

Designing for Bicyclist Safety

BIKING FACILITIES AT INTERSECTIONS



Meet the Speaker

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Note of Caution



The knowledge and practice of designing for bicyclists is rapidly changing. Images in these materials and other guidelines may be outdated. Always check for the latest MUTCD interim and experimental TCD's.



Key Safety Factors

- ▶ Speed
- ▶ Number of lanes
- ▶ Visibility
- ▶ Traffic volume & composition
- ▶ Conflict points
- ▶ Proximity
- ▶ Bike control
- ▶ Connectivity

Important
Message





Shared-use Path Crossings

DESIGNING FOR BICYCLIST SAFETY

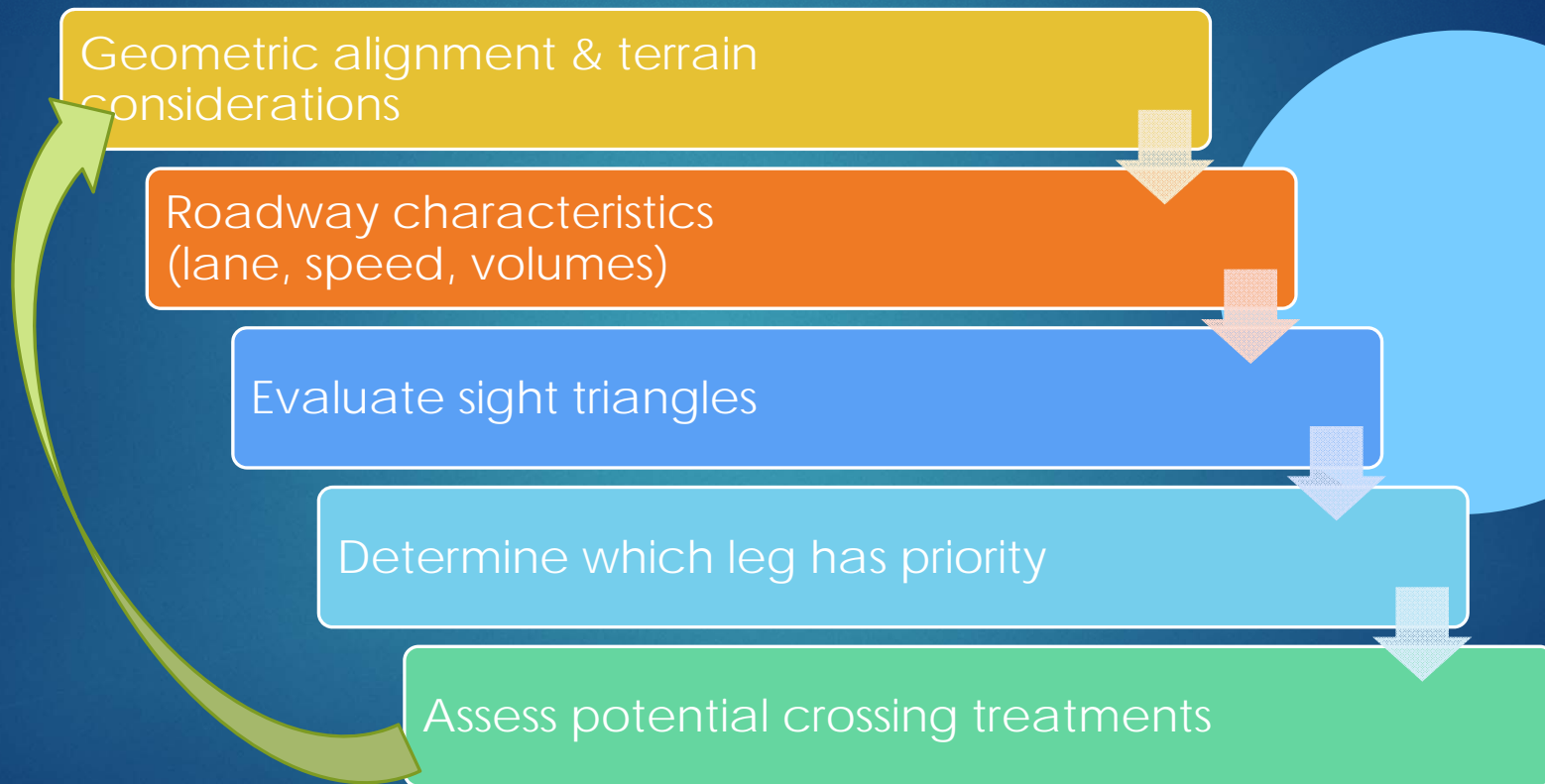
Side-street crossings



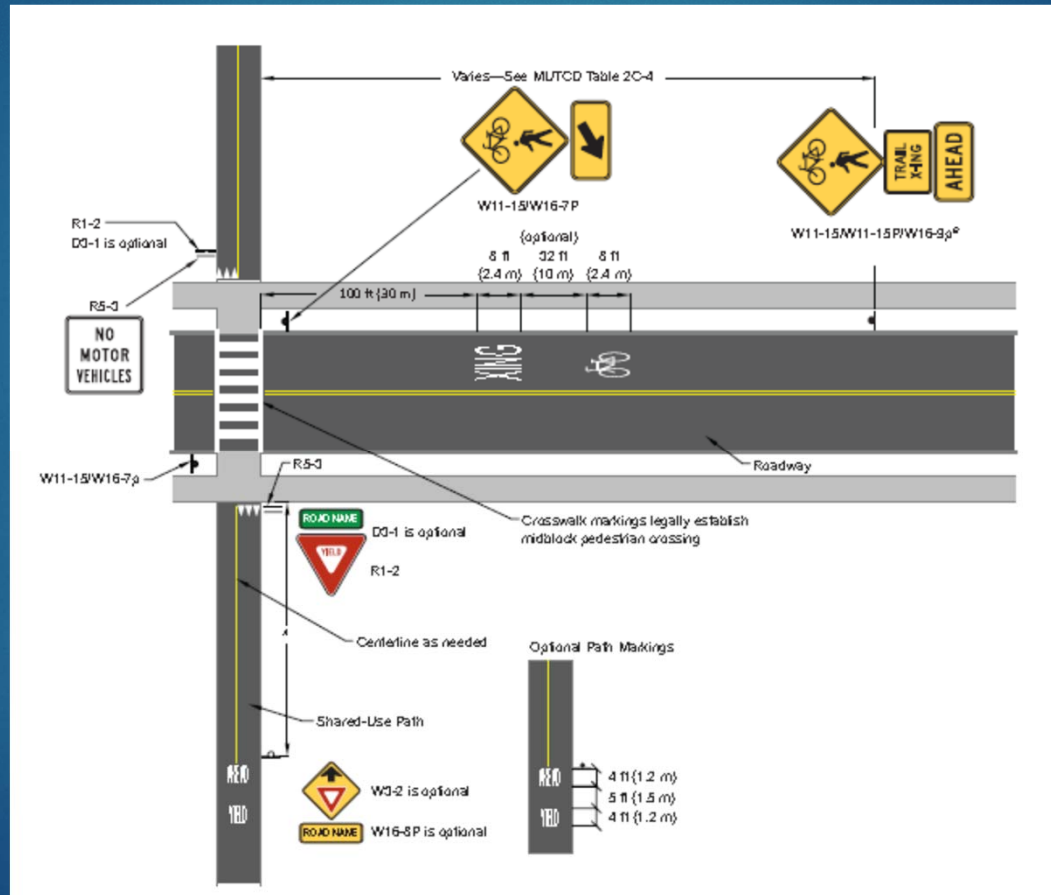
Adjacent Road Speed Limit (Mi/h)	Recommended Sidepath Separation Distance at Crossings
< 25 mi/h	6.5 ft (2.0 m)
35-45 mi/h	6.5-16.5 ft (2.0-5.0 m)
≥ 55 mi/h	16.5-24 ft (5.0-7.0 m)

**Separation distance may vary in response to available right of way, visibility constraints and the provision of a right turn deceleration lane.*

