SFMTA
Municipal Transportation Agency

Signal Timing and Pedestrians: San Francisco

10 | 28 | 2013

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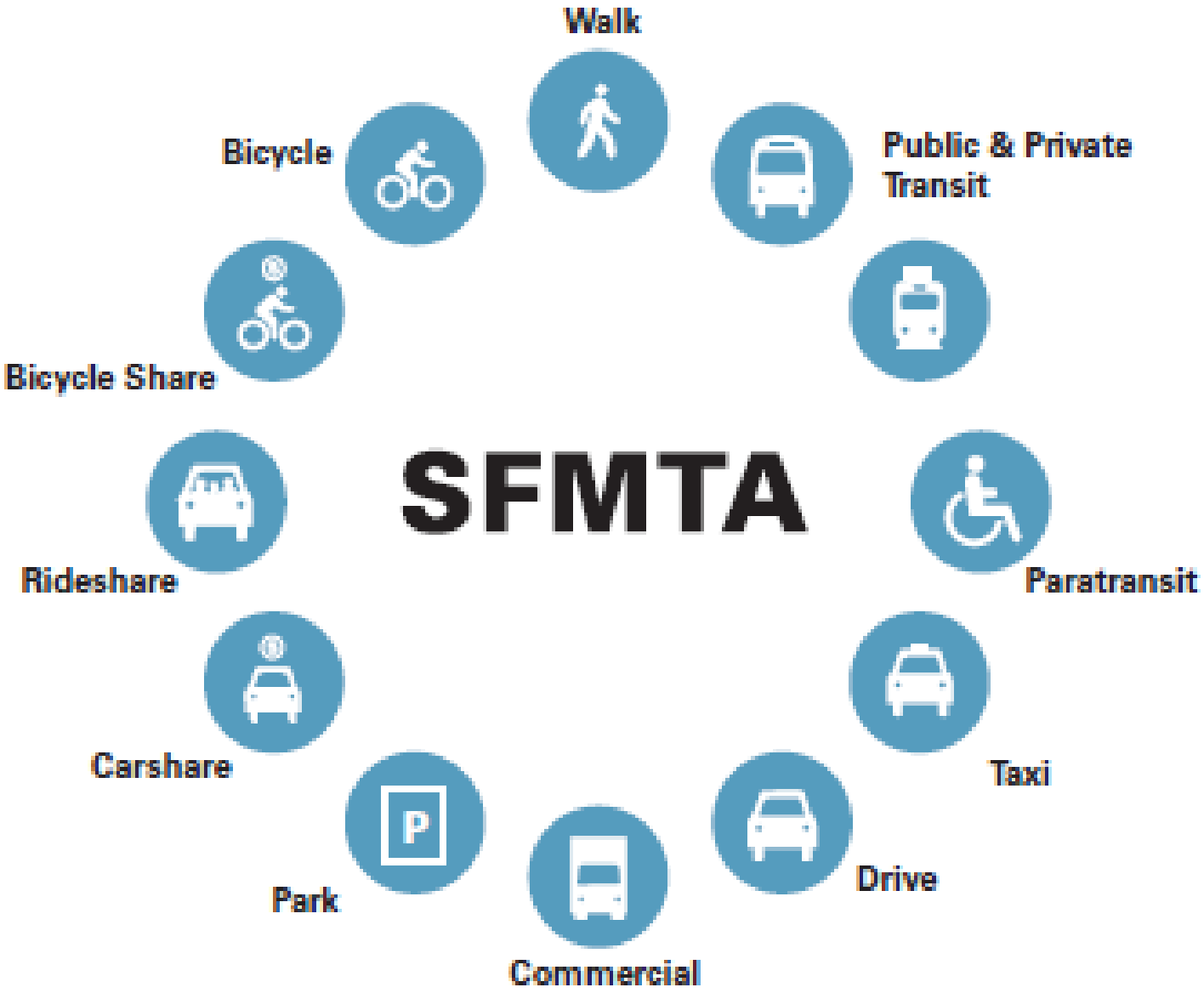
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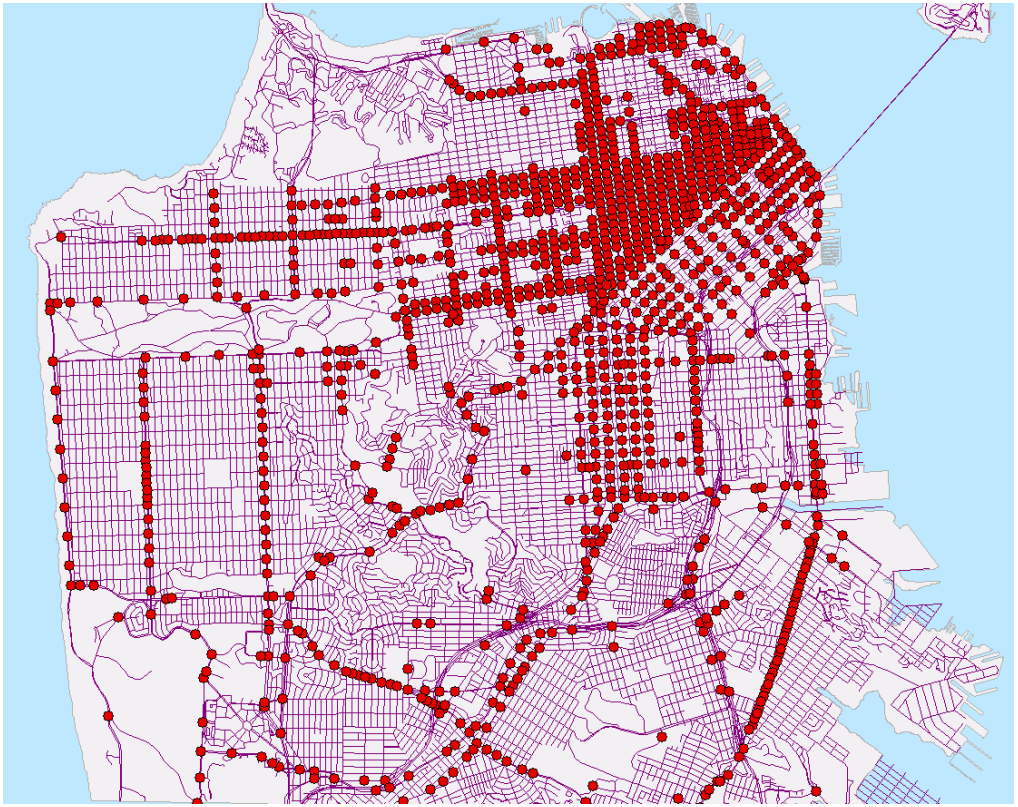
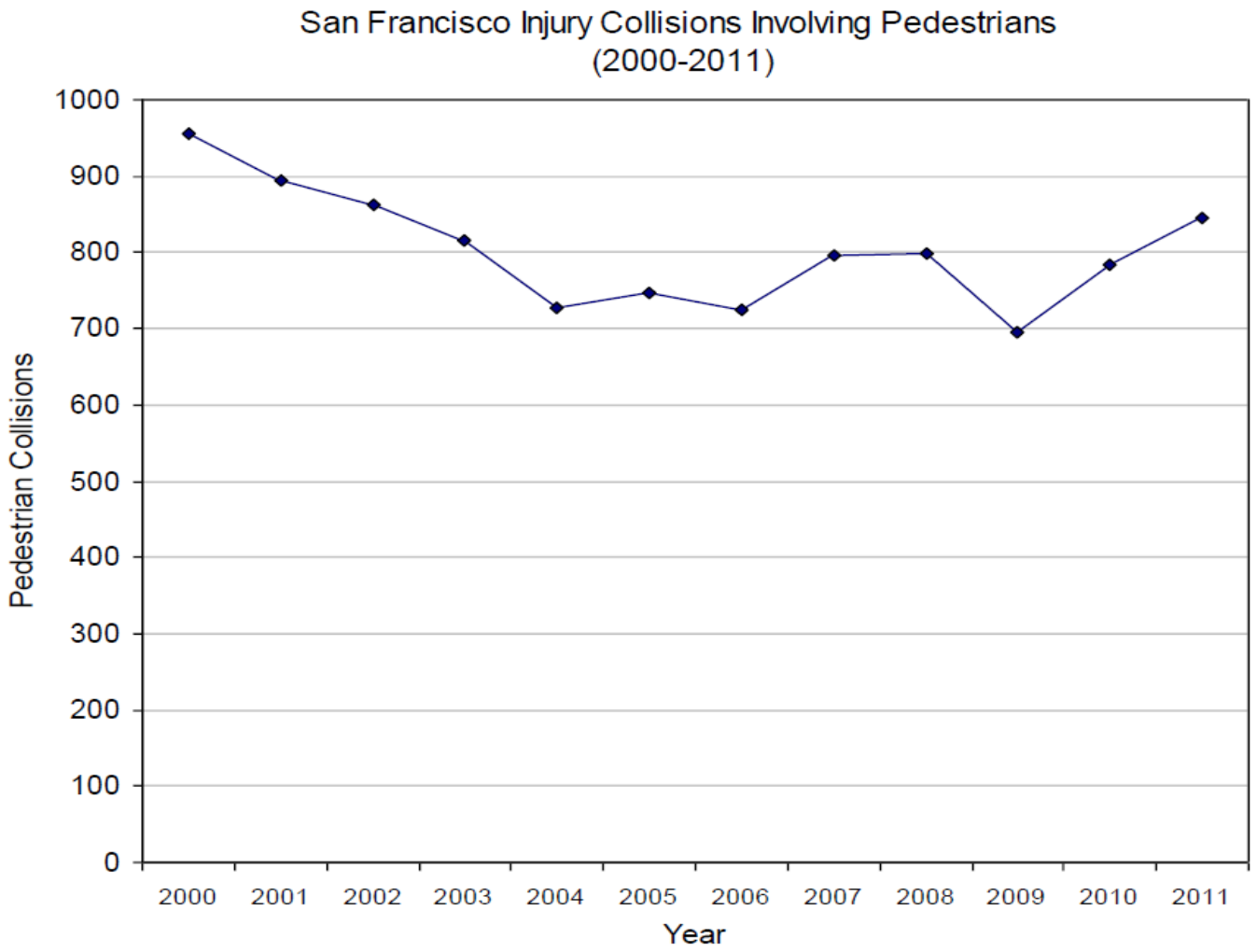
Rideshare
Paratransit
Carshare
Taxi
Park
Drive
Commercial

