

STEP

Safe Transportation for
Every Pedestrian



Considerations for Selecting Pedestrian Hybrid Beacon Locations

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April 22, 2020



U.S. Department of Transportation
Federal Highway Administration

Housekeeping

⇒ **Problems with audio?**

Dial into the phone line instead of using “mic & speakers”

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Re-Load the webpage and log back into the webinar. Or send note of an issue through the Question box.

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Archive posted at www.pedbikeinfo.org/webinars

- ⇒ Copy of presentations
- ⇒ Recording (within 1-2 days)
- ⇒ Links to resources

Follow-up email will include...

- ⇒ Link to certificate of attendance
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The screenshot shows the PBIC website with a green header. The header contains the PBIC logo (a pedestrian, a bicycle, and an information icon) and the text "Pedestrian and Bicycle Information Center". Below the header is a navigation menu with links for "Data & Resources", "Community Support", "Planning & Design", "Training & Events", and "Behavior Change". The main content area is titled "Webinars" and includes a description of the center's offerings, a list of upcoming webinars, and a list of recently delivered webinars.

Pedestrian and Bicycle Information Center

Data & Resources Community Support Planning & Design Training & Events Behavior Change

TRAINING & EVENTS

Webinars

Livable Communities
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Additional Webinars

University Courses

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CEU & PDH Information
Course Costs
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Conferences & Events

Webinars

The Pedestrian and Bicycle Information Center (PBIC) offers webinars on a variety of topics related to pedestrian and bicycle safety. Sign up for our [newsletter](#) to receive webinar announcements, and follow us on [Facebook](#) and [Twitter](#).

Upcoming Webinars

4/10/2018 - Tools to Inventory Pedestrian Crossing Infrastructure
Presented by: Tim Fremaux, Los Angeles Department of Transportation; Lorraine Moyle, Florida Department of Transportation; and Carey Shepherd, FHWA-Florida Division

To stay up to date on upcoming webinars, sign up for our [newsletter](#).

Recently Delivered Webinars

1/30/2018 - Selecting Countermeasures for Uncontrolled Crossing Locations
Presented by: Gabe Rousseau, FHWA; Lauren Blackburn, VHB; and Charlie Zegeer, UNC Highway Safety Research Center.

12/14/2017 - Safety Performance Measures for Bicyclists and Pedestrians
Presented by: David Kopacz, Federal Highway Administration; Amy Schick, National Highway Traffic Safety Administration.

12/11/2017 - Determining the Safety Impacts of Bicycling and Walking Investments
Presented by: Daniel Carter and Raghavan Srinivasan, UNC Highway Safety Research Center.



Previous STEP Webinar about PHBs

Improving Crossings with Pedestrian Hybrid Beacons

⇒ May 29, 2018

⇒ Panelists: Duane Thomas (FHWA), Joel Meyer (City of Austin), Ryan Lowe (City of Columbus)

Find the archived recording online:

⇒ [Pedbikeinfo.org/webinars](https://pedbikeinfo.org/webinars) (search Pedestrian Hybrid)

⇒ YouTube: https://youtu.be/JS6eUyjol_c



2018 STEP Guide



Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations

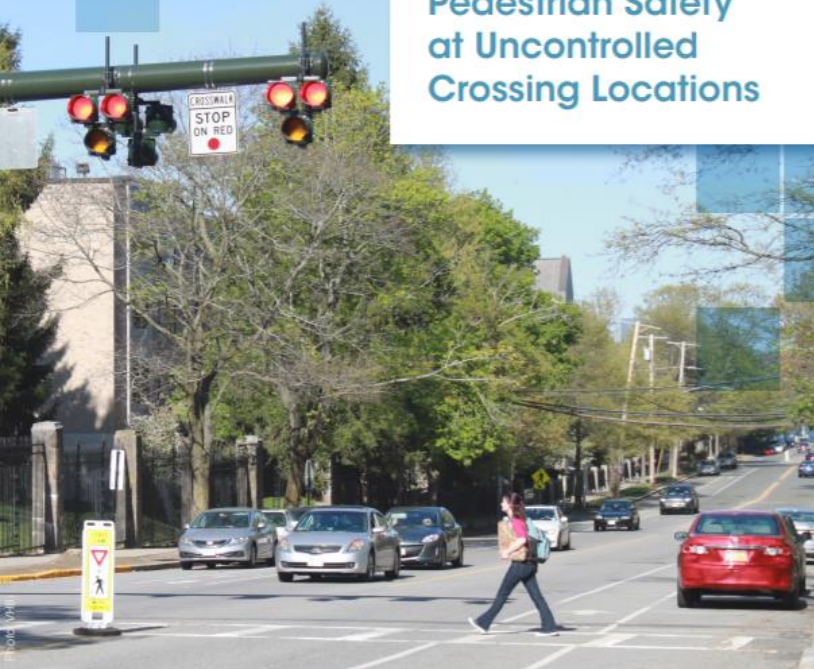


Table 1. Application of pedestrian crash countermeasures by roadway feature.

Roadway Configuration	Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
2 lanes (one lane in each direction)	① 2 3 4 5 6	① ③ 5 6	① ③ 5 6	① 3 4 5 6	① ③ 5 6	① ③ 5 6	① 3 4 5 6	① ③ 5 6	① ③ 5 6
3 lanes with raised median (one lane in each direction)	① 2 3 4 5	① ③ 5	① ③ 5	① 3 4 5	① ③ 5	① ③ 5	① ③ 4 5	① ③ 5 ⑦	① ③ 5
3 lanes w/o raised median (one lane in each direction with two-way left-turn lane)	① 2 3 4 5 6	① ③ 5 6	① ③ 5 6	① 3 4 5 6	① ③ 5 6	① ③ 5 6	① ③ 4 5 6	① ③ 5 6	① ③ 5 6
4+ lanes with raised median (two or more lanes in each direction)	① ③ 5	① ③ 5	① ③ 5	① ③ 5	① ③ 5	① ③ 5	① ③ 5	① ③ 5	① ③ 5
4+ lanes w/o raised median (two or more lanes in each direction)	① ③ 5 6	① ③ 5 6	① ③ 5 6	① ③ 5 6	① ③ 5 6	① ③ 5 6	① ③ 5 6	① ③ 5 6	① ③ 5 6

Given the set of conditions in a cell,

- # Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.
- Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.
- Signifies that crosswalk visibility enhancements should occur in conjunction with other identified countermeasures.*

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

- 1 High-visibility crosswalk markings, parking restriction on crosswalk approach, adequate nighttime lighting levels
- 2 Raised crosswalk
- 3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
- 4 In-Street Pedestrian Crossing sign
- 5 Curb extension
- 6 Pedestrian refuge island
- 7 Pedestrian Hybrid Beacon or Rectangular Rapid-Flashing Beacon
- 8 Road Diet
- 9 Pedestrian Hybrid Beacon

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





U.S. Department of Transportation
Federal Highway Administration



FHWA EVERY DAY COUNTS 5 / STEP

For Additional Information Contact:

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

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Arizona PHB Study on High-Speed Roads and PHB Safety Analysis

Bill Stone
Arizona DOT

Mike Cynecki
Lee Engineering





Pedestrian Hybrid Beacon (formerly HAWK)

	1 Blank for drivers	
	2 Flashing yellow	
	3 Steady yellow	
	4 Steady red	
	5 Wig-Wag	
	Return to 1	

Research Background

- **Arizona Department of Transportation (ADOT) developed PHB guidelines in 2012**
- **National research has reported effectiveness of PHBs in reducing crashes, injuries and fatalities**
- **ADOT interested in a study to evaluate state data and evaluate effectiveness of PHBs on safety in Arizona**

Research Objectives

- **Do PHBs reduce the severity of ped/bike collisions?**
- **What is the ped/bike compliance with PHBs?**
- **Determine characteristics for optimal placement**
- **Review ADOT's existing PHB guidelines**

Driver Behaviors

- **Percent of drivers yielding to pedestrians**
- **Number of drivers not stopping during the steady red indication.**
- **Number of drivers not stopping during flashing red indication.**
- **Number of drivers on cross-streets turning at active PHB**

Pedestrian Behaviors

- **Percent pedestrians using pushbutton**
- **Percent crossing during each PHB phase**
- **PHB display when pedestrian/bicycle begins crossing**
- **Other behaviors observed at PHBs**

Acknowledgments

- Contracting Agency: Arizona Department of Transportation
- Research Team:
 - Kay Fitzpatrick
 - Eun Sug Park
 - Michael Pratt
 - Michael Cynecki
 - Michelle Beckley



Question #1 - How Well Do PHBs Operate on Higher-Speed Roads?



