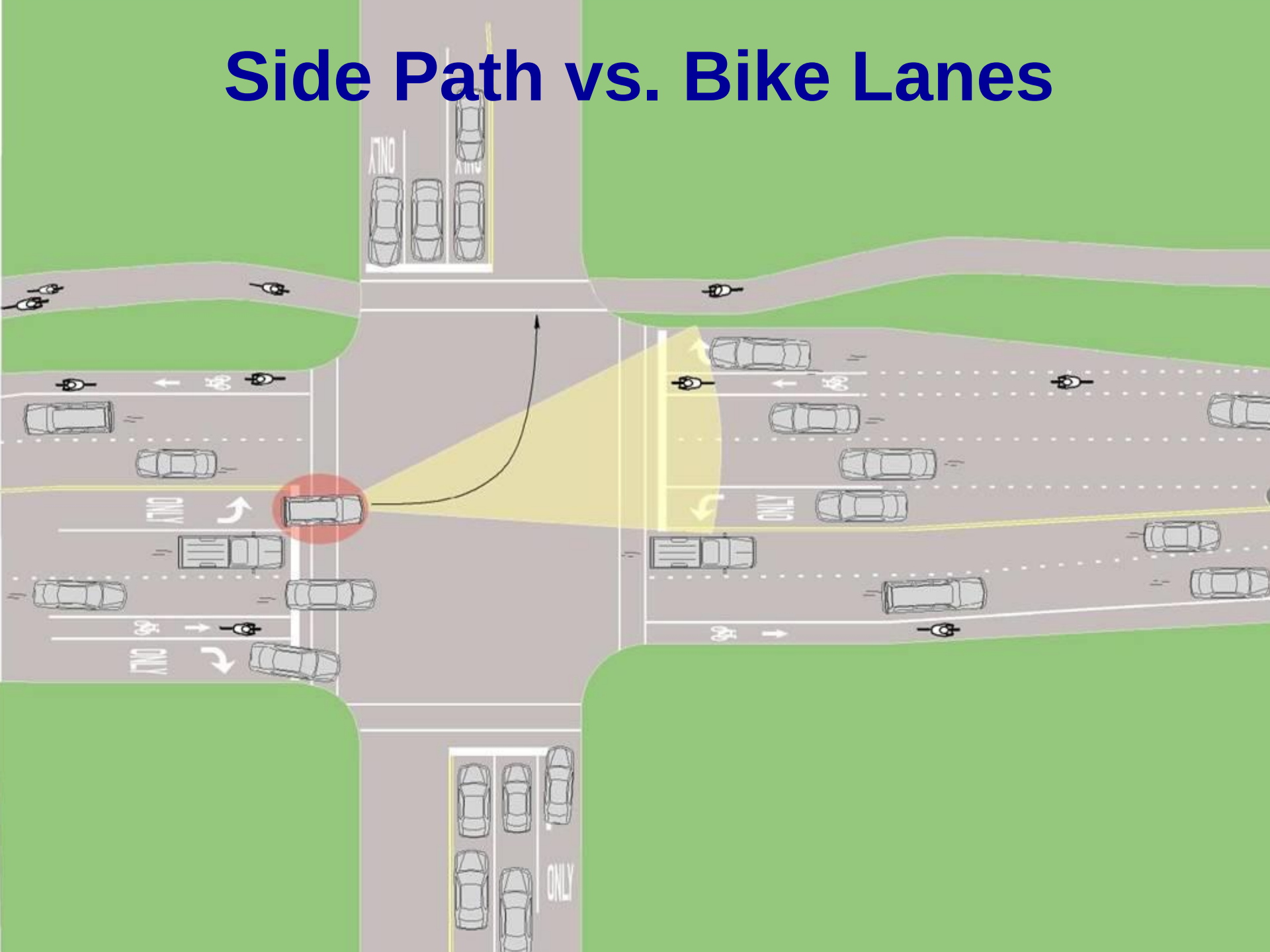
Adjacent Path Intersection



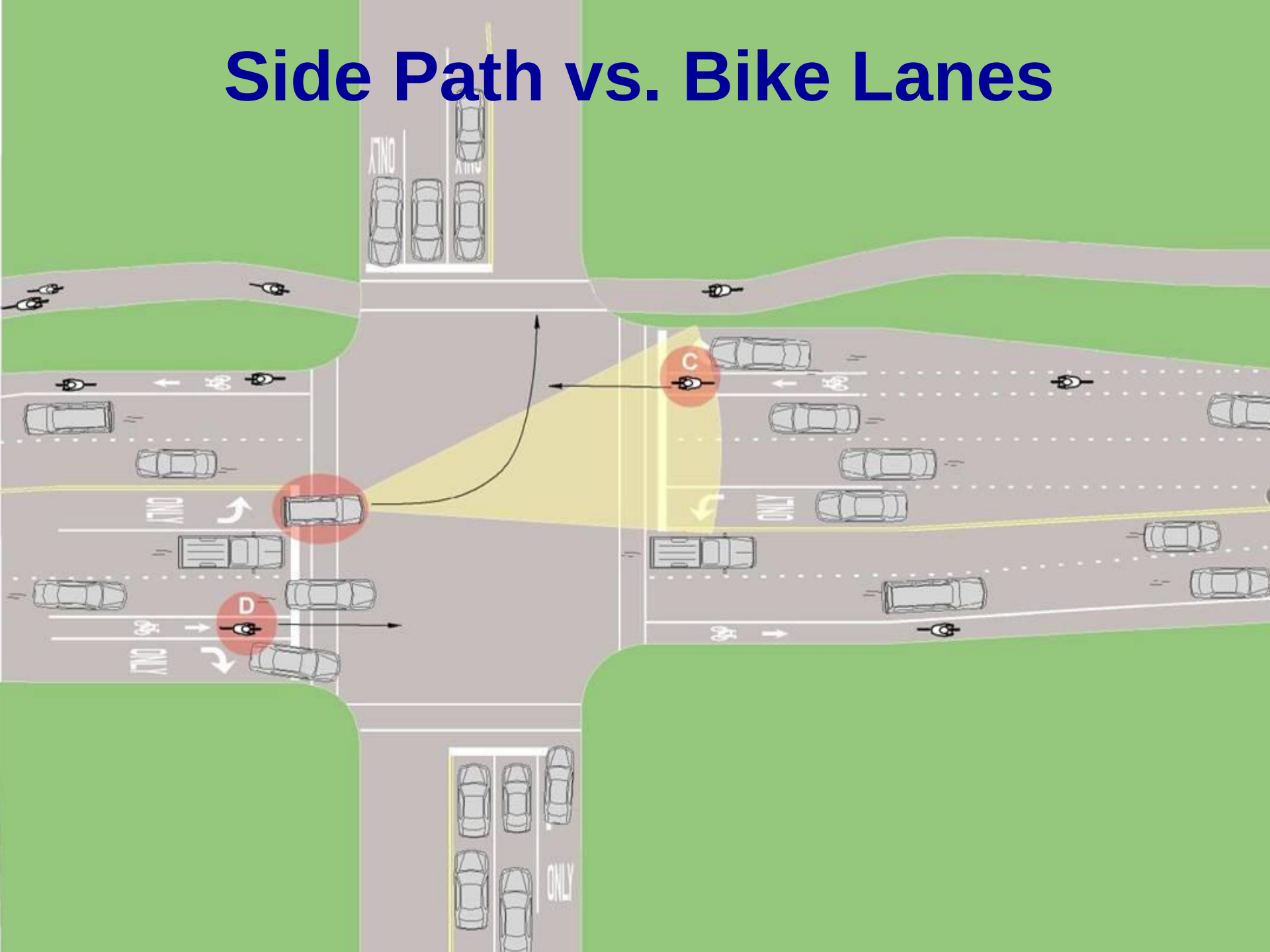
Side Path vs. Bike Lanes



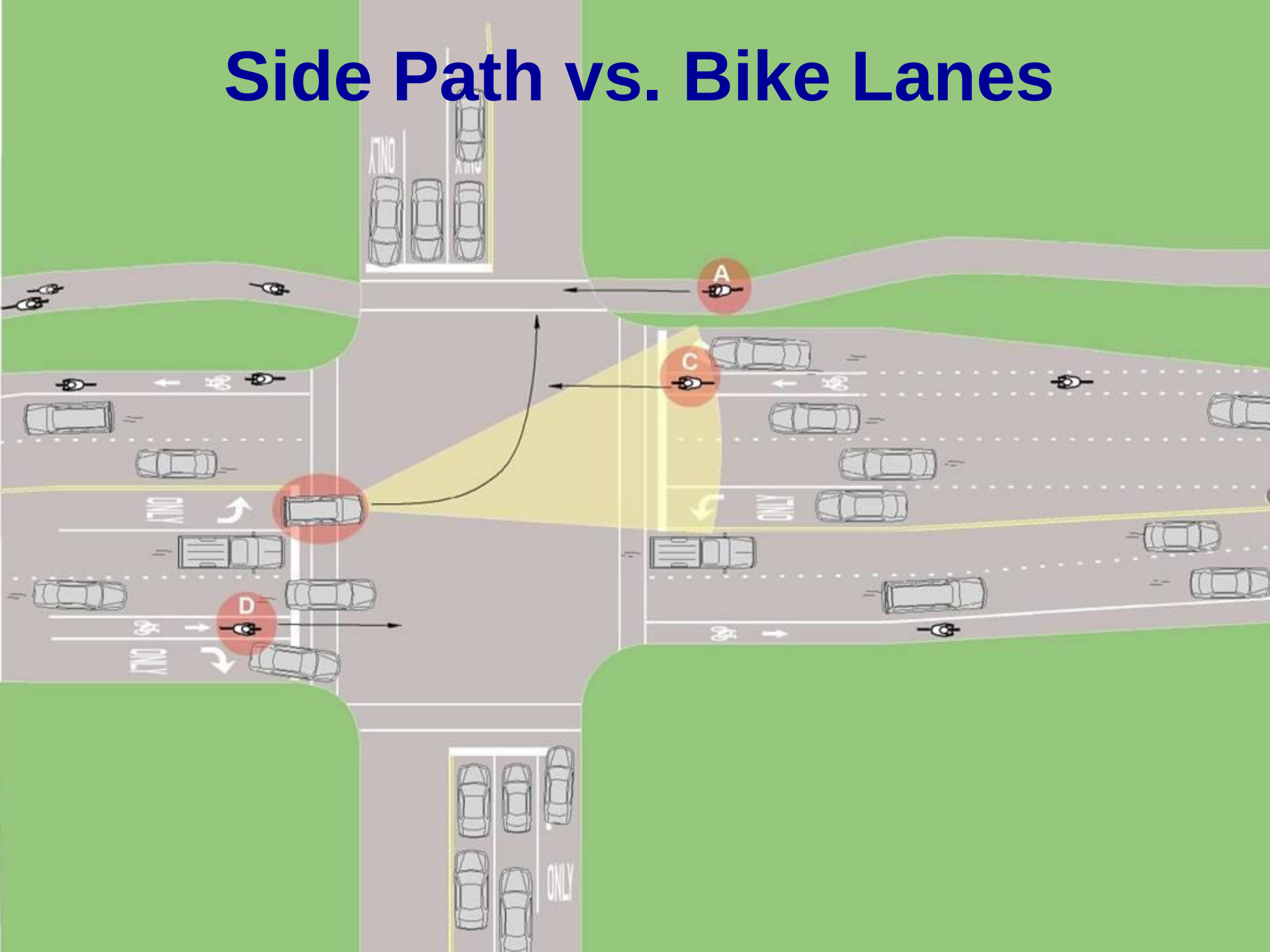
Side Path vs. Bike Lanes



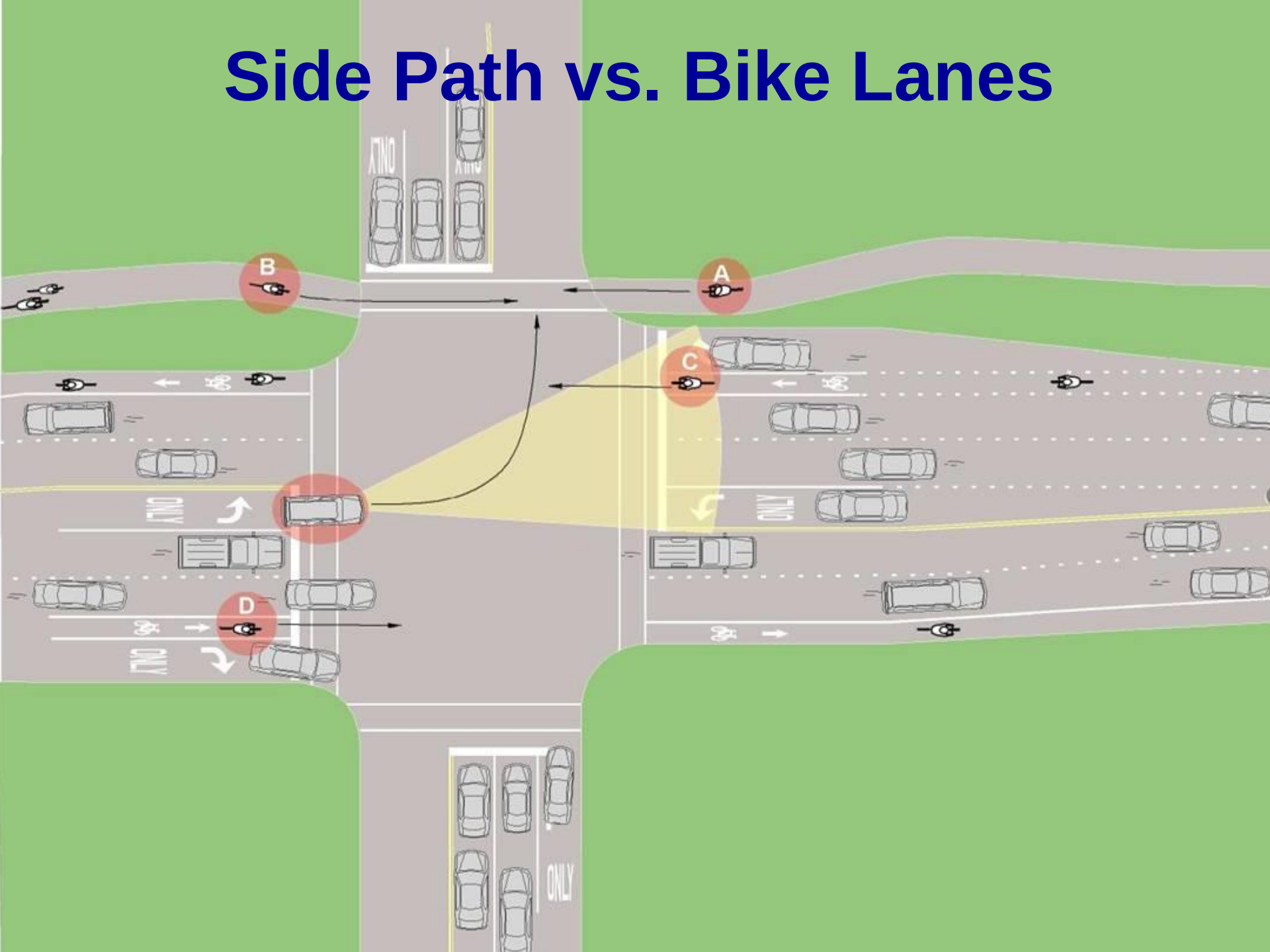
Side Path vs. Bike Lanes



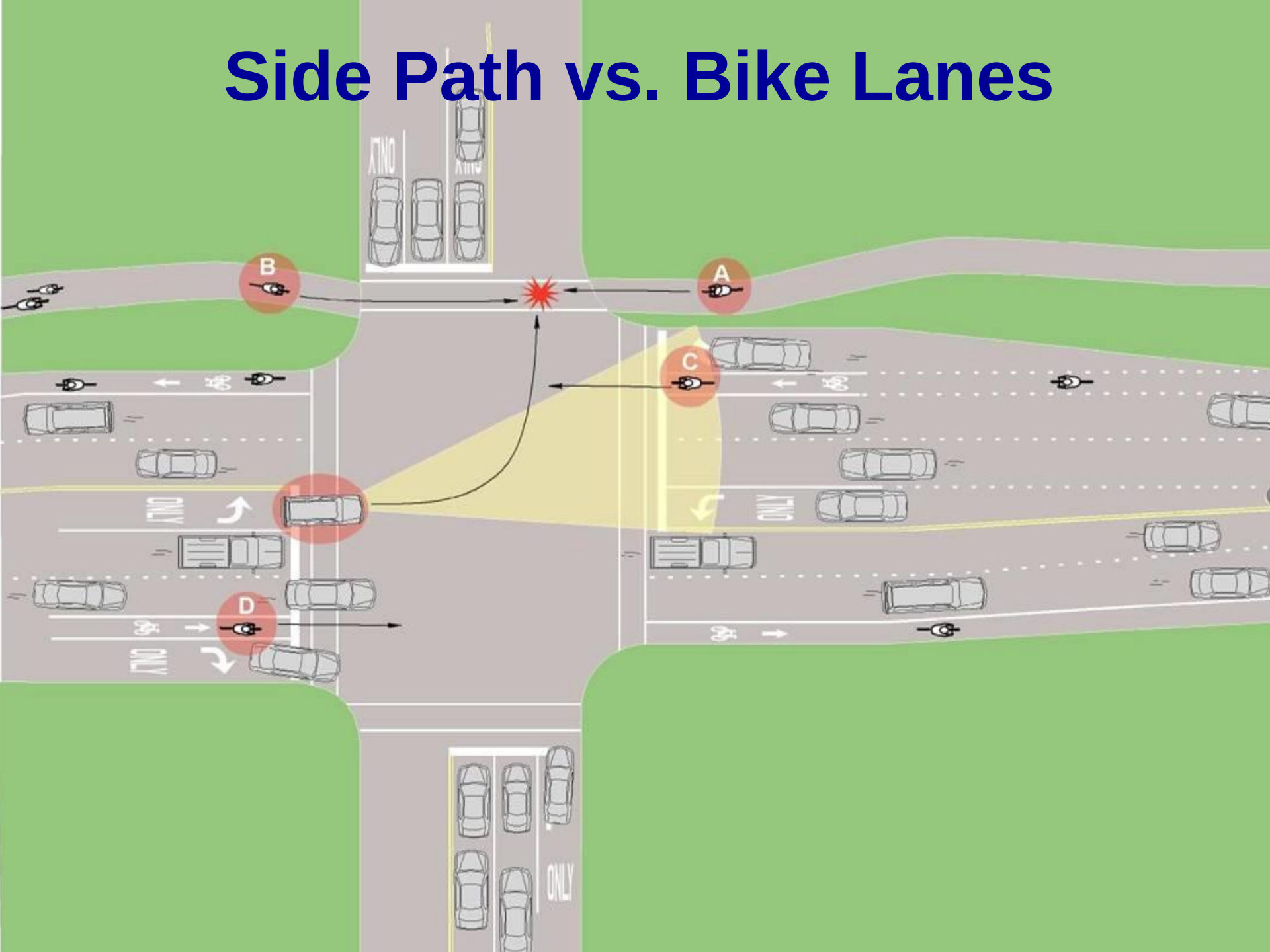
Side Path vs. Bike Lanes



Side Path vs. Bike Lanes

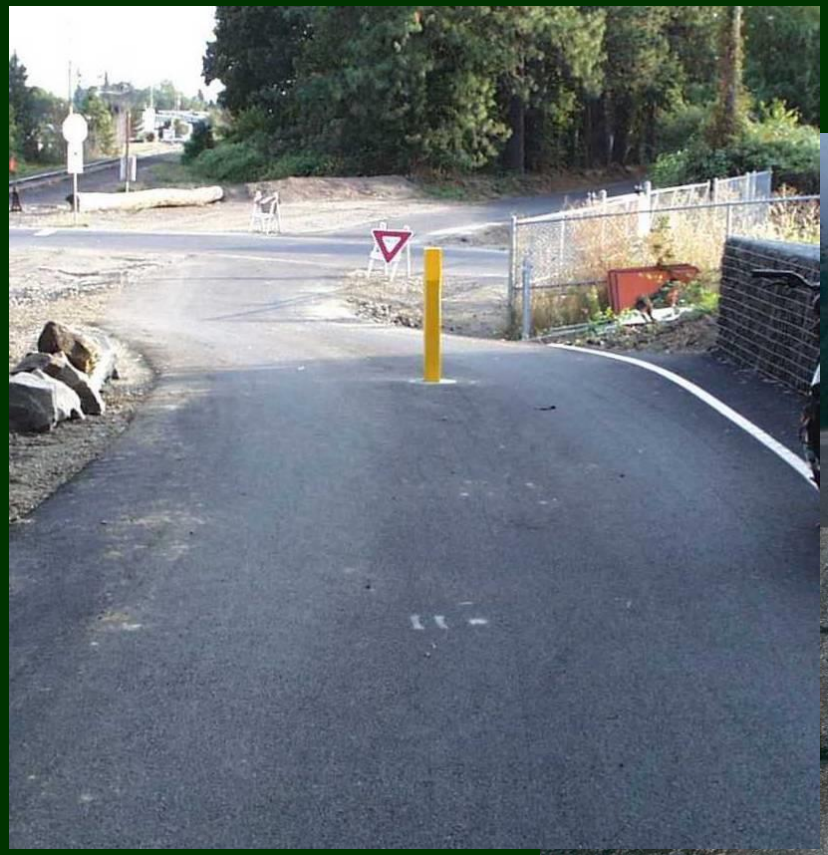


Side Path vs. Bike Lanes



Traffic Restrictions

- Use bollards only when absolutely necessary



Traffic Restrictions

- Use bollards only when absolutely necessary

Traffic Restrictions

