Improving Intersection Safety for All Road Users

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July 26, 2019

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FHWA Focused Approach to Safety

Initiative provides resources and assistance to help agencies address the most critical safety challenges.

- ⇨ **Focused Approach to Safety**

  https://safety.fhwa.dot.gov/fas/

- ⇨ **Intersection Safety**

  https://safety.fhwa.dot.gov/intersection/

- ⇨ **Pedestrian and Bicyclist Safety**

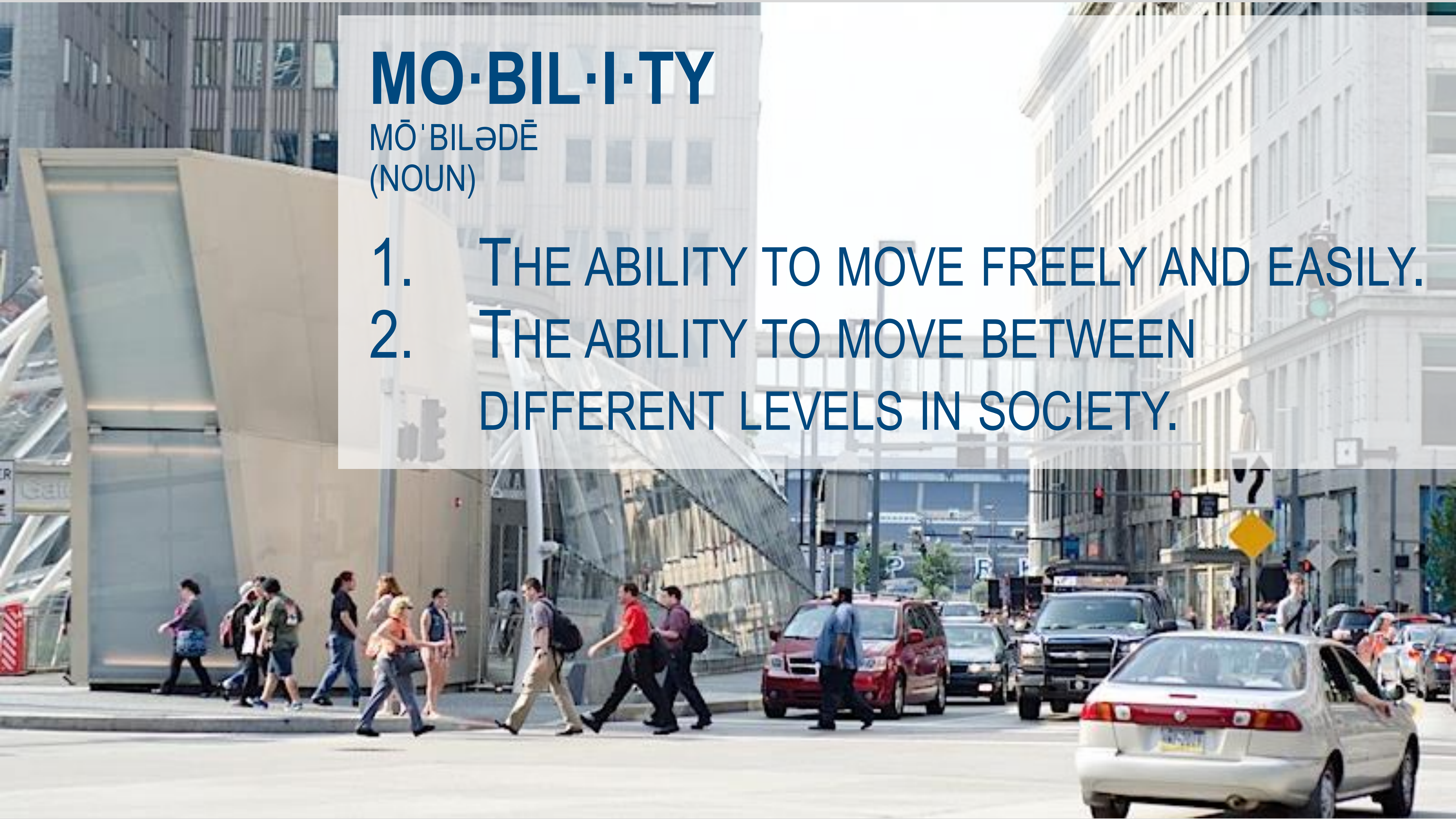
  https://safety.fhwa.dot.gov/ped_bike/

IMPROVING INTERSECTION SAFETY FOR ALL ROAD USERS

The Importance of Intuitive Design

Karina Ricks, Director
Department of Mobility and Infrastructure
City of Pittsburgh

July 2019


MO·BIL·I·TY
MŌˈBILƏDĒ
(NOUN)
1. THE ABILITY TO MOVE FREELY AND EASILY.
2. THE ABILITY TO MOVE BETWEEN DIFFERENT LEVELS IN SOCIETY.

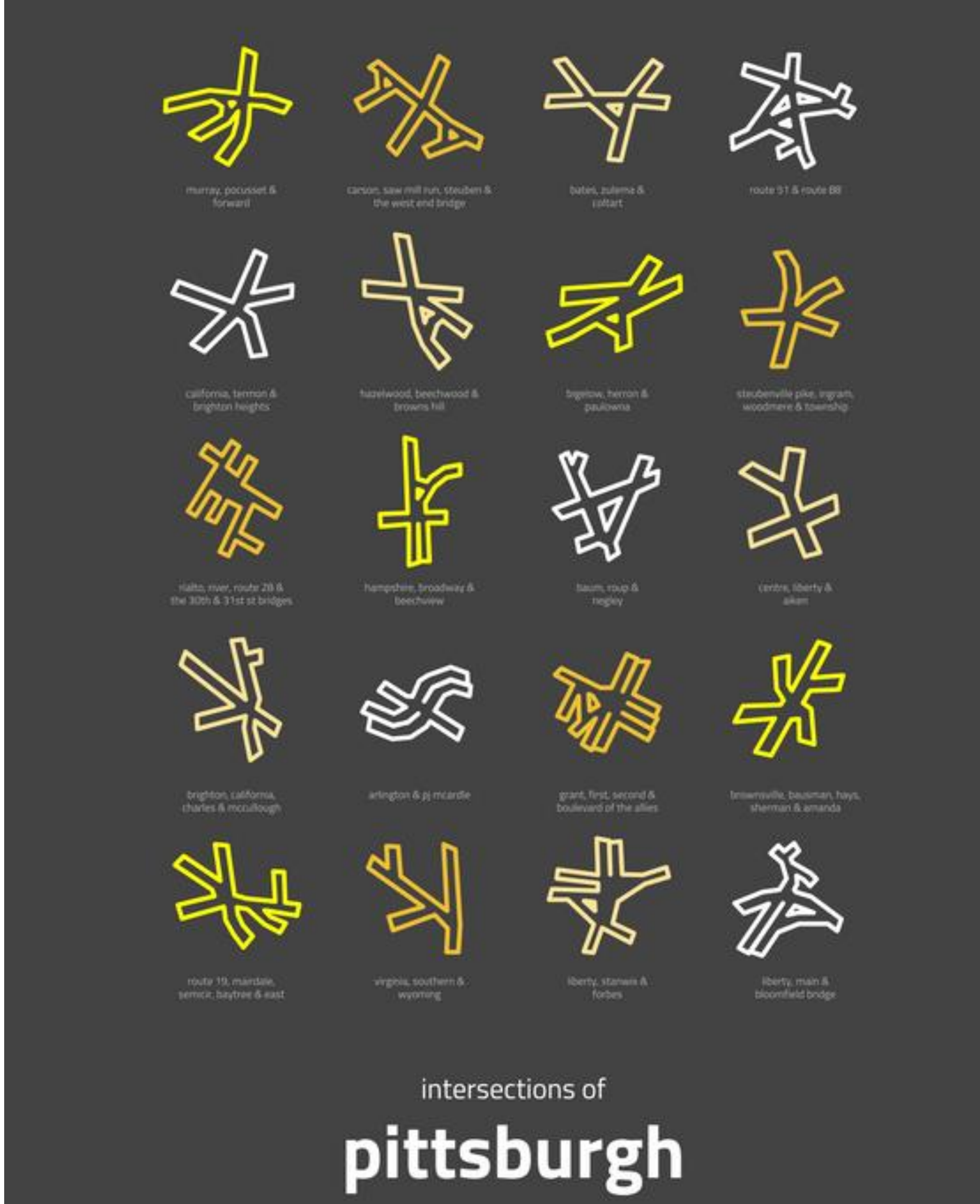
PITTSBURGH MOBILITY GOALS

1. No one dies or is seriously injured traveling on city streets; (streets and intersections are intuitive to use, even by an adolescent child).
2. Every resident can access fresh fruits and vegetables within 20 minutes travel of home (without the requirement of a private vehicle).
3. All trips less than 1 mile are most enjoyably achieved by non-vehicle travel.
4. Transportation, housing and energy consume less than 40% of household income (for any income quintile).
5. Streets and infrastructure reflect the pride and values of our city.

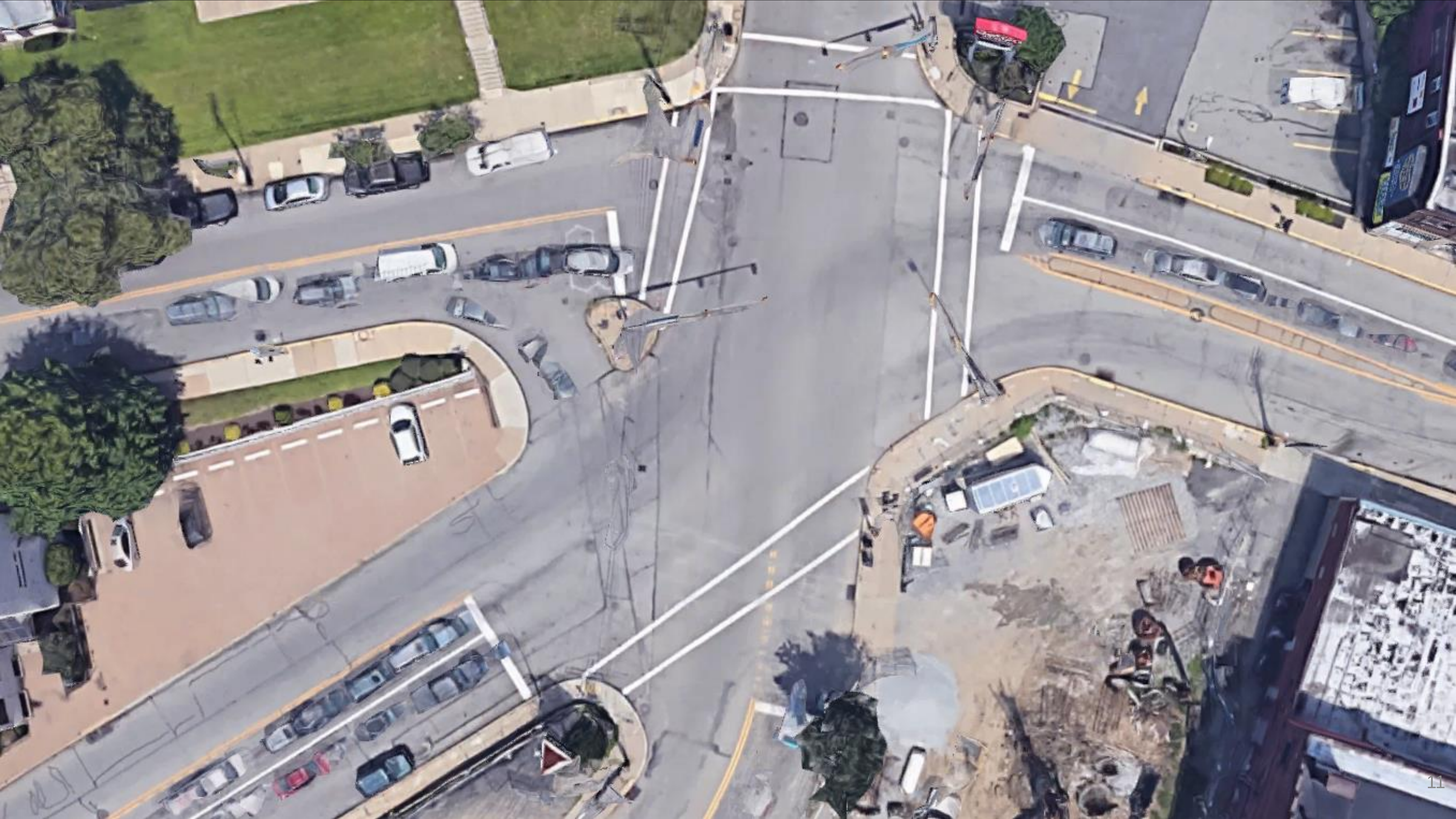
STREETS AND INTERSECTIONS ARE INTUITIVE TO USE, EVEN BY AN ADOLESCENT CHILD

"Pittsburgh is undoubtedly the cockeyedest city in the United States. Physically, it is absolutely irrational. It must have been laid out by a mountain goat."