San Francisco Context

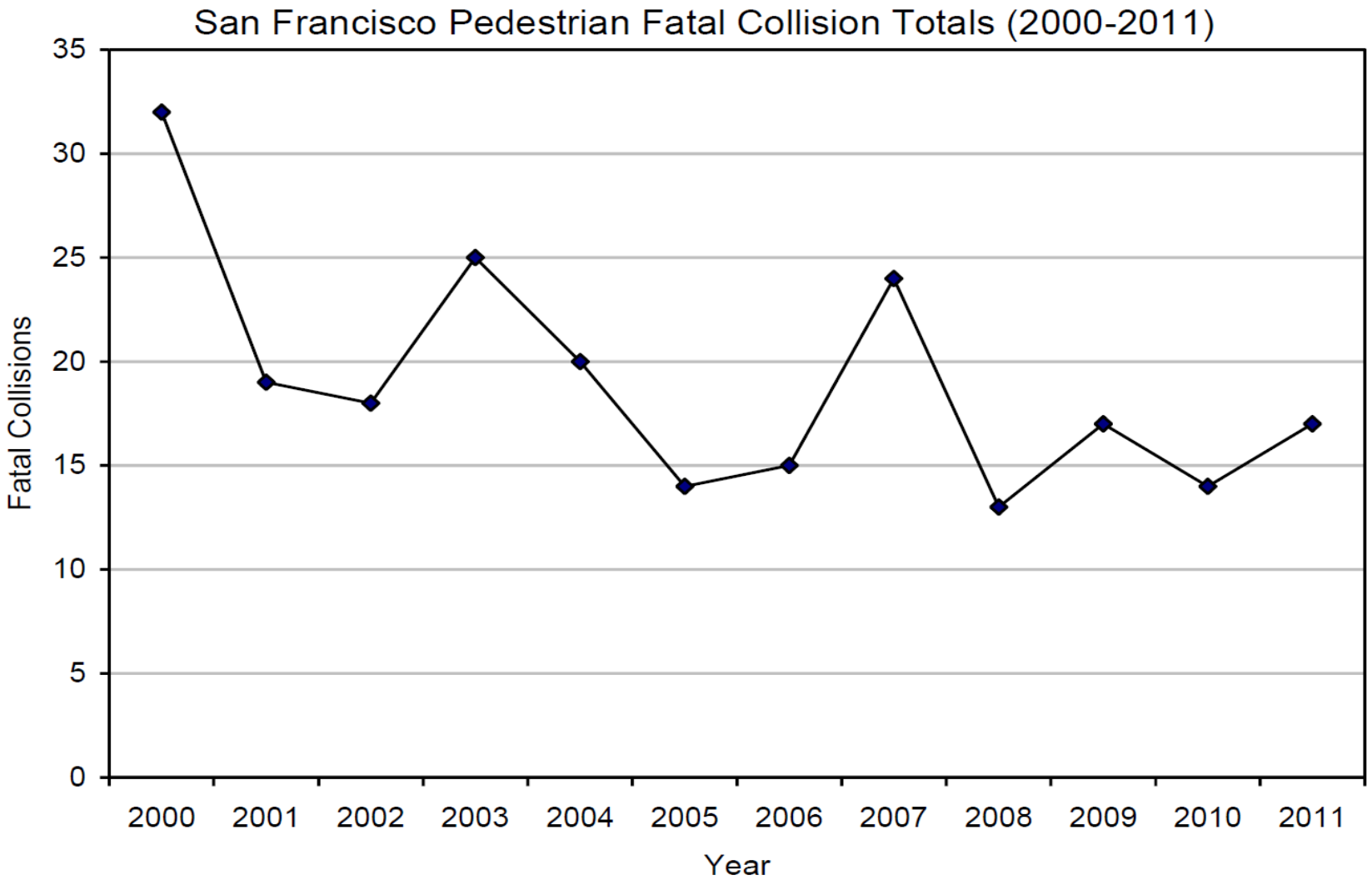
- **Population: 825,863**
- **About 1,200 traffic signals**
- **Half of citywide pedestrian collisions at signalized intersections (400 a year)**



More than two injury pedestrian collisions a day



Goal to cut serious pedestrian injury collisions in half by 2021



Pedestrian Signal Timing

1. Cycle Lengths
2. Pedestrian Crossing Times
3. Phasing
4. Fixed Time vs. Actuated
5. Yellow and All-Red Phases

Signal Timing Tension:
Reducing Pedestrian Delay ↔ Reducing Pedestrian Risk

Unique Aspects of Signal Timing

- A few simple settings can greatly affect street capacity and delay
- Some settings can be invisible to the public
- Settings can be changed without much public outreach
- Timing changes are relatively low cost (non-capital)

“Keep Cycle Lengths Short”

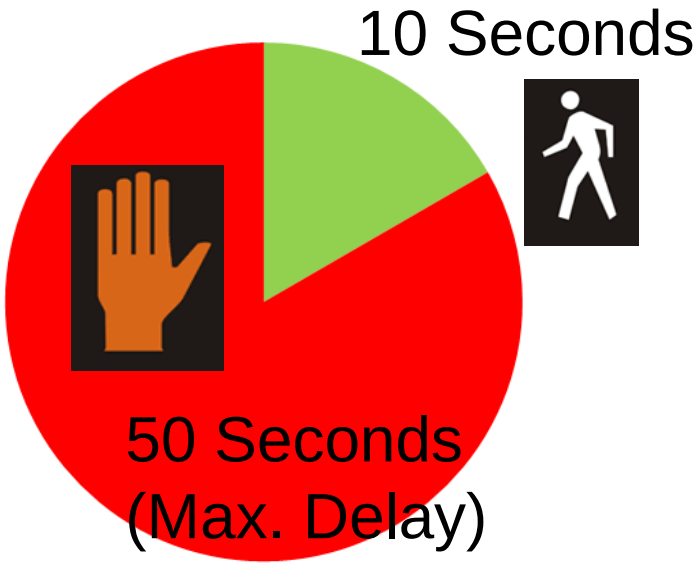
The longer it takes a signal to serve all approaches, the more pedestrians have to wait to cross a street.

