Countermeasure Strategies for Pedestrian Safety

Leading Pedestrian Interval

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Washington DC Department of Transportation

December 2, 2015

Today's Presentation

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- **Audio issues?**
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Pedestrian Safety at Interchanges

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Lighting Strategies for Pedestrian Safety

Tuesday, December 15 (1:00 – 2:30 PM Eastern Time)

Traffic Calming

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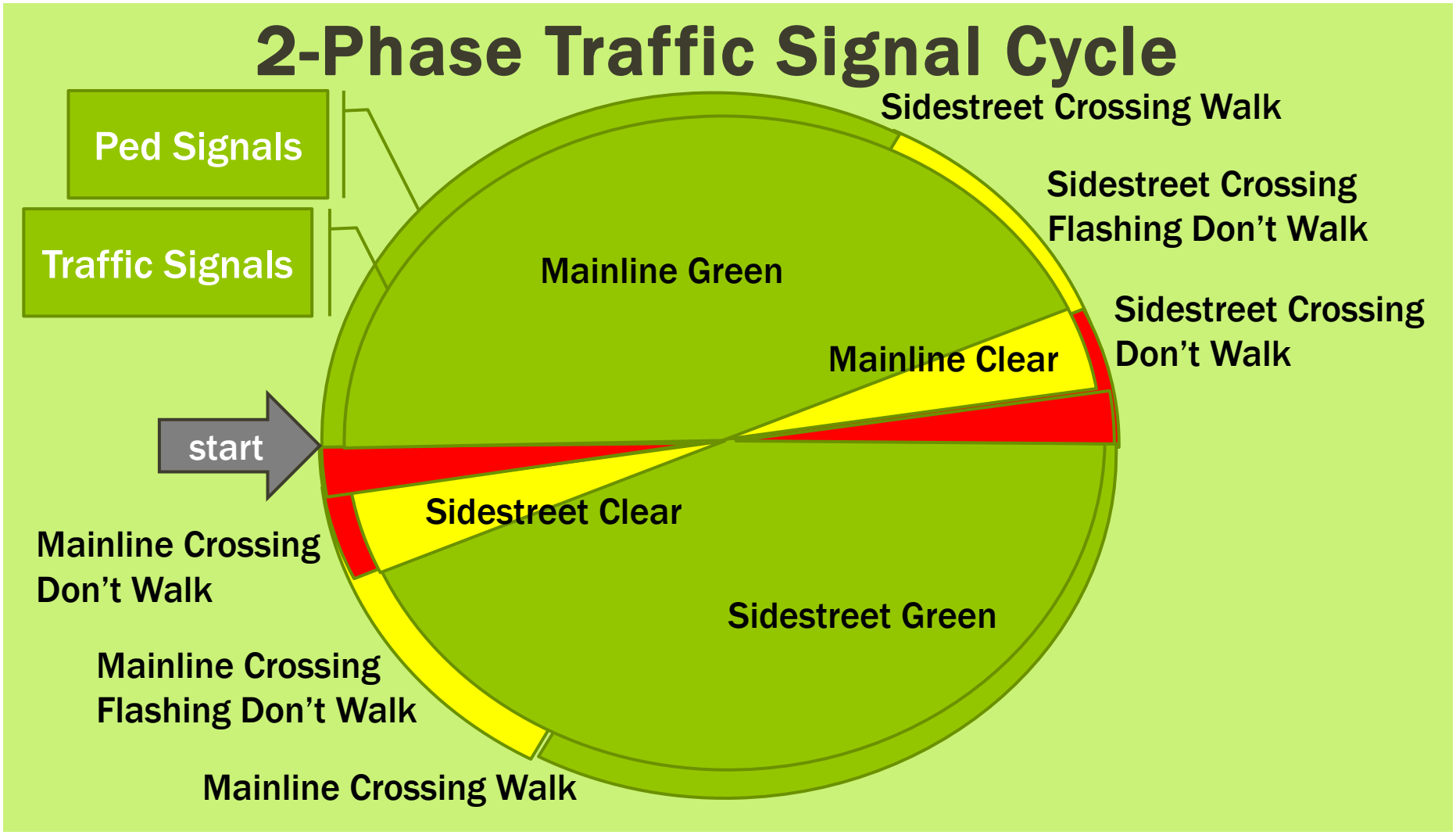
LEADING PEDESTRIAN INTERVAL (LPI)

