

PEDESTRIAN HYBRID BEACON (PHB)

A.K.A. HAWK

DPS 201



MODULE OBJECTIVES

- **Understand why, when and where to use PHB**
 - Warrants
 - Data needs
 - PHB location/placement
- **Understand design and operation of PHB**
 - MUTCD Standards and Guidance
- **Understand who to educate & what messages to deliver**
 - Drivers
 - Pedestrians and bicyclists
 - Police
- **Describe unique PHB applications**
 - Bike crossings/Roundabouts/two-stage PHBs

PHB (HAWK) HISTORY

High intensity Activated crossWalk



- **1st HAWK Tucson, AZ**
 - Year 2000
 - Pedestrian safety program “Watching over the Pedestrian Like a Hawk”
- **2009 MUTCD adopted HAWK as Pedestrian Hybrid Beacon (PHB)**

(The Puffin Signal is addressed later in the presentation)

REMINDER ON HOW IT WORKS



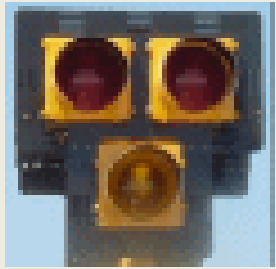
1

**Blank for
drivers**



4

**Steady
red**



2

**Flashing
yellow**



5

Wig-Wag



3

**Steady
yellow**



**Return
to 1**



WHY?

SAFETY!



CMF

Research


YIELD RATES EVEN HIGHER

Table 21. Summary of motorist yielding compliance from three sources for red signal or beacon and active when present.

Crossing Treatment	TCRP D-08/NCHRP 3-71 Study						Other Studies		
	Compliance – Staged Pedestrian Crossing			Compliance – General Population Pedestrian Crossing			Compliance – Literature Review (from Table L-1)		
	# of Sites	Range (%)	Average (%)	# of Sites	Range (%)	Average (%)	# of Sites	Range (%)	Average (%)
Red Signal or Beacon									
Midblock Signal	2	97 to 100	99%	4	91 to 98	95%	NA	NA	NA
Half Signal	6	94 to 100	97%	6	96 to 100	98%	1	99	99%
HAWK Signal Beacon	5	94 to 100	97%	5	98 to 100	99%	1	93	93%
Active When Present									
In-Roadway Warning Lights	NA	NA	NA	NA	NA	NA	11	8 to 100	66%
Overhead Flashing Beacon (Pushbutton Activation)	3	29 to 73	47%	4	38 to 62	49%	10	13 to 91	52%
Overhead Flashing Beacon (Passive Activation)	3	25 to 43	31%	3	61 to 73	67%	NA	NA	74%

CMF (CRF)

- CRF 69% pedestrian crashes
- CRF 29% all crash types
- CRF 15% all serious injury & fatal crashes


CRASH MODIFICATION FACTORS CLEARINGHOUSE

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▼ Category: Pedestrians (3)

▼ Countermeasure: Installation of a High intensity Activated crossWalk (HAWK) pedestrian-activated beacon at an intersection

CMF	CRF (%)	Quality	Crash Type	Crash Severity	Area Type	Reference	Comments
0.712	29	★★★★☆	All	All	Urban and suburban	Fitzpatrick, K., and Park, E.S., 2010	The authors of this study ... [read more]
0.849	15	★★★★☆	All	Fatal,Serious injury	Urban and suburban	Fitzpatrick, K., and Park, E.S., 2010	The authors of this study ... [read more]
0.309	69	★★★★☆	Vehicle/pedestrian	All	Urban and suburban	Fitzpatrick, K., and Park, E.S., 2010	The authors of this study ... [read more]

Fitzpatrick, K. and E. S. Park. (2010). Safety Effectiveness of the HAWK Pedestrian Crossing Treatment. Publication FHWA-HRT-10-042. FHWA, U.S. Department of Transportation.