- Ernie Pyle




START CROSSING
Watch For Vehicles
DON'T START
Finish Crossing If Started
FLASHING
STEADY
DON'T CROSS
TO CROSS
PUSH BUTTON



STREETS AND INTERSECTIONS ARE INTUITIVE TO USE, EVEN BY AN ADOLESCENT CHILD

PUTTING THIS INTO ACTION:

Pedestrian Safety Action Plan

- What may be intuitive, comfortable, or “safe” in one neighborhood or to certain age groups and abilities may not be to others.
- Special needs students are taught to wait 10 seconds after receiving the walk signal to allow drivers time to finish clearing the intersection.
- Need to better resident preferences and the driving factors behind those preferences.


Flickr / jdseibelphotography

NEW YORK CITY DOT

MULTIMODAL INTERSECTION DESIGN IN NYC

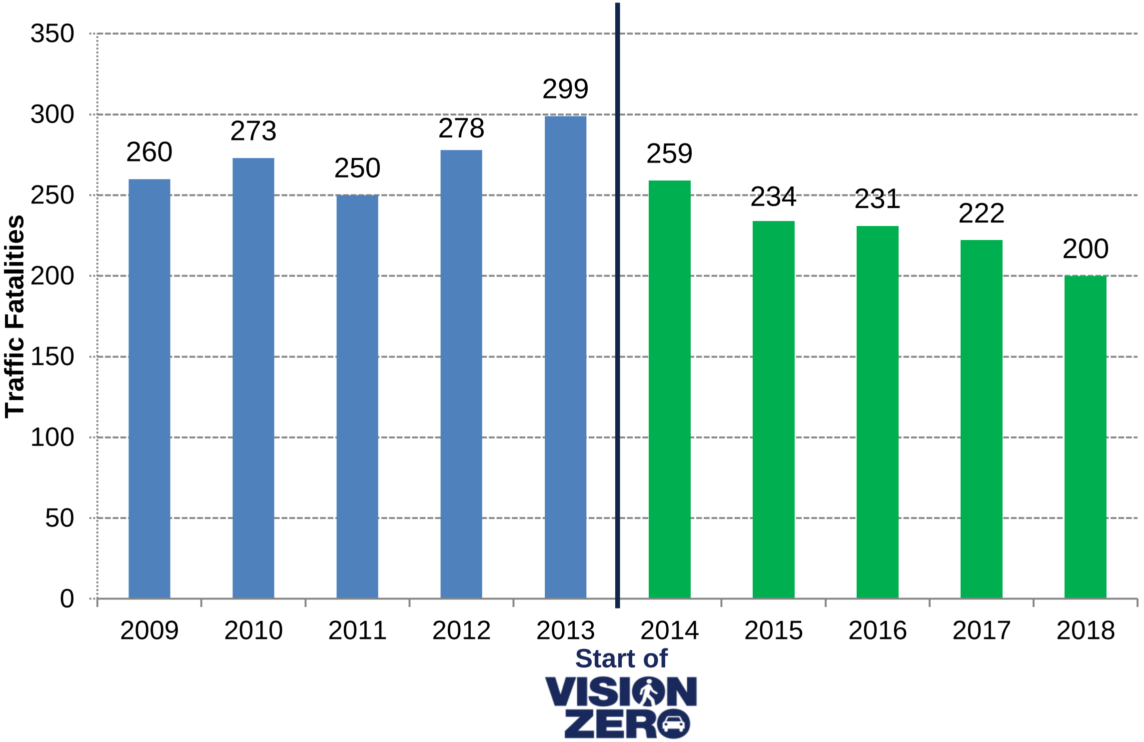
Federal Highway Administration Focused Approach to Safety Webinar

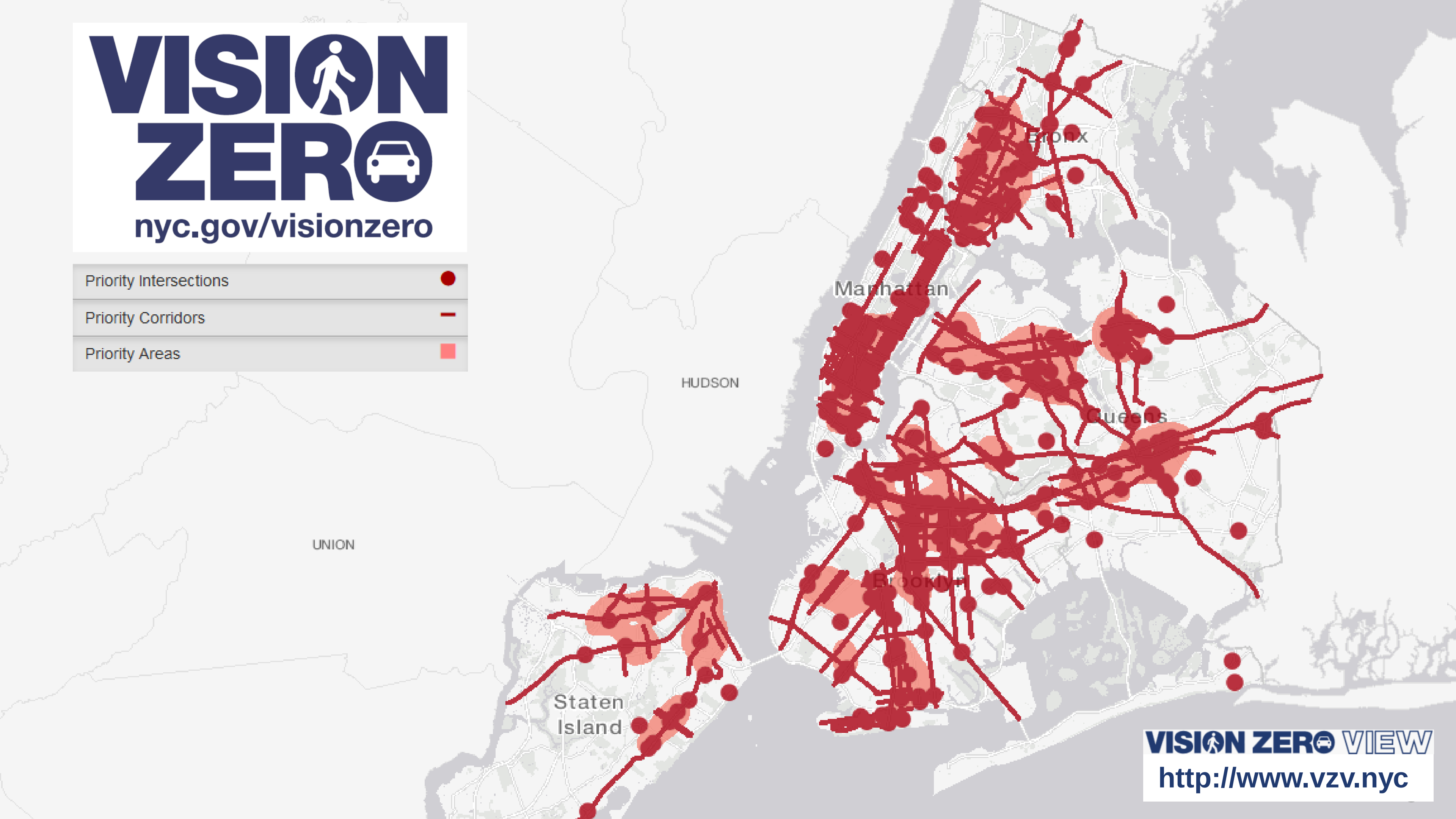
July 26, 2019

Carl Sundstrom, PE, New York City Department of Transportation

VISION ZERO

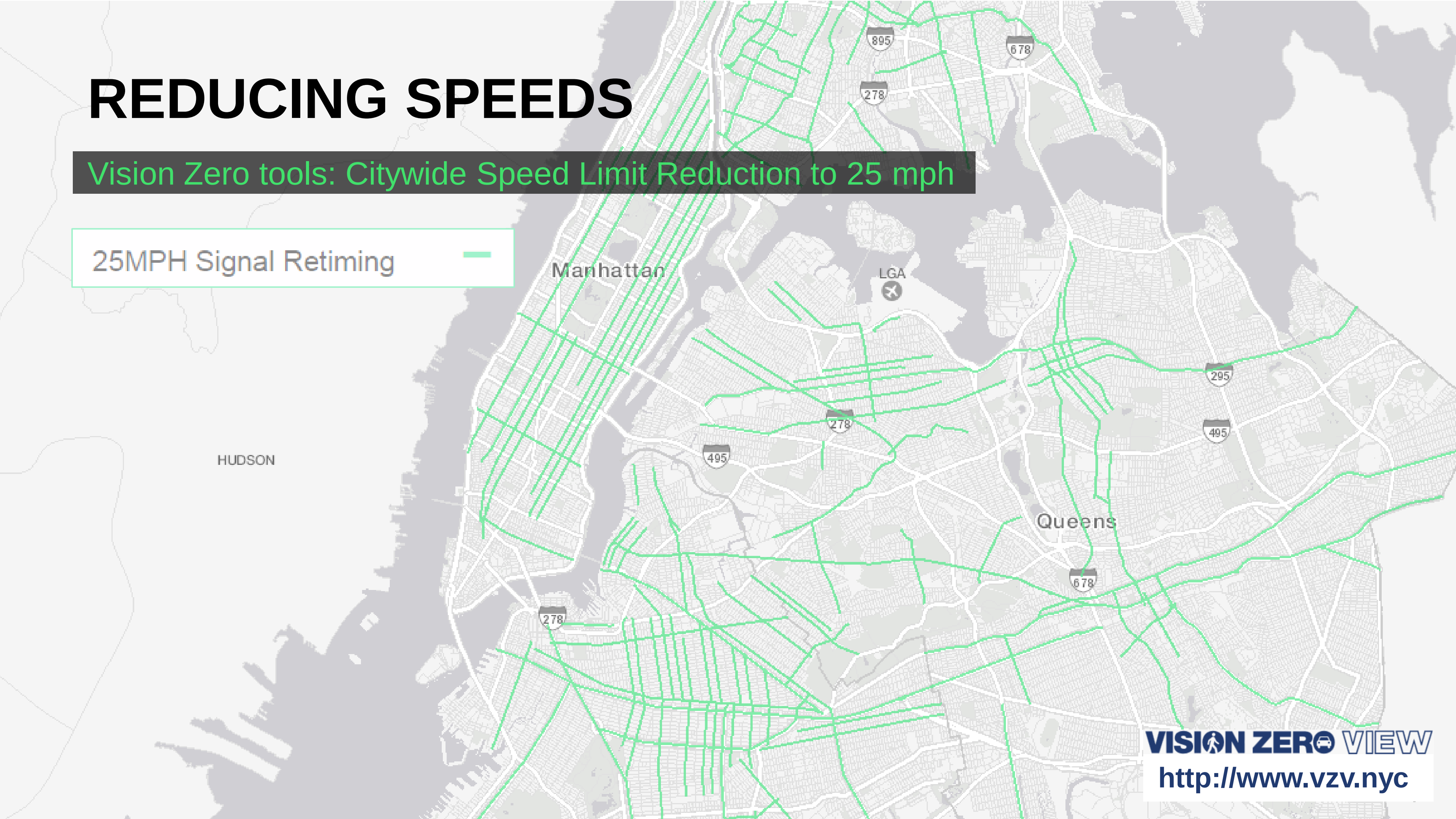
Crashes are Preventable through Engineering, Education and Enforcement




VISION ZERO
nyc.gov/visionzero
Priority Intersections
Priority Corridors
Priority Areas
Bronx
Manhattan
Queens
Brooklyn
Staten Island
HUDSON
UNION
VISION ZERO VIEW
http://www.vzv.nyc