- Use bollards only when absolutely necessary

Costs for Facilities for Nonmotorized Users

1. Pedestrians – Create gap infill program funded by developers, new roadway construction, program small amount each year
2. Bicycles – Low hanging fruit first: signing and restriping with street resurfacing
3. Transit

Costs for Facilities for Nonmotorized Users

1. Pedestrians – Create gap infill program funded by developers, new roadway construction, program small amount each year
2. Bicycles – Low hanging fruit first: signing and restriping with street resurfacing
3. **Transit**

Complete the Streets

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Transit: Bus is most common mode

Complete the Streets

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Transit: Only choice for many people

Shelters must be accessible
(grass makes it inaccessible)

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Every bus stop is a pedestrian crossing and all known crossing techniques apply to every bus stop

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Costs for Facilities for Nonmotorized Users

1. Pedestrians – Create gap infill program funded by developers, new roadway construction, program small amount each year
2. Bicycles – Low hanging fruit first: signing and restriping with street resurfacing
3. Transit – See ped friendly crossings previously described

Complete the Streets

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Perceived Barriers to Achieving Complete Streets

- Conflicts with Federal highway standards and guidelines
- Slower speeds reduce mobility and increase costs for all vehicles
- Required to design to Level of Service C for the peak half hour 20 years hence
- Spending for peds and bikes is a luxury we cannot afford

ALL MYTHS!

Complete the Streets

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What does a complete street look like?

- One size doesn't fit all:
  - Complete Streets doesn't mean every street has sidewalks, bike lanes and transit

There is no magic formula

Complete the Streets

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The many types of Complete Streets

A slow-speed shared street

Complete the Streets

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The many types of Complete Streets

One crossing completes a Safe Route to School

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The many types of Complete Streets

Shoulder bikeways on rural roads

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The many types of Complete Streets

Busy multi-modal thoroughfares

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Suburban thoroughfares

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Residential skinny streets

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Low traffic shared streets

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The many types of Complete Streets

Historic Main Street

Complete the Streets

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Complete Streets

- Are sensitive to the community
- Serve all who potentially will use the street
- Will **save money** if fully implemented