Study: Operational Analysis

- Video data - 10 sites (based on prior FHWA study)
- Evaluate - Driver yielding/compliance, ped/bike compliance, etc.
- Natural ped/bike crossings and staged crossings



First Task: Identify PHBs in Arizona

- Total PHBs identified - 207 in Arizona
- 10 higher-speed locations selected for study



Study: Operational Analysis

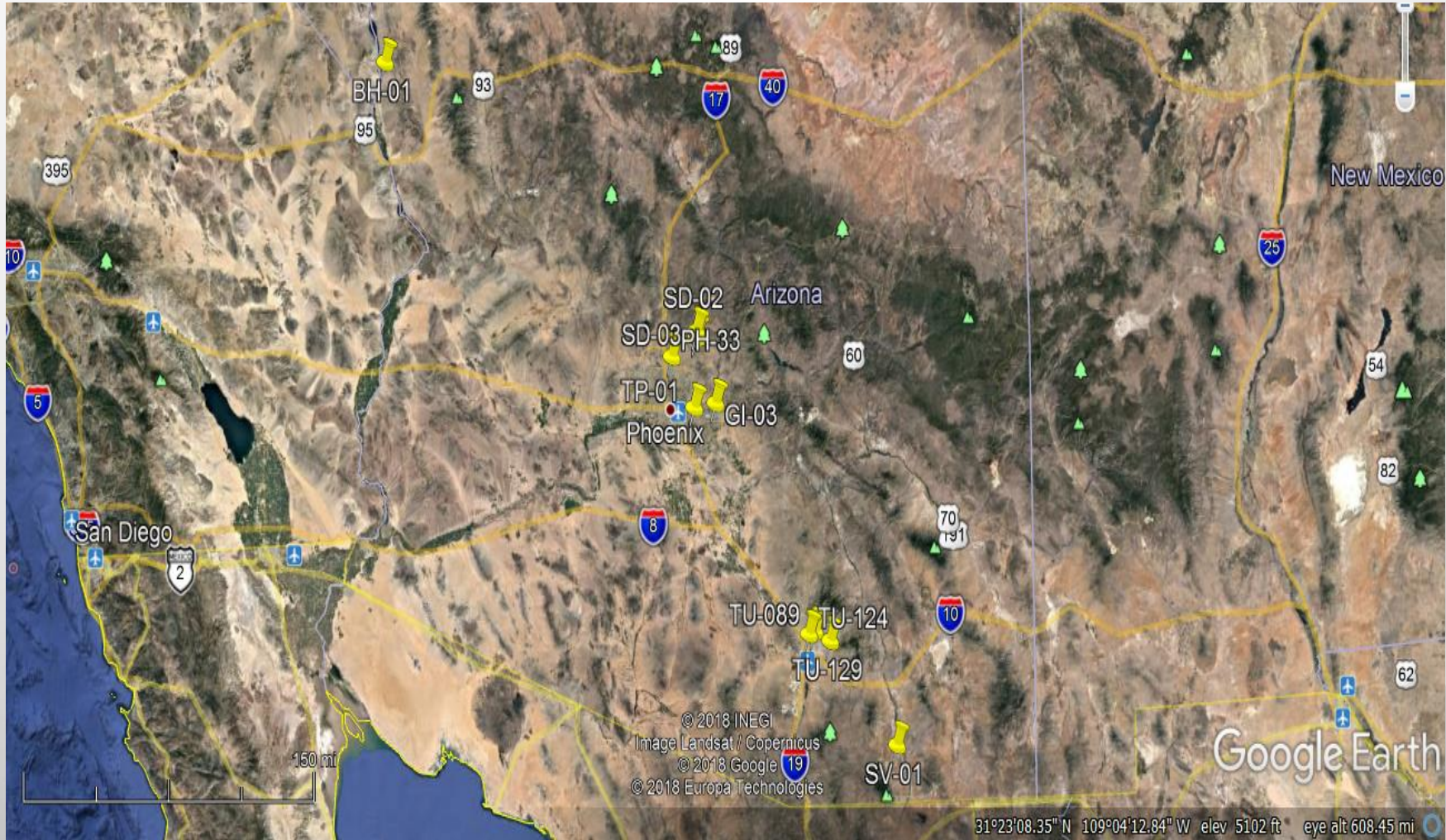
- Video data - 10 sites (based on prior FHWA study)
- Evaluate - Driver yielding/compliance, ped/bike compliance, etc.
- Natural ped/bike crossings and staged crossings



Operational Analysis: Study Sites

Posted Speed Limit	2 Lanes	4 Lanes	5 Lanes	Total
40 mph		1		1
45 mph		5	1	6
50 mph	2	1		3
Total:	2	7	1	10

- High speed sites (45 & 50 mph)
- 2 sites - state highways
- Most sites - multiple lanes on the major street



Study Sites

Site	PSL (mph)	85th-%ile (mph)	Date	Diff (mph)
BH-01	45	47	Sept 2017	+2
GI-03	45	44	May 2018	-1
PH-33	45	53	April 2018	+7
SD-02	50	53	2005	+3
SD-03	50	54	2005	+4
SV-01	45	48	April 2018	+3
TP-01	45	No Speed Data Available		N/A
TU-89	40	50	May 2018	+10
TU-124	45	48	May 2018	+3
TU-129	50	54	May 2018	+4

Example Study Site – 45 MPH

BH-01 Bullhead City: Highway 95 and 5th Street – Camera Locations



BH-01 – Bullhead City

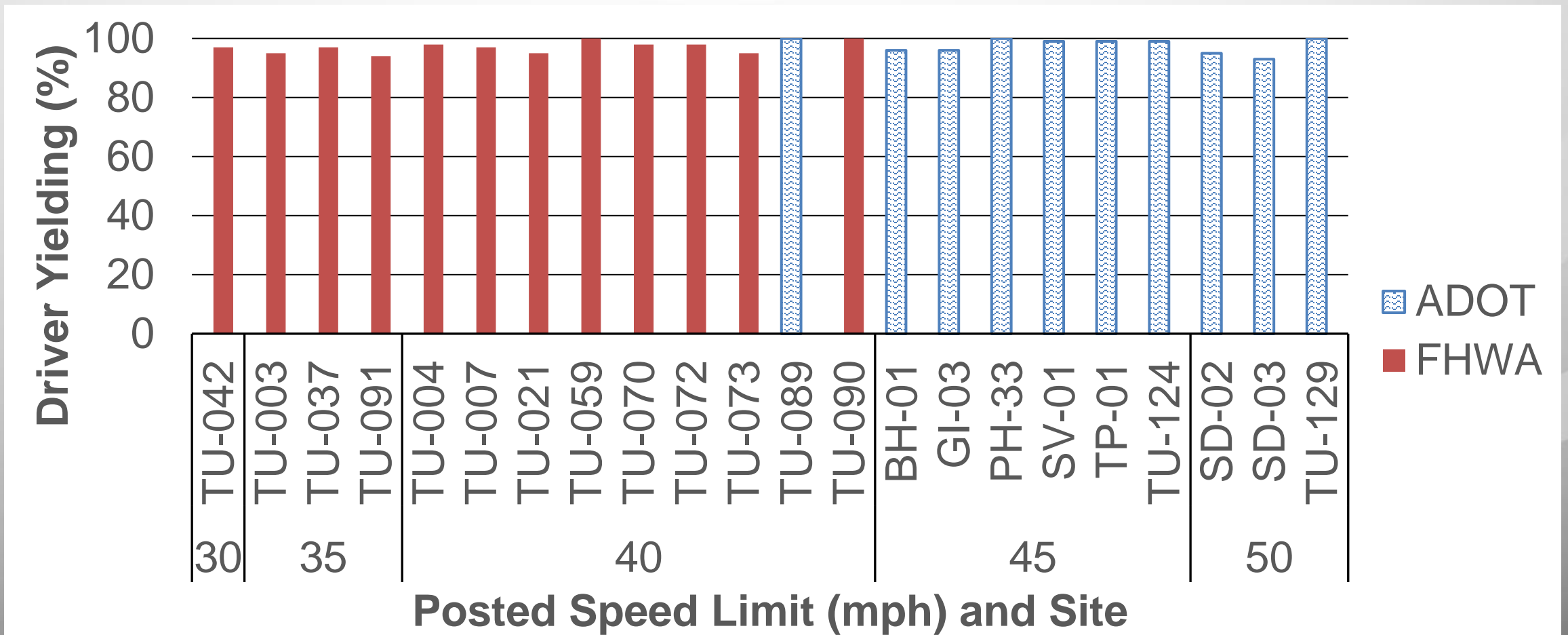
BH-01 – Bullhead City



Site	Yielders	Non-Yielders	All Vehicles	Yield Rate
BH-01	262	12	274	96%
GI-03	269	21	290	93%
PH-33	265	0	265	100%
SD-02	127	6	133	95%
SD-03	193	15	208	93%
SV-01	197	2	199	99%
TP-01	291	3	294	99%
TU-089	294	1	295	100%
TU-124	272	3	275	99%
TU-129	93	0	93	100%
All Sites	2,263	63	2,326	97%