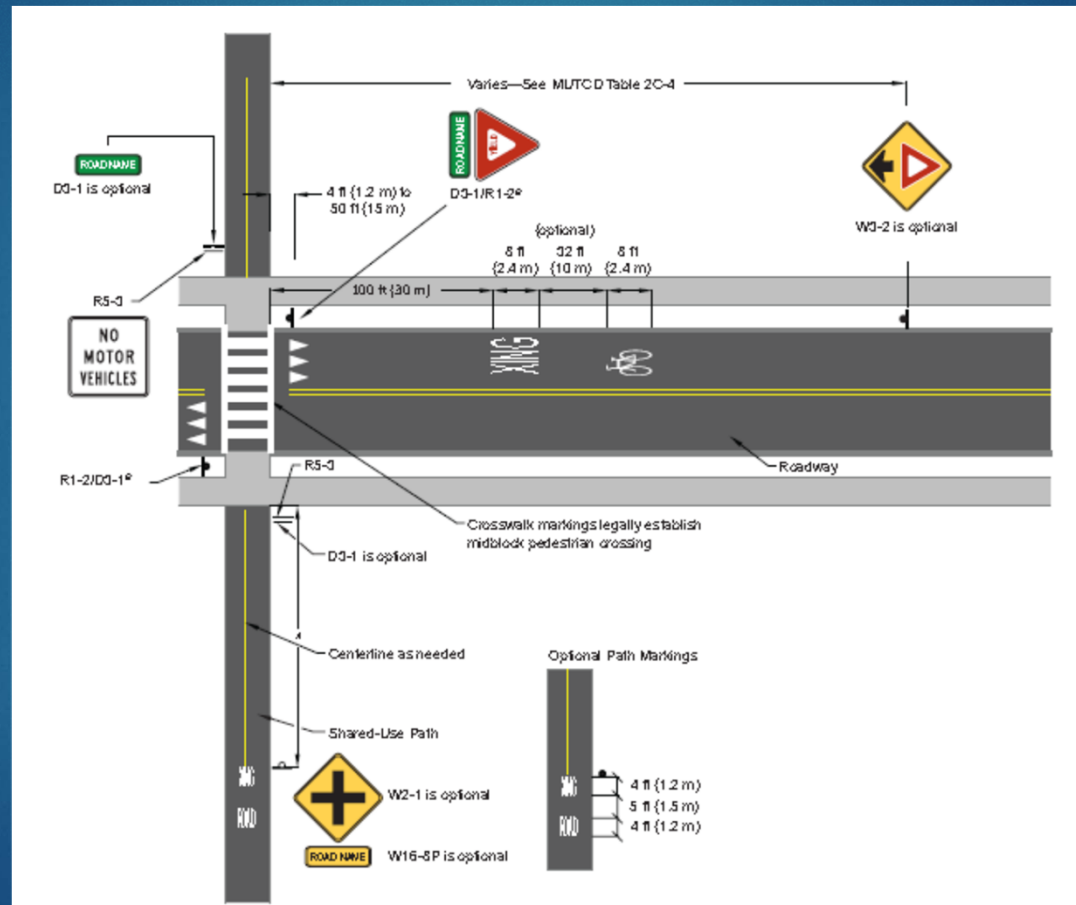
Mid-Block Crossing Design Process



Path Yields to Roadway



Road Yields to Pathway





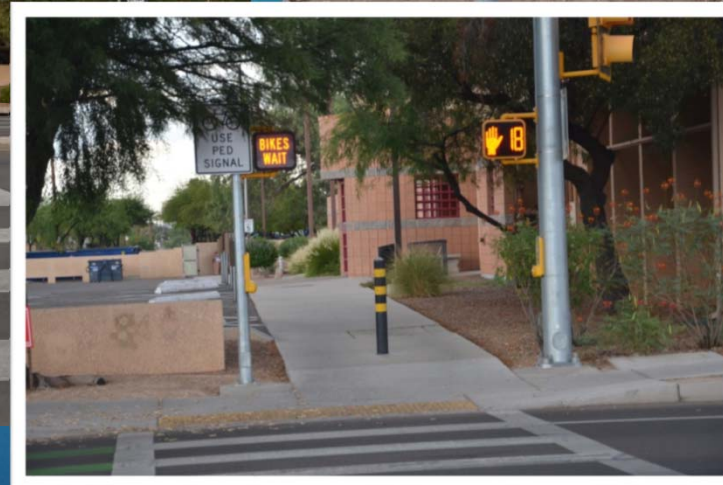
Crossing Countermeasures

- ▶ Advance warning signs
- ▶ Advance yield/stop line
- ▶ Raised island/crossing
- ▶ RRFB/PHB



Bike "Hawk" PHB

- ▶ First installation Tucson, AZ
- ▶ "BIKES WAIT" / "BIKES OK"





Intersection Design

DESIGNING FOR BICYCLIST SAFETY

Designed for bicyclist?



Designed for bicyclist?



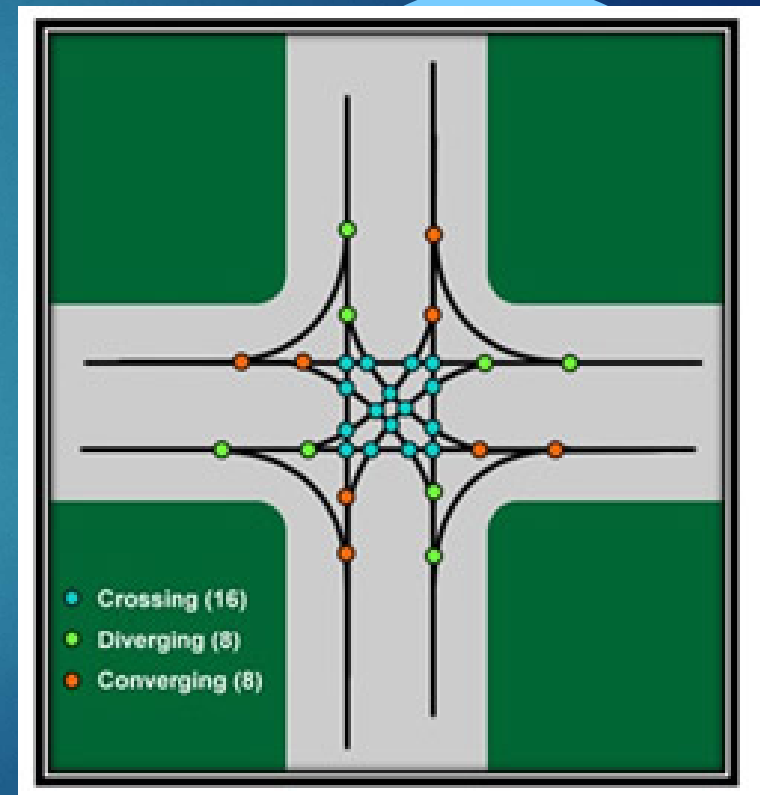
Intersection Design Principles

- ▶ Reduce speed
- ▶ Minimize exposure to conflicts
- ▶ Communicate right-of-way priority
- ▶ Provide adequate sight distance

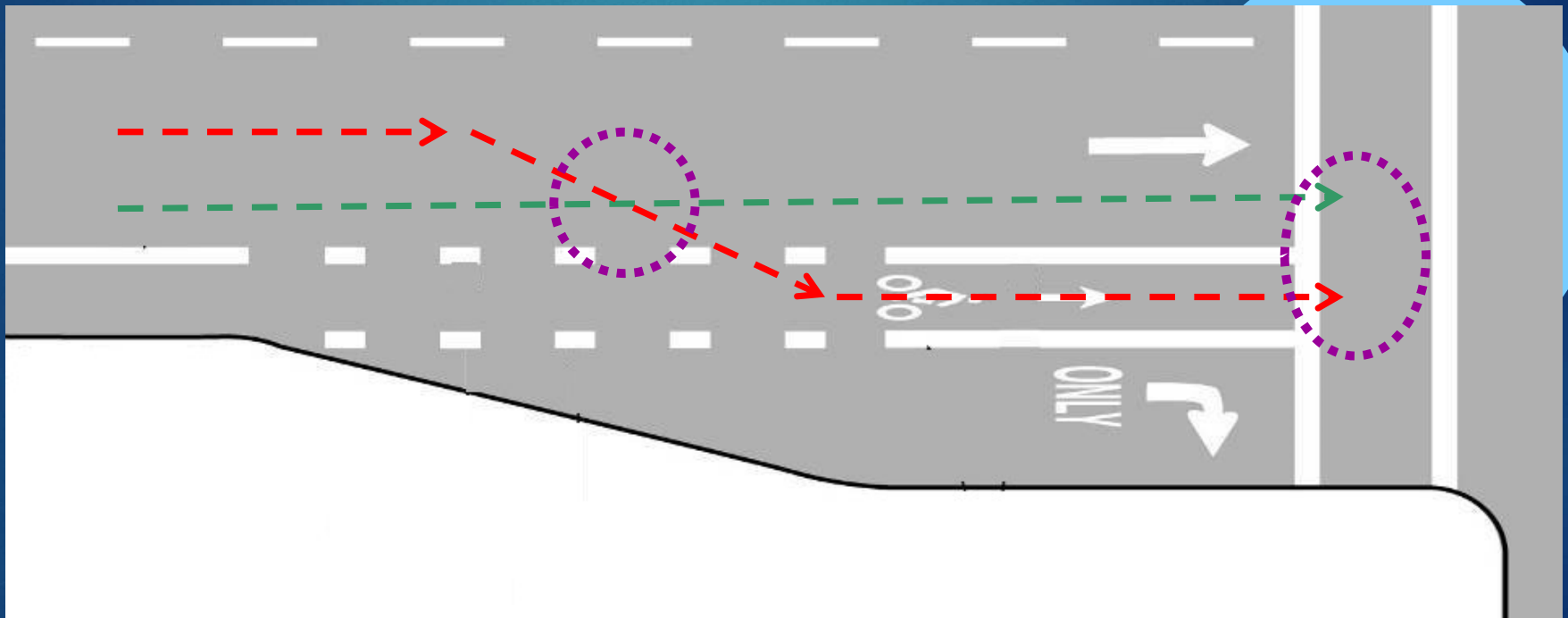


Intersection Conflicts

- ▶ Typical conflicts for both pedestrians and motorists, plus:
 - ▶ Right-turn/thru movement
 - ▶ Weaving to left turn



Right-turn Conflict



Left-turn Weave



Would you dare?