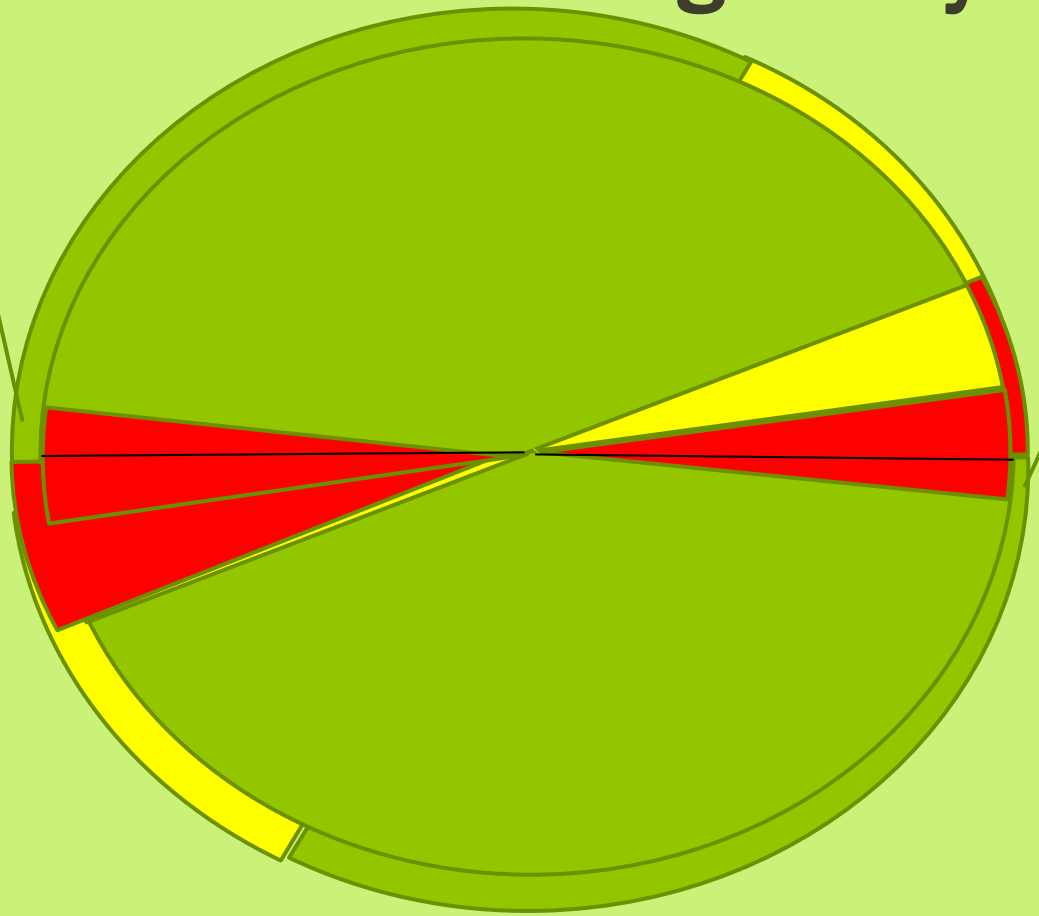
DPS 201

WHY – GETS PEDESTRIANS ESTABLISHED IN CROSSWALK



WHY – GETS PEDESTRIANS ESTABLISHED IN CROSSWALK

2-Phase Traffic Signal Cycle



LPI

Sidestreet Crossing Walk Starts ~3 secs before Mainline Green

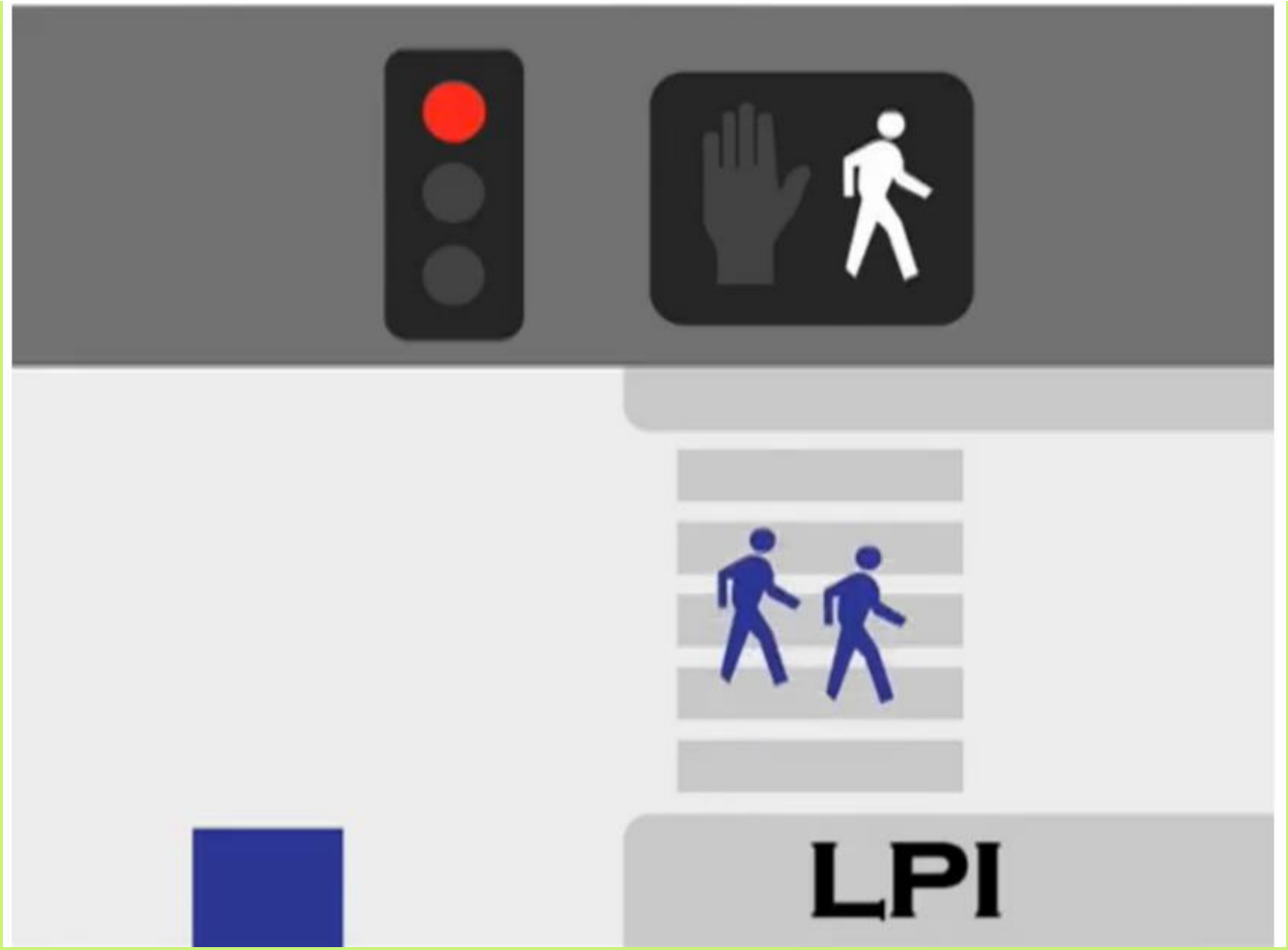
LPI

Mainline Crossing Walk Starts ~3 secs before Sidestreet Green

WHY – GETS PEDESTRIANS ESTABLISHED IN CROSSWALK

Taken from StreetFilms: http://www.streetfilms.org/lpi-leading-pedestrian-interval/

WHY – GETS PEDESTRIANS ESTABLISHED IN CROSSWALK



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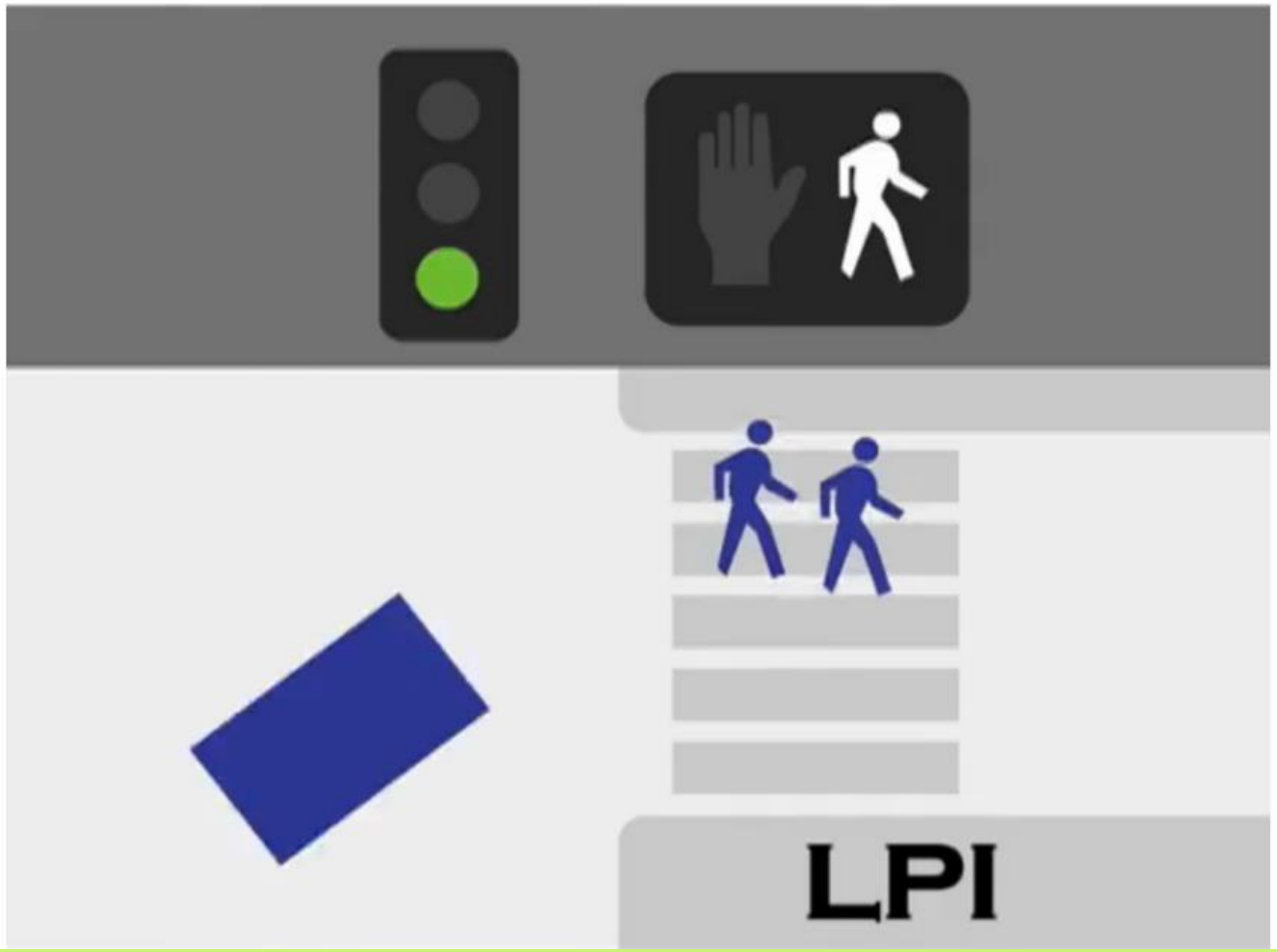
WHY – GETS PEDESTRIANS ESTABLISHED IN CROSSWALK



Taken from StreetFilms: http://www.streetfilms.org/lpi-leading-pedestrian-interval/

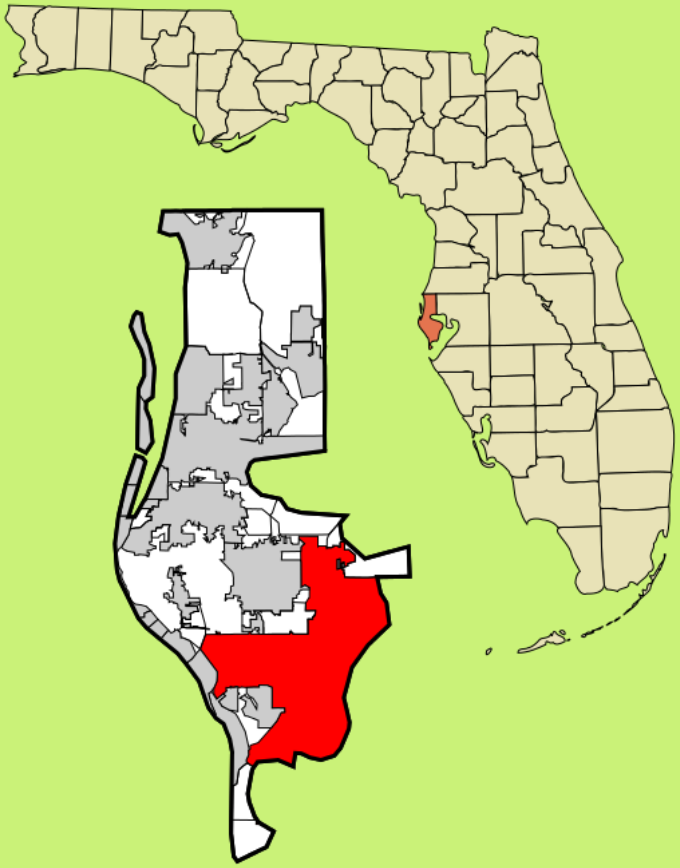
WHY – GETS PEDESTRIANS ESTABLISHED IN CROSSWALK

Taken from StreetFilms: http://www.streetfilms.org/lpi-leading-pedestrian-interval/

CASE STUDY: LPI (ST. PETERSBURG, FL)

Problem/Background

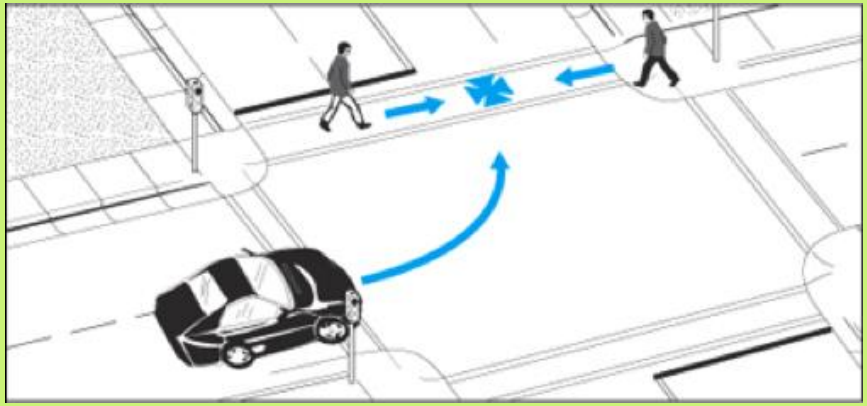
- High rate of collisions between left-turning motorists and pedestrians during WALK interval
- LPI - 3 intersections
- Pedestrian crossings averaged 60 per hour
- No public outreach / awareness to ensure unbiased results