Site	Vehicles, Steady Red	Steady Red Compliance	Vehicles, Flashing Red	Flashing Red Compliance
BH-01	203	88%	407	38%
GI-03	203	86%	340	58%
PH-33	161	96%	290	38%
SD-02	141	82%	311	41%
SD-03	137	74%	146	75%
SV-01	136	95%	370	41%
TP-01	158	93%	597	39%
TU-089	198	98%	663	26%
TU-124	147	91%	450	34%
TU-129	49	90%	146	79%
All Sites	1533	90%	3720	41%

Comparison with Previous Studies



Operational Analysis: Key Findings

- **Driver yielding for 10 sites = 97%**
 - Posted speed limits between 40 and 50 mph
 - 85th percentile speed between 44 and 54 mph
- **Similar driver yielding rate as lower speed sites**
- **Recommendation: Allow PHBs on 50 MPH streets**

Question #2 – How Safe are PHBs for Pedestrians and Motorists?



Safety Analysis

- **Previous research: PHBs effective in reducing crashes, but findings limited due to sample size challenges**
 - 2010 FHWA study: significant reduction for total (29%) and pedestrian (69%)
 - 2017 NCHRP study: significant reduction for total (18%), pedestrian (57%), rear-end (12%)
 - Findings for all crashes, not for severe (fatal + injury) crashes

Arizona DOT Research Project

- **Objective:**
 - Investigate changes in crash severity and type, also spacing between PHB and signal
- **Study approaches:**
 - Empirical Bayes (EB) before-after (preferred)
 - Cross sectional (CS)



Identify PHBs in Arizona

- **207 PHBs in Arizona identified**
- **52 = safety EB before-after (installed btw 2011 and 2015)**
- **186 = safety cross sectional analysis**
- **21 = not included in cross sectional analysis (installed too recently, major road ADT not available, etc.)**

EB Safety – Key Finding, Crashes

- **This ADOT study supports previous studies findings:**
 - 25% reduction in severe (fatal and injury) total crashes
 - (CMF of 0.75)
 - 45% reduction in severe pedestrian-related crashes
 - (CMF of 0.55)
 - 29% reduction in severe rear-end crashes
 - (CMF of 0.71)

Cross Sectional Safety – Findings

- **More lanes on major: more crashes**
- **More lanes on cross street: more total and angle crashes**
- **Presence of median: fewer crashes (similar finding as other studies)**
- **Spacing between PHB and signal: only rear-end crashes at 0.1 level**

Safety – Key Finding, #Legs

- Midblock (2-legs) versus intersection (3- or 4-legs)
 - Cross-sectional evaluation = no difference in crashes at PHBs with 2 legs (midblock) and at 3- or 4-leg intersections
- Provides additional support for the installation of PHBs at intersections or driveway approaches

Safety – Key Finding, Posted Speed

- **Lower speed (35 or less) versus higher speed (40 or higher):**
 - Not significant for all crash types studied except rear-end crashes
 - Rear-end crashes = fewer rear-end crashes are present when the posted speed limit is 35 or below
- **Findings supports the inclusion of PHBs on higher speed roads**




“Evaluation of Pedestrian Hybrid Beacons on Arizona Highways”

September 2019
SPR-756



ADOT Final Report:

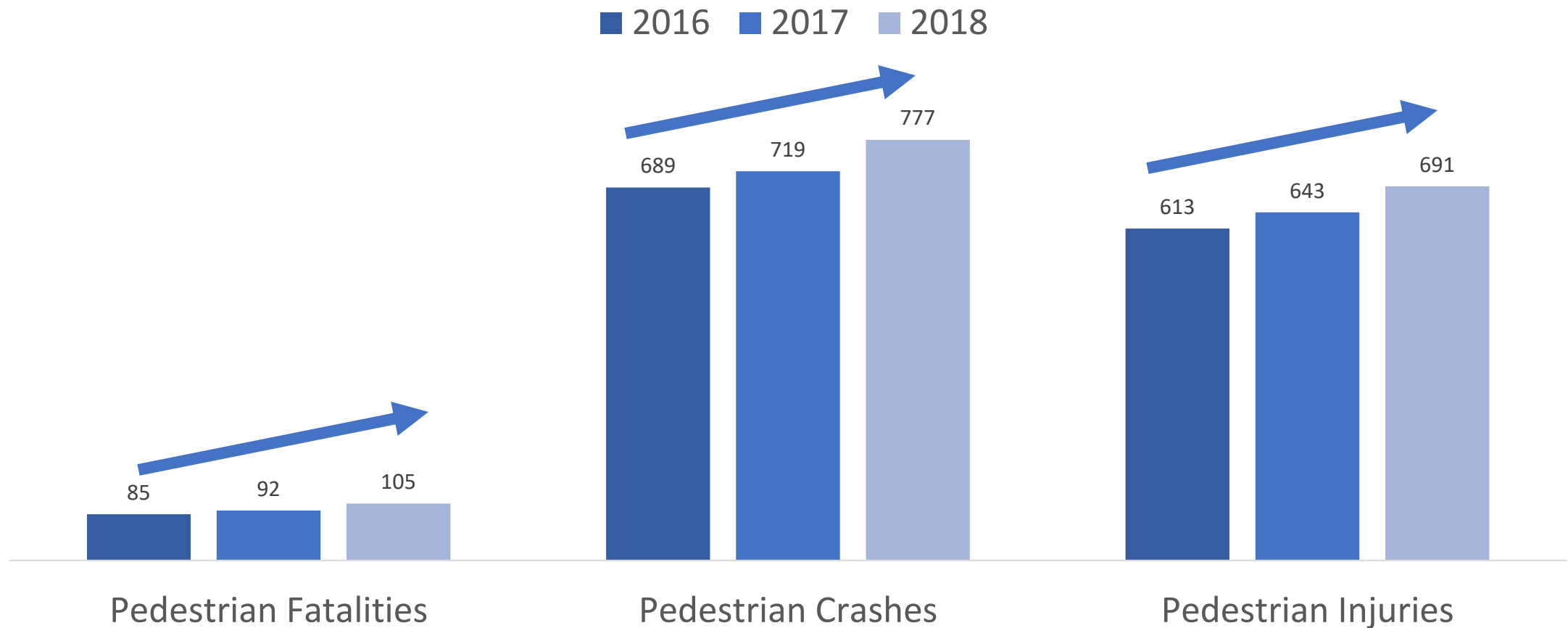
[https://apps.azdot.gov/files/
ADOTLibrary/publications/pr
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City of Phoenix Approach to PHBs