30 **60** **90** **120** **150**

Cycle Length Seconds

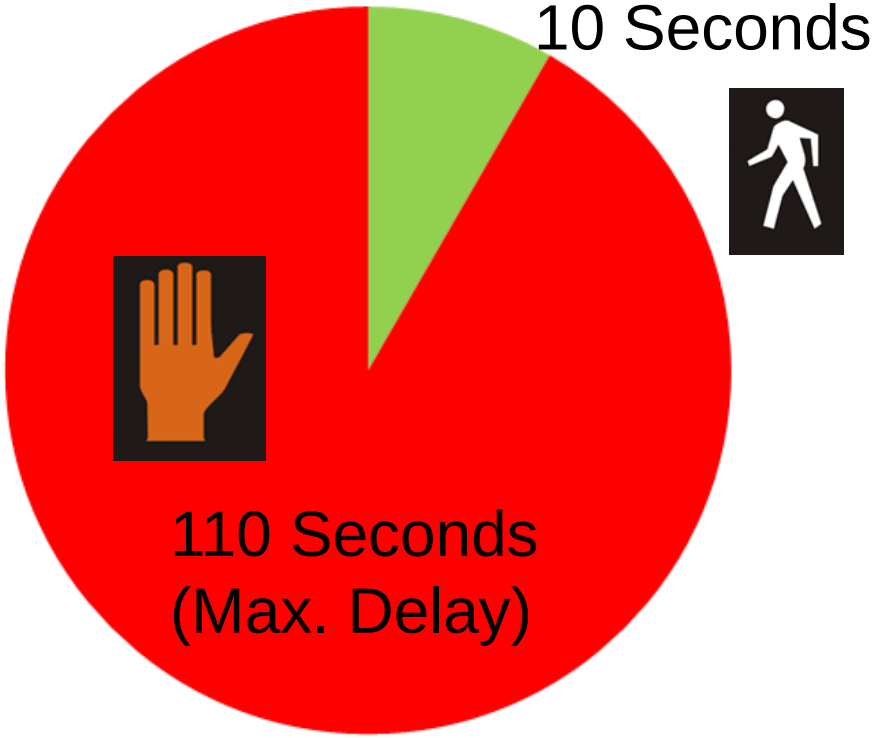
Cycle Lengths and Pedestrian Delay

60 SECOND CYCLE



Average delay =
21 seconds

120 SECOND CYCLE



Average delay =
50 seconds

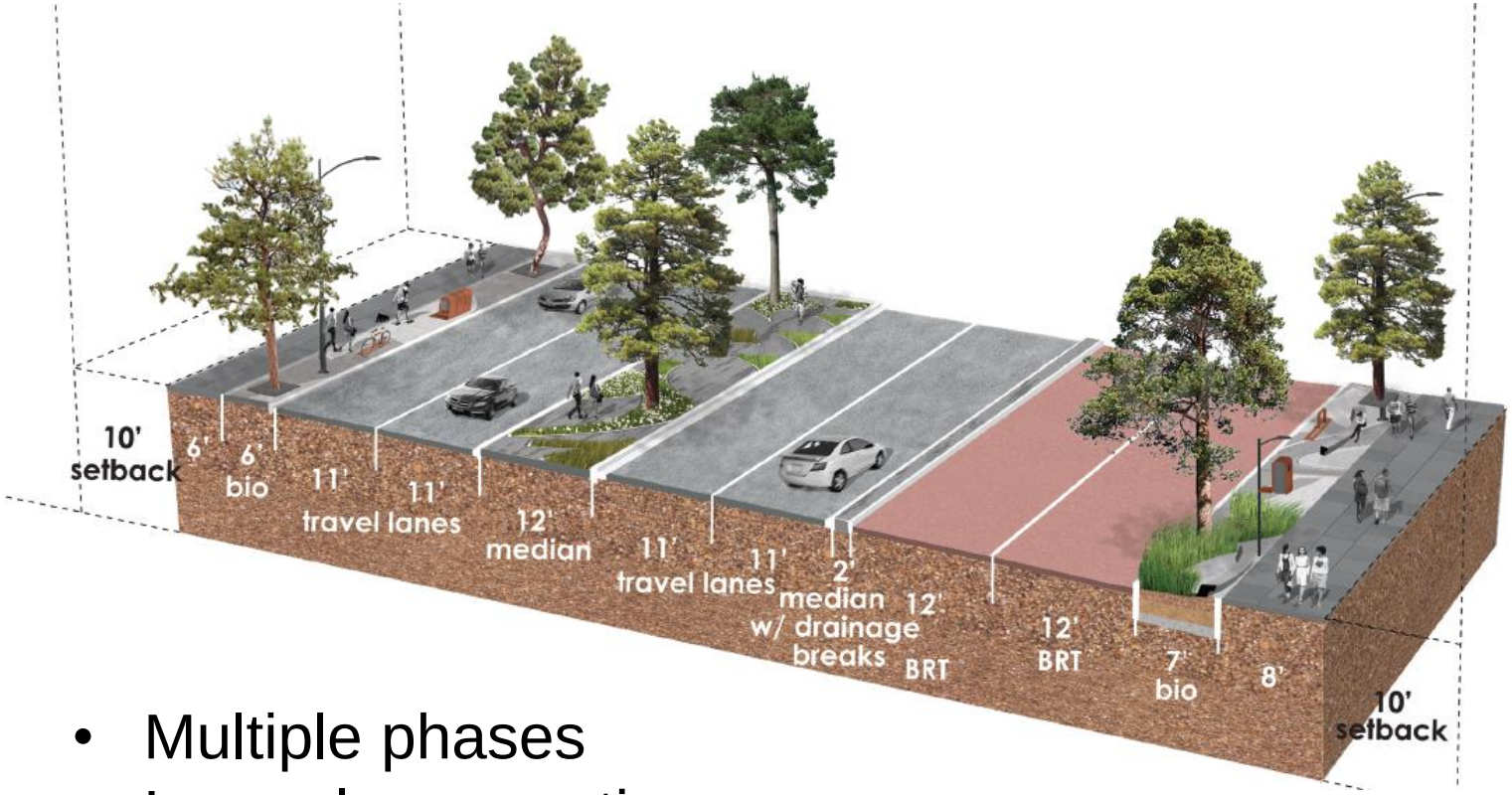
Long cycle lengths…

- **Interrupt and degrade the overall pedestrian walking experience**
- **Have cumulative delay impacts if signals are closely spaced**
- **Can decrease pedestrian signal compliance, particularly when there is no cross traffic**

Downtown San Francisco: 60 Second Cycle Lengths

Complex Intersection = Higher Cycle Length

Complex Cross Section = Higher Cycle Length



- Multiple phases
- Long clearance times
- Long pedestrian crossing distances

Complex Phasing = Higher Cycle Length

Pedestrian Crossing Times

- **2009 MUTCD walking design speed is 3.5 feet per second for clearance.**
- **Former value was 4.0 feet per second.**
- **Clearance = Total time available after WALK and before cross street green light**

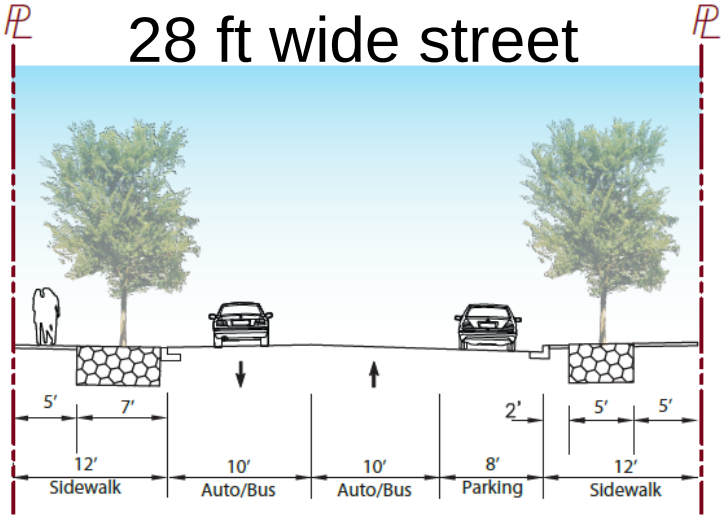
Sidewalk Bulb Widening and 3.5 ft/s

A seven foot sidewalk extension cuts the pedestrian clearance needed by 2 seconds

Pedestrian Crossing Times: Accommodation for Slowest Pedestrians

- **2009 MUTCD 4E.06: The total of the walk interval and pedestrian clearance time should be sufficient to allow a pedestrian to travel at 3 feet per second to the far side of the traveled way or to a median**
- **San Francisco has been using a value of 2.5 feet per second since the 1990s.**