REDUCING SPEEDS

Vision Zero tools: Citywide Speed Limit Reduction to 25 mph



VISION ZERO VIEW
http://www.vzv.nyc

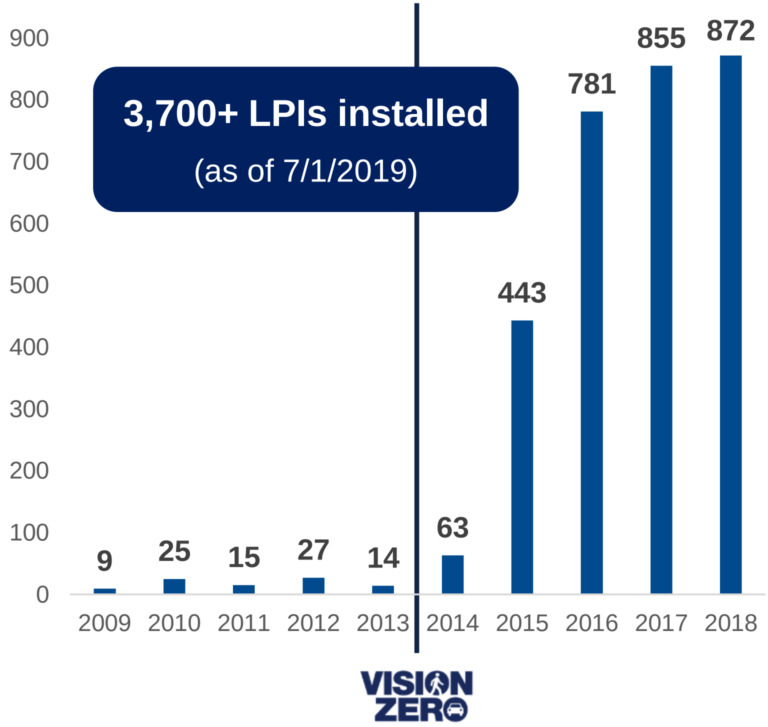
REDUCING EXPOSURE

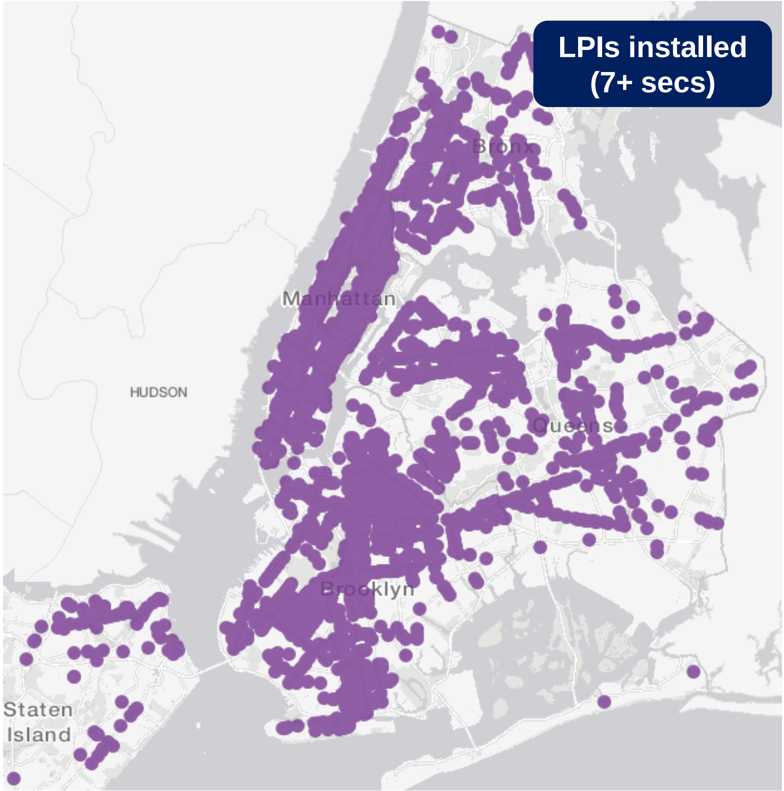
Vision Zero tools: Intersection toolkit

- Reallocate space
- Remove complexity
- Improve visibility & decrease exposure
- Transform into vibrant social public spaces
- Utilize temporary “quick” materials

REDUCING EXPOSURE

Vision Zero tools: Leading Pedestrian Interval (LPI)





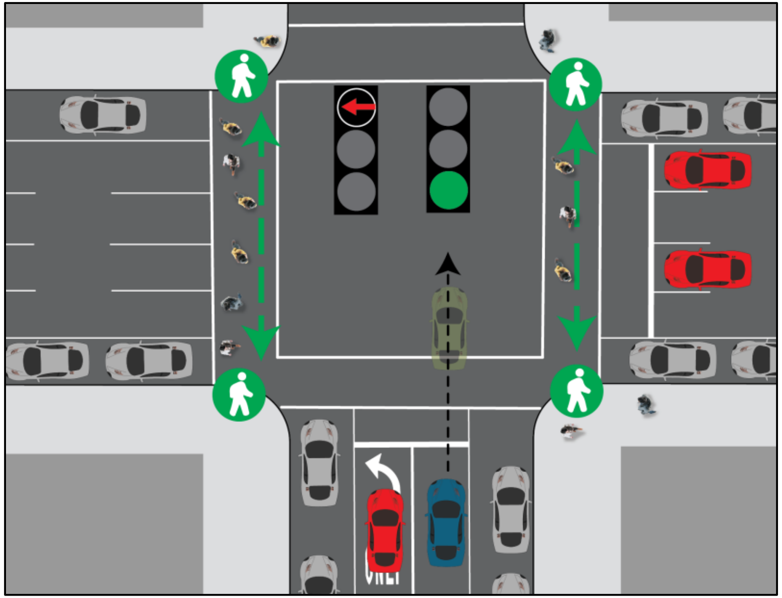
REDUCING EXPOSURE

Vision Zero tools: LPI

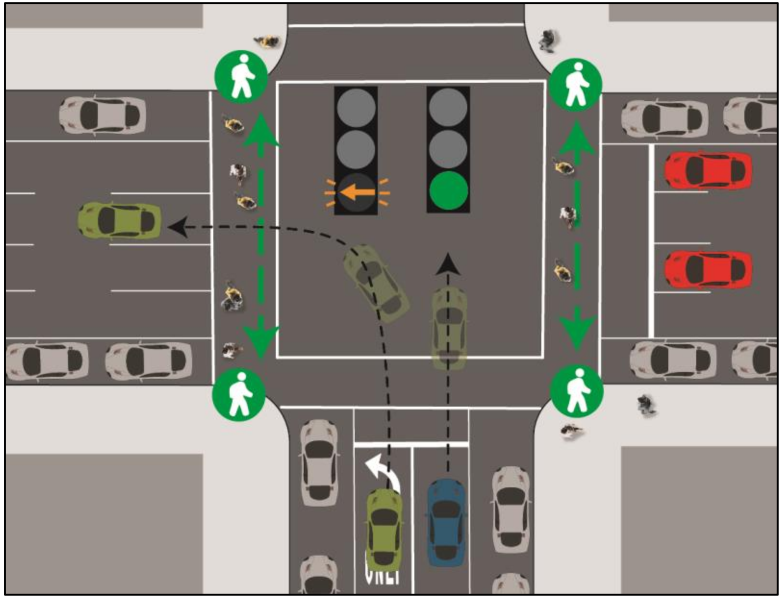
How do you take away time from traffic in a congested environment?

REDUCING EXPOSURE

Vision Zero tools: Delayed Turn (Split LPI)



Leading Pedestrian Interval Phase (7+ secs)



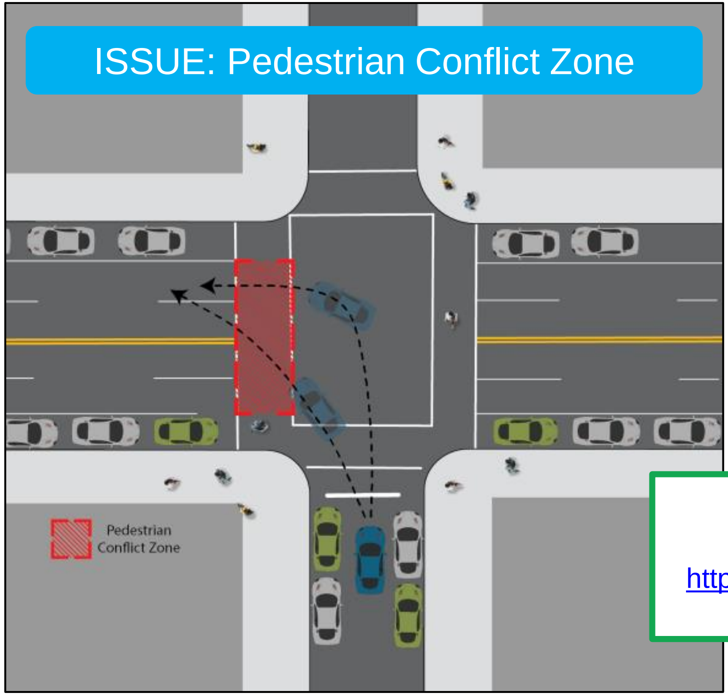
Flashing Yellow Turn Phase

BIKES ON LPI

- Successful 50 intersection pilot w/ signs
- Supported City Council legislation
- No signs will be used under citywide rule

LEFT-TURN TRAFFIC CALMING

Vision Zero tools



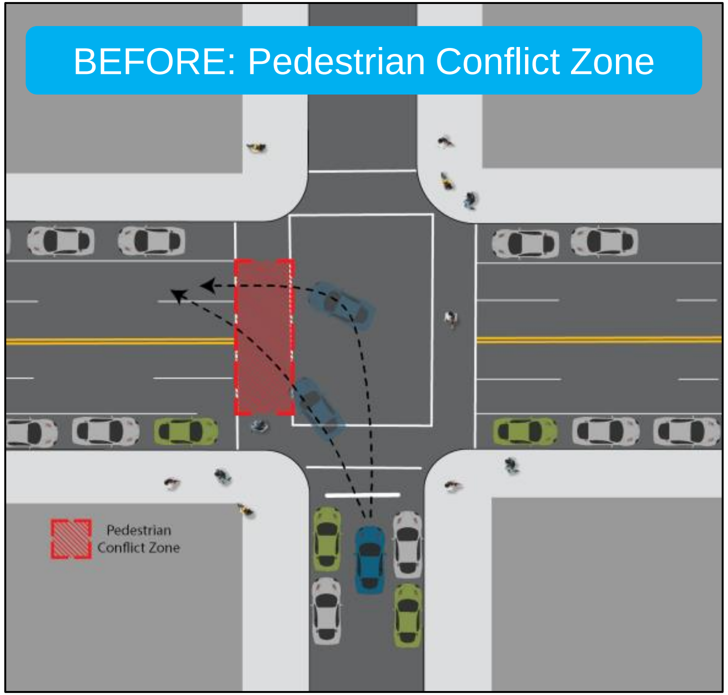
» Left turn pedestrian and bicyclist KSI crashes occur 3x more often than right turn pedestrian and bicyclist KSI crashes

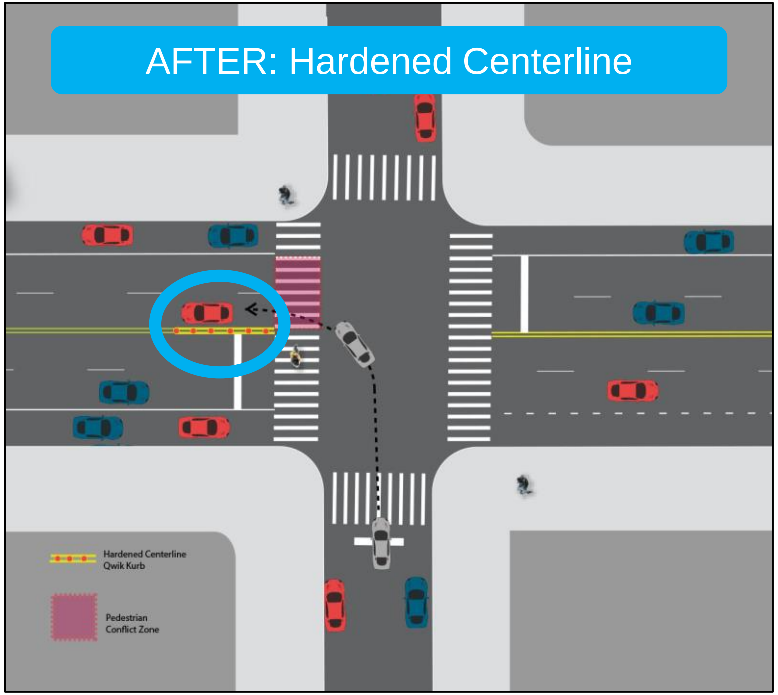
» Crash frequency highest from minor onto major street

Don't Cut Corners: Left Turn Pedestrian & Bicyclist Crash Study
full report available at:
https://www1.nyc.gov/html/dot/downloads/pdf/left-turn-pedestrian-and-bicycle-crash-study.pdf

LEFT-TURN TRAFFIC CALMING

Vision Zero tools





LEFT-TURN TRAFFIC CALMING

Countermeasure designs

LEFT-TURN TRAFFIC CALMING

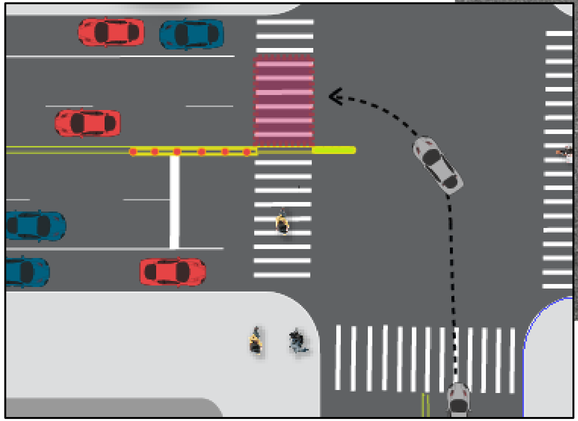
Evaluation results

» Median turn speeds ↓24%

» Vehicles crossing Double Yellow Line ↓98%

» Some durability issues:

Speed bumps are being tested to protect treatment elements

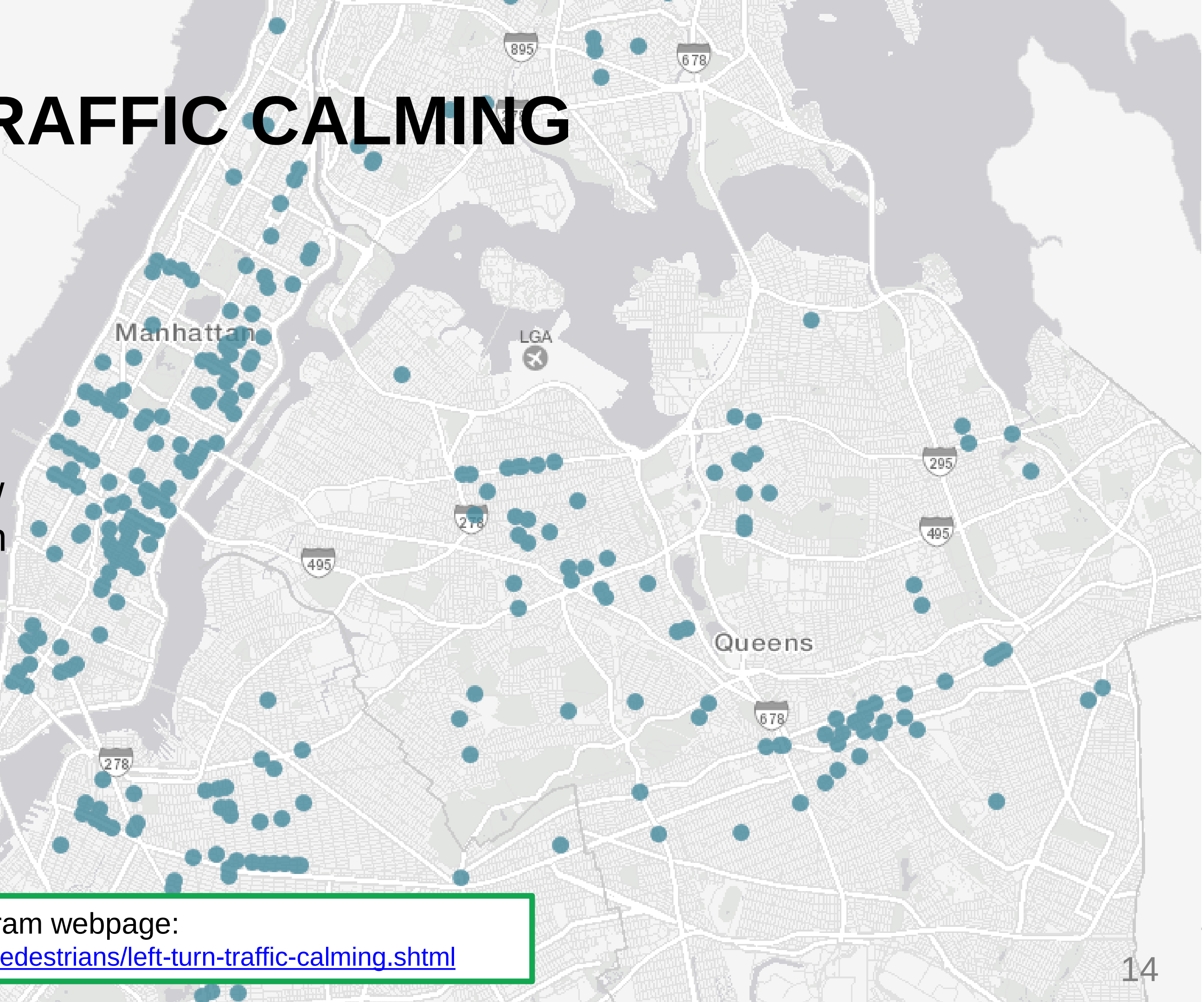


LEFT-TURN TRAFFIC CALMING

Implementation

» 100+ annual locations citywide

» 525 intersections in New York City had >5 left turn pedestrian and bike injuries over 5 years



LTTC program webpage:
https://www1.nyc.gov/html/dot/html/pedestrians/left-turn-traffic-calming.shtml

NEW TREATMENTS

Advancements: Roundabouts

PROTECTED BIKE LANE INTERSECTION DESIGN

Typical Treatments in NYC

Mixing Zone
ORIGINAL PBL TOOLKIT

Fully Split Phase
ORIGINAL PBL TOOLKIT

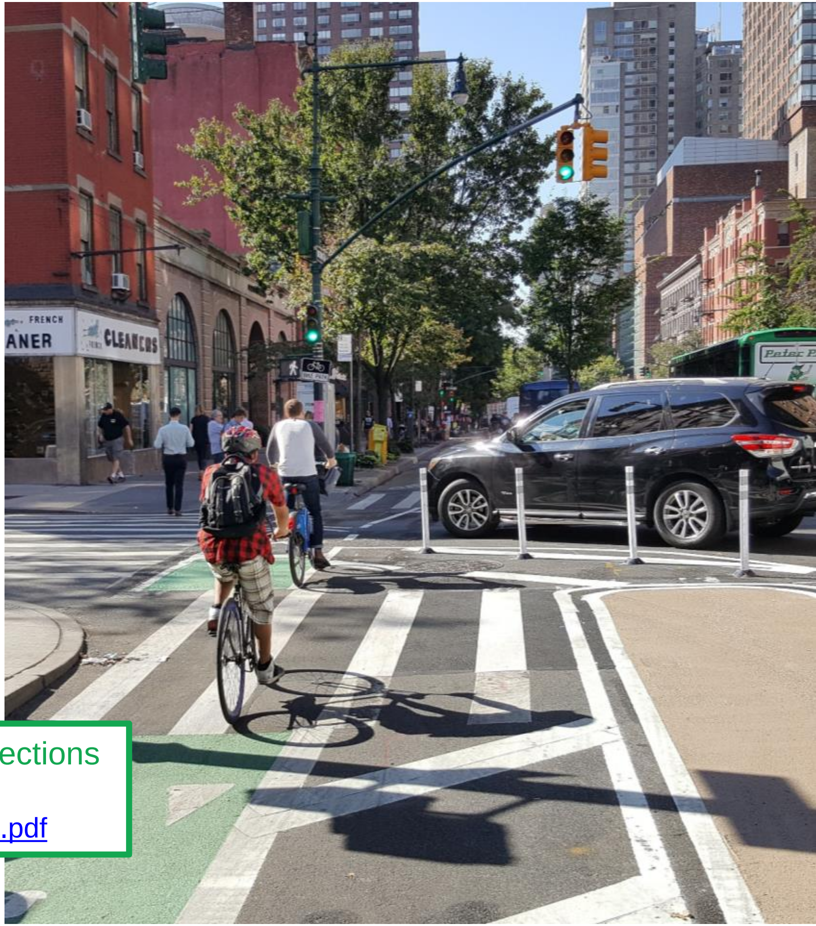
Delayed Turn (AKA Split LBI)
Pilot treatment, not in widespread use

Offset Crossing
Pilot treatment, not in widespread use

PROTECTED BIKE LANES

Intersection Study: Summary of Results

- » ↓30% reduction of intersection bicycle crashes per cyclist following PBL installation
  - Split phase has a lower crash rate at wider intersections
- » New designs show promise but some design modifications are needed
- » Need to balance comfort, safety and mobility.



Cycling at a Crossroads: The Design Future of New York City Intersections
full report available at:
http://www.nyc.gov/html/dot/downloads/pdf/cycling-at-a-crossroads-2018.pdf

INTERSECTION DESIGN MATRIX FOR ONE-WAY PBLS

Source: Cycling at a Crossroads Report available at:
http://www.nyc.gov/html/dot/downloads/pdf/cycling-at-a-crossroads-2018.pdf

Application Considerations		**Mixing Zone**	**Fully Split Phase**	**Delayed Turn (AKA Split LBI)** Continue with limited use under specific conditions	**Offset Crossing**
Along a one-way street with cross-street lanes:	**1**	Preferred for higher turn volumes	Preferred when a gap in ped traffic is required to process traffic	Possible for turn volumes <150/hr where a LPI is needed	Preferred for turn volumes <120/hr
	2+	Possible with turn volumes <60/hr	Preferred	Possible with turn volumes <60/hr where a LPI is needed	Possible with turn volumes <60/hr
Cross-street is two-way		Possible with turn volumes <80/hr and LTTC	Preferred	Possible with turn volumes <150/hr and LTTC	Possible with turn volumes <80/hr and Left Turn Traffic Calming (LTTC)
PBL is along a two-way street		Consider when left turns <50/hr	Consider when left turns >50/hr	Consider when left turns <50/hr	Consider when left turns <50/hr
Leading Pedestrian Interval		Possible with sign: 'Bikes May Use Ped Signal'	Possible	Possible	Possible with bike signal or sign: 'Bikes May Use Ped Signal'
Curb space needed (parking/loading loss)		Typically 90 ft	Typically 130 ft - Based on 85th percentile queue	Typically 110 ft	Typically 25 ft on mainline and 20 ft on narrow cross-streets
Speed limit ≥30mph		Not recommended	Preferred	Not recommended	Not recommended
Other considerations		• The current, shorter design should be used • If used at multilane cross-streets, traffic calming and visibility measures should be included • Consider context (e.g. schools, paths, etc.) where more comfortable designs with the tradeoffs such as higher delay may be desirable	• Turn lane/bay is req'd, of a length that can store all turning vehicles • Consider where a lower stress connection is preferable • Where multiple turn lanes/turning movements cross the impacted crosswalk/bike facility • No gap for turning vehicles due to high pedestrian and bike volumes • If several split phases are used along a corridor, a progression speed for bicyclists should be considered	• **Continue with limited use when a LPI without delaying through traffic is needed – must meet conditions in this table** • **Preferred installation is at a two-way cross-street w/ LTTC due to additional maneuvering space before conflict** • **Not recommended at downhill locations where cyclist speed may be higher** • Moderate turning volumes, but minimal storage space for turning lane/bay • High through volumes that would be delayed by a standard LPI • A turn lane or bay is required	• A 15 ft offset requires approximately 17 ft from curb to edge of travel lane • If used at multilane cross-streets, traffic calming and visibility measures should be included (i.e. high visibility markings, LTTC) • If a turn lane is provided, the full 15 ft offset may be reduced • Operationally not recommended on streets with >300 through veh/lane/hour • Truck and bus routes require additional care • Requires 40 ft of clear distance on approach to the Point of Curvature

OFFSET CROSSING

Treatment example

THANK YOU!

NYCDOT   nyc_dot   nyc_dot   NYCDOT

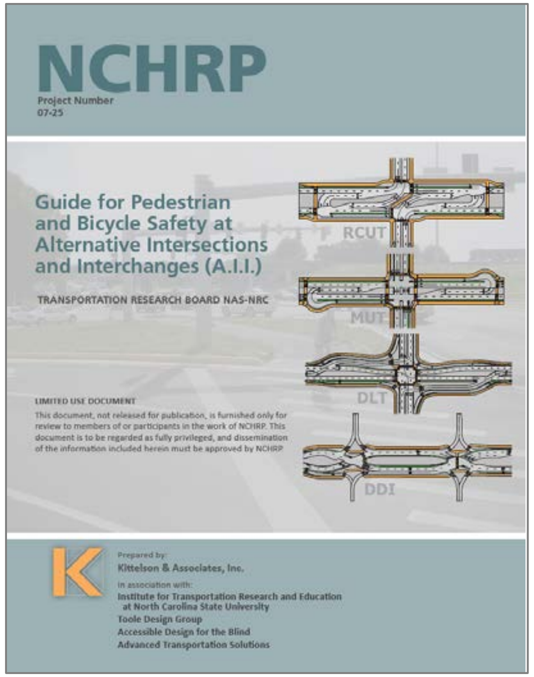
Pedestrian and Bicycle Safety at (Alternative) Intersections & Interchanges

July 2019 Webinar

Bastian Schroeder

Kittelson and Associates

The objective of this research is to develop a guide for transportation practitioners to improve and integrate pedestrian and bicycle safety considerations at (Alternative) Intersection and Interchanges through planning, design, and operational treatments.