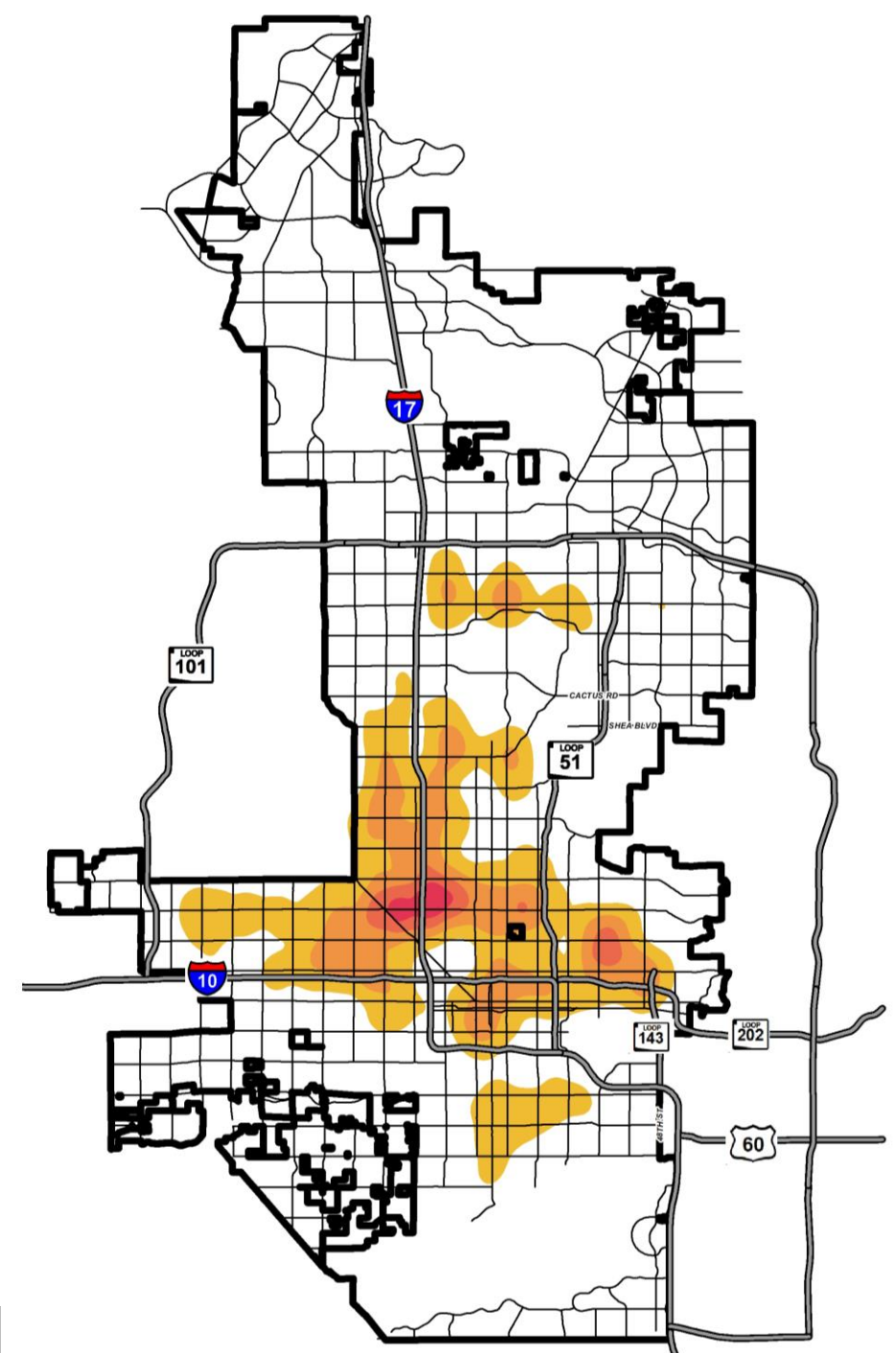
Mailén Pankiewicz –
Pedestrian Safety
Coordinator

Phoenix pedestrian collisions 3-year trends



PHBs in Phoenix (HAWKs)

- High pedestrian collision locations
- Walking / crossing patterns
- Designing useful infrastructure
- Educating the public



1. Get a good idea of pedestrian traffic and desire lines



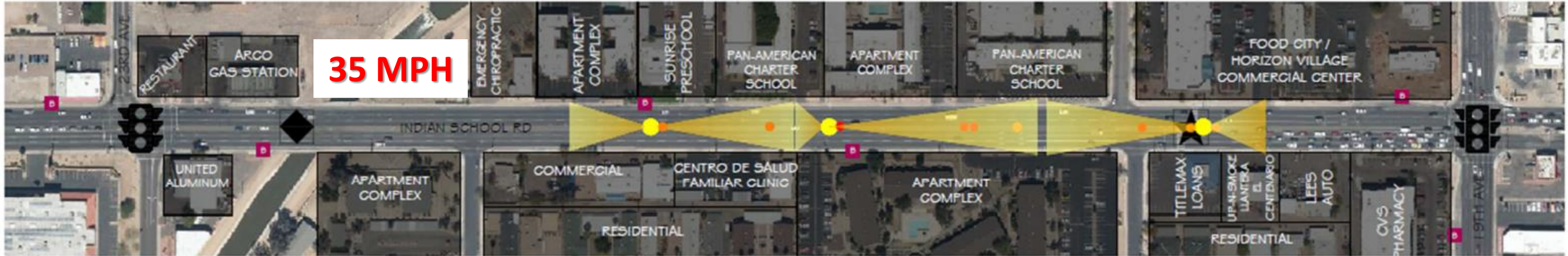
- Schools / Childcare
- Grocery stores / food
- Parks
- Multi-family developments
- Bus and light rail stops



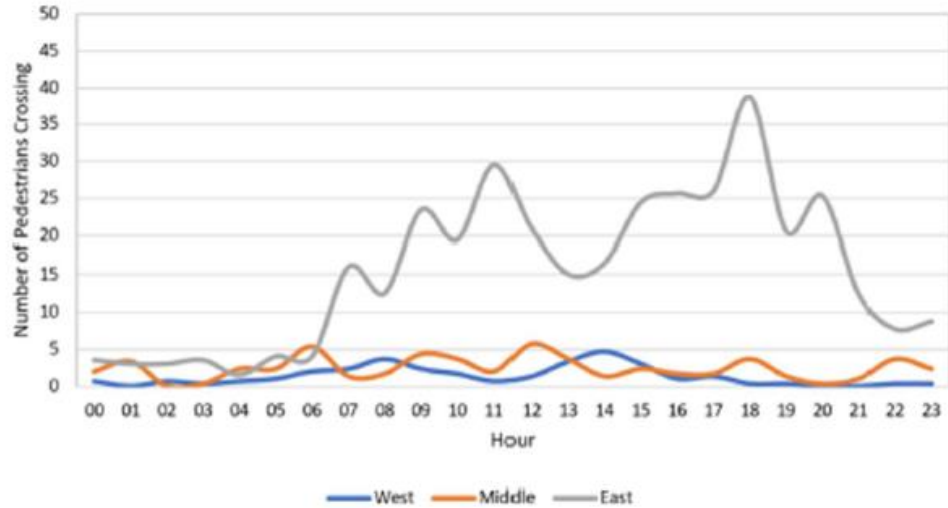


2. Be a pedestrian: Get a 3 dimensional, people-scale perspective

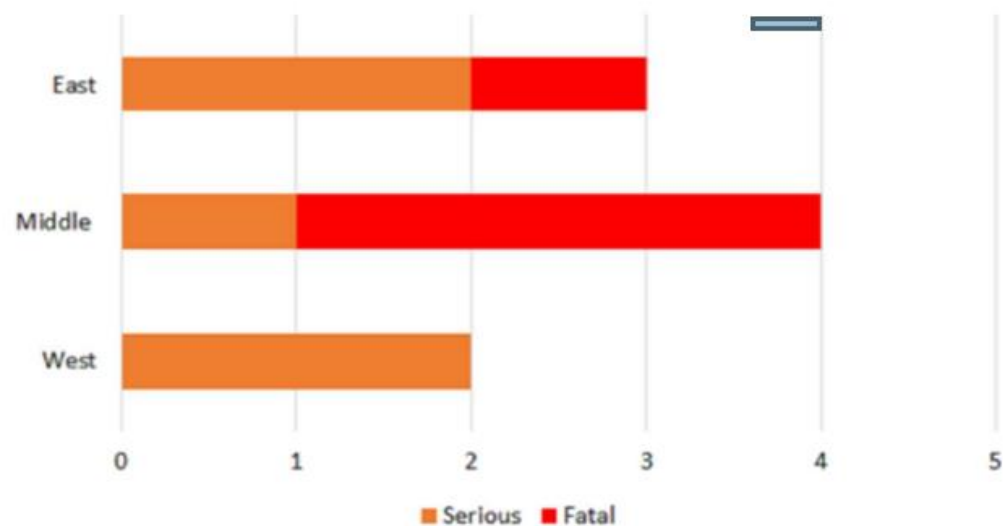
Many land uses, many patterns



Indian School Road - Weekday



Crash Severity



LEGEND

- FATAL CRASH
- SERIOUS INJURY CRASH
- ▶ TRAFFIC CAMERA
- B BUS STOP
- SIGNALIZED INTERSECTION
- 2-STAGE RRFB CROSSING
- HAWK CROSSING