CASE STUDY: LPI (ST. PETERSBURG, FL)

Details

- Installed 3-second LPI
- Studies pedestrian behavior and conflicts with turning vehicles
- Each street had four lanes & high traffic volume
- 30 mph posted speed
- Data collected for:
  - pedestrian/motor vehicle conflicts
  - pedestrians beginning to cross during the 5-second period at the start of the WALK interval
  - pedestrians starting to cross during the remainder of the WALK interval



CASE STUDY: LPI (ST. PETERSBURG, FL)

Results

- Conflicts virtually eliminated for pedestrians departing during start of the WALK interval
  - Before: average of 2-3 conflicts per 100 pedestrians
  - After: no observation period had more than 2 conflicts per 100 pedestrians & 34 of the 41 periods had no conflicts
- Smaller reduction in conflicts during the remainder of the WALK interval
- Four months after installation, no reduction in effectiveness

LEADING PEDESTRIAN INTERVAL - SAFETY

- ITE Toolbox: Modify signal phasing to implement LPI - associated with a 5% decrease in pedestrian crashes.

- Reference
  - Institute of Transportation Engineers (2004). Toolbox of Countermeasures and Their Potential Effectiveness to Make Intersections Safer, Briefing Sheet 8, FHWA.
  - Orlando, Florida study (2000)
  - CMF Star Rating: Cannot be rated – Insufficient information about study

CMF (CRF)

- **CRF 37% pedestrian crashes**
  - Study Citation: Fayish, and Gross, "Safety Effectiveness of Leading Pedestrian Intervals Using the Empirical Bayes Method." TRB 88th Annual Meeting Compendium of Papers CD-ROM. Washington, DC (2009).

CRASH MODIFICATION FACTORS CLEARINGHOUSE

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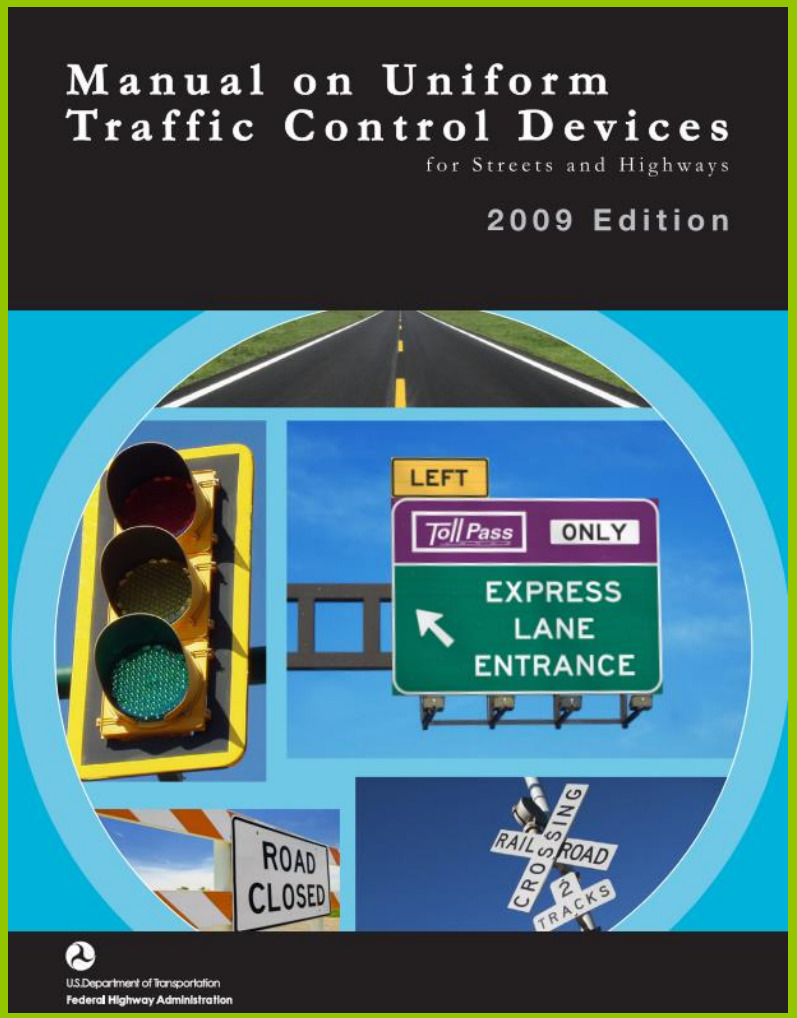
Countermeasure: Modify signal phasing (implement a leading pedestrian interval)

CMF	CRF (%)	Quality	Crash Type	Crash Severity	Area Type	Reference	Comments
0.63	37	★★★☆☆	Vehicle/bicycle,Vehicle/pedestrian	All	Urban	Fayish and Gross, 2009	
0.554	44.6	★★★☆☆	Vehicle/bicycle,Vehicle/pedestrian	All	Urban	Fayish and Gross, 2009	
0.577	42.3	★★☆☆☆	Vehicle/bicycle,Vehicle/pedestrian	All	Urban	Fayish and Gross, 2009	
0.639	36.1	★★☆☆☆	Vehicle/bicycle,Vehicle/pedestrian	All	Urban	Fayish and Gross, 2009	
0.608	39.2	★★☆☆☆	Vehicle/bicycle,Vehicle/pedestrian	All	Urban	Fayish and Gross, 2009	
0.63	37	★★☆☆☆	Vehicle/bicycle,Vehicle/pedestrian	All	Urban	Fayish and Gross, 2009	
0.711	28.9	★★☆☆☆	Vehicle/bicycle,Vehicle/pedestrian	All	Urban	Fayish and Gross, 2009	

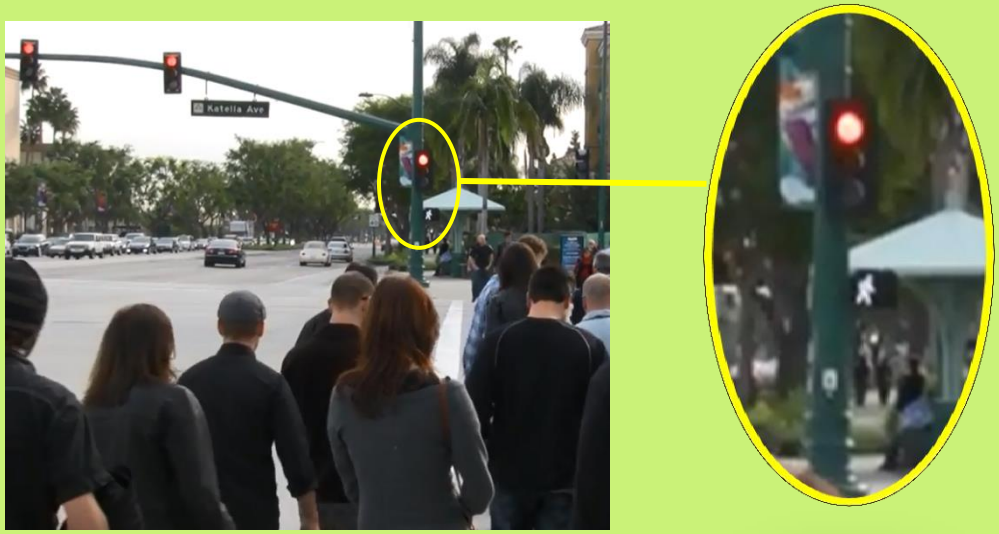


MUTCD

Section 4E.06 Pedestrian Intervals and Signal Phases

MUTCD OPTION

- At intersections with high pedestrian volumes and high conflicting turning vehicle volumes, a brief leading pedestrian interval, during which an advance WALKING PERSON (symbolizing WALK) indication is displayed for the crosswalk while red indications continue to be displayed to parallel through and/or turning traffic, may be used to reduce conflicts between pedestrians and turning vehicles.



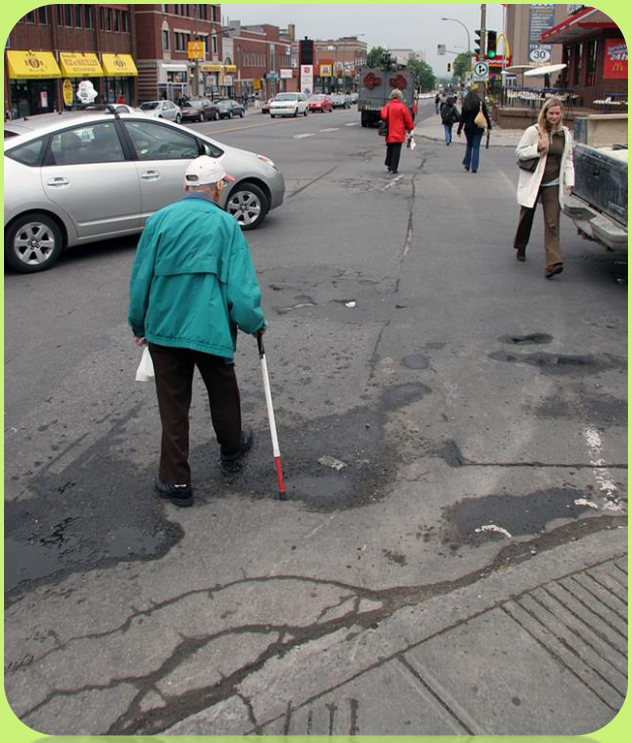
Section 4E.06, Paragraph 19

MUTCD GUIDANCE
ACCESSIBLE PEDESTRIAN SIGNALS

- *Guidance:*
  If a leading pedestrian interval is used, the use of accessible pedestrian signals (see Sections 4E.09 through 4E.13) should be considered.