NCHRP

Project Number
07-25

Guide for Pedestrian and Bicycle Safety at Alternative Intersections and Interchanges (A.I.I.)

TRANSPORTATION RESEARCH BOARD NAS-NRC

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Prepared by:
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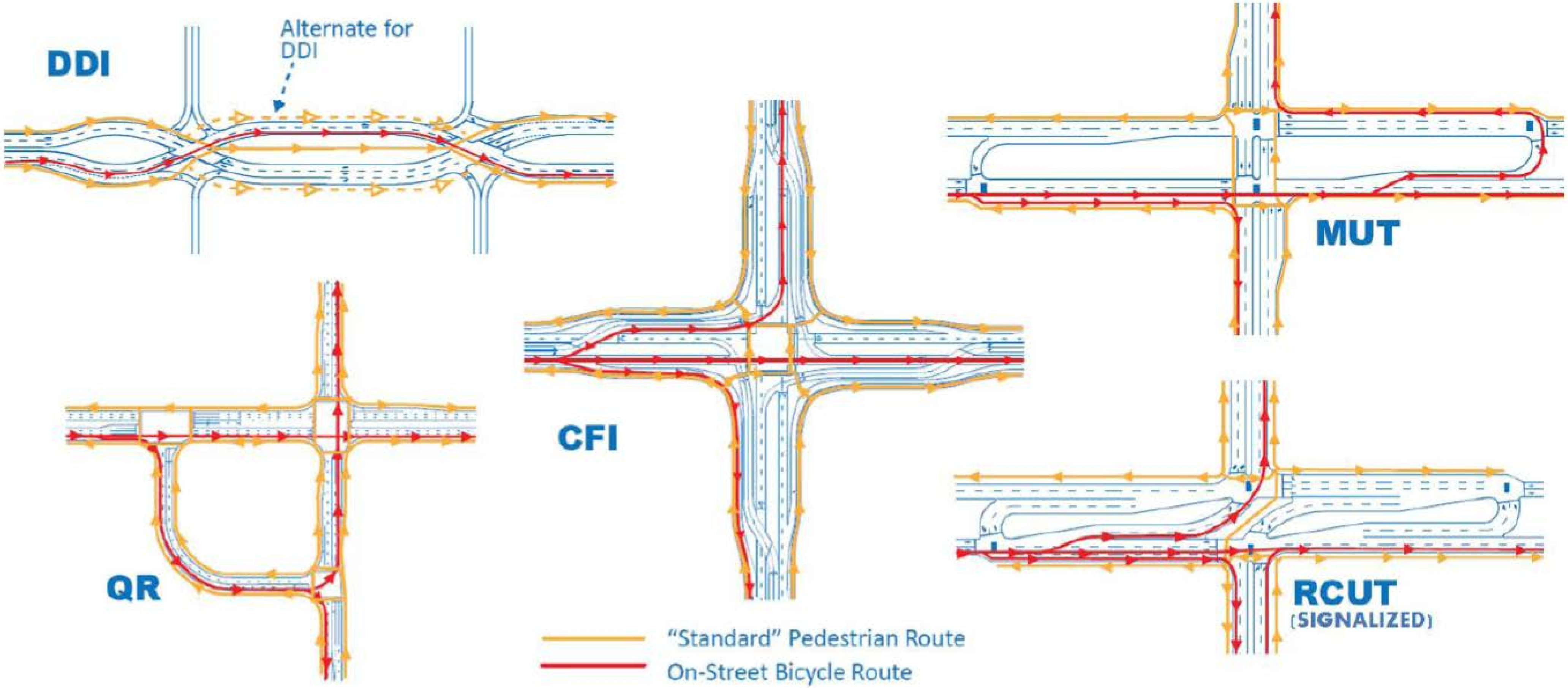
In association with:
Institute for Transportation Research and Education at North Carolina State University
Toole Design Group
Accessible Design for the Blind
Advanced Transportation Solutions

Publication expected early 2020

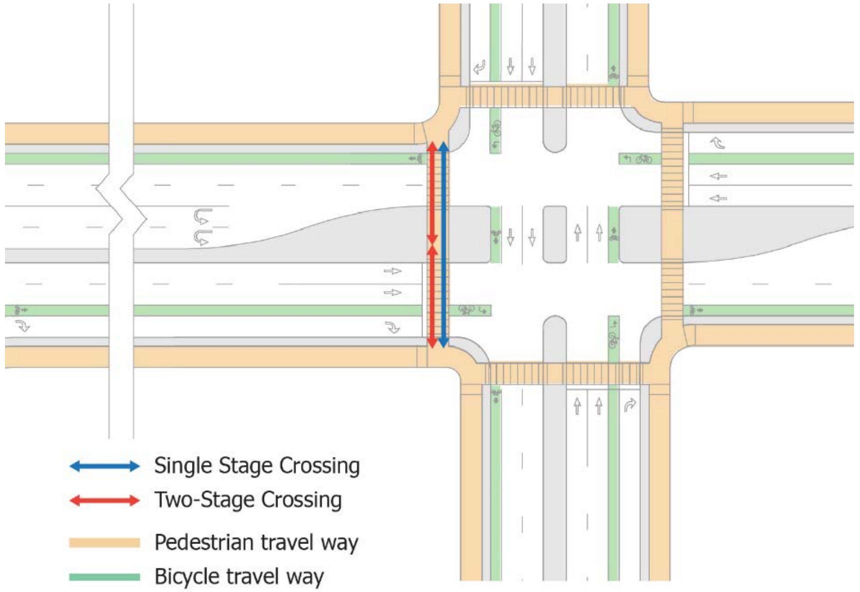
Moving Beyond “Standard” *Accommodations*

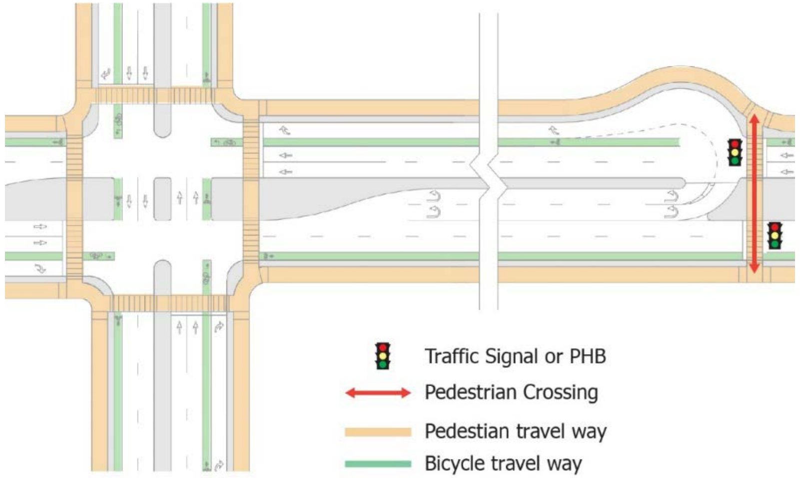


Considering Intersection Context

Multimodal Benefits of A.I.I.s

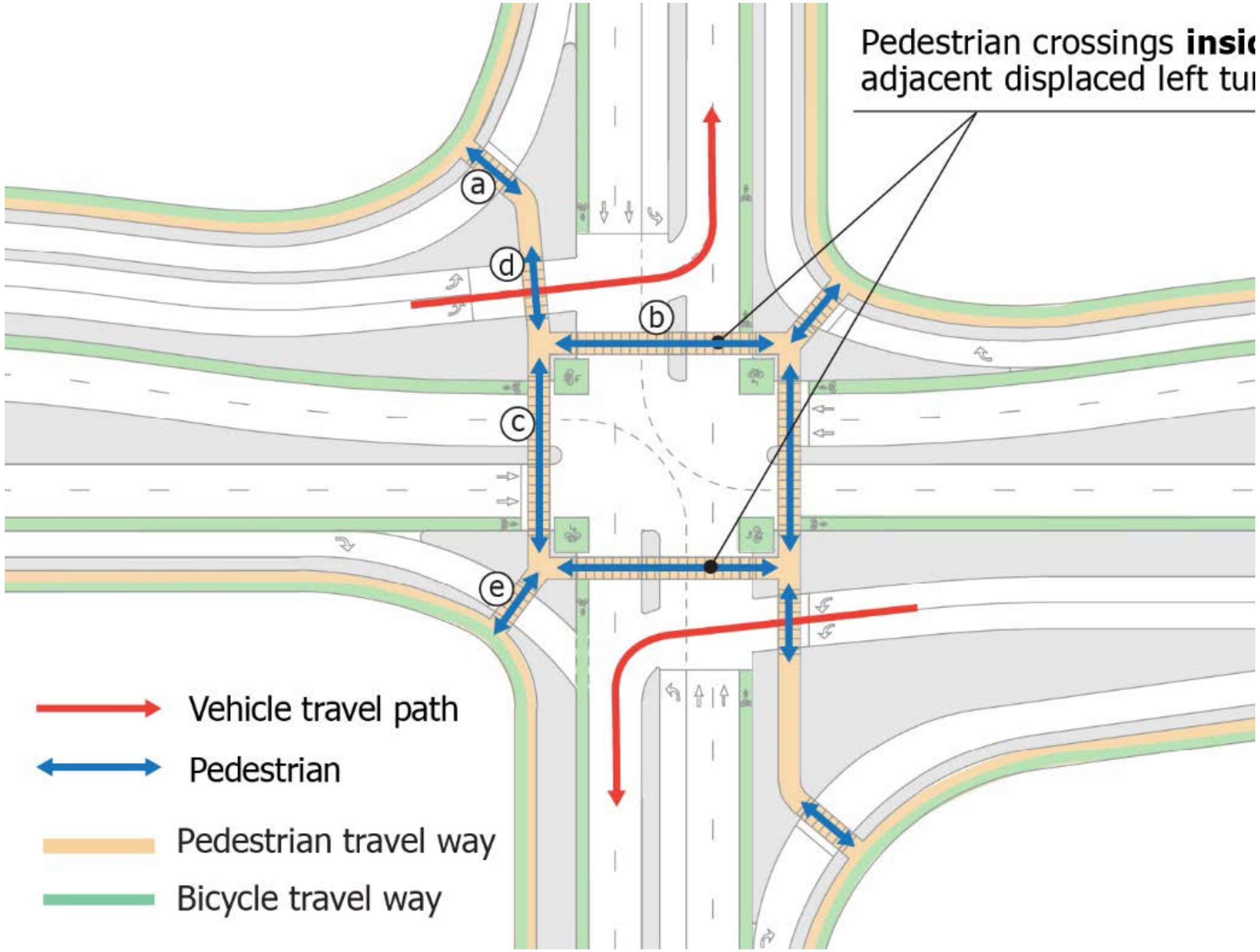
- Potentially reduced pedestrian-vehicle conflict points
- Simplified two-phase traffic signal control
- Minimized crossing distances
- Break up long crossings
- One-directional vehicular traffic
- May feature reduced turn lanes and permissive turns
- May provide opportunities for separated paths





Multimodal Challenges of A.I.I.s

- Altered travel paths
- Channelized vehicle movements
- Traffic approaching from unexpected directions
- Unfamiliar signal phases
- Multi-stage crossings
- Uncontrolled crossing of turn lanes
- Accessibility and Wayfinding