3. Set up the environment for success: Work with new developments to create direct pedestrian access to front doors

- Allow short distances between infrastructure and front doors
- Remove obstructions between infrastructure and front doors





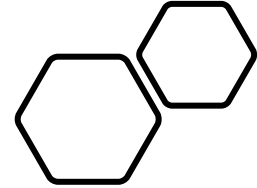
CROSSWALK

CROSSWALK STOP ON RED



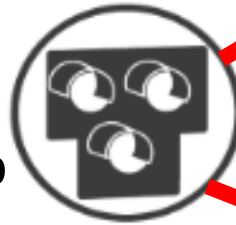


4. Incentivize and guide walkers to use your infrastructure



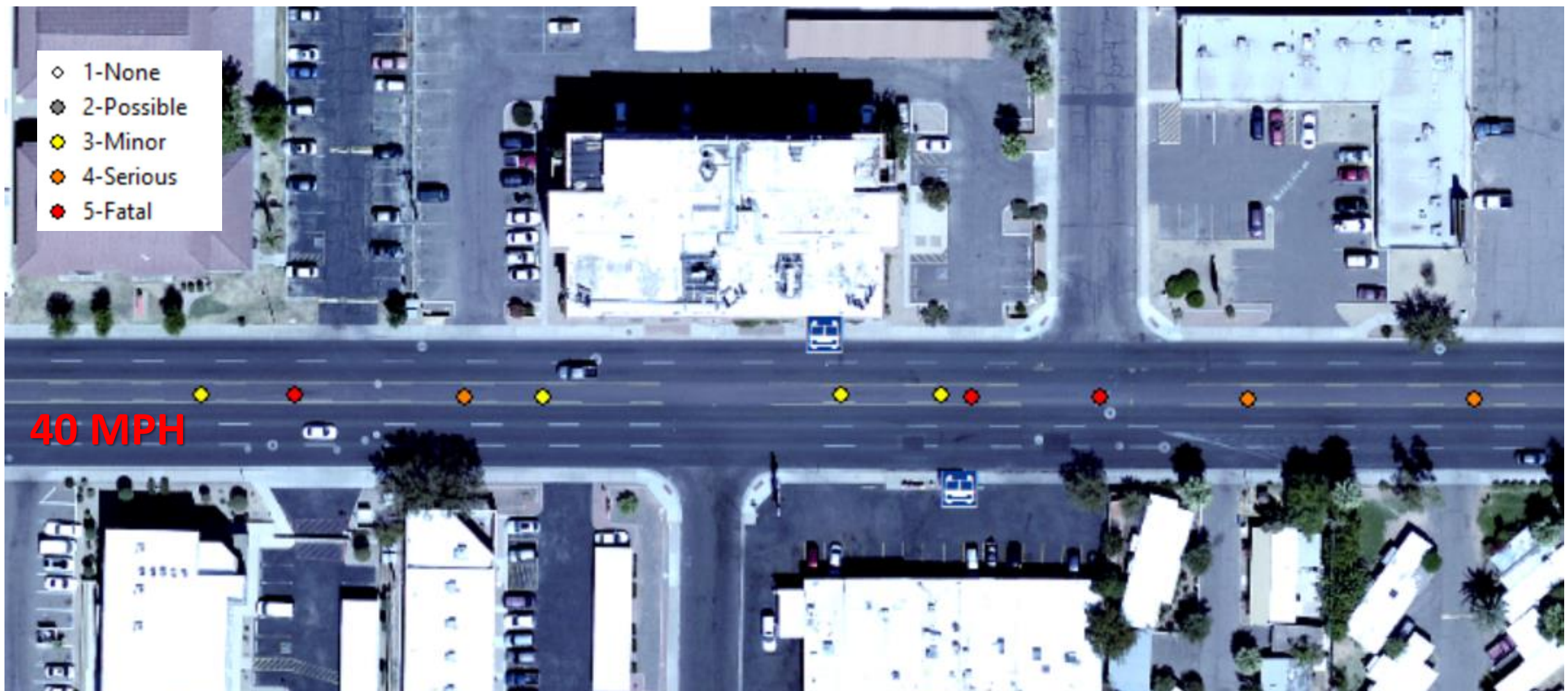
5. Prioritize equity

- Low income
- Poverty level
- Low car ownership
- Access to food

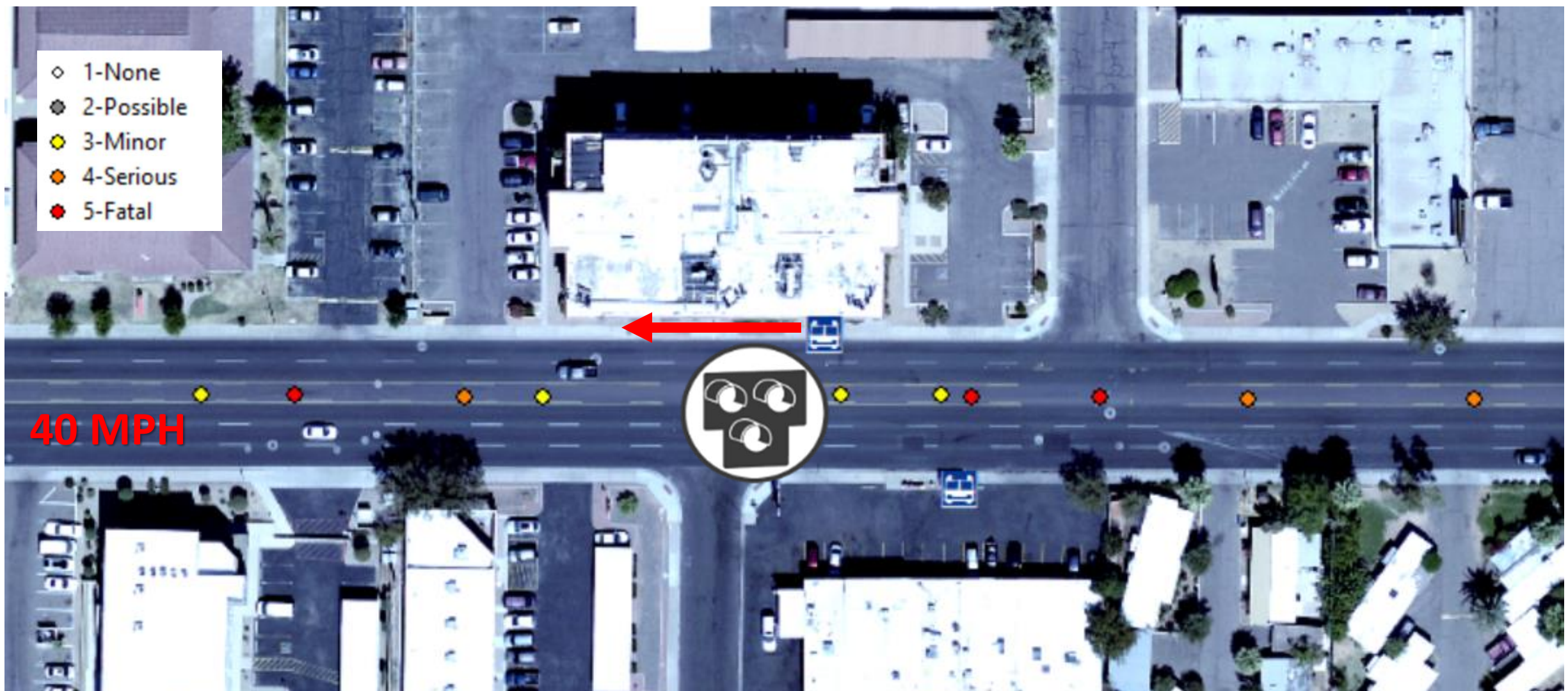


35 MPH

- ◇ 1-None
- ◇ 2-Possible
- ◇ 3-Minor
- ◇ 4-Serious
- ◇ 5-Fatal



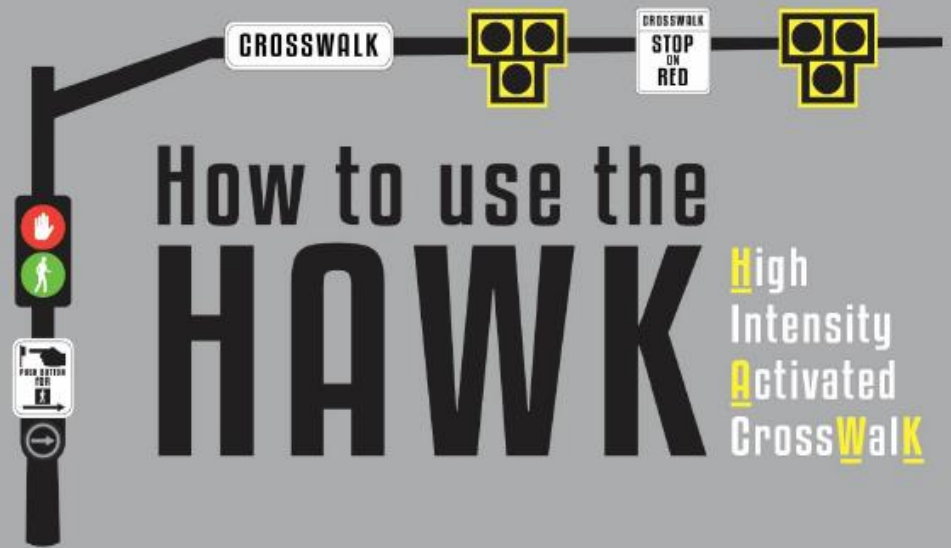
6. Work with public transit authorities to discuss bus stop locations









6. Work with public transit authorities to discuss bus stop locations

Education adults

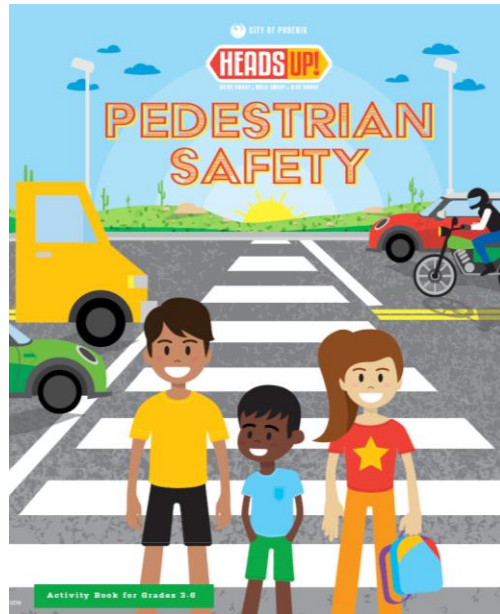
www.phoenix.gov/streets/hawkmap



PEDESTRIANS 	
SEE THIS	DO THIS