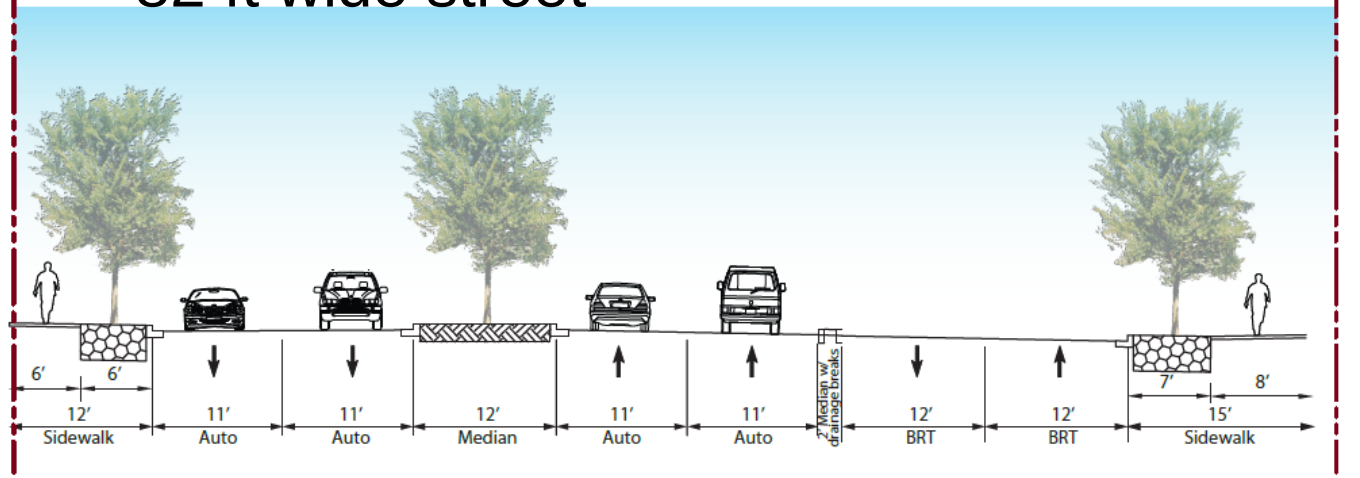
28 ft wide street



At 4.0 ft/s = 7 seconds
At 3.5 ft/s = 8 seconds
At 2.5 ft/s = 11.2 seconds

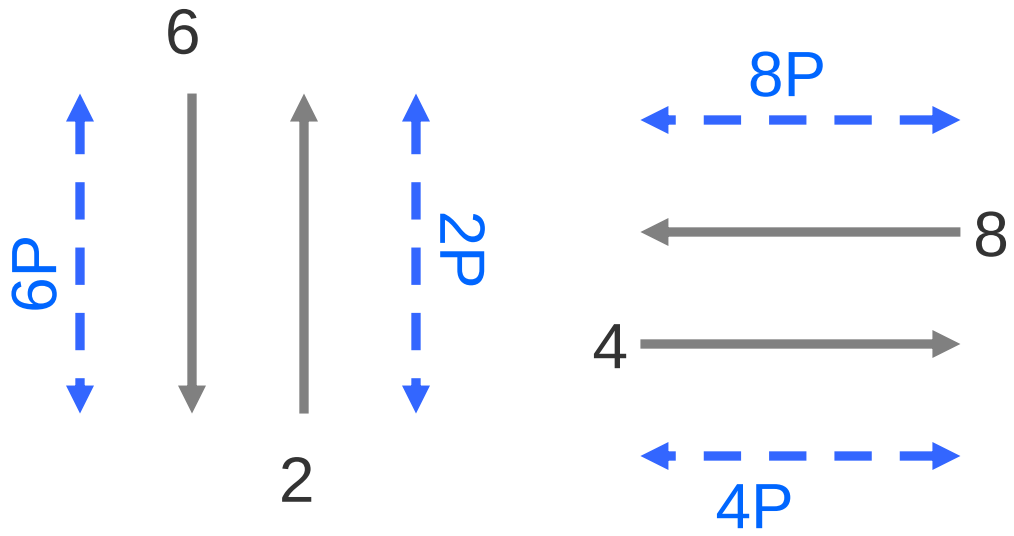
At 4.0 ft/s = 20.5 seconds
At 3.5 ft/s = 23.4 seconds
At 2.5 ft/s = 32.8 seconds

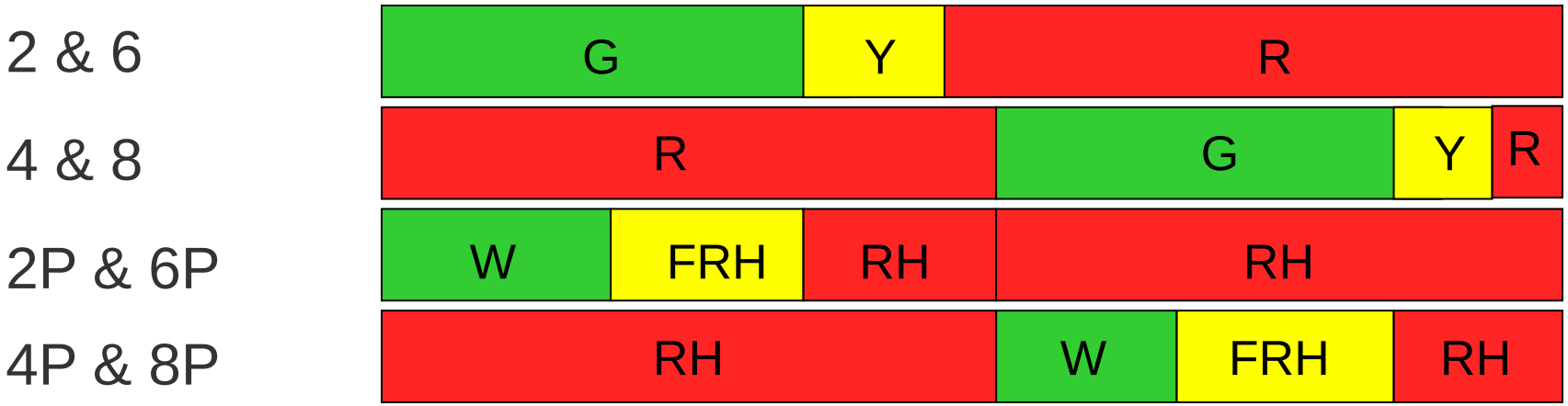
82 ft wide street



“Keep Signal Phases to a Minimum”

Simple two phase reduces delay and helps keep cycles short

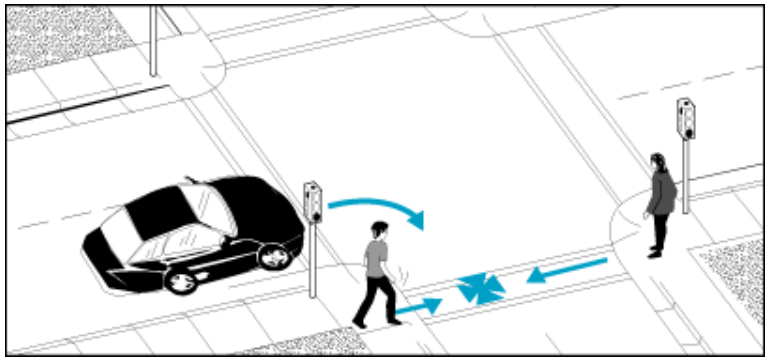


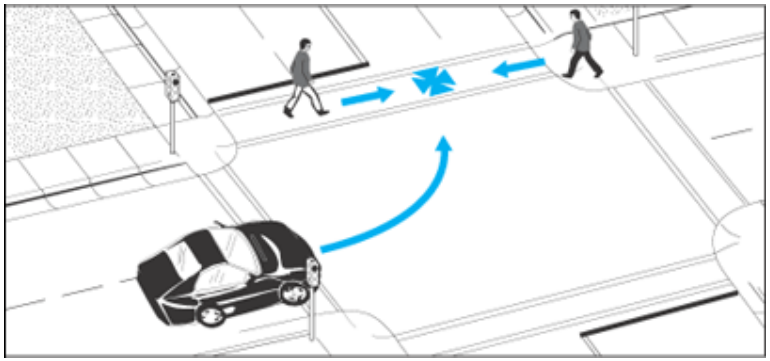


However…

Adding phases to separate vehicle turns from pedestrian movements can improve safety:

- **Leading pedestrian intervals**
- **Pedestrian only phases / scrambles**
- **Signalized right and left turn car phases**





www.walkinfo.org

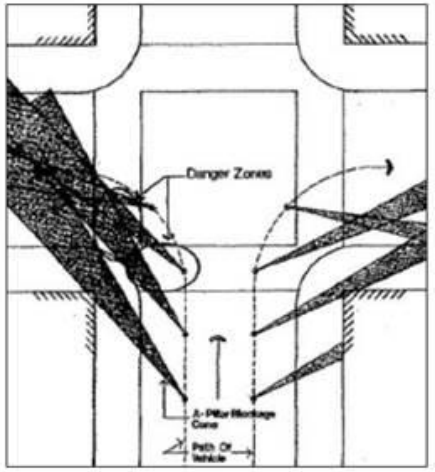
San Francisco and Turning Collisions

- **More than one fourth of pedestrian collisions in San Francisco are caused by vehicles turning at intersections.**
- **Left turn pedestrian collisions are more frequent by a 3 to 1 margin.**