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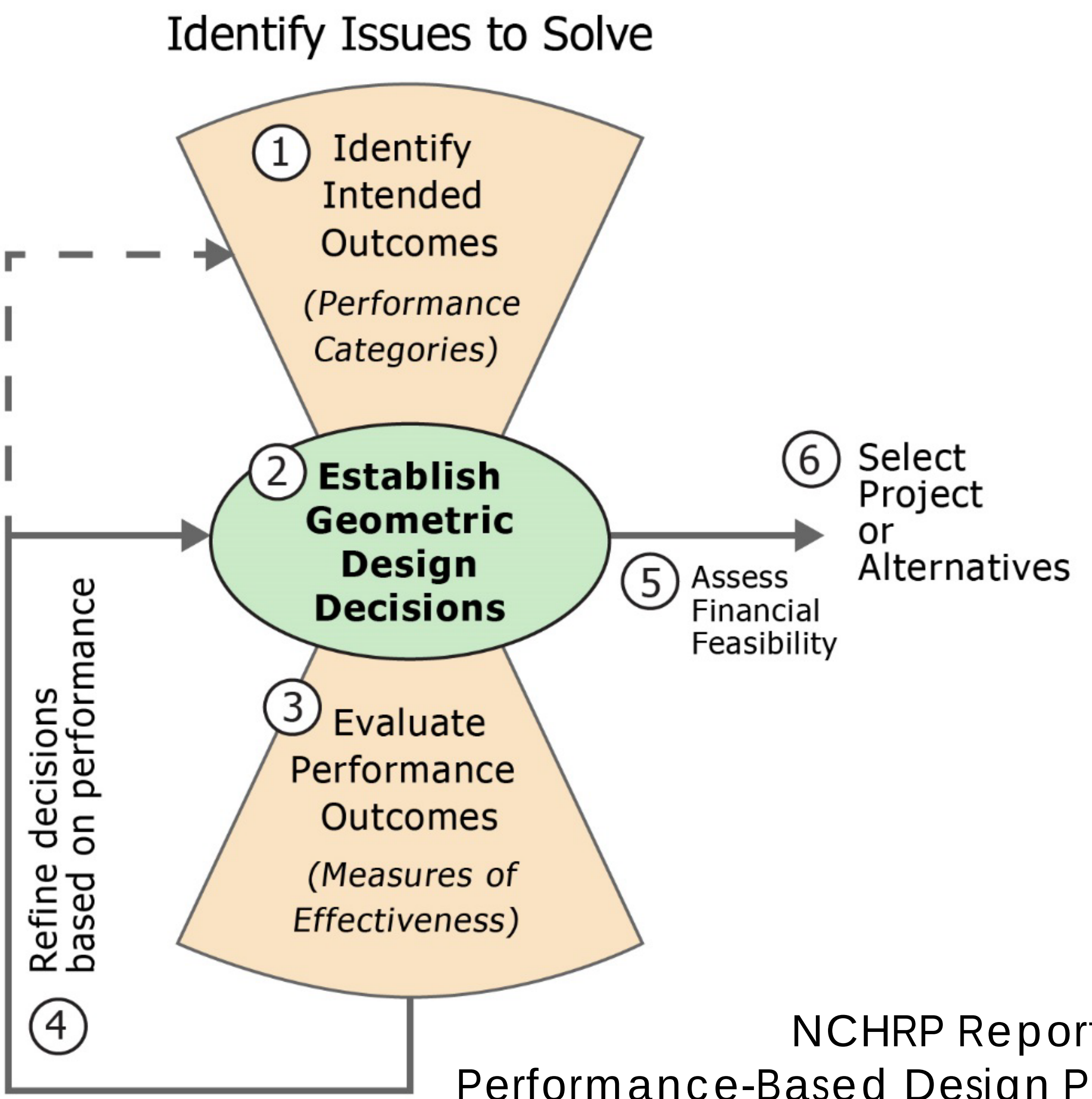
Performance-Based Design Process

- Identify intended outcomes
- Establish geometric design decisions
- **Evaluate performance outcomes**
- Refine decisions based on performance
- Assess financial feasibility
- Select project or alternatives



NCHRP Report 785 –
Performance-Based Design Process

Integration with ICE – Intersection Control Evaluation

ICE Stage 1

- **Vehicles**
  - Capacity and Level of Service
  - Safety performance
- **Pedestrians and Bicyclists**
  - Safe origin-destination movements
  - Adequate facility type

ICE Stage 2

- **Vehicles**
  - Delay and queuing analysis
  - Safety modeling
- **Pedestrians and Bicyclists**
  - Operations analysis
  - Design-flag assessment of design elements

Assessment Framework

Traversing

Traveling through the intersection or interchange along one or more segments

Wayfinding

Navigating pedestrian or bicycle features and finding crossing locations

Crossing

Walking/riding across an intersection feature and interacting with vehicular traffic navigating pedestrian or bicycle features and finding crossing locations

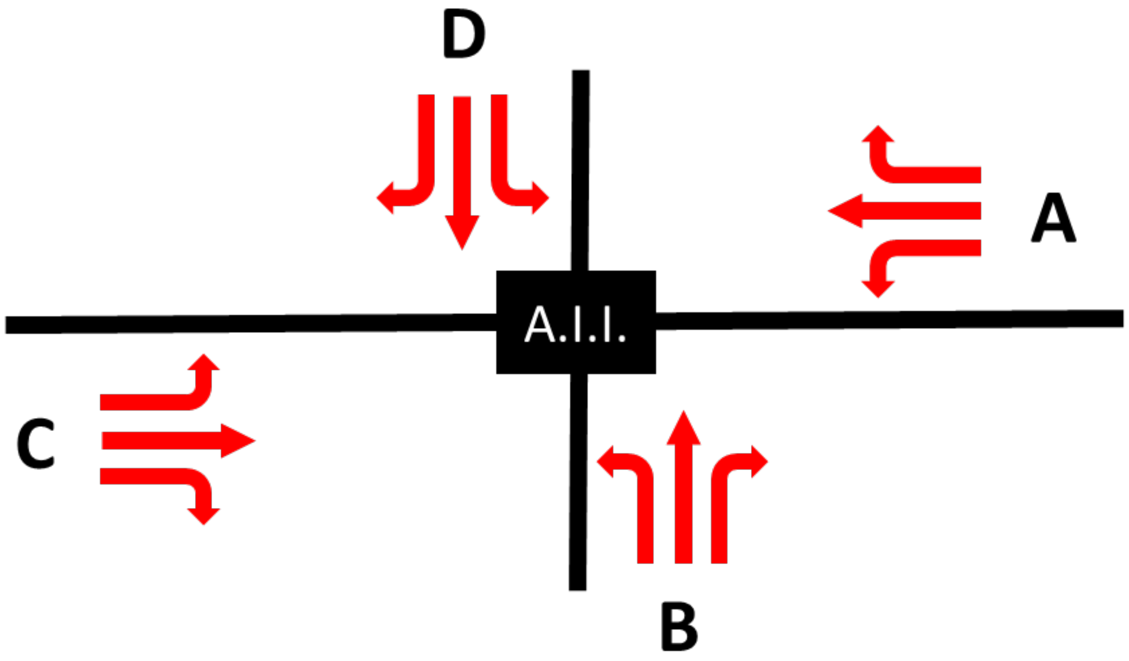
Design Flag Assessment Method – 20 Questions

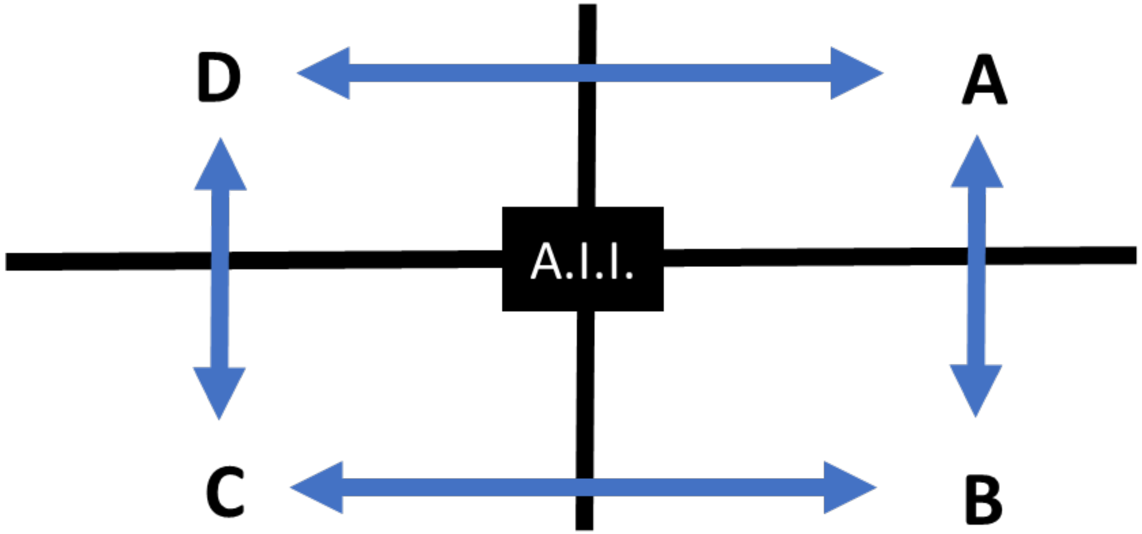
Motor Vehicle Right Turns	Uncomfortable/Tight Walking Environment	Non-intuive Motor Vehicle Movements	Crossing Yield- or Uncontrolled Vehicle Paths
Indirect paths	Executing Unusual Movements	Multilane Crossings	Long Red Times
Undefined Crossing at Intersections	Motor Vehicle Left Turns	Driveways and Side Streets	Sight Distance for Gap Acceptance
Grade Change	Riding in Mixed Traffic	Bicycle Clearance Times	Lane Change Across Motor Vehicle Lanes
Channelized Lanes	Turning Motorists Crossing Bicycle Paths	Riding between travel lanes	Off-tracking trucks in multi-lane curves

Yellow vs. Red Flags

Yellow Flags, for design elements negatively affecting user comfort (in other words, increasing user stress) or the quality of the walking or cycling experience.

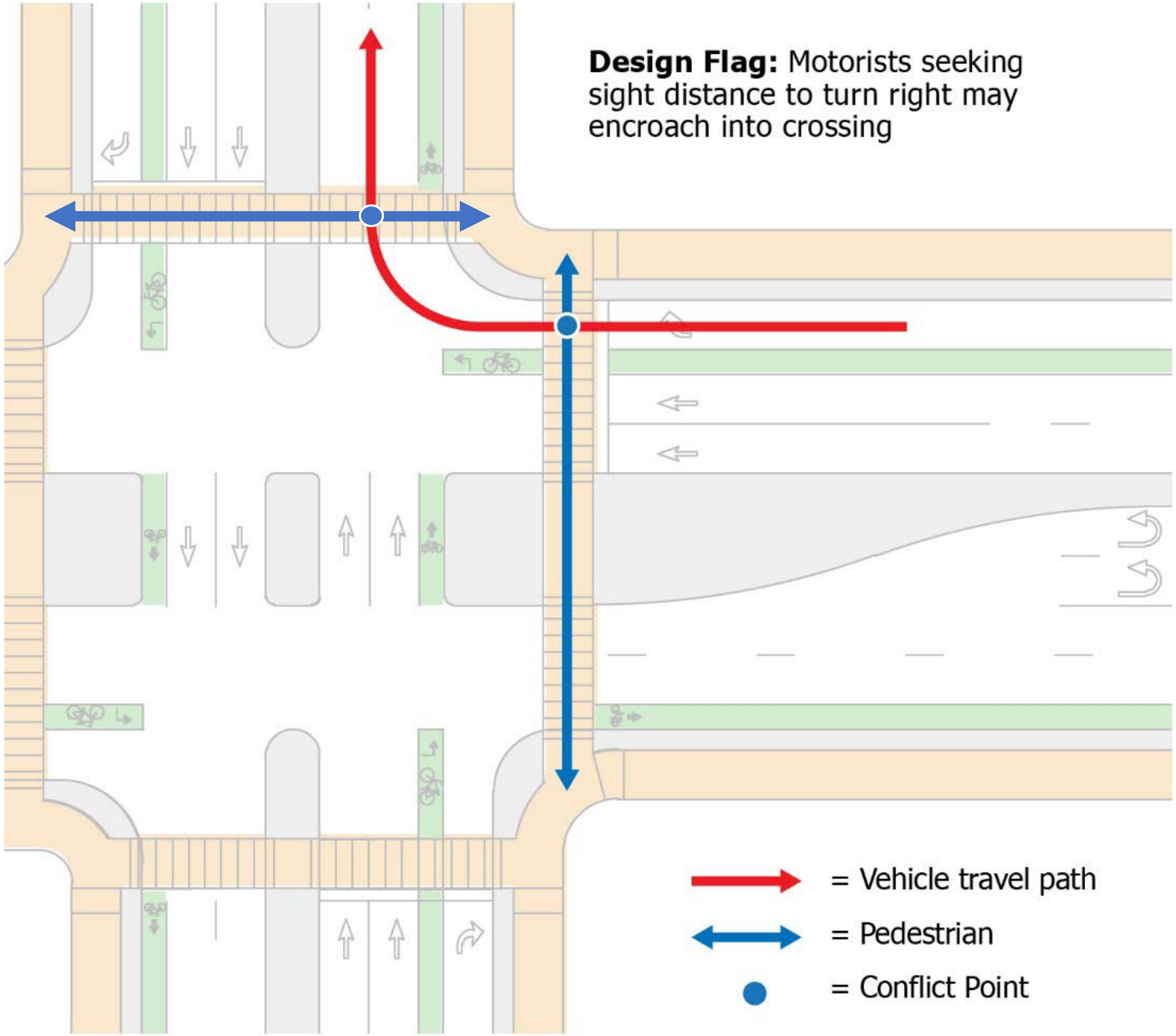
Red Flags, for design elements that are directly related to a safety concern for pedestrians or bicyclists.