Vision-impaired pedestrians use the sound of moving traffic to start crossing

If No APS, How do Vision Impaired Pedestrians Know When to Cross?



MUTCD GUIDANCE

- *If a leading pedestrian interval is used, it should be at least 3 seconds in duration and should be timed to allow pedestrians to cross at least one lane of traffic or, in the case of a large corner radius, to travel far enough for pedestrians to establish their position ahead of the turning traffic before the turning traffic is released.*
- *If a leading pedestrian interval is used, <u>consideration should be given</u> to prohibiting turns across the crosswalk during the leading pedestrian interval*

HOW MANY SECONDS TO LEAD WITH?

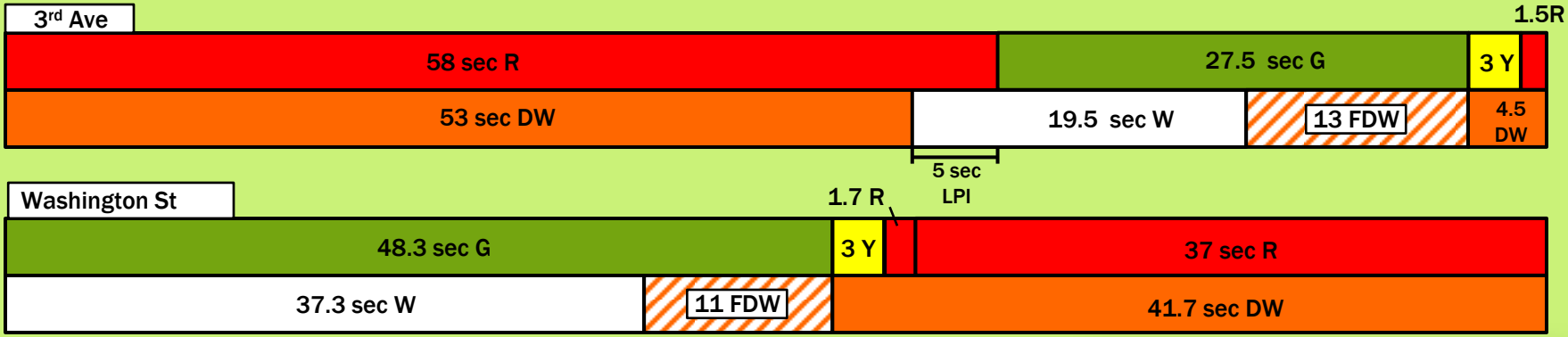
MUTCD minimum is 3 seconds - but is there good guidance to determine other values?

- D.C. has 117 intersections with LPI
  - Most of these intersections have LPI on all four approaches
  - Typically use 3 sec
  - Rare occasions 7 or 8 sec used for unusual geometrics.
  - No chart or diagram for calculating time
- Philadelphia has about 24 LPI intersections
  - Use 3 sec
- Boston
  - 3 to 7 sec
- Phoenix has 3 LPI intersections
  - Use 5 sec
  - Intersections have time of day LPI

LPI INTERSECTION - PHOENIX

- Two one-way streets
- 5 sec LPI
- Heavy left-turn movement conflicts with heavy crossing
- Outside City Hall & City Court and main marking structure for both

LPI SIGNAL PHASING DIAGRAM
3RD AVE AND WASHINGTON ST



- Heavy northbound left-turn conflicts
- 5 Sec LPI provided for north/south pedestrians crossing with 3rd Ave traffic

LPI CAN BE FIXED-TIME OR ACTUATED

- Fixed-time:
  - 24-hours
  - Time-of-day
- Push-button actuated

HANDBOOK FOR THE DESIGN OF ROADWAYS FOR AGING POPULATIONS

$$LPI = (ML + PL + 6.0) / 3.0$$

Where:

LPI (sec)

ML = width of moving lane in ft

PL = width of parking lane (if any) in ft

6.0 = distance from the edge of curb (ft)

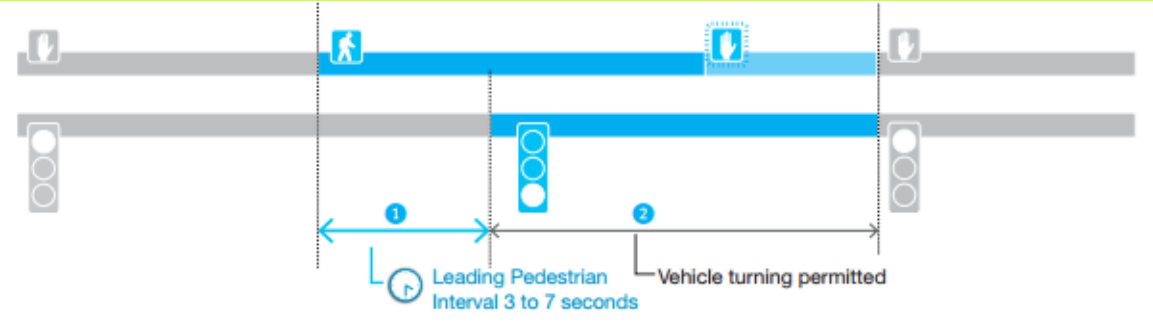
3.0 = walking speed in ft/s

BOSTON COMPLETE STREETS GUIDE

- 3 to 7 seconds
- Consider if high conflicts between Peds and Turning Vehicles
- Lagging Left Turn Arrow
- Use TURNING VEHICLES YIELD TO PEDESTRIANS signs
- Use APS

<u>Consider</u>

- NTOR signs
- Allow turns after the pedestrian crossings
- Leading Bicycle Interval



CITY OF TORONTO

LPI = greater of 5 seconds, or (TL/2 + PL)/W

Where:

- LPI (seconds)
- TL = distance to clear the total width of all moving lanes between the curb and the center line, not including the parking lane (m)
- PL = distance to clear the parking/merging lane, if any (m)
- W = walking speed of 1.0 m/s (3 ft/sec).

CITY OF TORONTO

Suitability Assessment for LPI based on:

- Drivers make left turns without the need to yield to oncoming traffic
- Visibility issues
- High pedestrian crossings
- Close proximity to elementary schools
- High level of elderly ped activity
- Impact on vehicular traffic

LPI ASSESSMENT WORKSHEET

	Values	Score	Score allocation guide	Justification
a) Is the pedestrian crossing at a T-intersection (crossing is parallel to a road that ends at the intersection) **and/or** **Is the pedestrian crossing parallel to a one-way road?**		0 to 2	Yes = 2 No = 0	High level of potential safety improvement with LPI at T-intersections compared to regular intersections because all vehicles approaching a T-intersection make a left/right turn and left turning vehicles do not need to wait for and yield to vehicles in the opposing direction. Similarly, left turning vehicles travelling on a one-way road do not need to wait for and yield to vehicles in the opposing direction.
b) Are there issues such as safety concerns verified by staff or visibility issues due to features such as irregular intersection geometry, wide turning radius, crosswalk placement, obstructions such as buildings or base of a bridge, blinding sun angle?		0 to 2	Yes (4 or more issues) = 2 Yes (between 1 to 3 of issues) = 1 No = 0	High level of potential safety improvement
c) 8-Hour volume of pedestrians crossing the leg being considered for LPI (p)		0 to 2	2 if $p > 1000$ 1 if $200 < p \leq 1000$ 0 if $p \leq 200$	High level of benefit for the highest number of pedestrians

LPI ASSESSMENT WORKSHEET (CONT.)

	Values	Score	Score allocation guide	Justification
d) What is the overall total impact on vehicles using the intersection? **What is the increase in intersection total or average delay (%) (a)** **What is the through phase V/C ratio of the signal with LPI (b)** **What is the total 8-Hour vehicular volume at the intersection (c)**		0 to -6	Overall impact = -1 x |Min(A,B) x C| , where $A=\begin{Bmatrix} 0\ if\ a < 10\% \\ -1\ if\ 10\% < a \leq 30\% \\ -2\ if\ a > 30\% \end{Bmatrix}$ $B=\begin{Bmatrix} 0\ if\ b < 0.9 \\ -1\ if\ b \geq 0.9 \end{Bmatrix}$ $C=\begin{Bmatrix} -1\ if\ c < 16{,}000 \\ -2\ if\ c \geq 16{,}000 \\ and < 30{,}000 \\ -3\ if\ c \geq 30{,}000 \end{Bmatrix}$	High level of negative impact on traffic operations for a large number of drivers
e) What is the rate of annual collisions between pedestrians and left or right turning vehicles per 1000 8-hour pedestrian crossings at the specific crossing in the past 5 years?		0 to 2	None = 0 Between 0 and 3 = 1 Greater than 3 = 2	High level of potential safety improvement
f) What is the rate of conflicts* [conflicts per 1000 8-hour observations] between pedestrians and left or right turning vehicles at the specific crossing during 8 hours of observation during area specific pedestrian peak and non peak periods?**		0 to 2	None = 0 Between 0 and 3 = 1 greater than 3 = 2	

LPI ASSESSMENT WORKSHEET (CONT.)