New York City Study

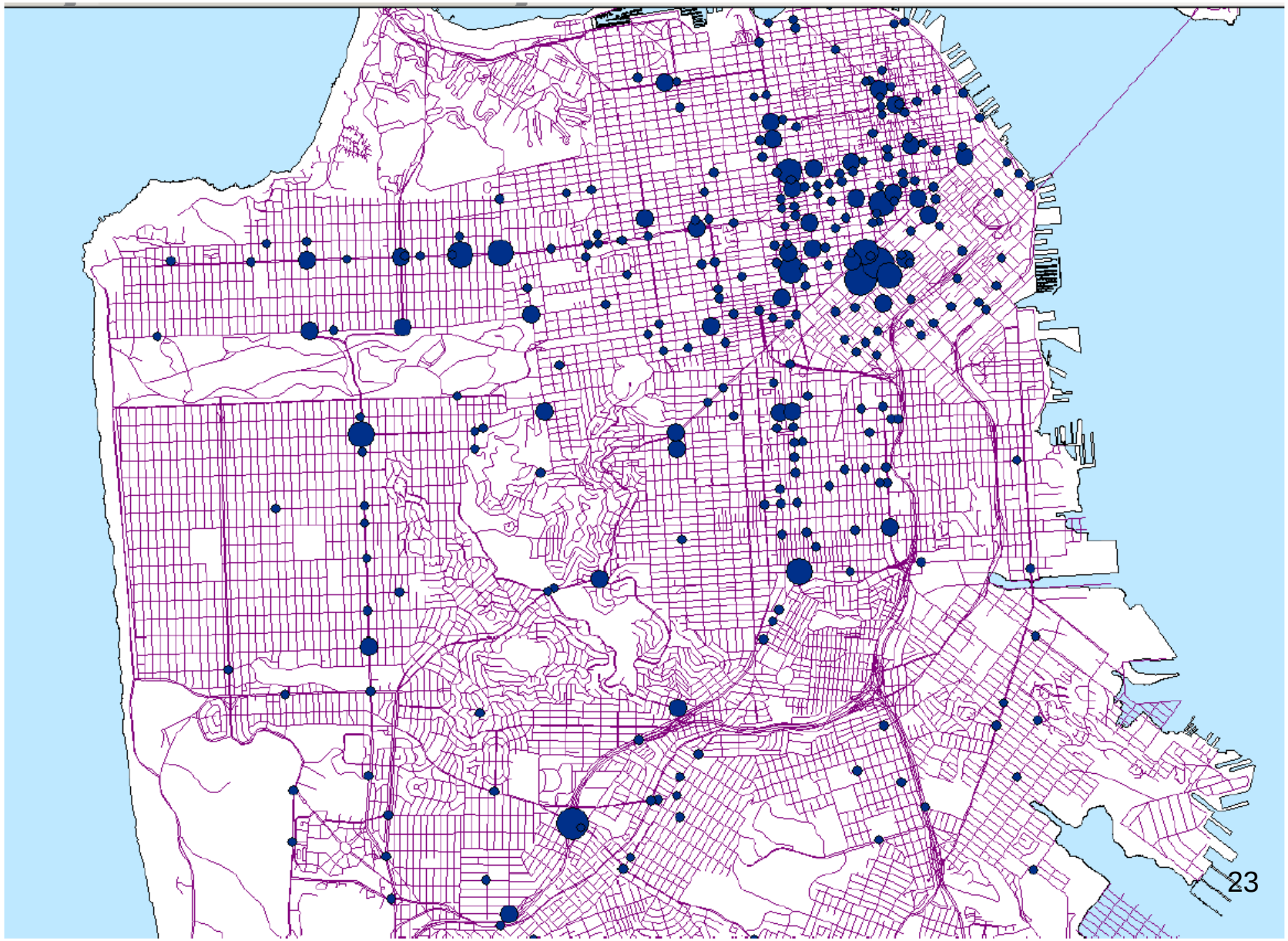
One-Way Streets: The Left Turn Problem

- "A-pillar" between windshield and driver window creates blind spot on left side
- Parking blocks view of pedestrians at approach
- Blind spot tracks pedestrians crossing in the same direction as moving vehicles

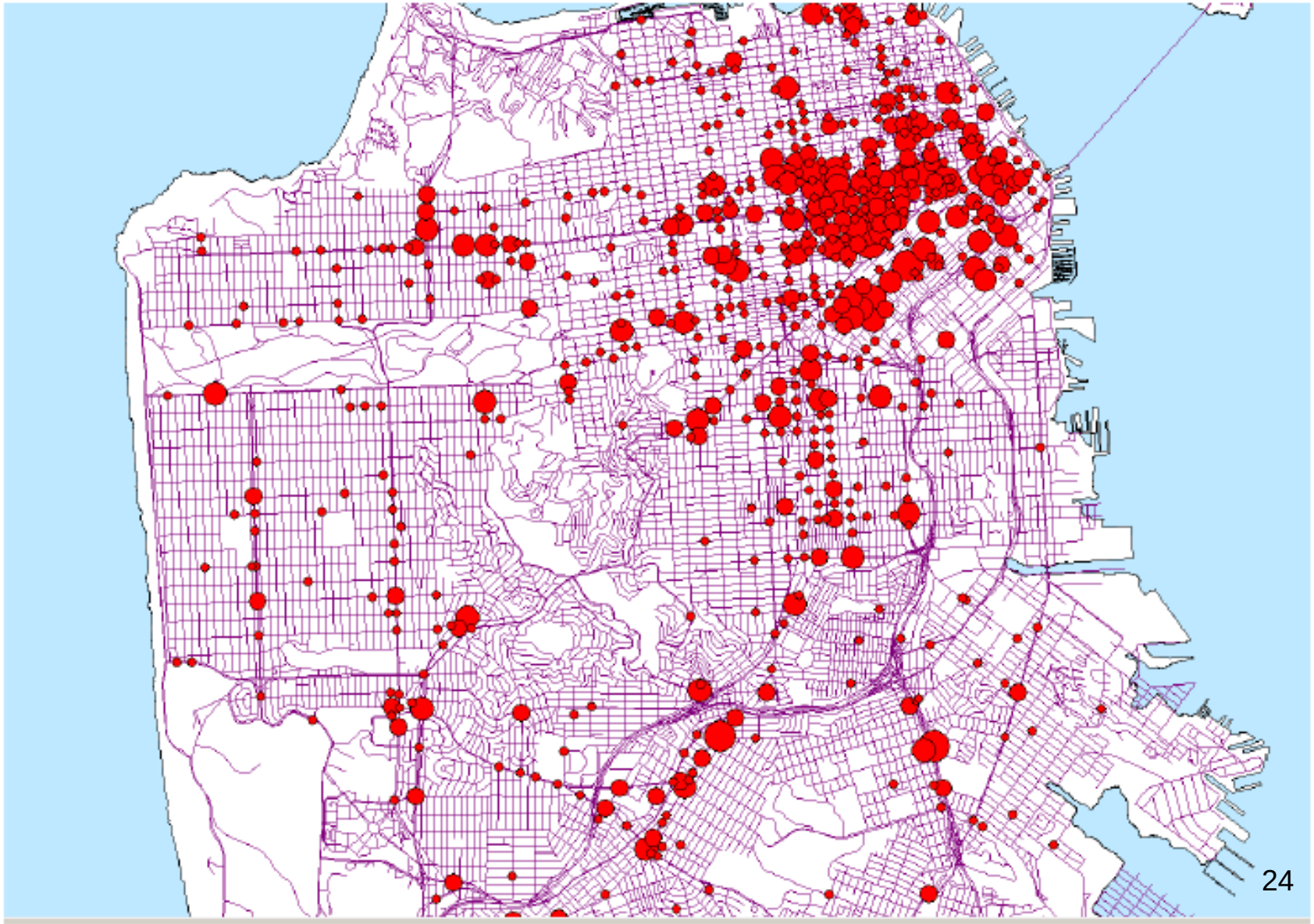


http://www.nyc.gov/html/dot/downloads/pdf/2012_left-turns-pedestrian-safety_trb2012.pdf

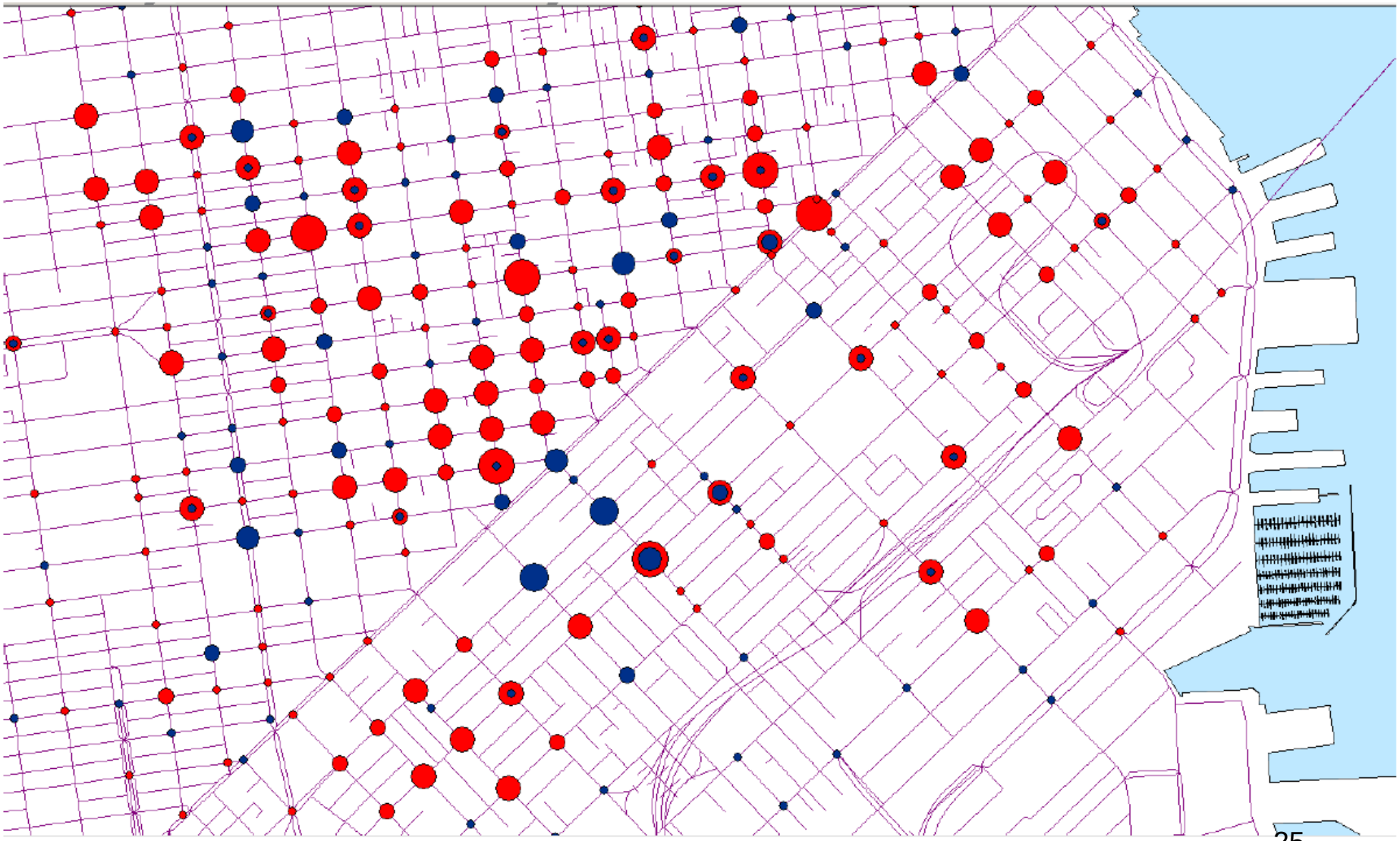
SAN FRANCISCO COLLISIONS (FIVE YEARS – 1st Q 2011) INVOLVING A RIGHT TURNING VEHICLE AND A PEDESTRIAN (354 TOTAL)