Applying Design Flag Checks

Design Flag 1: Motorist Right Turns



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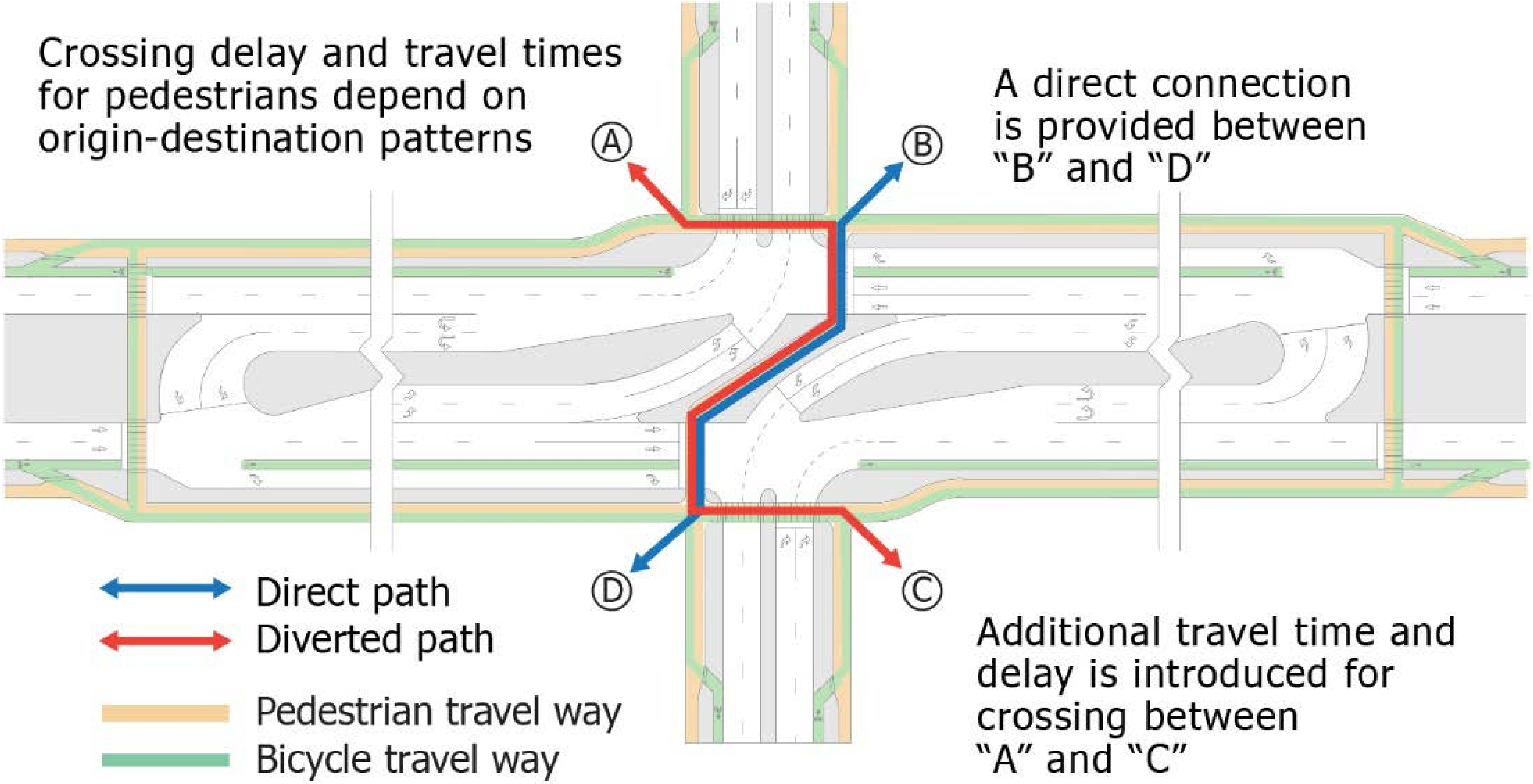
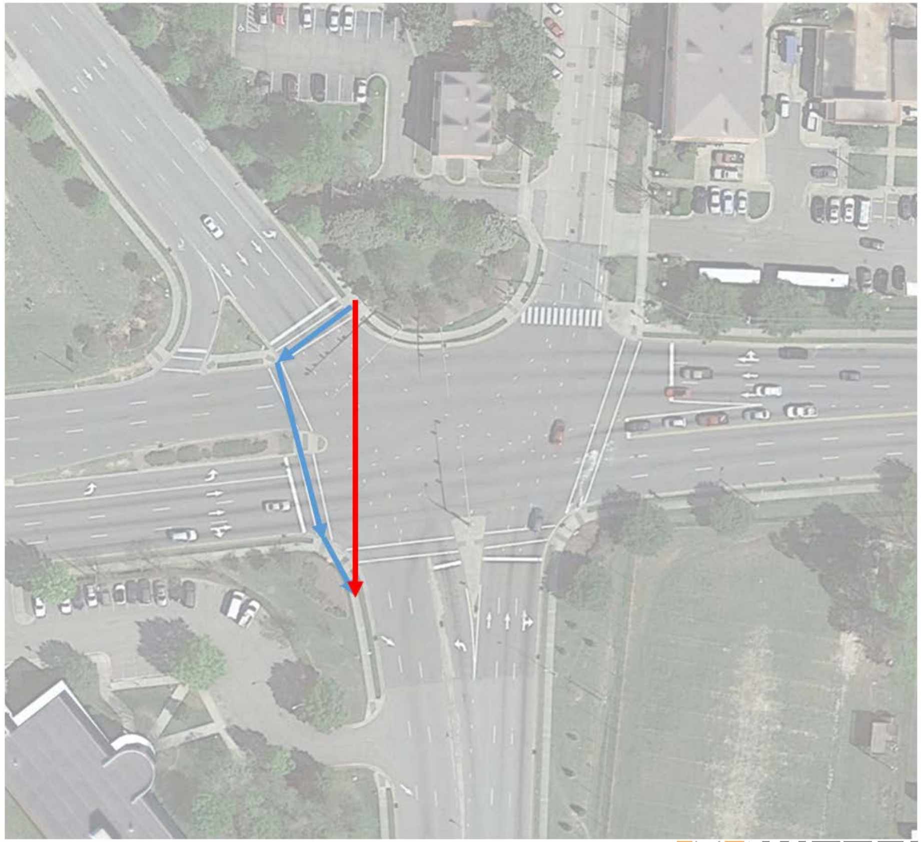
Design Flag 1 at Conventional Intersections

Design Flag 5: Indirect Paths



Design Flag 5 at Conventional Intersections



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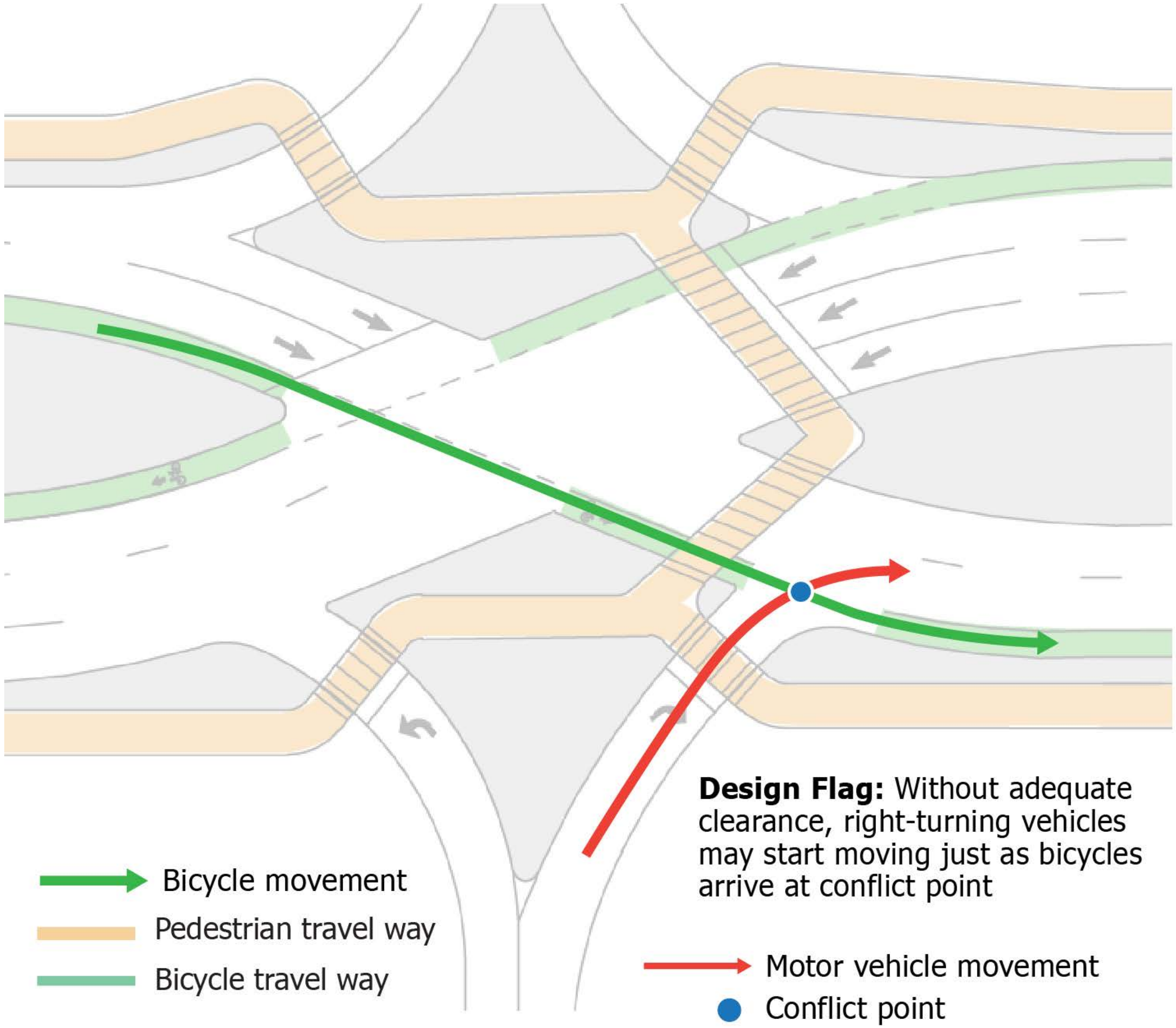
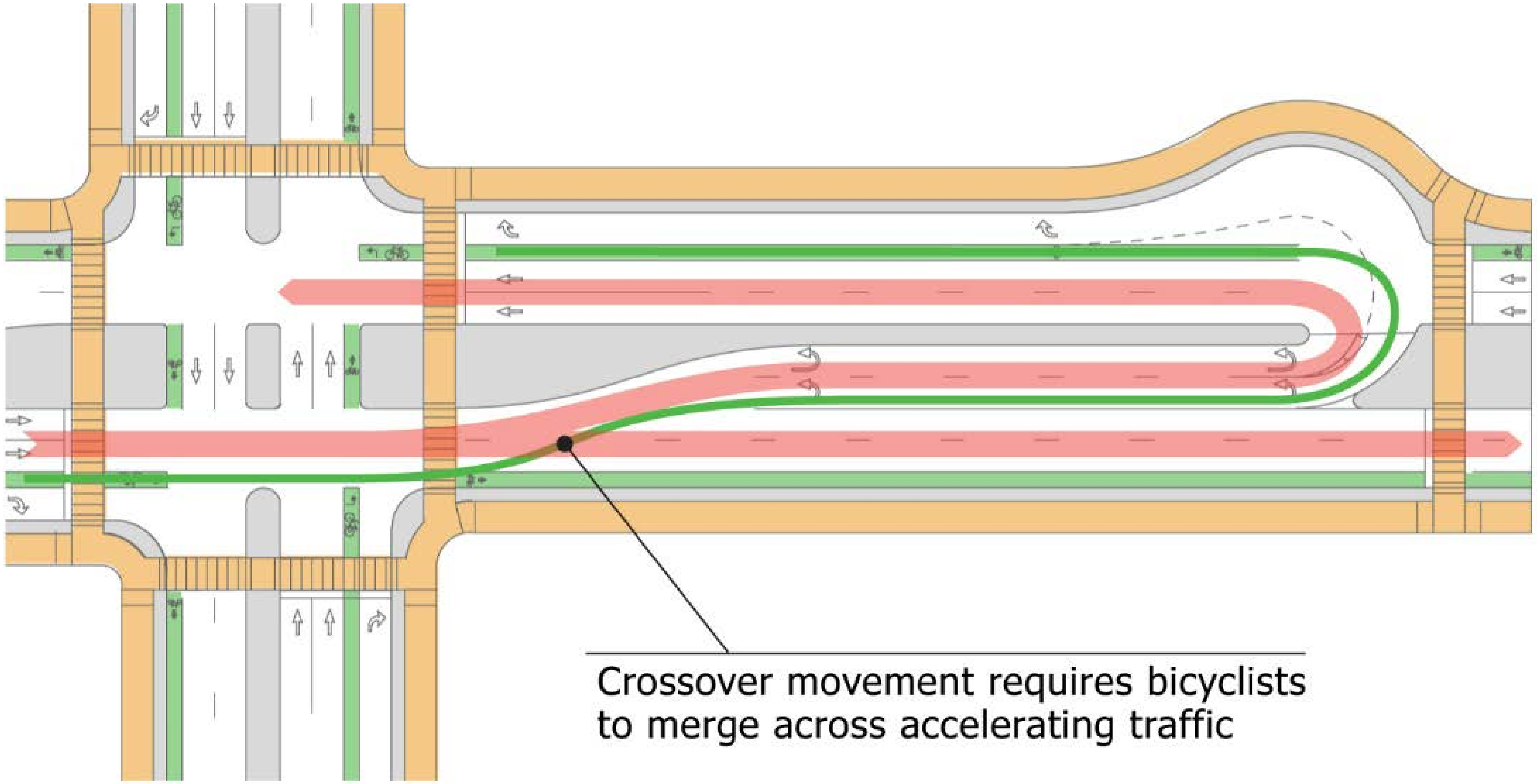
Design Flag 15 – Bicycle Clearance Times