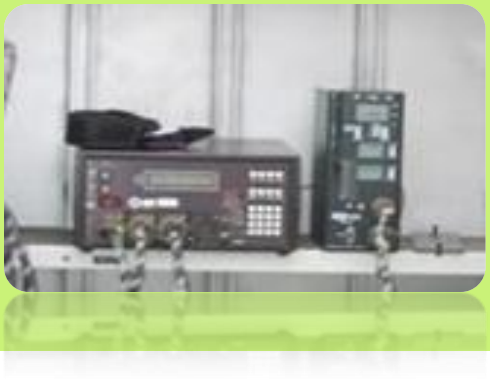
	Values	Score	Score allocation guide	Justification
g) How far is the location from the nearest elementary school?		0 to 2	<200m = 2 >200m and <850m = 1 >= 850m = 0	High level of benefit to smaller school children who are more negatively affected by visibility issues Average distance of walk trips to school in Toronto is 850m (Transportation Tomorrow Survey). 6% of walk trips to school are less than or equal to 200m in distance (Transportation Tomorrow Survey).
h) What is the Elderly demand score[1] of the area where the intersection is located? (e)		0 to 2	2 if e = 5 1 if 4≤ e <5 0 if e<4	High level of benefit to slower walking pedestrians: elderly
Total score				

NO RIGHT TURN ON RED

- "NO RIGHT TURN ON RED" sign highly recommended
- What NTOR sign works best for various circumstances?

SIGNAL CONTROLLER COMPATIBILITY
OLDER SIGNAL CONTROLLERS

- Too many to list but two are: TCT8000, TMP390
- Older signal controllers may need to utilize a new/additional phase for LPI interval, allowing the WALK to occur before the green interval and holding all of the other movements in red. Typically requires creation of a dummy phase to link the LPI with the rest of the WALK and pedestrian clearance interval
  - Can be done with concurrent operating phases or controllers capable of pedestrian overlaps
  - Can be more complex to establish left-turn phases with LPI because of increased number of phases utilized & limitations of older controllers



SIGNAL CONTROLLER COMPATIBILITY
NEWER SIGNAL CONTROLLERS

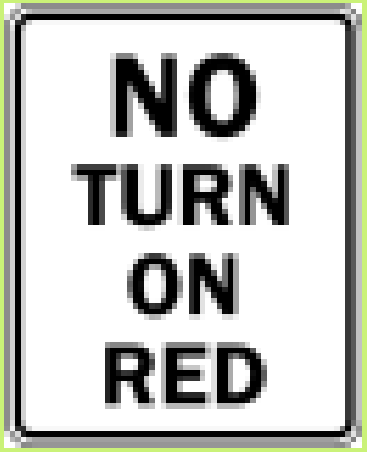
- Examples: ASC/2 or ASC/3
- Use Delayed Green feature (DLY GRN)
  - Defined (per the ASC/3 Programming Manual) as: "*The time that the vehicle green indication will be delayed from the start of the WALK interval. The delay is ignored if there is no pedestrian service call when the phase is started (actuated mode). If the delay time is greater than the WALK time, the WALK is extended to the end of the delay green.*"
  - For fixed-time or non-actuated operation, delayed green (for LPI) will be provided for every signal cycle.
  - Per the ASC/3 Programming Manual, the delayed green can be set from 0 to 255 seconds
- Can be push-button, automated detection, or time-of-day
- D.C. DOT implements LPI through a central controller

ISSUES

- Left Turn Arrows – Best with lagging protected arrows
- Synchronization with other signals – should not be an issue
- One-Way Streets – Treat left-turn LPI same as right-turn – May want to add a few more seconds in some instances
- NTOR –RTOR prohibitions highly recommended for LPI to work for pedestrians
- Congestion – separating pedestrians from turns should help reduce congestion

HOW TO INCREASE LPI EFFECTIVENESS

- Provide enough LPI time for pedestrians to occupy crosswalk
- Prohibit turns on red
- Provide APS for vision-impaired pedestrians



COST

- Low (if new controller not needed)
- Time & effort to program & implement
- NTOR signs
- APS push buttons
  (Highly Desirable)

CASE STUDIES

CASE STUDY: LPI (STATE COLLEGE, PA)

Details

- High pedestrian-vehicle crash rates, especially in central business district
- LPIs installed at 10 intersections downtown
- Each street had two through lanes
- 12,000 - 13,500 ADTs

CASE STUDY: LPI (STATE COLLEGE, PA)

Details

- 25 mph speed limit
- Pedestrians: 100 to 1,000 per hour
  - Fluctuation due to university class schedules
- LPI - 3 seconds

CASE STUDY: LPI (STATE COLLEGE, PA)

Results

- Study in 2010 compared the 10 sites with LPIs to other STOP-controlled intersections in the borough*
- Crash counts for 4-year before and 3-year after period: LPIs resulted in a 46.2 - 71.3% reduction in crashes
- LPIs resulted in cost savings of $92,130 per intersection per year

Period	*Time (year)*	*Treatment Group*	*Comparison Group*
Before	4	24	13
After	3	14	17

Before and After Crash Counts

*Fayish, Aaron C; Gross, Frank. "Safety Effectiveness of Leading Pedestrian Intervals Evaluated by a Before–After Study with Comparison Groups." TRB, Issue 2198, 2010, pp 15-22.

NYC LPI LOCATIONS
BRONX MANHATTAN QUEENS

- Listing of LPI Signals
  - http://www.nyc.gov/html/dot/html/infrastructure/leading-ped-intervals.shtml

Broadway at West 225th Street	the Bronx
East 147th Street at Willis Avenue	the Bronx
East 149th Street at Morris Avenue	the Bronx
East 161st Street at Gerard Avenue	the Bronx
East 233rd Street at Carpenter Avenue	the Bronx
East Tremont Avenue at Ericson Place/Hutchinson River Parkway exit ramp	the Bronx
River Avenue at East 162nd Street	the Bronx
Sedgwick Avenue at Dickinson Avenue	the Bronx
West Fordham Road at University Avenue	the Bronx