SAN FRANCISCO COLLISIONS (FIVE YEARS – 1st Q 2011) INVOLVING A LEFT TURNING VEHICLE AND A PEDESTRIAN (975 TOTAL)



DOWNTOWN COLLISIONS (FIVE YEARS – 1st Q 2011) INVOLVING RIGHT (BLUE) AND LEFT (RED) TURNING VEHICLE AND A PEDESTRIAN



Leading Pedestrian Interval (LPI)

- **Pedestrians are given a WALK signal three to five seconds before parallel traffic is given a green light.**
- **With short cycle lengths, LPI's can absorb 10 to 15 percent of vehicular green time.**
- **Example:**

  60 second cycle

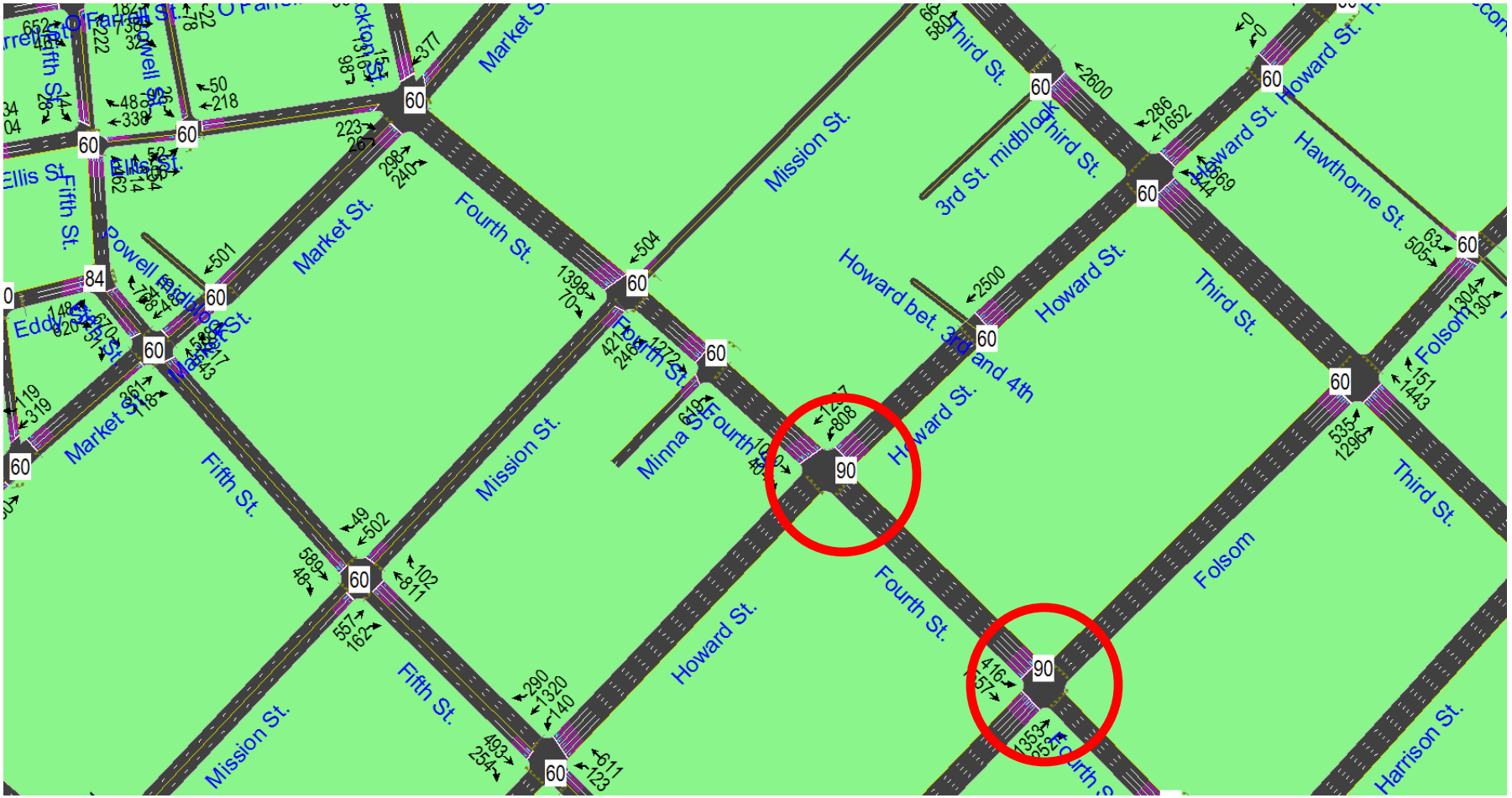
  26 second green

  Add 4 second LPI } **15 % less green**

Pedestrian Only Phases
Barnes Dance
Pedestrian Scrambles

- Pedestrians given a signal phase during which no other vehicle movements are allowed
- Completely eliminates vehicle turn conflicts
- Increases pedestrian delay
- Pedestrian compliance can be a problem