Design Flag 15 at Conventional Intersections

Design Flag 17 – Lane Change Across Motor Vehicle Lanes



Design Flag 17 at Conventional Intersections

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Design Flag Assessment Method – 20 Questions

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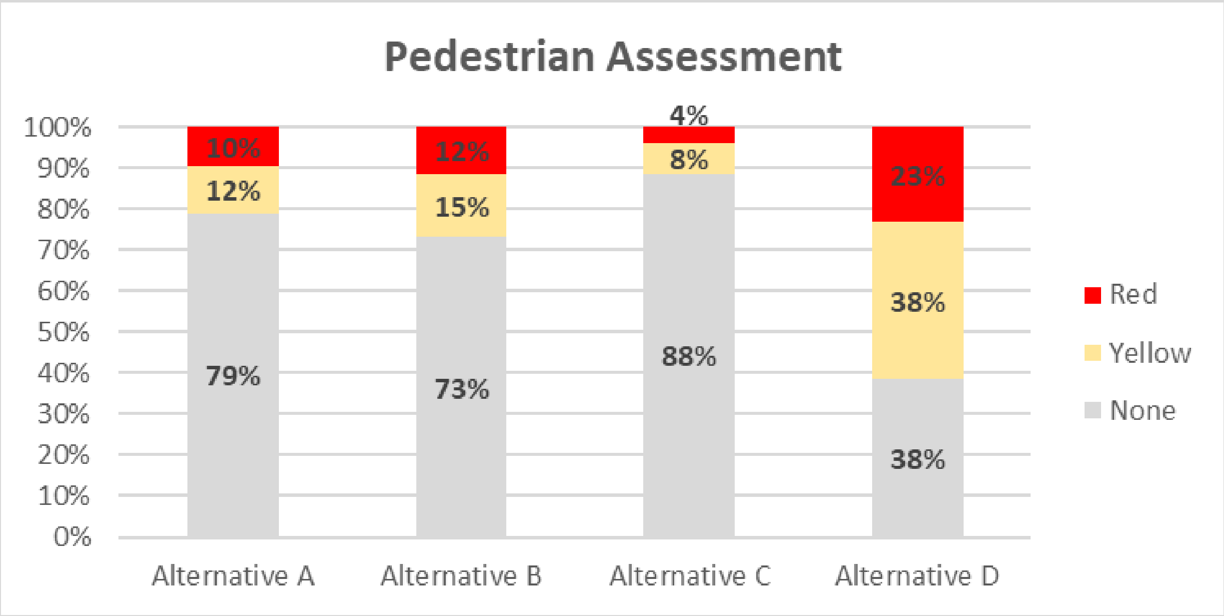
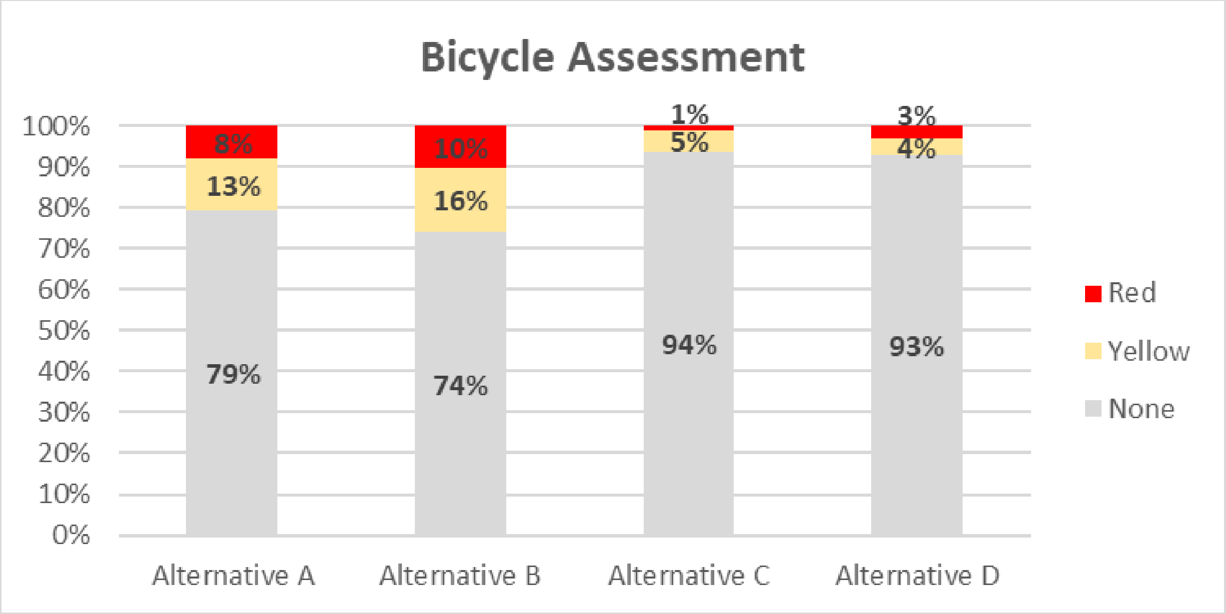
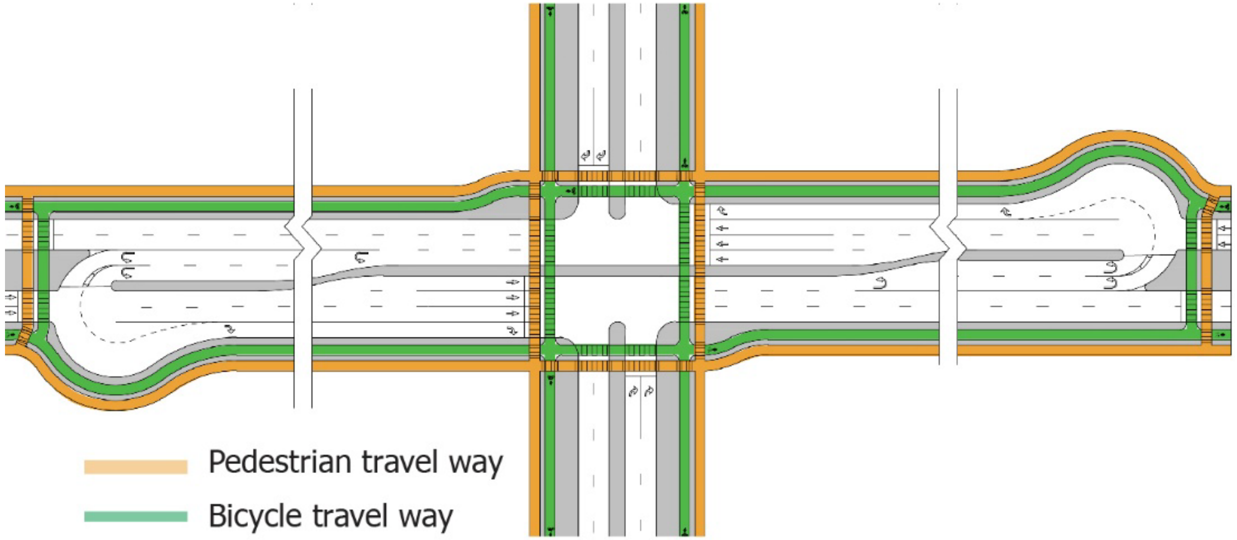
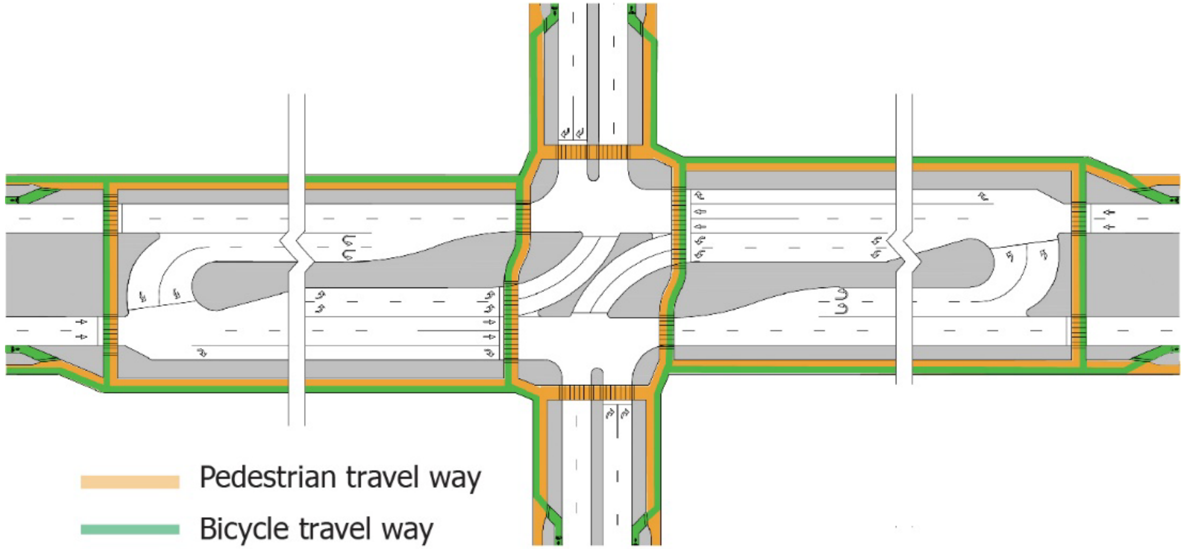
Comparing Alternatives

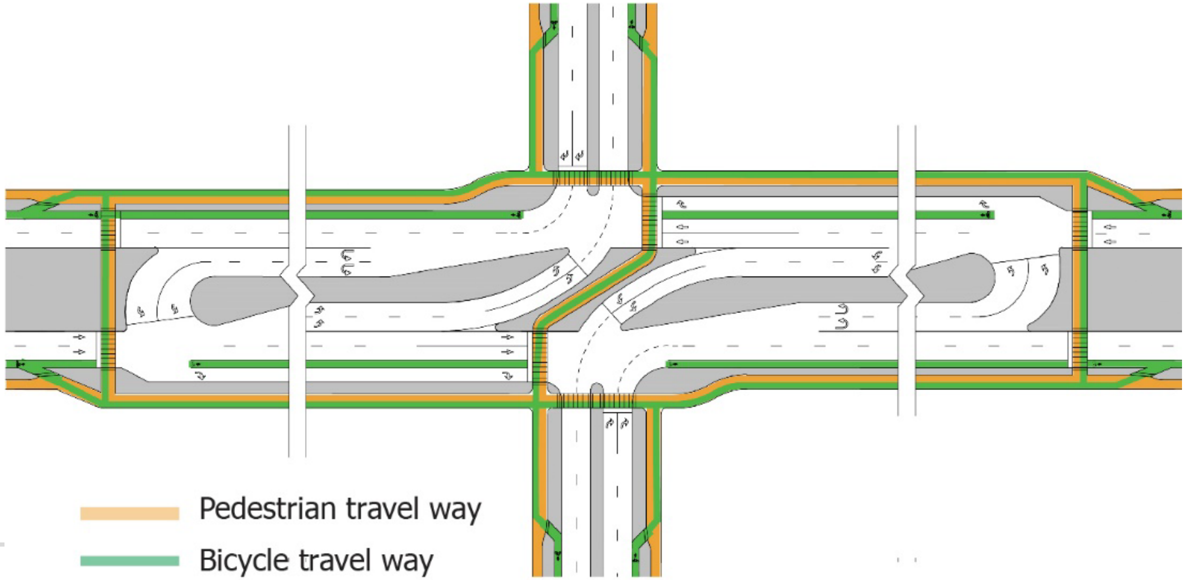




Re-thinking A.I.I.s to overcome design flags







Questions and Discussion

Bastian Schroeder
bschroeder@kittelson.com

Discussion

- Send us your questions
- Follow up with us:
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  - Karina Ricks karina.ricks@pittsburghpa.gov
  - Carl Sundstrom csundstrom@dot.nyc.gov
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