Amsterdam Avenue at West 72nd Street	Manhattan
Amsterdam Avenue at West 73rd Street	Manhattan
Amsterdam Avenue at West 79th Street	Manhattan
Amsterdam Avenue at West 97th Street	Manhattan
Avenue C/FDR Drive at East 20th Street	Manhattan
Bowery at Bayard Street	Manhattan
Broadway at Astor Place	Manhattan
Broadway at Cathedral Drive	Manhattan
Broadway at Chambers Street	Manhattan
Broadway at West 110th Street	Manhattan
Broadway at West 145th Street	Manhattan
Broadway at West 178th Street	Manhattan
Broome Street at Lafayette Street	Manhattan
Broome Street at Varick Street	Manhattan
Canal Street at Bowery	Manhattan
Central Park South at Central Park East Drive	Manhattan
Central Park South at Sixth Avenue	Manhattan
Central Park West at West 100th Street	Manhattan
Central Park West at West 97th Street	Manhattan
Chambers Street at Broadway	Manhattan
Chambers Street at Greenwich Street	Manhattan
Chrystie Street at Grand Street	Manhattan
Church Street at Cortlandt Street	Manhattan
Church Street at Day Street	Manhattan
Church Street at Fulton Street	Manhattan
Clinton Street at Grand Street	Manhattan
Columbus Avenue at West 79th Street	Manhattan
Columbus Avenue at West 97th Street	Manhattan
Delancey Street at Essex Street	Manhattan
Division Street at Market Street	Manhattan
Dyckman Street at Broadway/Riverside Drive	Manhattan
East 135th Street at Madison Avenue	Manhattan
East 14th Street at Broadway, Union Square West	Manhattan
East 14th Street at University Place	Manhattan
East 14th Street at University Place & Union Square West	Manhattan
East 20th Street at First Avenue	Manhattan
East 23rd Street at First Avenue	Manhattan
East 34th Street at First Avenue	Manhattan
East 34th Street at Second Avenue	Manhattan
East 35th Street at Second Avenue	Manhattan
East 39th Street at Fifth Avenue	Manhattan
East 42nd Street at Second Avenue	Manhattan
East 57th Street at First Avenue	Manhattan
East 57th Street at Sutton Place	Manhattan
East 59th Street at First Avenue	Manhattan
East 62nd Street at Second Avenue	Manhattan
East 62nd Street at York Avenue	Manhattan
East 63rd Street at York Avenue	Manhattan
East 65th Street at Fifth Avenue	Manhattan
East 65th Street at Second Avenue	Manhattan
East 66th Street at Fifth Avenue	Manhattan
East 66th Street at Third Avenue	Manhattan
East 79th Street at Fifth Avenue	Manhattan
East 79th Street at York Avenue	Manhattan
East 79th Street at York Avenue	Manhattan
East 86th Street at Fifth Avenue	Manhattan
East 86th Street at Lexington Avenue	Manhattan
East 96th Street at Second Avenue	Manhattan
East 97th Street at Madison Avenue	Manhattan
East Houston Street at Avenue A/Essex Street	Manhattan
East Houston Street at Avenue B/Clinton Street	Manhattan
East Houston Street at Avenue C/Pitt Street	Manhattan
East Houston Street at Avenue D/Columbia Street	Manhattan
East Houston Street at Chrystie Street	Manhattan
Eighth Avenue at West 125th Street	Manhattan
Eighth Avenue at West 22nd Street	Manhattan
Eighth Avenue at West 34th Street	Manhattan
FDR Drive at East 23rd Street	Manhattan
Fifth Avenue at West 116th Street	Manhattan
Fifth Avenue at West 86th Street	Manhattan
First Avenue at East 20th Street	Manhattan
First Avenue at East 22nd Street	Manhattan
First Avenue at East 42nd Street	Manhattan
First Avenue at East 42nd Street	Manhattan
First Avenue at East 57th Street	Manhattan
First Avenue at East 60th Street	Manhattan
Lafayette Street at Kenmare Street	Manhattan
Lenox Avenue at West 125th Street	Manhattan
Madison Avenue at East 135th Street	Manhattan
Madison Avenue at East 59th Street	Manhattan
Madison Avenue at East 96th Street	Manhattan
Mangitat Street at West 125th Street	Manhattan
Ninth Avenue at West 22nd Street	Manhattan
Ninth Avenue at West 30th Street	Manhattan
Ninth Avenue at West 37th Street	Manhattan
Ninth Avenue at West 47th Street	Manhattan
Old Slip at South Street	Manhattan
Rector Street at Trinity Place	Manhattan
Riverside Drive at Broadway/Dyckman Street	Manhattan
Riverside Drive at West 90th Street	Manhattan
Second Avenue at East 57th Street	Manhattan
Second Avenue at East 63rd Street	Manhattan
Seventh Avenue at West 116th Street	Manhattan
Seventh Avenue at West 125th Street	Manhattan
Sixth Avenue at West 23rd Street	Manhattan
Sixth Avenue at West 40th Street	Manhattan
Sixth Avenue at West 8th Street	Manhattan
Sixth Avenue at West Houston Street	Manhattan
Tenth Avenue at West 42nd Street	Manhattan
Third Avenue at East 14th Street	Manhattan
Third Avenue at East 23rd Street	Manhattan
Third Avenue at East 42nd Street	Manhattan
Third Avenue at East 42nd Street	Manhattan
Third Avenue at East 57th Street	Manhattan
Union Square west at East 16th Street	Manhattan
Varick Street at Beach Street	Manhattan
Water Street/Pearl Street at Fulton Street	Manhattan
West 145th Street at Broadway	Manhattan
West 145th Street at Malcolm X Boulevard	Manhattan
West 14th Street at Sixth Avenue	Manhattan
West 168th Street at Fort Washington Avenue	Manhattan
West 17th Street at Broadway	Manhattan
West 178th Street at Broadway	Manhattan
West 225th Street at Broadway	Manhattan
West 23rd Street at Seventh Avenue	Manhattan
West 23rd Street at Sixth Avenue	Manhattan
West 30th Street at Ninth Avenue	Manhattan
West 34th Street at Dyer Avenue	Manhattan
West 38th Street at Ninth Avenue	Manhattan
West 41st Street at Dyer Avenue	Manhattan
West 41st Street at Ninth Avenue	Manhattan
West 42nd Street at Ninth Avenue	Manhattan
West 57th Street at Ninth Avenue	Manhattan
West 57th Street at Sixth Avenue	Manhattan
West 60th Street at Columbus Avenue	Manhattan
West 61st Street at Broadway	Manhattan
West 65th Street at Amsterdam Avenue	Manhattan
West 66th Street at Amsterdam Avenue	Manhattan
West 70th Street at West End Avenue	Manhattan
West 72nd Street at Central Park West	Manhattan
West 72nd Street at Columbus Avenue	Manhattan
West 72nd Street at West End Avenue	Manhattan
West 79th Street at Broadway	Manhattan
West 79th Street at West End Avenue	Manhattan
West 81st Street at Central Park West	Manhattan
West 86th Street at Central Park West	Manhattan
West 96th Street at Amsterdam Avenue	Manhattan
West 96th Street at West End Avenue	Manhattan
West 97th Street at West End Avenue	Manhattan
West Broadway at Vesey Street	Manhattan
West End Avenue at West 65th Street	Manhattan
West End Avenue at West 72nd Street	Manhattan
West End Avenue at West 79th Street	Manhattan
York Avenue at East 60th Street	Manhattan

108th Street at Otis & Van Cleef Streets	Queens
178th Street at Hillside Avenue	Queens
188th Street at Grand Central Parkway Service Road North	Queens
73rd Avenue at Bell Boulevard	Queens
99th Street at Horace Harding Expressway Service Road North	Queens
Archer Avenue at Parsons Boulevard	Queens
Archer Avenue at Sutphin Boulevard	Queens
Broadway at 21st Street	Queens
Corporal Kennedy Street at 26th Avenue	Queens
Cross Bay Boulevard at 157th Avenue	Queens
Eliot Avenue at 71st Street	Queens
Grand Avenue at 69th Street	Queens
Grand Avenue at Long Island Expressway North	Queens
Grand Avenue at Long Island Expressway South	Queens
Hempstead Avenue at Springfield Boulevard	Queens
Jamaica Avenue at 162nd Street	Queens
Jamaica Avenue at Parsons Boulevard	Queens
Junction Boulevard at Long Island Expressway South Service Road	Queens
Kissena Boulevard at Elder Avenue	Queens
Kissena Boulevard at Sanford Avenue	Queens
Main Street at 40th Road	Queens
Main Street at 41st Road	Queens
Merrick Boulevard at Hillside Avenue	Queens
Northern Boulevard at Main Street	Queens
Northern Boulevard at Parsons Boulevard	Queens
Queens Boulevard at 32nd Place	Queens
Queens Boulevard at 33rd Street	Queens
Queens Boulevard at 34th Street	Queens
Queens Boulevard at 35th Street	Queens
Queens Boulevard at 36th Street	Queens
Queens Boulevard at 37th Street	Queens
Queens Boulevard at 38th Street	Queens
Queens Boulevard at 39th Place	Queens
Queens Boulevard at 39th Street	Queens
Queens Boulevard at 40th Street	Queens
Queens Boulevard at 41st Street	Queens
Queens Boulevard at 42nd Street	Queens
Queens Boulevard at 43rd Street	Queens
Queens Boulevard at 44th Street	Queens
Queens Boulevard at 45th Street	Queens
Queens Boulevard at 46th Street	Queens
Queens Boulevard at 47th Street	Queens
Roosevelt Avenue at Main Street	Queens
Union Turnpike at Springfield Boulevard	Queens
Whitestone Expressway Service Road at 20th Avenue	Queens

QUESTIONS / RESOURCES

- MUTCD Section 4E.06 Pedestrian Intervals and Signal Phases
  - http://mutcd.fhwa.dot.gov/htm/2009r1r2/part4/part4e.htm
- "Safety Effectiveness of Leading Pedestrian Intervals Using the Empirical Bayes Method." TRB 88th Annual Meeting Compendium of Papers CD-ROM. Washington, DC (2009). Study Citation: Fayish, and Gross
  - http://nacto.org/docs/usdg/safety_effectiveness_of_lpi_fayish.pdf

Leading Pedestrian Interval Signal Operations in Washington DC

George Branyan
Pedestrian Program Coordinator
DC Department of Transportation

Leading Pedestrian Intervals (LPIs)

- LPIs hold the red indication for drivers for 3-4 seconds while releasing pedestrians, (longer LPIs can be used)
- Primary purpose is to reduce conflicts between right turning vehicles and pedestrians