Would you dare?



Would you dare?



Would you dare?



Would you dare?



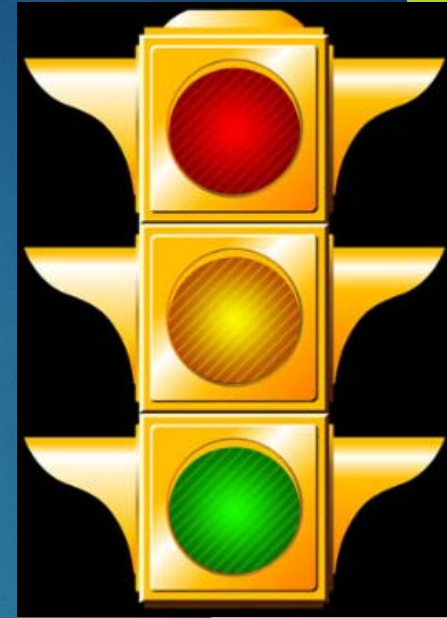
Safer Signals for Cyclists

- ▶ Set initial and gap times for bicyclists
- ▶ Differentiate detection to optimize signal
- ▶ Leading bicyclist interval (LBI)
- ▶ Segregate conflicting movements



Signal Timing

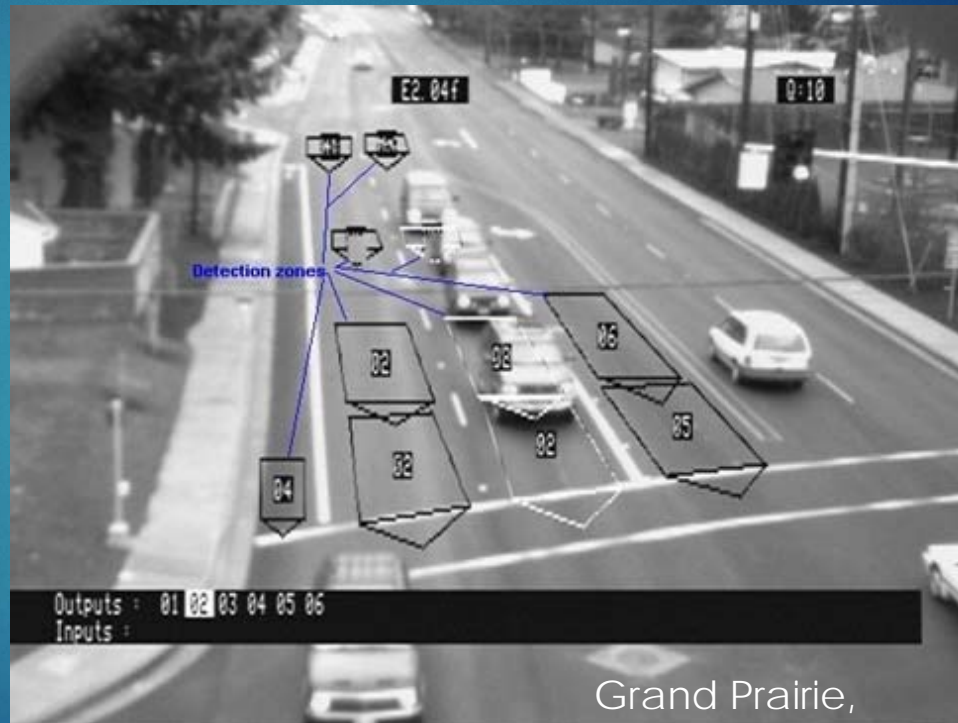
- ▶ MUTCD
 - ▶ Section 9D.02
 - ▶ Standard: On bikeways, signal timing and actuation shall be reviewed and adjusted to consider the needs of bicyclists.
- ▶ Yellow change interval
- ▶ Red clearance interval



Bicyclists are slower!