Moscone Convention Center 90 Second Pedestrian Only Phase Cycles

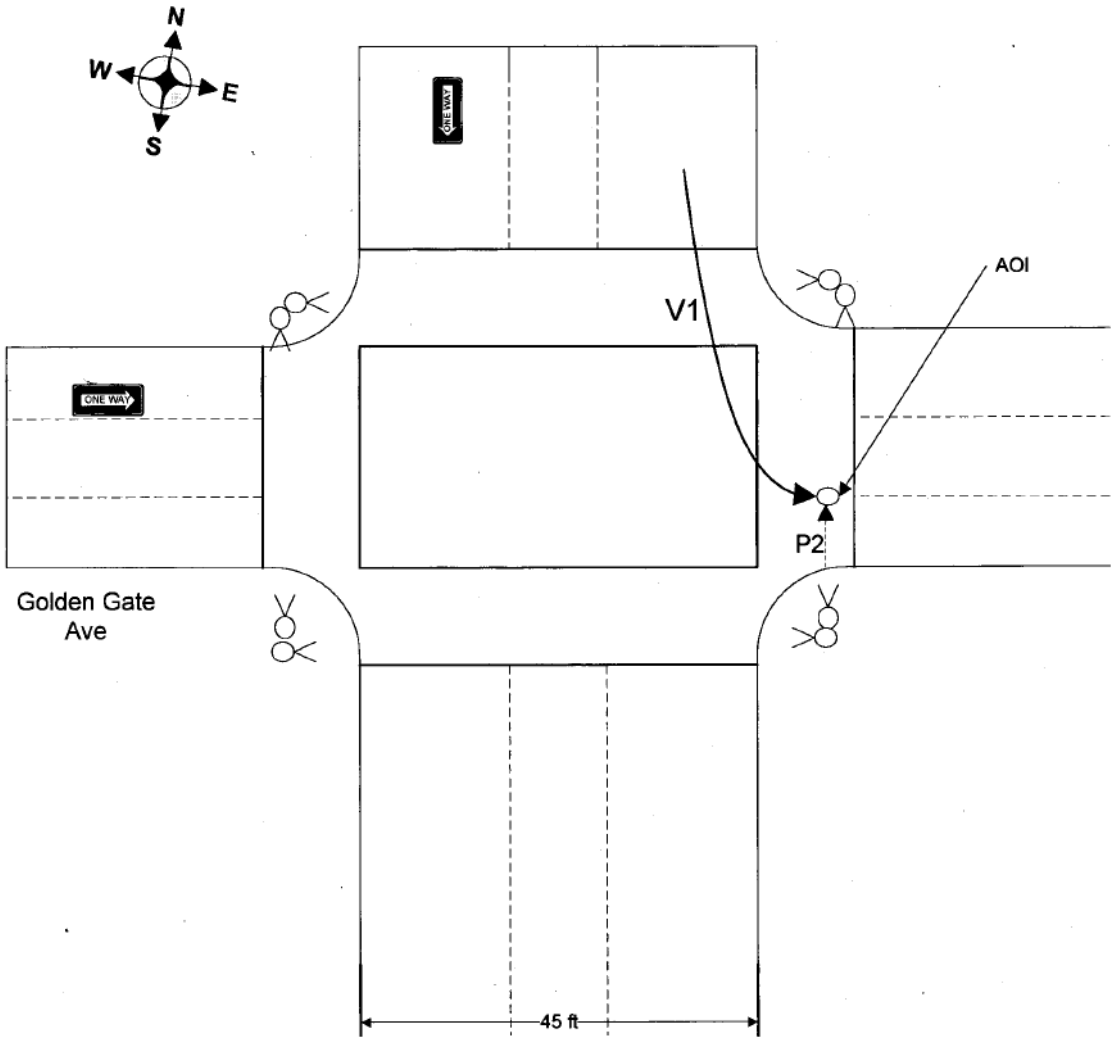


Golden Gate and Jones: Newest Pedestrian Only Phase

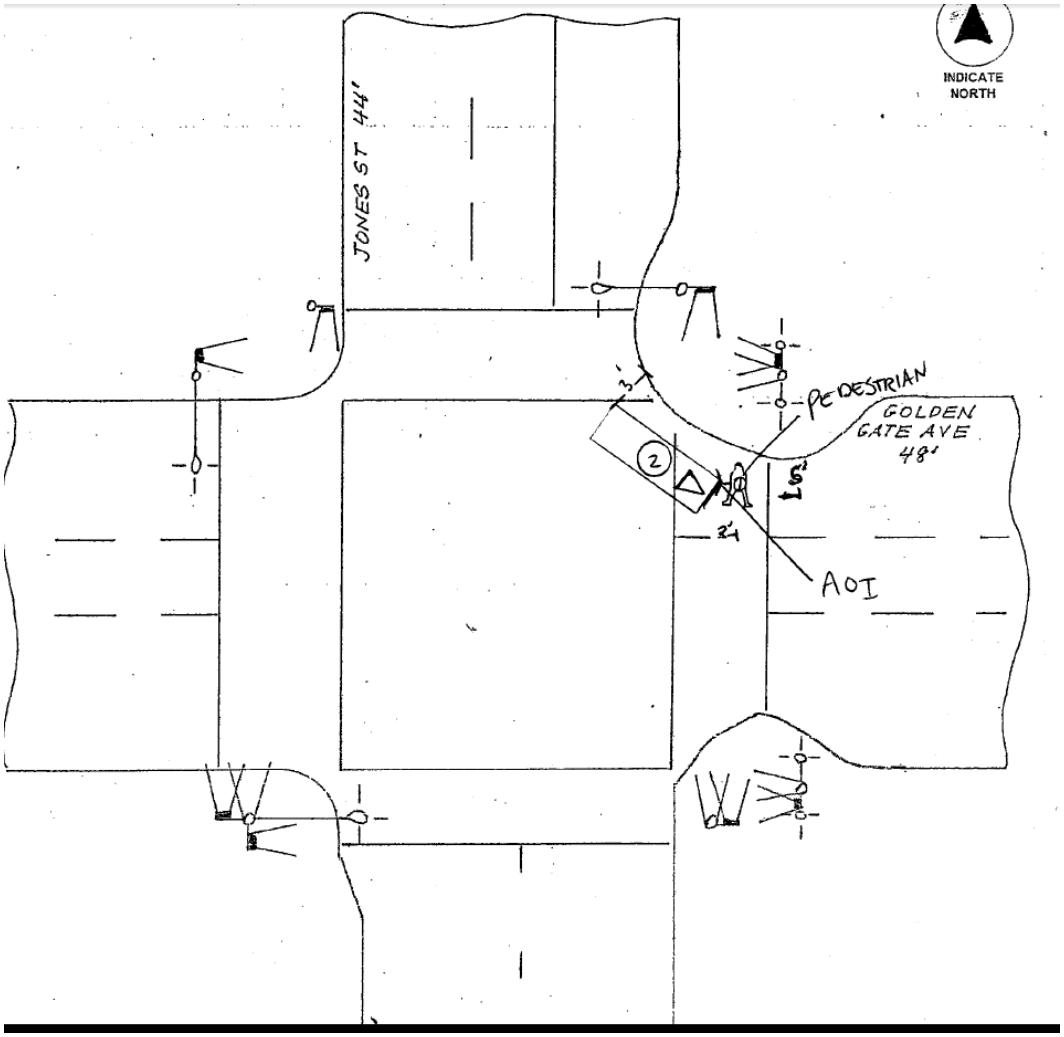
Three Year Highest Injury Vehicle-Pedestrian Collision Intersections
Intersections with seven or more collisions resulting in injury, 2009-2011

Street A	Street B	2009-2011 Injury Collisions
Golden Gate Ave	Jones Street	9
6th Street	Howard Street	8
7th Street	Mission Street	7

Collision Pattern: One-Way Left Turn

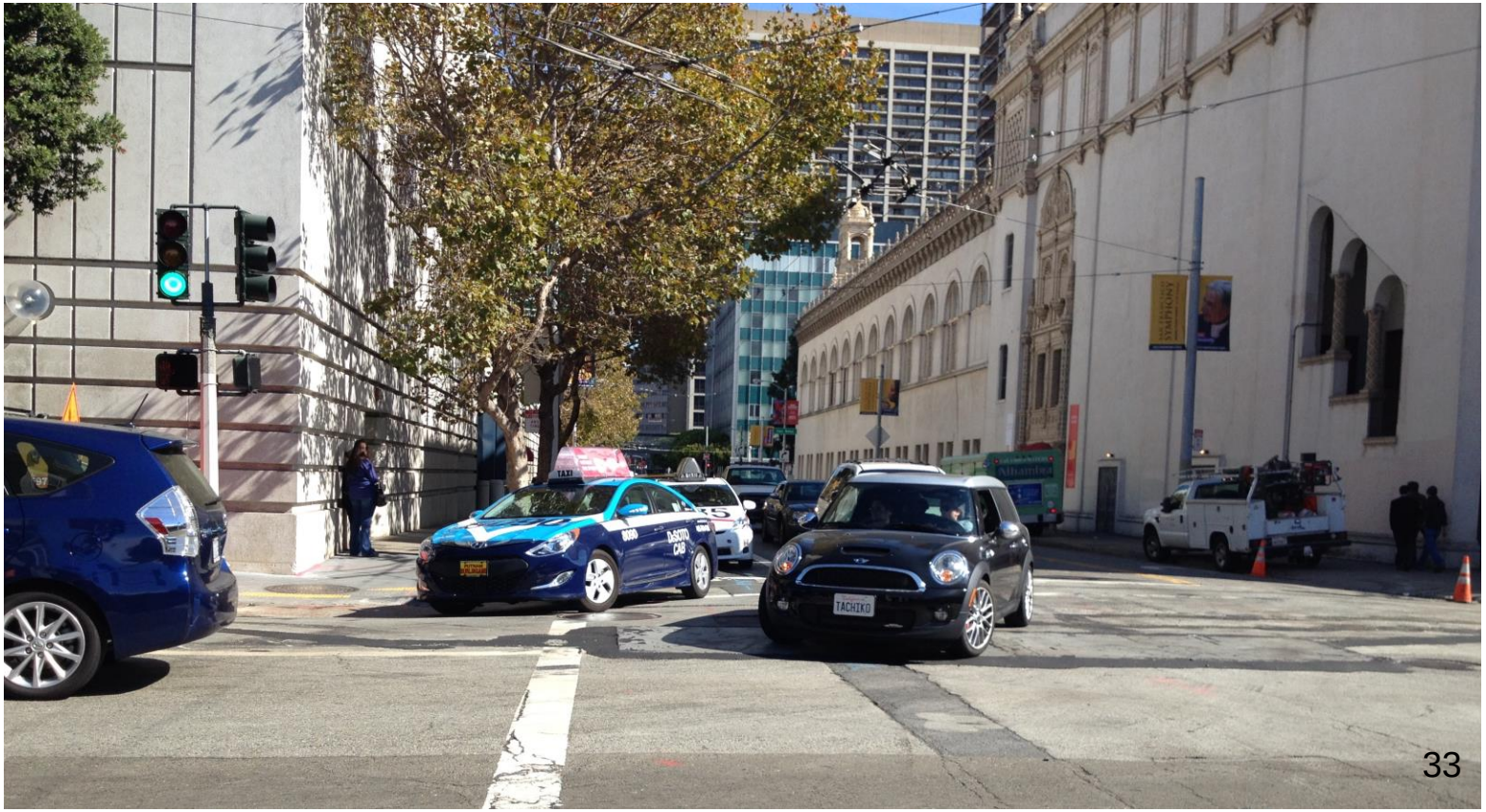


Various Mitigations Didn't Work



LPI plus Partial Turn Phase: Hayes and Franklin Streets

Dual vehicular turn lane, crosswalk kept open for pedestrians




TURNING VEHICLES
TO
Through May 2014
on the go
DI SUVERO
CRISSY FIELD
300
FRANKLIN
ONLY
ONLY
Hayes Street Grill