Complete the Streets

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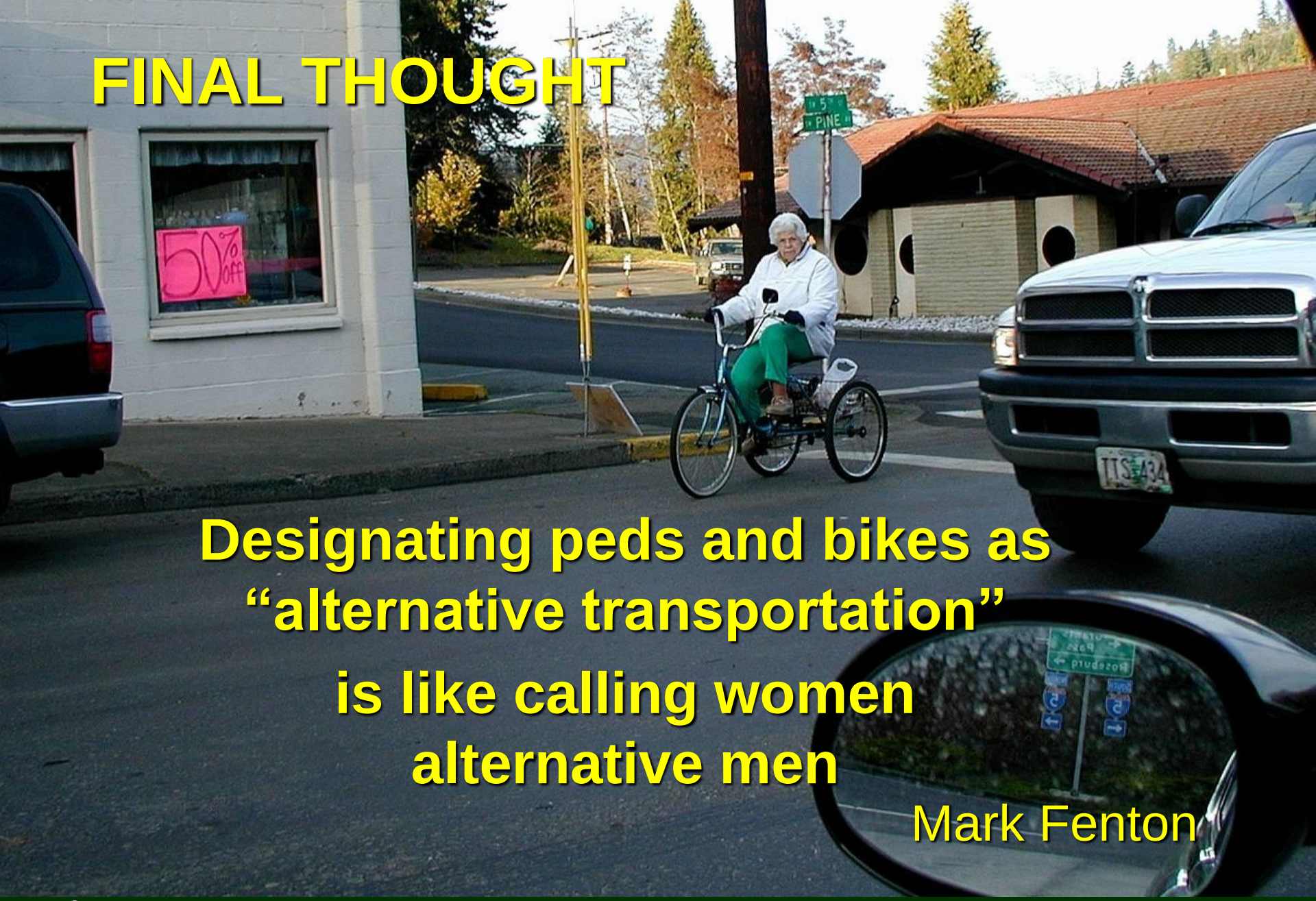
FINAL THOUGHT



Designating peds and bikes as "alternative transportation"

is like calling women alternative men

Mark Fenton

Thank you!

Complete the Streets

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