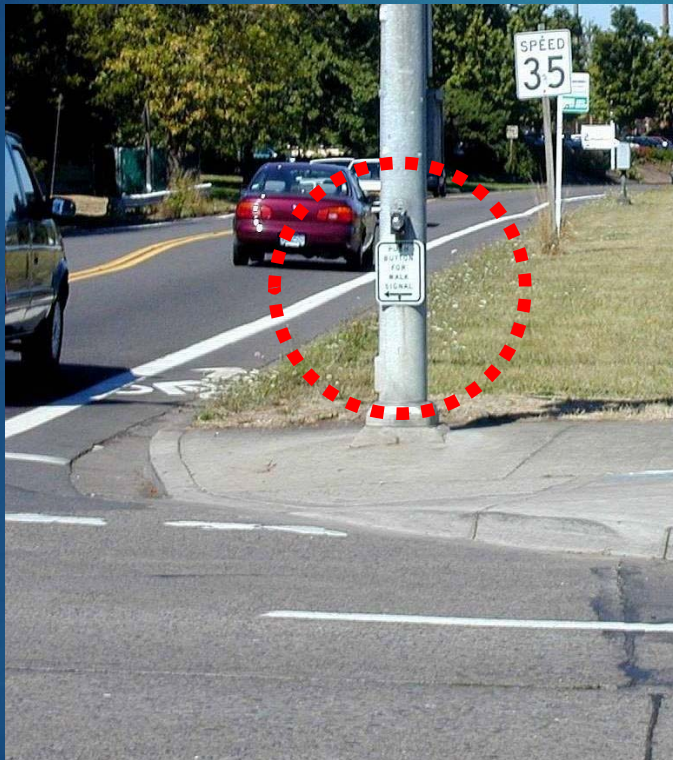
Bicycle Detection

- ▶ Buttons
- ▶ Loops
- ▶ Video
- ▶ Microwave
- ▶ Radar
- ▶ Infrared

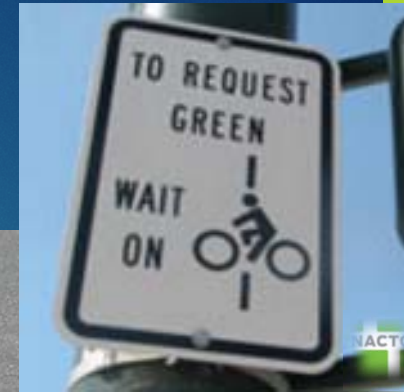


Grand Prairie,
Alberta

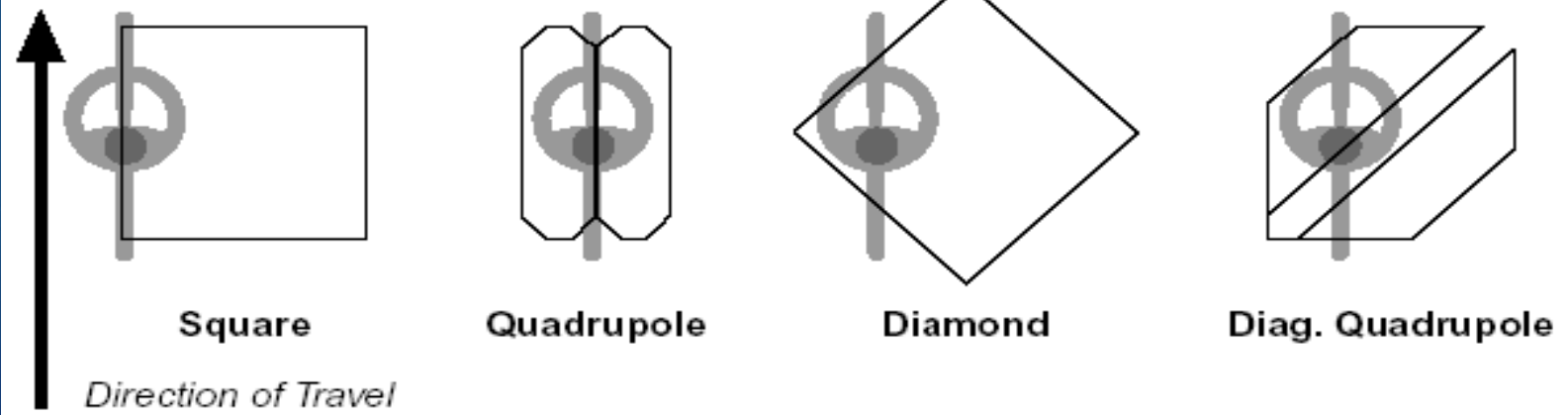
Push Buttons



Loop Detection



Portland, OR



Square

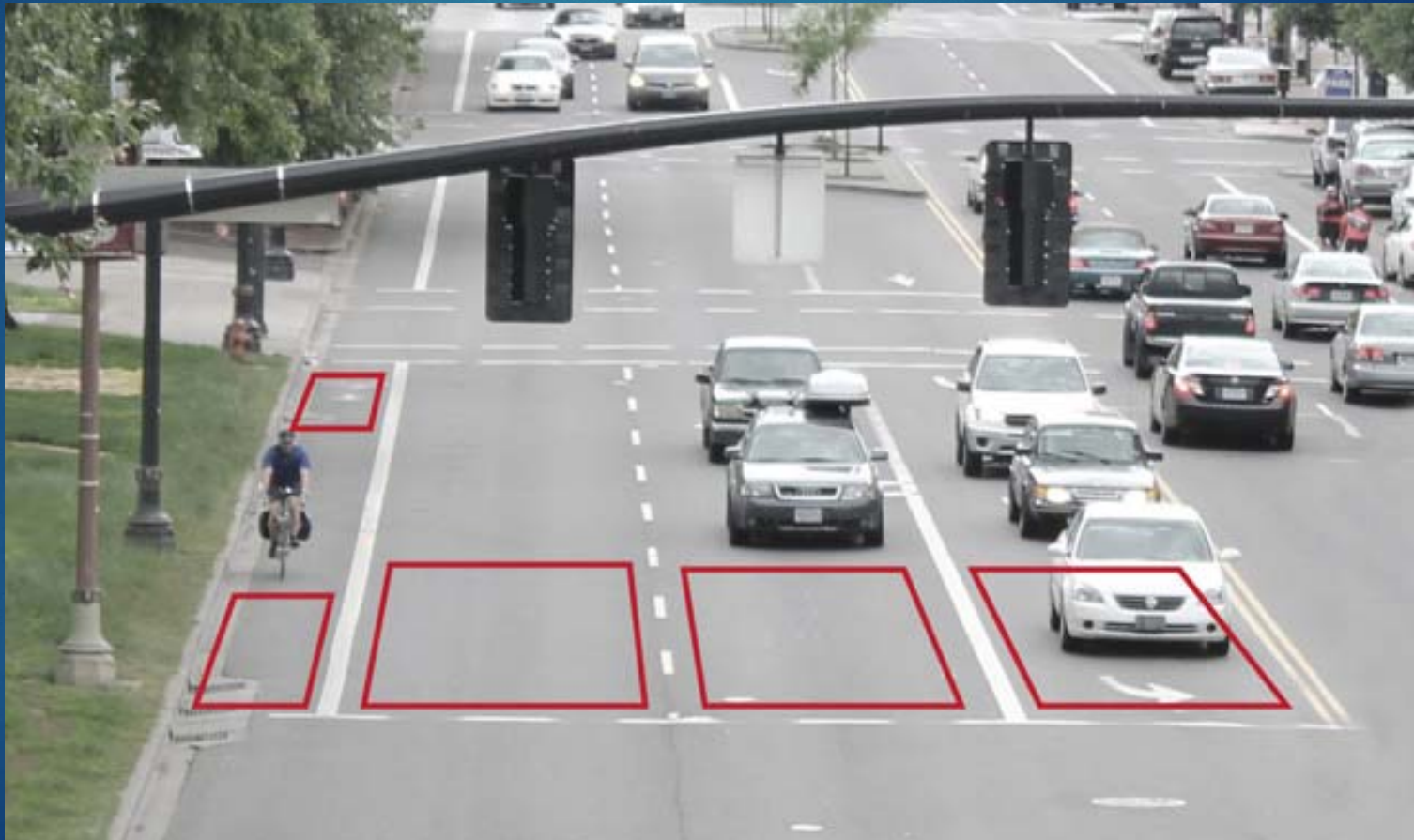
Quadropole

Diamond

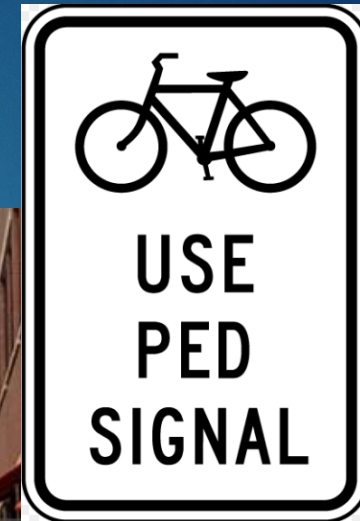
Diag. Quadropole

Direction of Travel

Passive detection



Leading Bicyclist Interval



Segregate Conflicting Movements















Bicycle Signal Face

- ▶ Bicyclist non-compliance
- ▶ Provide a leading or lagging bicycle interval
- ▶ Continue the bicycle lane on the right-hand side of an exclusive turn lane
- ▶ Augment the design of a segregated counter-flow
- ▶ Unusual or unexpected arrangements of the bicycle movement through complex