	PUSH THE BUTTON
	STOP & WAIT for the WALK signal.
	START CROSSING Always watch for cars.
	FINISH CROSSING

DRIVERS 	
SEE THIS	DO THIS
	DRIVE Always look for people who plan to cross.
	SLOW DOWN A person has activated the push button.
	PREPARE TO STOP
	STOP for pedestrian. (As with any signal RED means STOP)
	STOP FIRST Proceed with caution if no people are present.

Education
children



www.phoenix.gov/streets/headsup

HEADS UP!
DRIVE SMART • WALK SMART • BIKE SMART

Find eleven hidden objects.

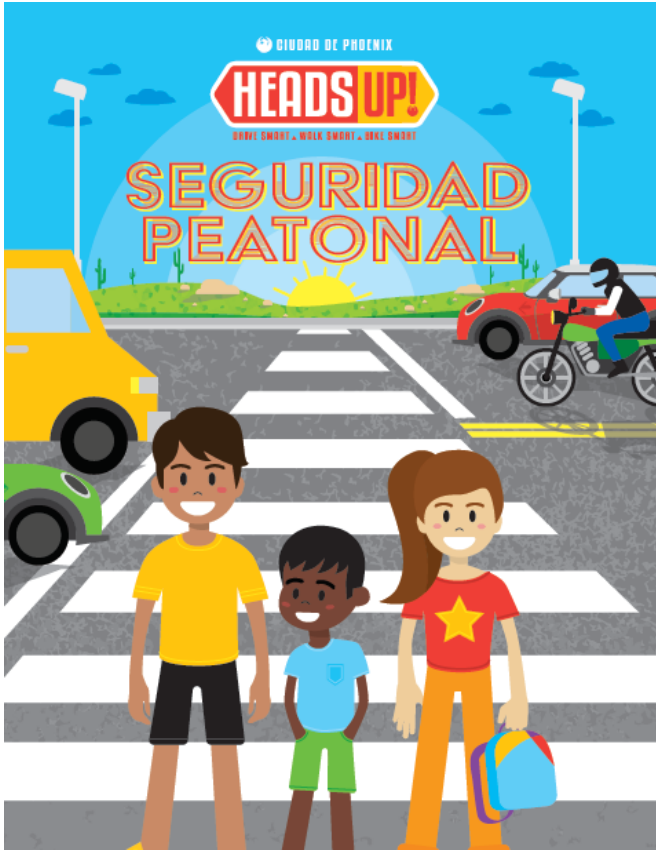
WHAT IS A "HAWK"?

HIGH INTENSITY ACTIVATED CROSSWALK

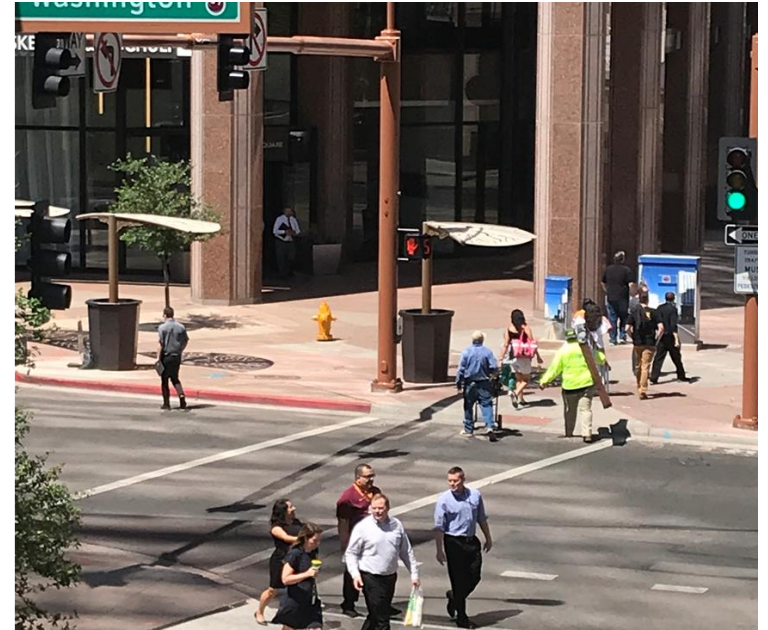
Is it a bird!? Not quite!
It's just a special traffic signal to help people cross the road.
Have you seen one?

HOW TO USE:

- 1. PUSH** the button to call for WALK signal
- 2. WAIT!** (It may take up to a minute for the signal to change)
- 3. Start crossing** after you see the **WALK** signal
- 4. CONTINUE** crossing until you cross the street



¿CÓMO USARLO?