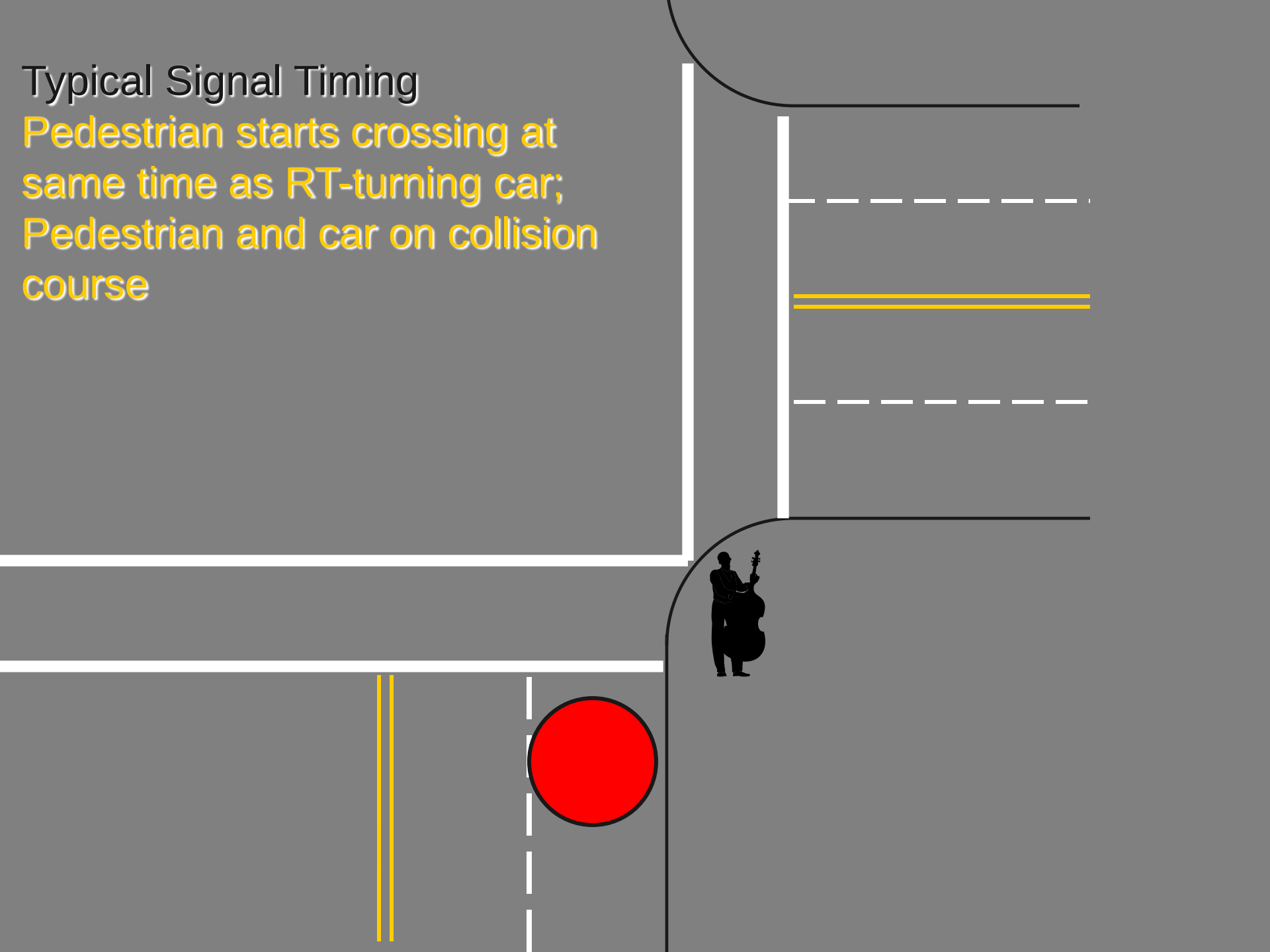
LPIs in The District

- Since early 2010, DDOT has installed LPIs at 162 intersections (~10%).
- Nearly all use 3 seconds of lead time
- Listed in FHWA's Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes with a Crash Reduction Factor of 5%. A 3 star 2009 study showed a 37% (CMF Clearing- house)
- Awarded "Best Pedestrian Safety Improvement" by the DC *City Paper*.

BEST of D.C. 2011

Typical Signal Timing

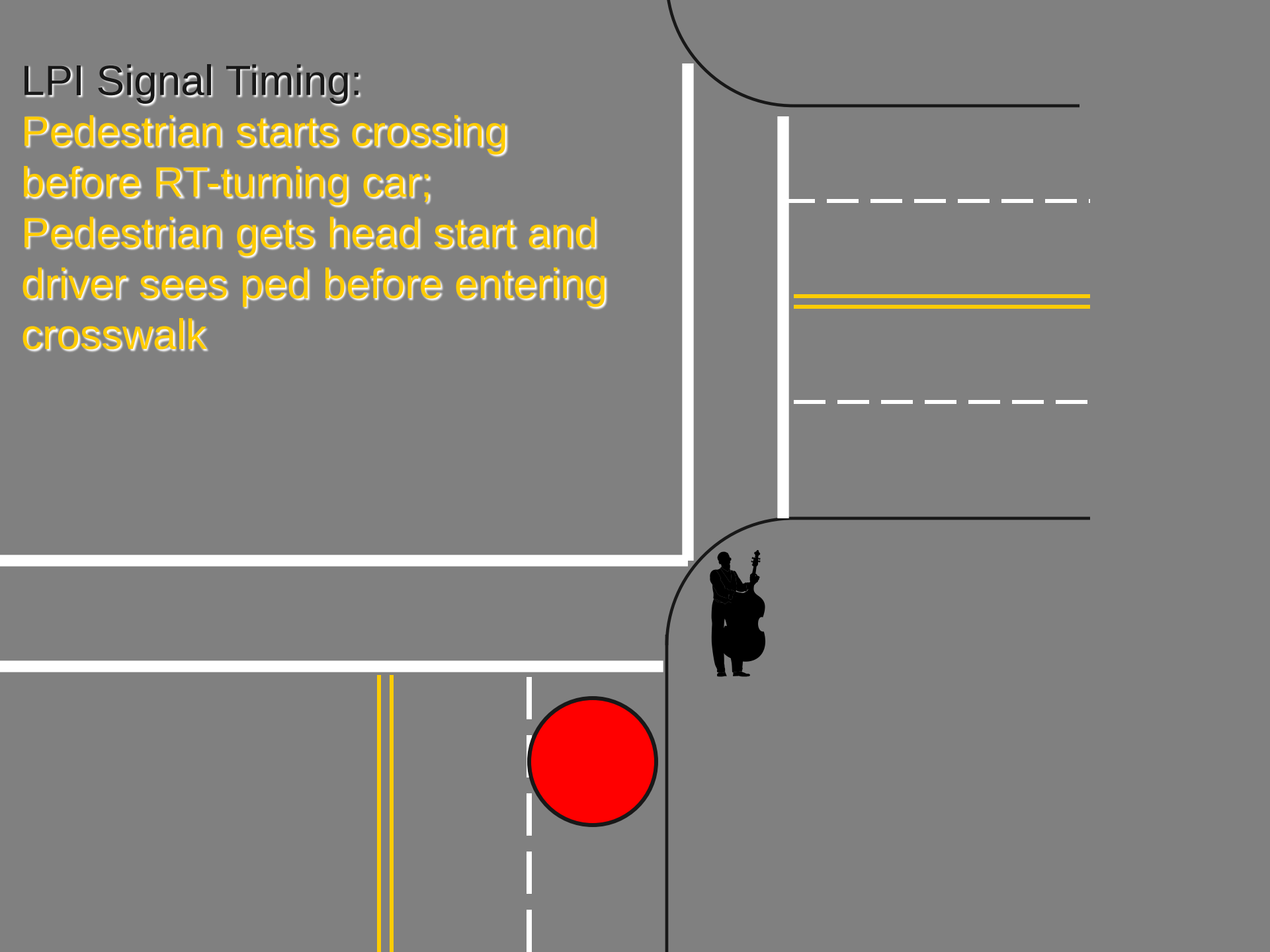
Pedestrian starts crossing at same time as RT-turning car; Pedestrian and car on collision course



LPI Signal Timing:

Pedestrian starts crossing before RT-turning car;

Pedestrian gets head start and driver sees ped before entering crosswalk

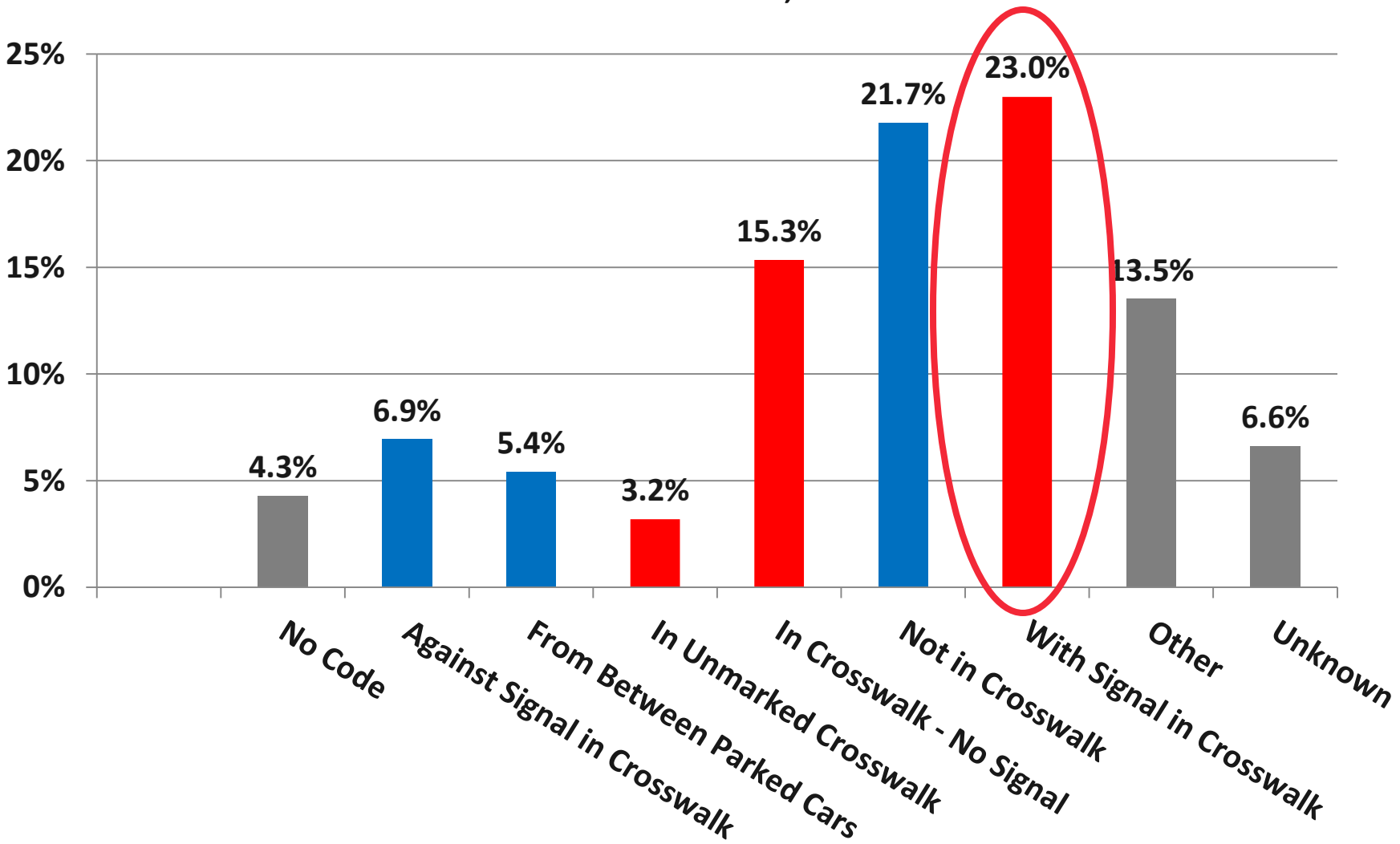


LPI Location Selection

- Use crash data to identify locations with high proportions of crashes involving turning vehicles and pedestrians with signal in crosswalk
- High complaint locations
- When analyzing count data – DDOT Signal Optimization Project
- More effective when No Right Turn on Red is posted