Roy Crisman/Flickr

Traffic Control Devices

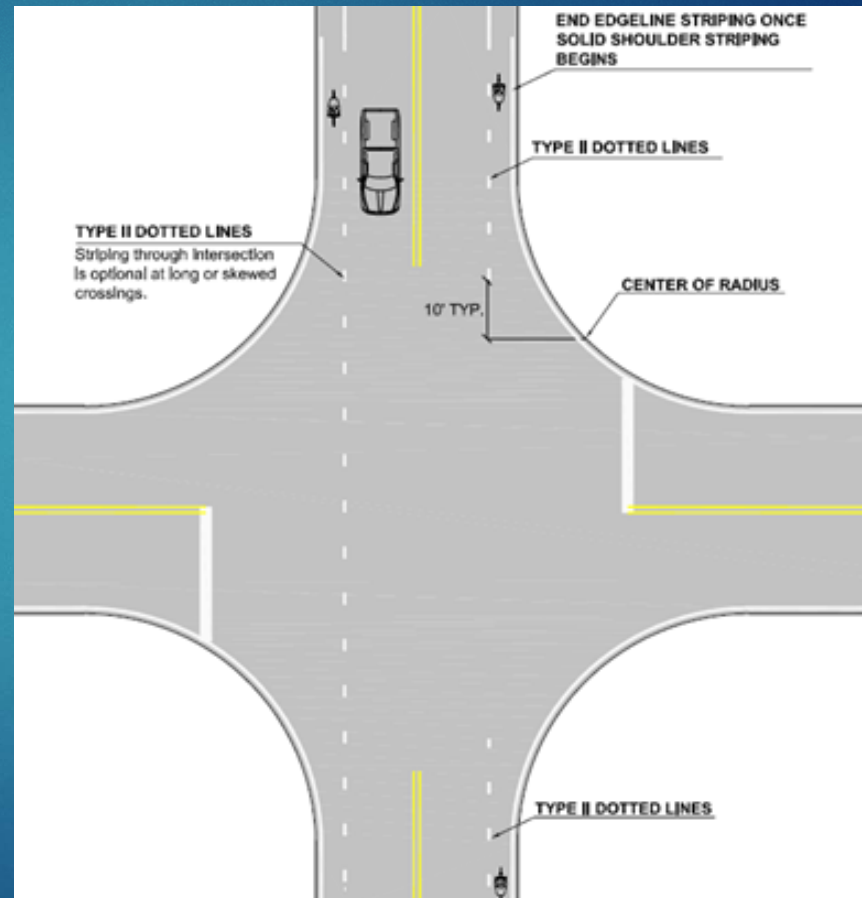
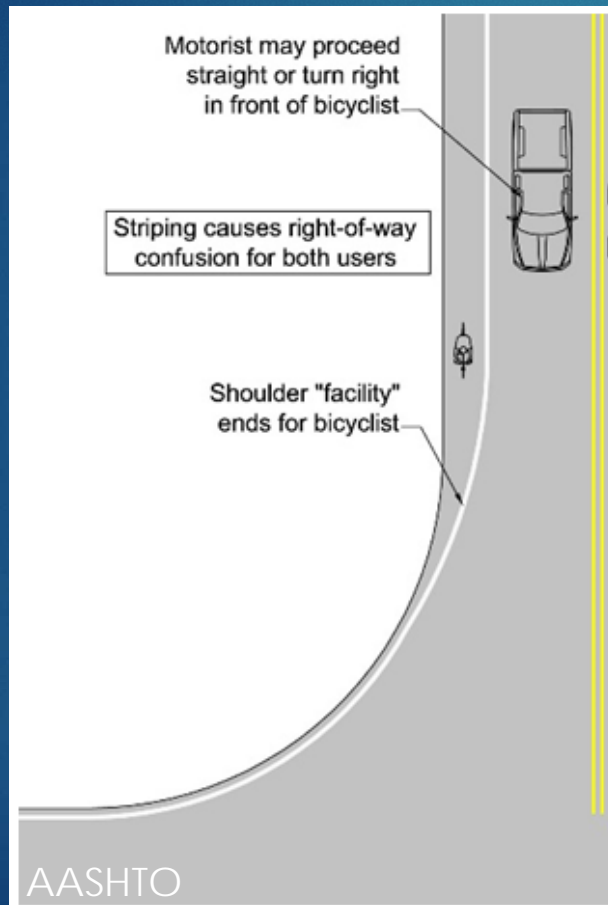
Subject to Experimentation	Available through Interim Approval	Interpretations
 <p data-bbox="415 662 579 682">Two-Stage Turn Box</p>	 <p data-bbox="829 662 1031 682">Green-Colored Pavement</p>	 <p data-bbox="1243 662 1514 699">Use of R4-11 Sign on Roads with Speed Limits Above 35mph</p>
 <p data-bbox="415 888 590 907">Dashed Bicycle Lanes</p>	 <p data-bbox="829 888 1121 925">Alternate Design for the U.S. Bicycle Route (M1-9) Sign</p>	 <p data-bbox="1243 888 1514 907">Modified Bicycle Destination Sign</p>
 <p data-bbox="415 1114 789 1133">Destination Guide Signs for Shared-Use Paths</p>	 <p data-bbox="829 1114 989 1133">Bicycle Signal Faces</p>	 <p data-bbox="1243 1114 1514 1167">Installation of Advance Turn and Directional Assemblies for Bike Route Signs</p>
 <p data-bbox="415 1357 821 1395">Green-Colored Pavement for Use with the Shared-Lane Marking</p>	 <p data-bbox="829 1357 919 1377">Bicycle Box</p>	 <p data-bbox="1243 1357 1457 1395">Pavement Markings for Designated Bicycle Routes</p>

Shoulder Bikeways

- ▶ Shoulder not a travel lane
- ▶ Modify shoulder striping
- ▶ Opportunity to switch to shared lanes **OR**
- ▶ Add bike lane thru intersection



Shoulder Striping



Intersection with Shared Lanes

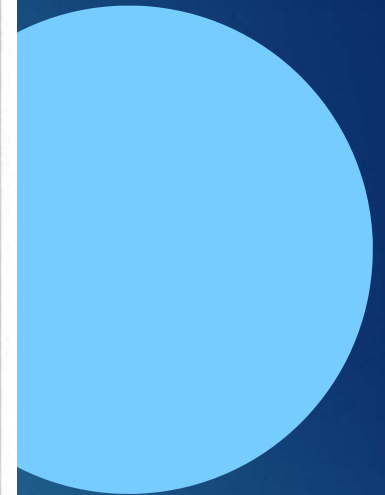
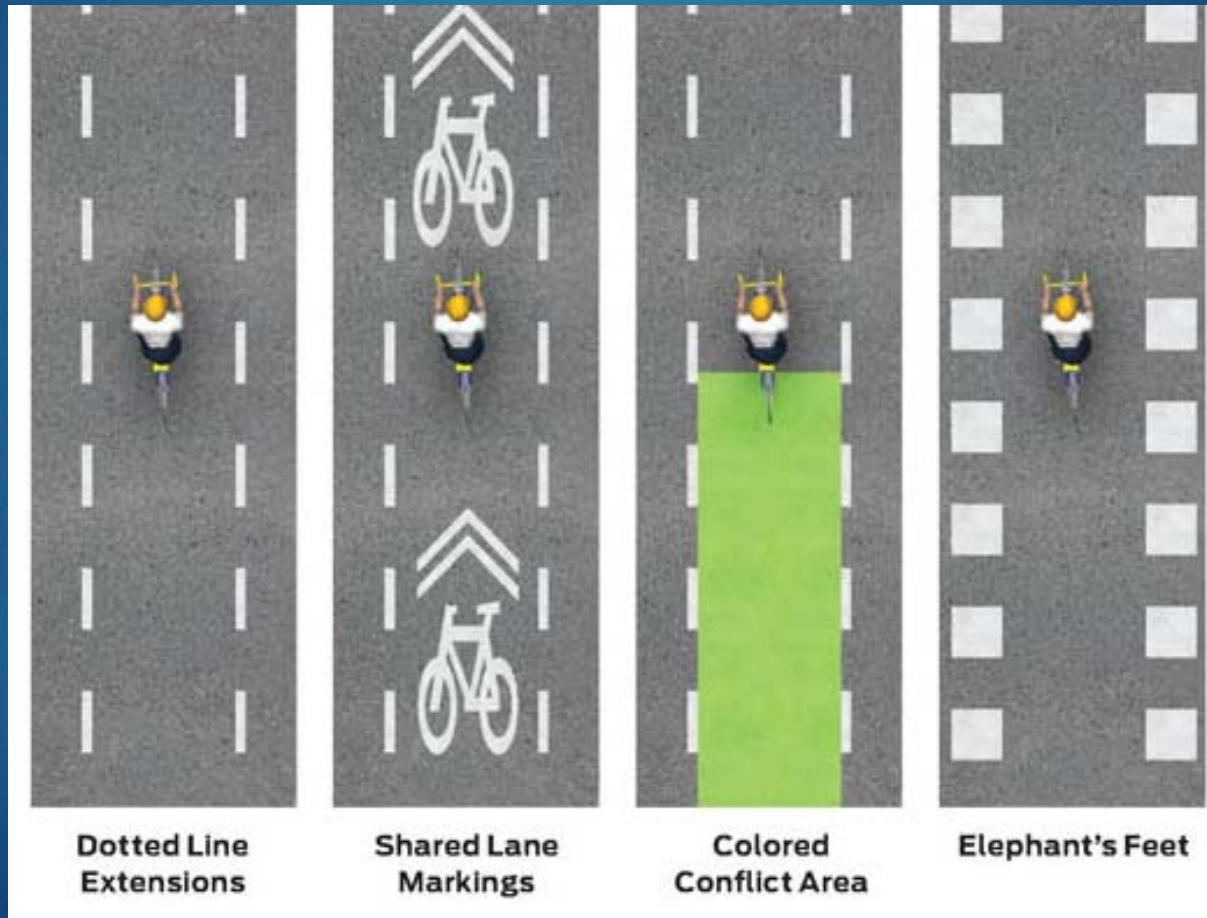
- ▶ Additional/all lanes are shared