Thank You

Mailén Pankiewicz
mailen.pankiewicz@phoenix.gov

Arizona PHB Study: Recommendations for Selection, Design and Operation of PHBs

Mike Cynecki
Lee Engineering



Acknowledgments

- Contracting Agency: Arizona Department of Transportation 
- Research Team For Recommendations:
 - Kay Fitzpatrick
 - Michael Cynecki



Recommendations for ADOT to Consider

- Refinements or changes to Arizona guidelines (TGP 640) for evaluating, selecting PHB locations
- Recommendations for design and operation of PHBs

ADOT TGP 640 – Pedestrian Hybrid Beacons

- Traffic Engineering Guidelines and Processes (TGP)
- Evaluation guidelines for PHB locations
- Point System: 35 points (or more) justifies consideration
- Additional considerations:
 - Utility conflicts/ROW needed
 - Adjacent crossing opportunities and signals
 - Power available
 - Cost / Others

PEDESTRIAN HYBRID BEACON (PHB) EVALUATION

Location: _____ Date: _____

1. Motor vehicle crashes correctable by installation of PHB – Award 5 points for each crash (for the most recent 5 years of data) involving pedestrians, bicyclists, wheel chairs, skateboards, motorized scooters, or golf carts crossing within 500 feet on either side of the proposed PHB locations, or half the distance to the nearest signal (whichever is less): _____
 2. Peak hour pedestrian crossing volume – Award points if the average peak hour pedestrian crossing volume within 500 feet on either side of the proposed PHB location, or half the distance to the nearest traffic signal (whichever is less): _____
 0 points → 0 – 10 pedestrians per peak hour (average)
 2 points → 11 – 20 pedestrians per peak hour (average)
 4 points → 21 – 39 pedestrians per peak hour (average)
 6 points → 40+ pedestrians per peak hour (average)
 3. Location of nearest existing traffic signal or existing PHB – Award points: _____
 - 5 points → Less than 500 feet
 0 points → 500 – 1,000 feet
 5 points → Over 1,000 feet
 4. Posted speed limit – Award points: _____
 0 points → Under 30 mph
 2 points → 30 – 35 mph
 4 points → 40 – 45 mph
 5. Roadway traffic volume (AADT) – Award points: _____
 0 points → Less than 5,000
 2 points → 5,000 – 9,999
 4 points → 10,000 – 14,999
 6 points → 15,000+
 6. Raised median – Award 5 points if the roadway does not have a raised median with a minimum width of 6 feet. _____
 7. Shared-use path or walkway – Award 5 points if a designated, maintained, and permitted shared-use path or walkway crosses the road at the proposed PHB location. _____
 8. Pedestrian activity generator – Award 5 points if the proposed PHB location is within 500 feet of a senior center, medical facility, community center, school, or other pedestrian activity generator. _____
 9. Roadway illumination – Award 5 points if the proposed PHB location does not have roadway illumination. _____
 10. Crossing distance – Award 5 points if the crossing distance is greater than 36 feet. (If a raised median with a minimum width of 6 feet is present, the crossing distance is measured to the median). _____
- GRAND TOTAL** _____

PHB Evaluation Criteria

- Ped crashes (5 years)
- Peak hour crossing volume
- Distance to nearby crossing
- Posted speed limit
- AADT
- Median / Illumination
- Shared path / walkway / trail
- Pedestrian Generator
- Crossing Distance (width)

Recommended Revisions to TGP 640

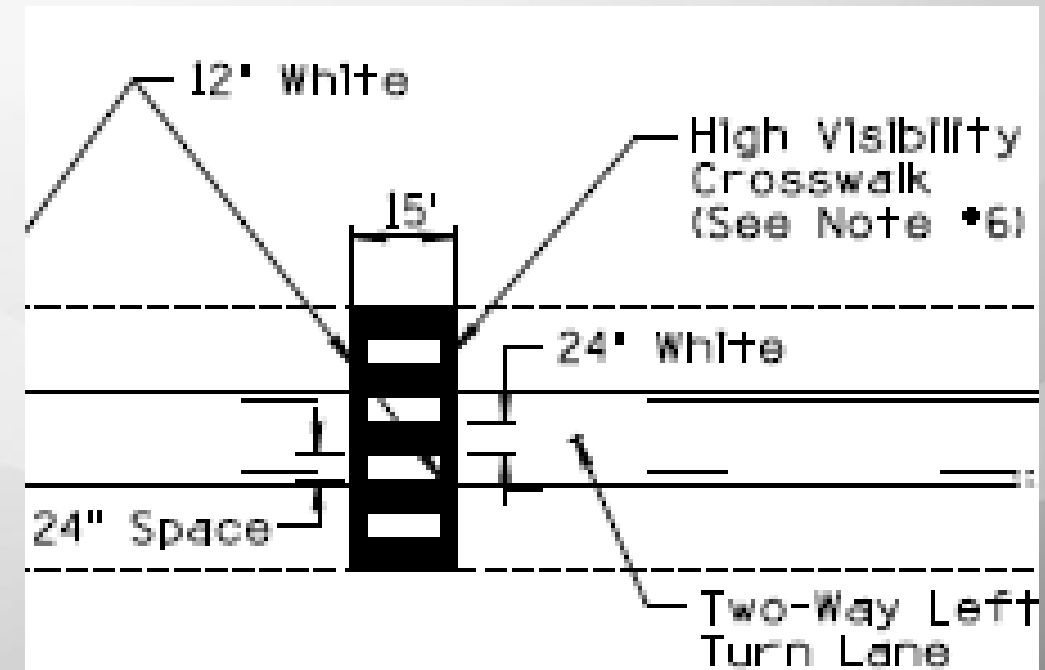
- Initial crossing assessment – consult AZ STEP Guide
- Allow with 50 MPH posted speed
- Fine-tune PHB Evaluation Form (Exhibit 640 A)
 - Conduct ped counts during peak pedestrian crossing times
 - Fine-tune points for distance to nearest signal
 - Add points for 50 mph streets
 - Revise Points for ADT Levels to match FHWA STEP Guide

Recommended Revisions to TGP 640

- Revise points for raised median – consider min 10 ft median if 40 MPH or higher street
- Add ‘church’ & ‘park’ to list of pedestrian generators
- Revise points for crossing distance to be consistent with AASHTO Pedestrian Design Guide
- Add guidance regarding latent crossing demand

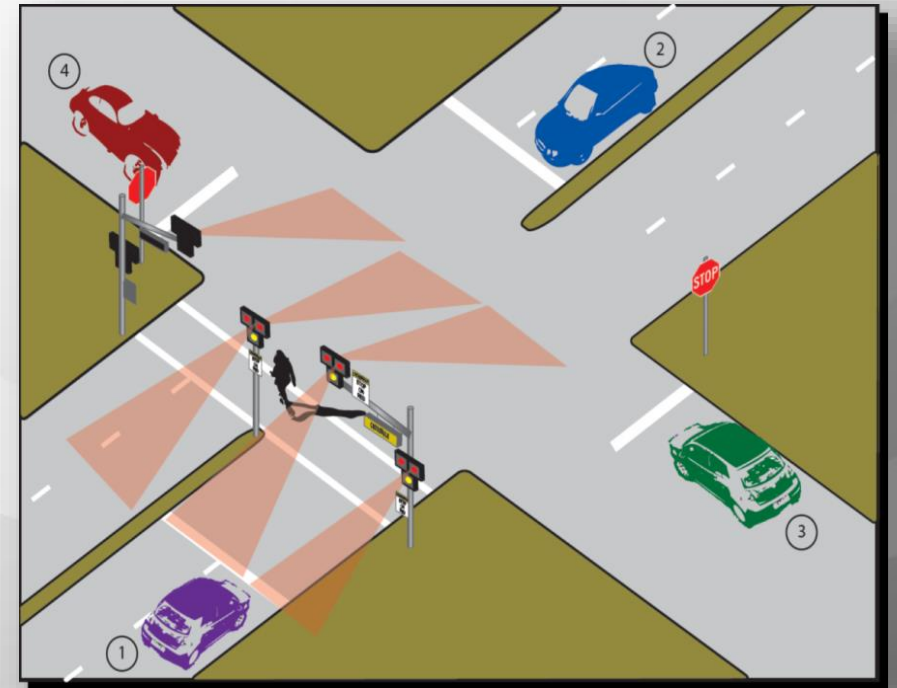
Design Recommendations

- Create PHB standard drawing
- High visibility crosswalk markings
15-foot wide ladder design
(ADOT Standard Drawing M-2)
or wider for higher speeds