1. Start Red

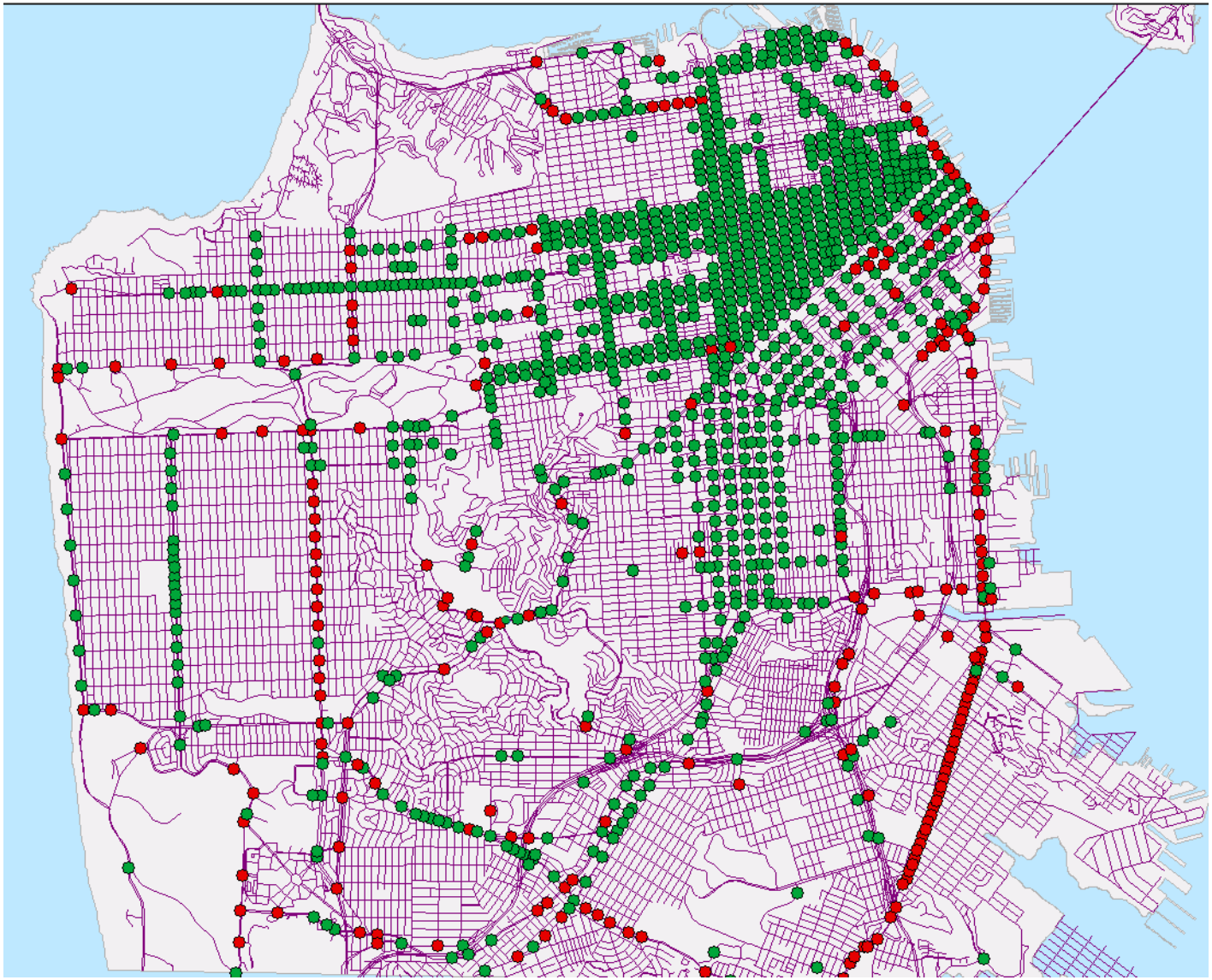
2. Leading Pedestrian Interval

3. Permissive vehicular right turn operation begins

4. Pedestrian clearance (permissive vehicular right turn)

5. Once pedestrians complete crossing, vehicles shown green arrow (exclusive phase)

"Use Fixed Time Signals"



80% FIXED

- High pedestrian volumes
- Commercial areas
- Coordinated network
- Downtown

20% PUSH BUTTON:

- LRVs
- State roads
- Isolated
- Lower pedestrian density
- Mid-block crossings

Lombard Street (US 101)

Actuation added by State but removed by City

Why “beg buttons” can be pedestrian unfriendly

- Add delay if not pressed at the “right moment” in cycle
- Add delay if pedestrian not aware of need to push button (or assumes someone else did)
- Requiring constant push button calls can be distracting or annoying
- Lack of pedestrian compliance can result in crossing with very short vehicular green

San Francisco uses of pedestrian actuation

- To reduce significant transit delays in lower pedestrian streets
- To allow a crosswalk to remain open that would otherwise create safety concerns
- To facilitate installation of additional mid-block or intersection signal on major street with low ped volumes

Actuation to keep crosswalk open

Critical Seconds:
What yellow timing does your city use?

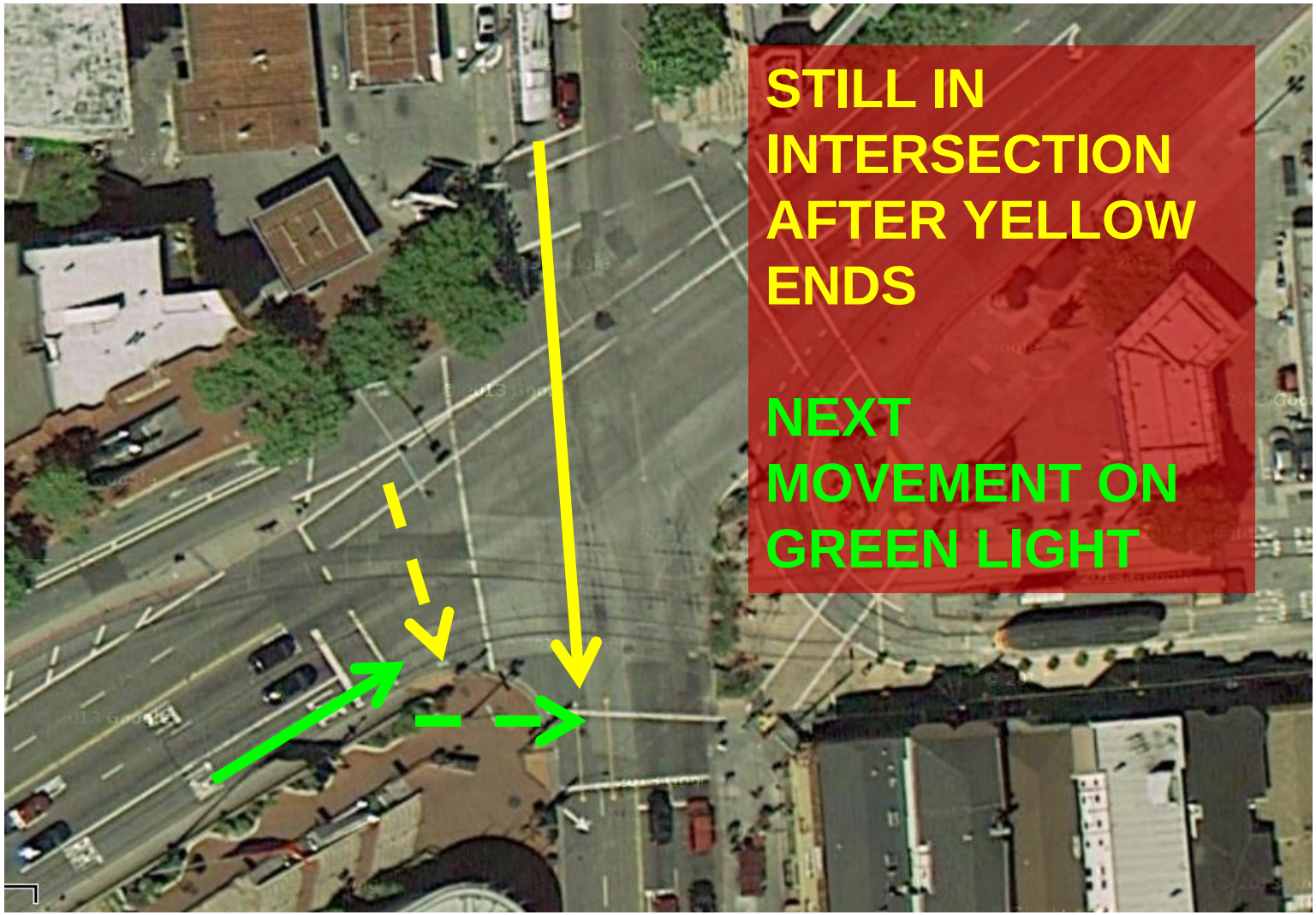
Table A. Yellow Change Interval (seconds) by Approach Speed Limit and Grade

Posted Speed Limit (mph)*	Grade (%) -4	-2	0	2	4
25	3.7	3.5	3.4	3.2	3.1
30	4.1	3.9	3.7	3.6	3.4
35	4.5	4.3	4.1	3.9	3.7
40	5.0	4.7	4.5	4.2	4.1
45	5.4	5.1	4.8	4.6	4.4
50	5.8	5.5	5.2	4.9	4.7
55	6.2	5.9	5.6	5.3	5.0

*Yellow change intervals calculated using 85th percentile approach speed estimation of posted speed limit +7 mph

FROM: *NCHRP REPORT 731 - Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections (Appendix A)*

Critical Seconds: All-Red Clearance Phase



Final Thoughts

- **When a roadway is redesigned, decide up front what cycle lengths are desired.**
- **Staff, public, and decision-makers often focus on physical changes to streets when timing changes can also be important.**
- **How do we balance minimizing pedestrian delay and increasing protection for pedestrians at traffic signals?**