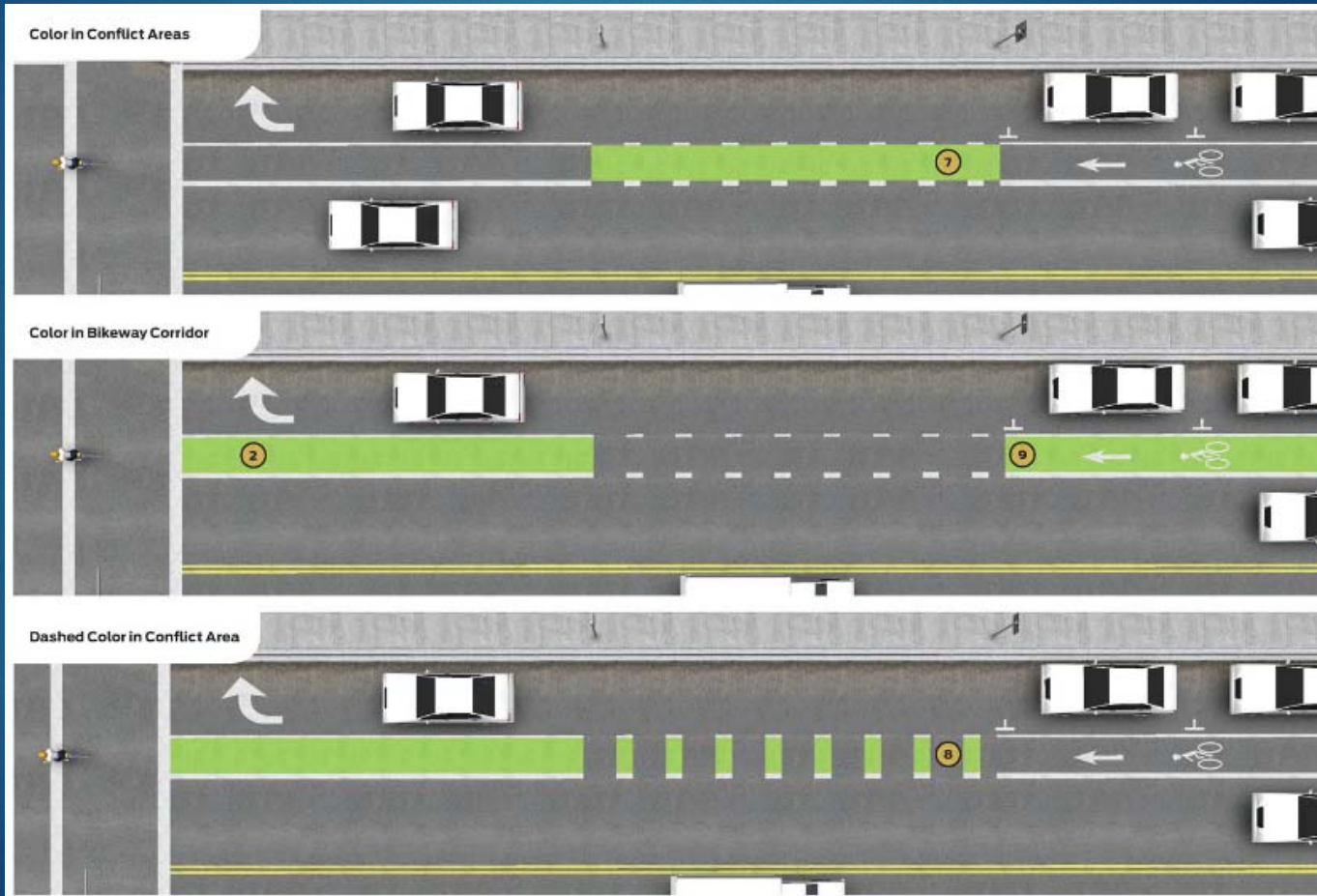
Bike Lane Thru Intersection



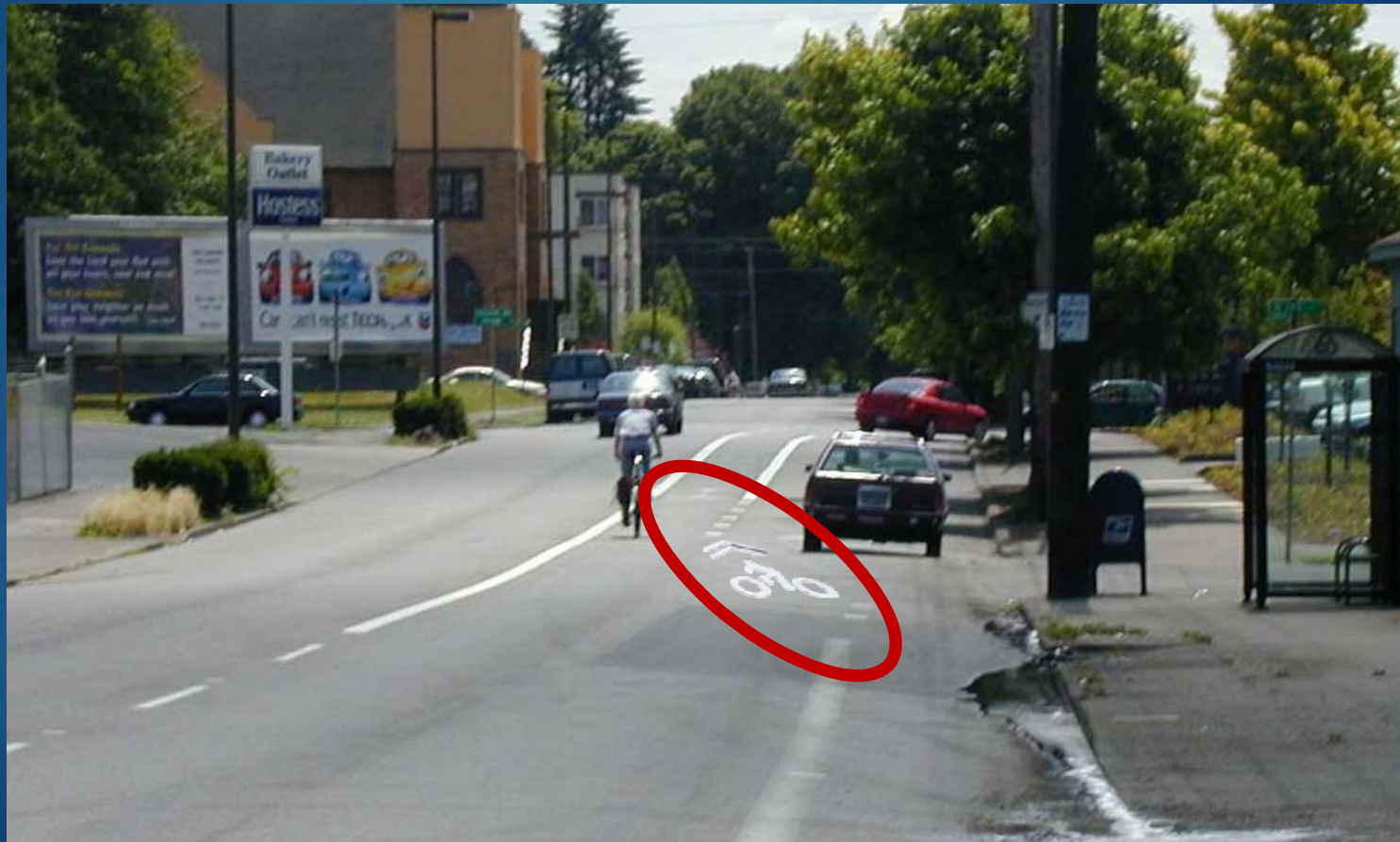
Highlight Conflict Zone



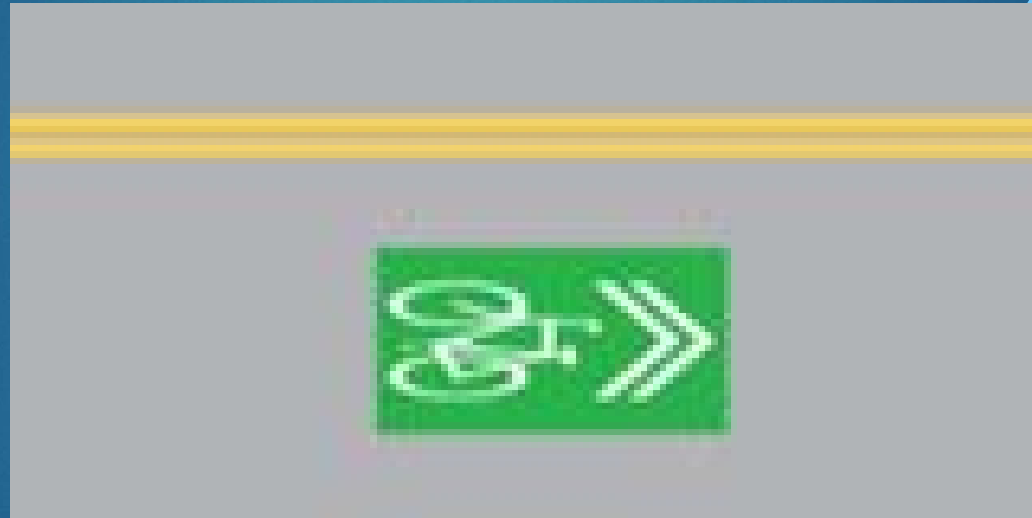
Highlight Conflict zone



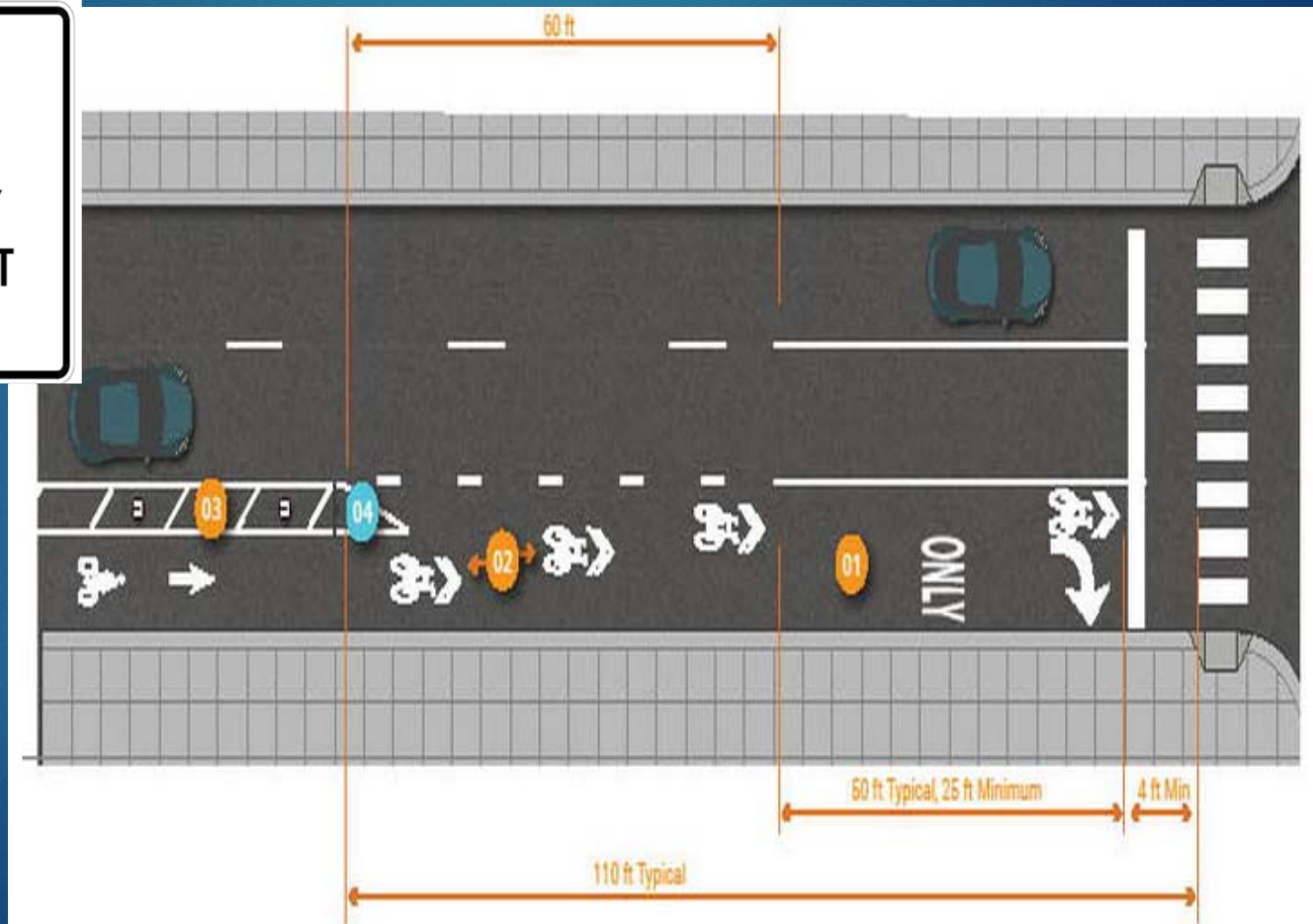
Bike Lane Thru Intersection



Sharrow w/ Green background



Right Turn Shared Lane



Right Turn Shared Lane



Two-stage left turn box



Two-Stage Left Turn Queue Box

- ▶ Required design elements include:
 - ▶ Bicycle symbol
 - ▶ Turn or through arrow
 - ▶ Turn on red prohibition
 - ▶ Passive detection of bicycles
- ▶ Size to prevent conflicts



SALT LAKE CITY, UT (PHOTO: SALT LAKE CITY PUBLIC WORKS)