DC Pedestrian Crash Types

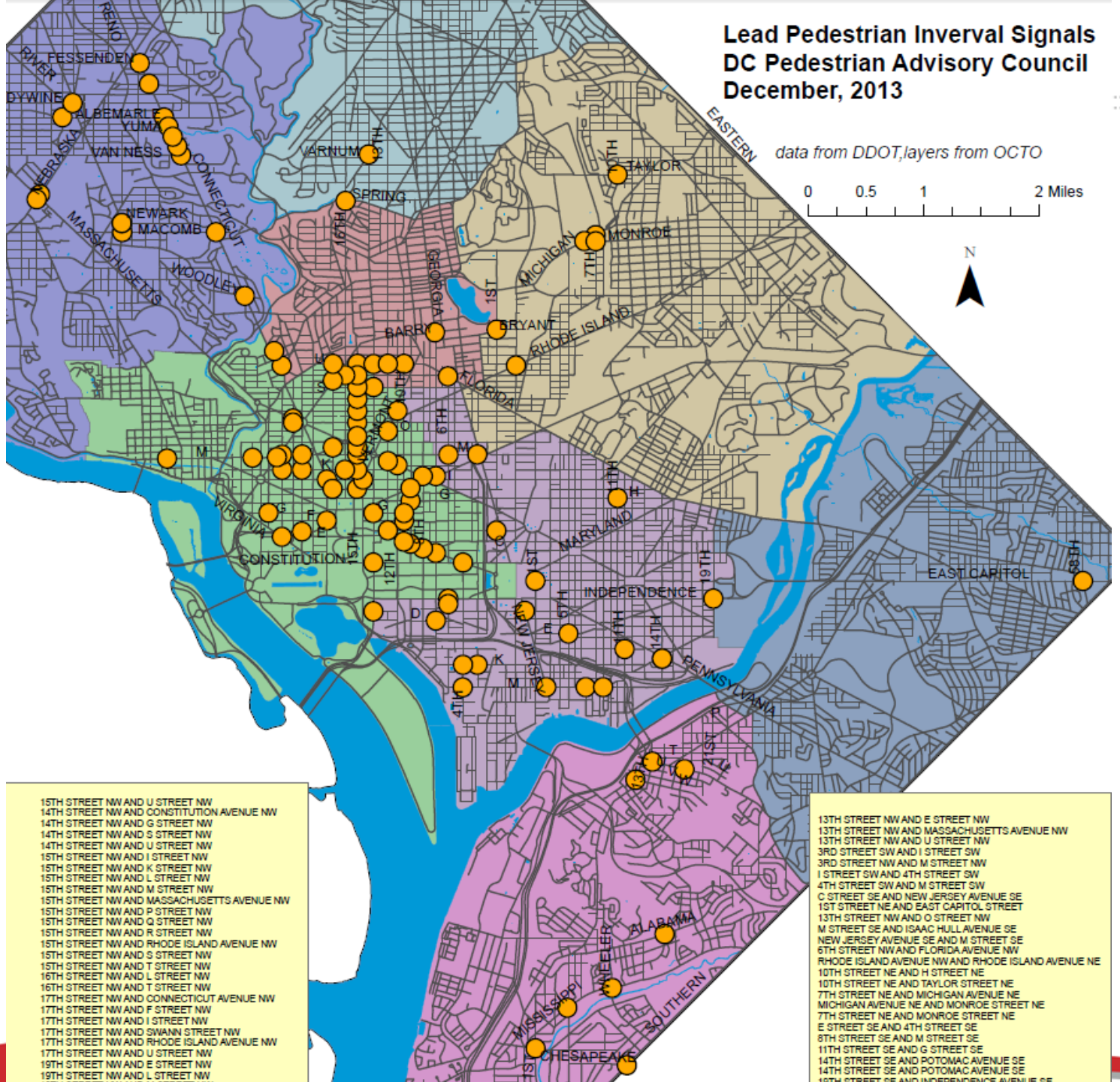
Pedestrian Action, 2004-2010



LPI Location Selection

- Use crash data to identify locations with high proportions of turning vehicle/ped with signal in crosswalk crashes

Type of Collision	On Street	# of Fat	# of Inj	# of Ped	Road Condition	Street Lighting	Lighting Condition	Weather Condition	Traffic Condition	Pedestrian Action
Right Turn Hit Ped	At Intersect	0	0	1	Dry	Unknown	Daylight	Clear	Unknown	Wth Signal in CW
Rear End	At Intersect	0	1	1	Dry	Lights Off	Daylight	Clear	Heavy	Other
Right Turn Hit Ped.	At Intersect	0	1	1	Dry	Lights Off	Daylight	Clear	Heavy	Unknown
Right Turn Hit Ped	At Intersect	0	1	1	Dry	Lights Off	Daylight	Clear	Medium	Wth Signal in CW
Fixed Object	At Intersect	0	1	1	Dry	Lights On	Dark (Lighted)	Clear	Unknown	Wth Signal in CW
Back Hit Ped.	Within 100ft	0	1	1	Dry	Lights On	Daylight	Clear	Heavy	Other
Right Turn Hit Ped	At Intersect	0	1	1	Dry	Lights On	Dark (Lighted)	Clear	Medium	Wth Signal in CW
Left Turn Hit Ped.	At Intersect	0	0	1	Dry	Lights On	Dusk	Clear	Heavy	Wth Signal in CW
Right Turn Hit Ped.	At Intersect	0	1	1	Dry	Lights Off	Daylight	Clear	Medium	Wth Signal in CW
Right Turn Hit Ped	Other	0	1	1	Dry	Lights Off	Daylight	Clear	Medium	Wth Signal in CW
Straight Hit Ped.	At Intersect	0	1	1	Dry	Lights Off	Daylight	Clear	Heavy	Agst Signal in CW


Lead Pedestrian Inverval Signals
DC Pedestrian Advisory Council
December, 2013
data from DDOT,layers from OCTO
0 0.5 1 2 Miles
N
15TH STREET NW AND U STREET NW
14TH STREET NW AND CONSTITUTION AVENUE NW
14TH STREET NW AND G STREET NW
14TH STREET NW AND S STREET NW
14TH STREET NW AND U STREET NW
15TH STREET NW AND I STREET NW
15TH STREET NW AND K STREET NW
15TH STREET NW AND L STREET NW
15TH STREET NW AND M STREET NW
15TH STREET NW AND MASSACHUSETTS AVENUE NW
15TH STREET NW AND P STREET NW
15TH STREET NW AND Q STREET NW
15TH STREET NW AND R STREET NW
15TH STREET NW AND RHODE ISLAND AVENUE NW
15TH STREET NW AND S STREET NW
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16TH STREET NW AND L STREET NW
16TH STREET NW AND T STREET NW
17TH STREET NW AND CONNECTICUT AVENUE NW
17TH STREET NW AND F STREET NW
17TH STREET NW AND I STREET NW
17TH STREET NW AND SWANN STREET NW
17TH STREET NW AND RHODE ISLAND AVENUE NW
17TH STREET NW AND U STREET NW
19TH STREET NW AND E STREET NW
19TH STREET NW AND L STREET NW
13TH STREET NW AND E STREET NW
13TH STREET NW AND MASSACHUSETTS AVENUE NW
13TH STREET NW AND U STREET NW
3RD STREET SW AND I STREET SW
3RD STREET NW AND M STREET NW
I STREET SW AND 4TH STREET SW
4TH STREET SW AND M STREET SW
C STREET SE AND NEW JERSEY AVENUE SE
1ST STREET NE AND EAST CAPITOL STREET
13TH STREET NW AND O STREET NW
M STREET SE AND ISAAC HULL AVENUE SE
NEW JERSEY AVENUE SE AND M STREET SE
6TH STREET NW AND FLORIDA AVENUE NW
RHODE ISLAND AVENUE NW AND RHODE ISLAND AVENUE NE
10TH STREET NE AND H STREET NE
10TH STREET NE AND TAYLOR STREET NE
7TH STREET NE AND MICHIGAN AVENUE NE
MICHIGAN AVENUE NE AND MONROE STREET NE
7TH STREET NE AND MONROE STREET NE
E STREET SE AND 4TH STREET SE
8TH STREET SE AND M STREET SE
11TH STREET SE AND G STREET SE
14TH STREET SE AND POTOMAC AVENUE SE
14TH STREET SE AND POTOMAC AVENUE SE

LPI Evaluation

- Compare turning vehicle/pedestrian crashes before and after installation.
- Simple before/after comparison shows some improvement. Statistically rigorous study needed to accurately evaluate.
  - Crash Reduction Factor of 5%. A 3 star 2009 study showed a 37% (CMF Clearinghouse)
- Impact on traffic delay? We have a lot of traffic delay, so no one is blaming the LPI!

Thank You!

- **Archive at www.pedbikeinfo.org/webinars**
  - Downloadable/streaming recording and presentation slides
- **Questions?**
  webinars@hsrc.unc.edu