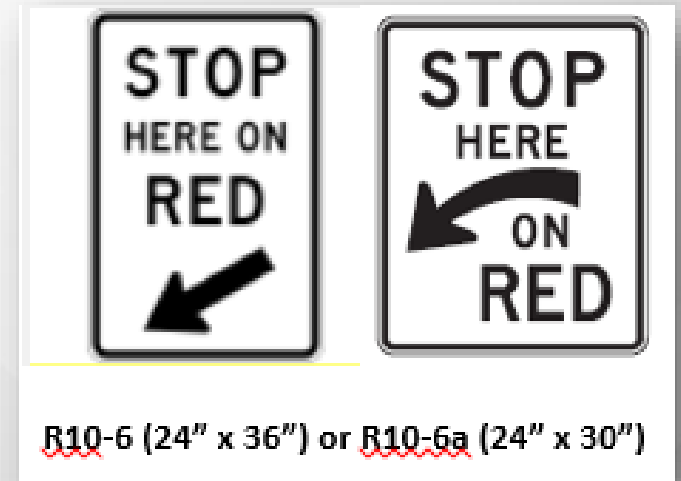
Design Recommendations

- Cross on one side of intersection
- Prohibit crossing on other side



Design Recommendations

- Advance stop line
30 to 50 ft in advance of crosswalk
40 to 60 ft in advance of mast arm
- STOP HERE ON RED sign
- CROSSWALK STOP ON RED sign (R10-23AZ)



Design Recommendations

- Consider optional sign to encourage motorists to proceed when appropriate/safe
- Add to Arizona Manual of Approved Signs (MOAS)



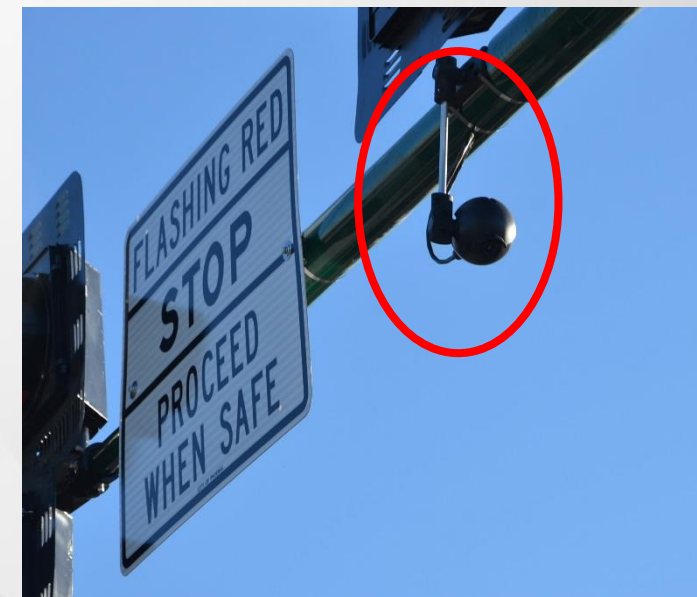
Design Recommendations

- Consider Standard Drawing with notes:
 - Street lighting (double-sided for wide crossings)
 - Number and placement of PHB signal faces
 - Backplates with reflective border (ADOT Standard Drawing T.S 8-5)
 - Optional advance warning signs
 - Spacing of PHBs to adjacent traffic signals (min 300 feet)
 - Pedestrian detection (APS pushbutton + optional passive detection)

Glendale Ave at 21st St

Optional Passive
Detection

(Infra-Red)



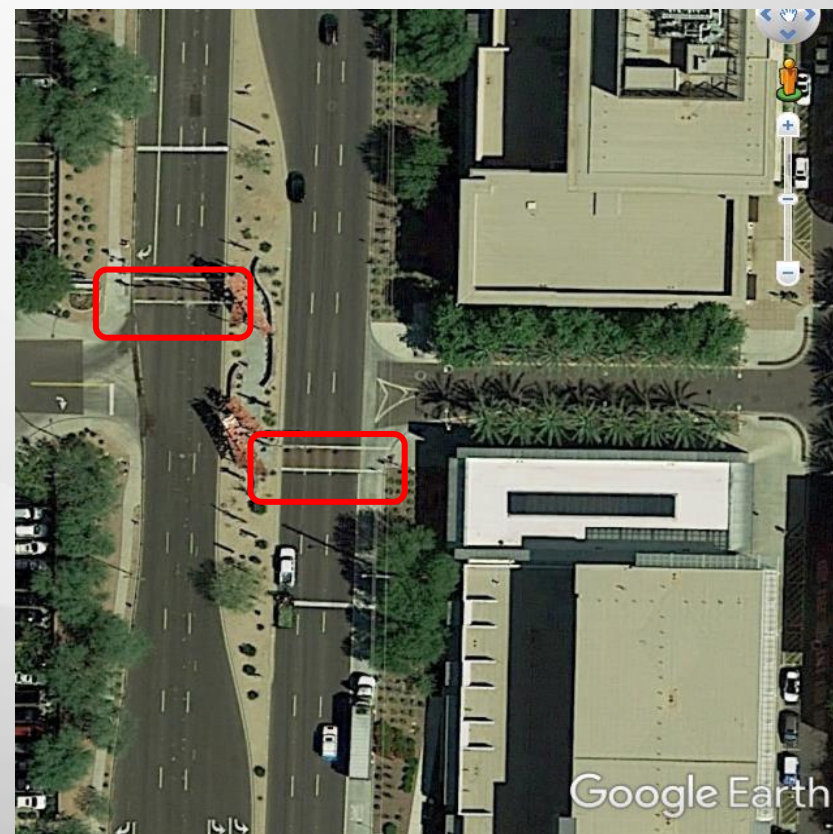
56th St North of Sweetwater Ave

Double-Sided Lighting with Overhead Utility Conflicts



Other Design Considerations

- 2-stage PHB
- Trail Crossing (BikeHAWK)



Operational Recommendations

- “Hot-Button” operation versus synchronization
 - Default – “Hot Button”
 - Synchronization during peak hours if >15,000 ADT
 - “Hot Button during off-peak hours
 - Consider synchronization if 600 ft or less to adjacent signal

Operational Recommendations

- Flashing yellow – 4 to 6 sec
- Steady yellow – 3 to 6 sec
- WALK – min 7 sec
- All-Red before start of WALK – 1 to 2 sec
- Buffer at end of clearance – 4 sec (per AZ Supplement – 4F.04)
 - May be contained within pedestrian clearance interval

Operational Recommendations

- Vehicle interval between subsequent actuations – 30 to 60 sec
- Do not use 15 MPH zones at PHBs on State highways
- Flashing yellow if conflict detected
 - Ped signal to go dark if conflict detected

Implementation Recommendations

- Review existing ADOT PHB implementation materials, other agency materials, and findings from this research
- Explore recommendations for mainstreaming PHBs into ADOT standard plans and standard details
- Fine-tune uniform selection and operational guidelines for ADOT TGP 640
- Suggest changes to training resources

Suggested Implementation Plan

- 1 - Review and finalize updates to TGP 640 & MOAS
- 2 - Create *new* standard drawing for typical applications
- 3 - Apply *new* TGP 640 evaluation criteria to candidate sites
 - Reevaluate select previously rejected candidate sites
- 4 - Develop training program for ADOT staff & consultants
 - PowerPoint Based on FHWA DPS 201, case studies, handouts
 - Present to PAG & MAG bike/ped committees & ITE/IMSA

Suggested Implementation Plan

- 5 – Schedule PHB training for ADOT staff & consultants
 - Seek FHWA assistance for workshops
 - Coordinate with FHWA Arizona Division Representative
 - PHB training for consultants
- 6 – Assess existing PHBs on State highways
 - Allow existing equipment to remain for service life
 - Changes with other scheduled maintenance
 - Review PHBs currently under design

Suggested Implementation Plan

- 7 - Review guides, pamphlets on ADOT website
 - Update AZ Driver License Manual to add info on PHBs
 - Update AZ Commercial Driver License Manual to add PHBs
 - Add questions on PHBs for the AZ driver license exam

Suggested Implementation Plan

- 8 - Develop guidance to evaluate unique PHB applications
 - Latent crossing demand
 - Conduct before/after counts to evaluate PHB effectiveness
 - 2-stage PHB crossings
 - BikeHAWK design and application
 - Develop ranking program for PHB applications

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September 2019
SPR-756



ADOT Final Report:

https://apps.azdot.gov/files/ADOTLibrary/publications/project_reports/pdf/spr756.pdf

QUESTIONS?



Discussion

⇒ **Send us your questions**



⇒ **Follow up with us:**

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