Bike Box



Bike Box



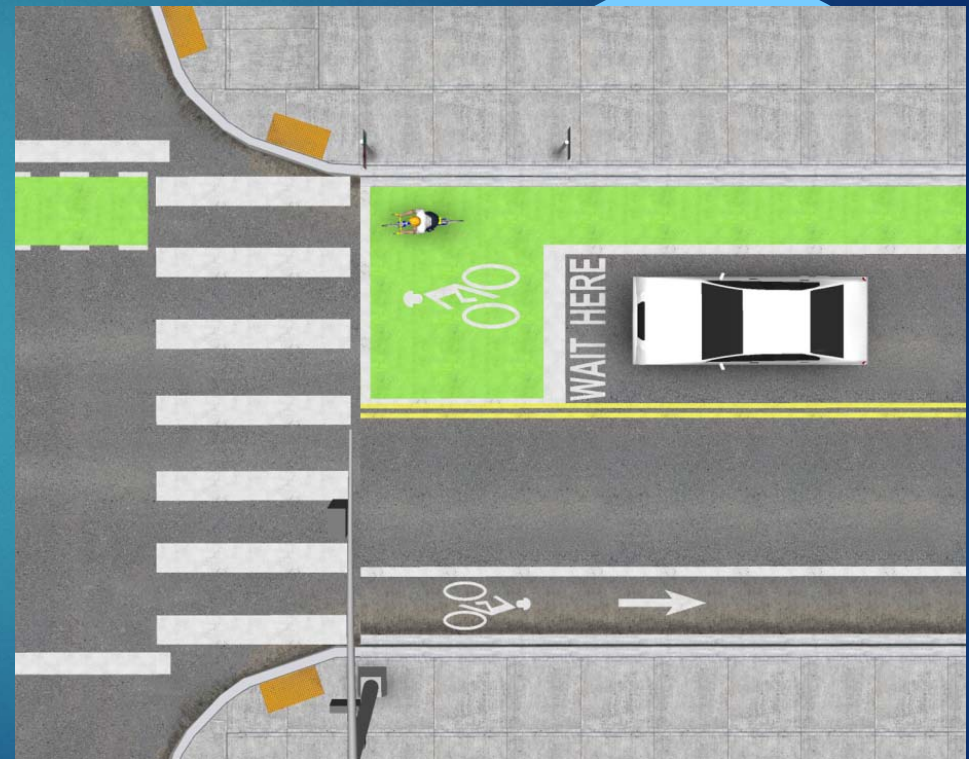
- ▶ Increase visibility
- ▶ Reduce signal delay for bikes
- ▶ Positioning for left-turn
- ▶ Prevent "right-hook" (except at onset of green)
- ▶ Groups bikes



Bike Box



- ▶ Required elements:
 - ▶ Advance stop bar
 - ▶ Bike symbol
 - ▶ RTOR prohibited
 - ▶ Setback from crosswalk
 - ▶ Countdown ped signal
 - ▶ Yellow change & red clearance





Bicyclists at Roundabouts

DESIGNING FOR BICYCLIST SAFETY

Making roundabouts work

- ▶ Slow speeds
 - ▶ Deflection
 - ▶ Truck apron
 - ▶ NO BIKE LANES
- ▶ Simple
 - ▶ Single lane
 - ▶ NO BIKE LANES
- ▶ Splitter islands
- ▶ Bike ramps



Bike Lane Ends at Splitter Island



Bend, Oregon

Slower Speeds & Fewer Conflicts

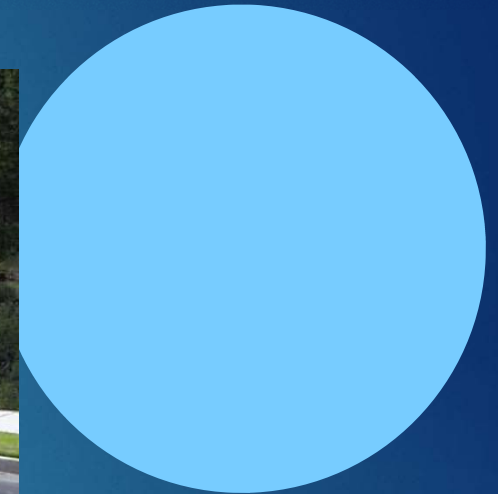


Bend, Oregon

Slower Speeds & Fewer Conflicts



Bend, Oregon



Bike Lane Begins



Bend, Oregon

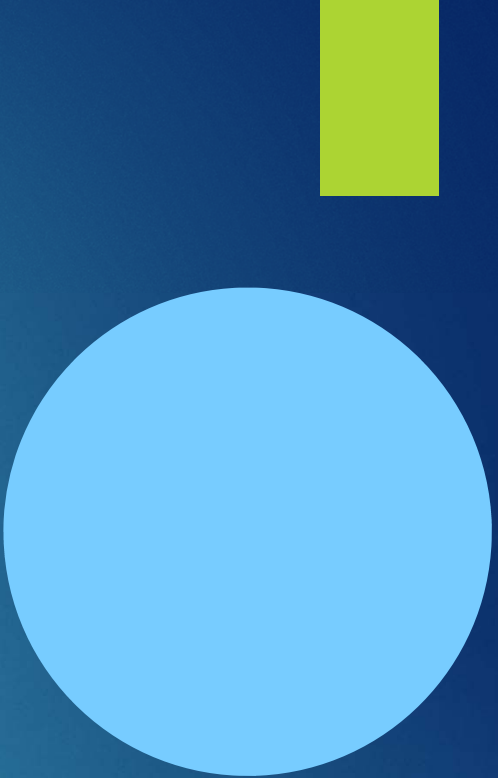


Bike Ramp



Bend, Oregon

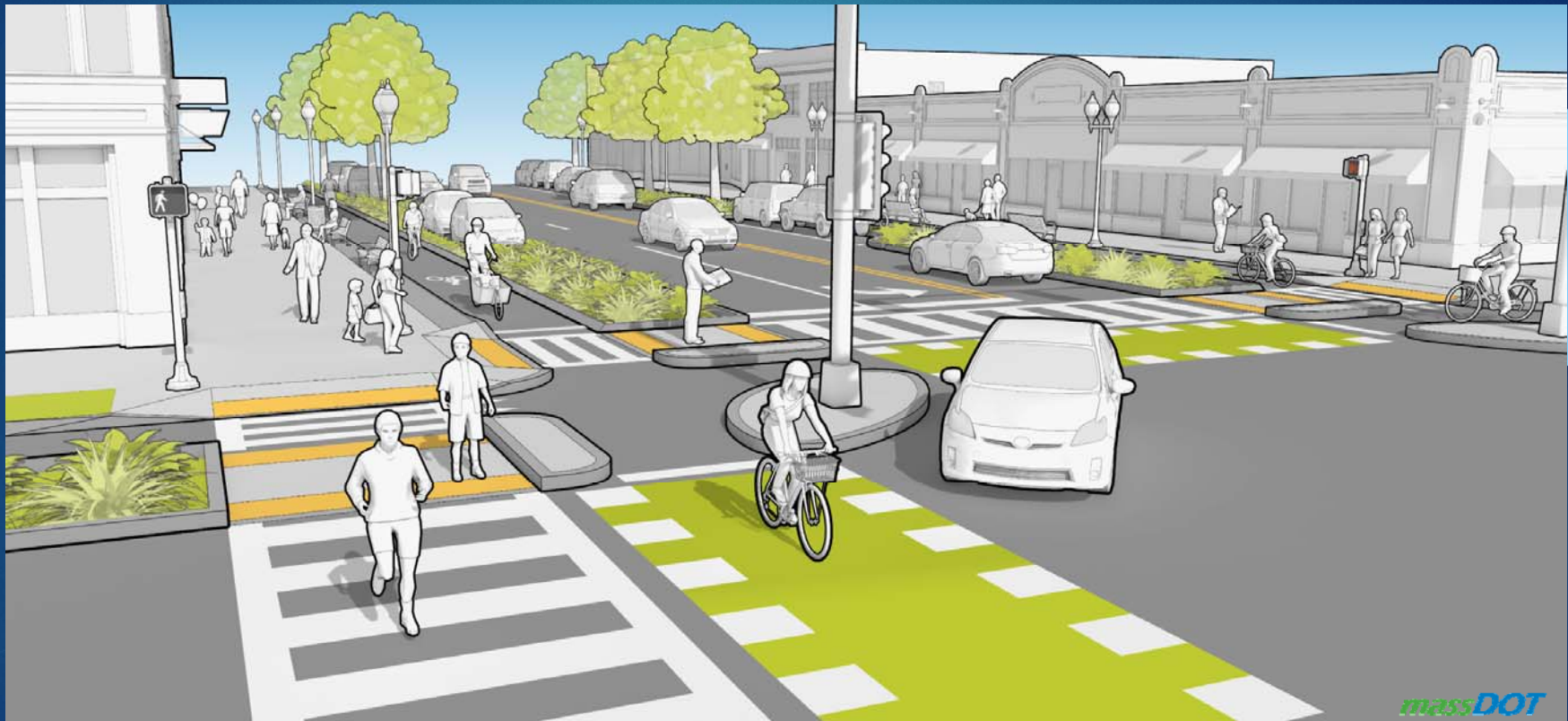




“Protected” Intersections

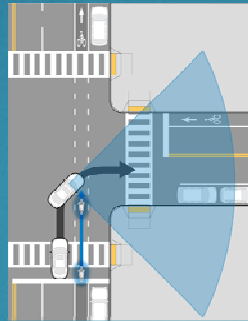
DESIGNING FOR BICYCLIST SAFETY

“Protected” Intersections

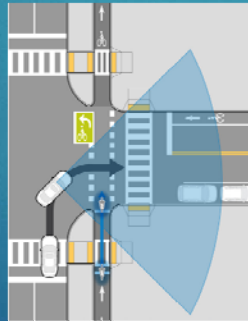


Visibility at Conflict Points

motorist's view at
conventional bike lane



motorist's view at
separated bike lane



Visibility at Conflict Points



protected intersection

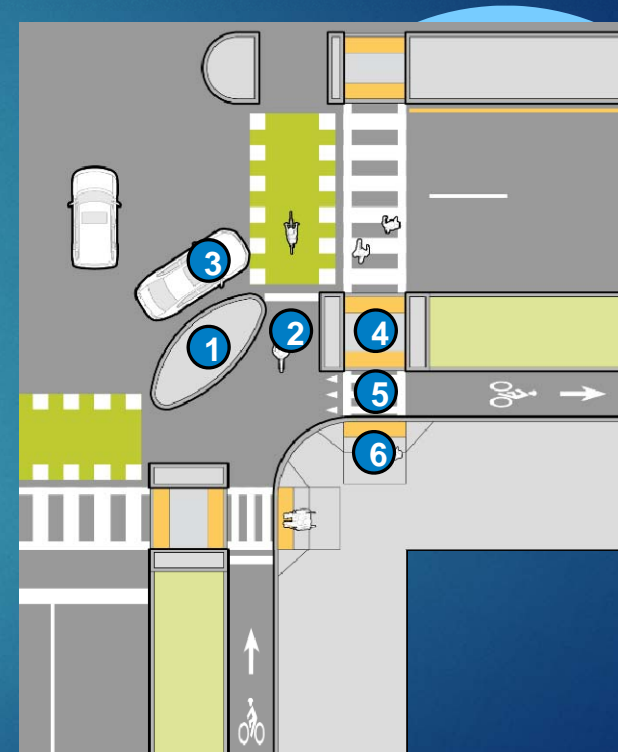


photo source: Jonathan Maus

conventional bike lane

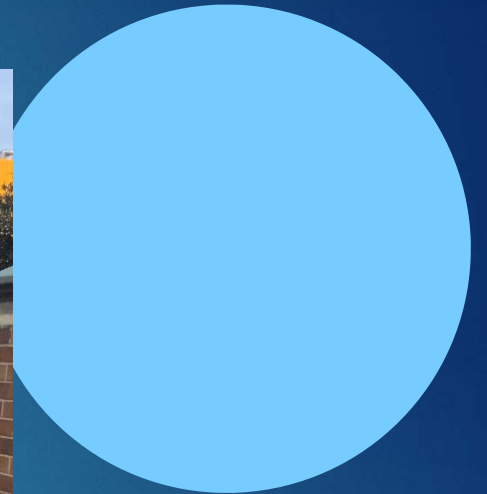
“Protected” Intersections

- 1 Corner refuge island
- 2 Forward bicycle queuing area
- 3 Motorist yield zone
- 4 Pedestrian crossing island
- 5 Pedestrian crossing of separated bike lane
- 6 Pedestrian curb ramp



massDOT

“Protected” Intersections





Dare to Experiment



Dare to Experiment



Useful References

- ▶ http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/mutcd/index.cfm
- ▶ <https://nacto.org/publication/urban-bikeway-design-guide/>
- ▶ http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/separated_bikelane_pdg/
- ▶ <https://www.mass.gov/lists/separated-bike-lane-planning-design-guide>
- ▶ City of Edmonton video on bike box: <https://www.youtube.com/watch?v=siixA3EJc1I>