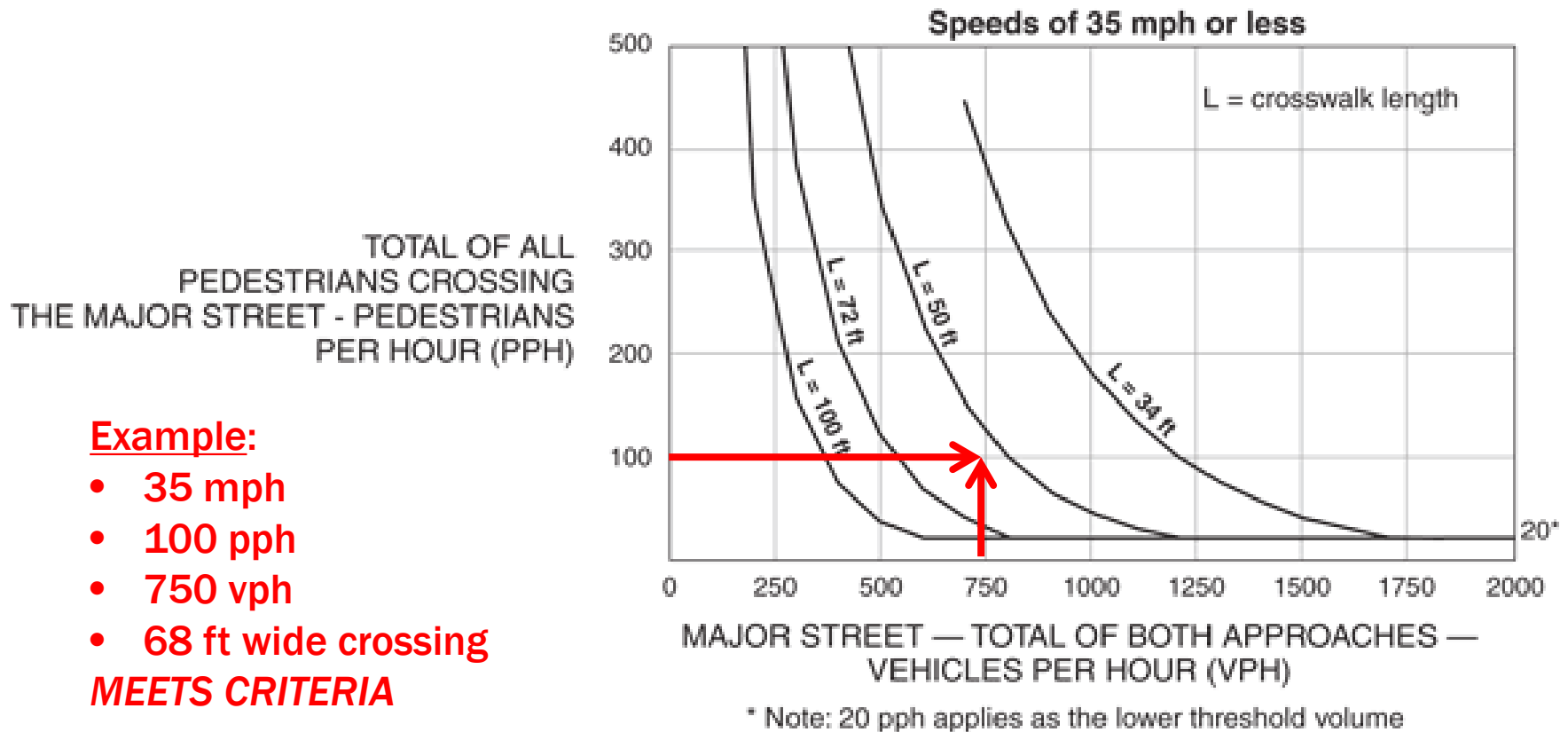
WHEN

- Pedestrians want or need to cross the high speed multilane roadways
- Crossing location doesn't meet signal warrants
- Crosswalk markings and signs just won't do
 - if there are any at all
- Pedestrians complain or crash data shows a problem



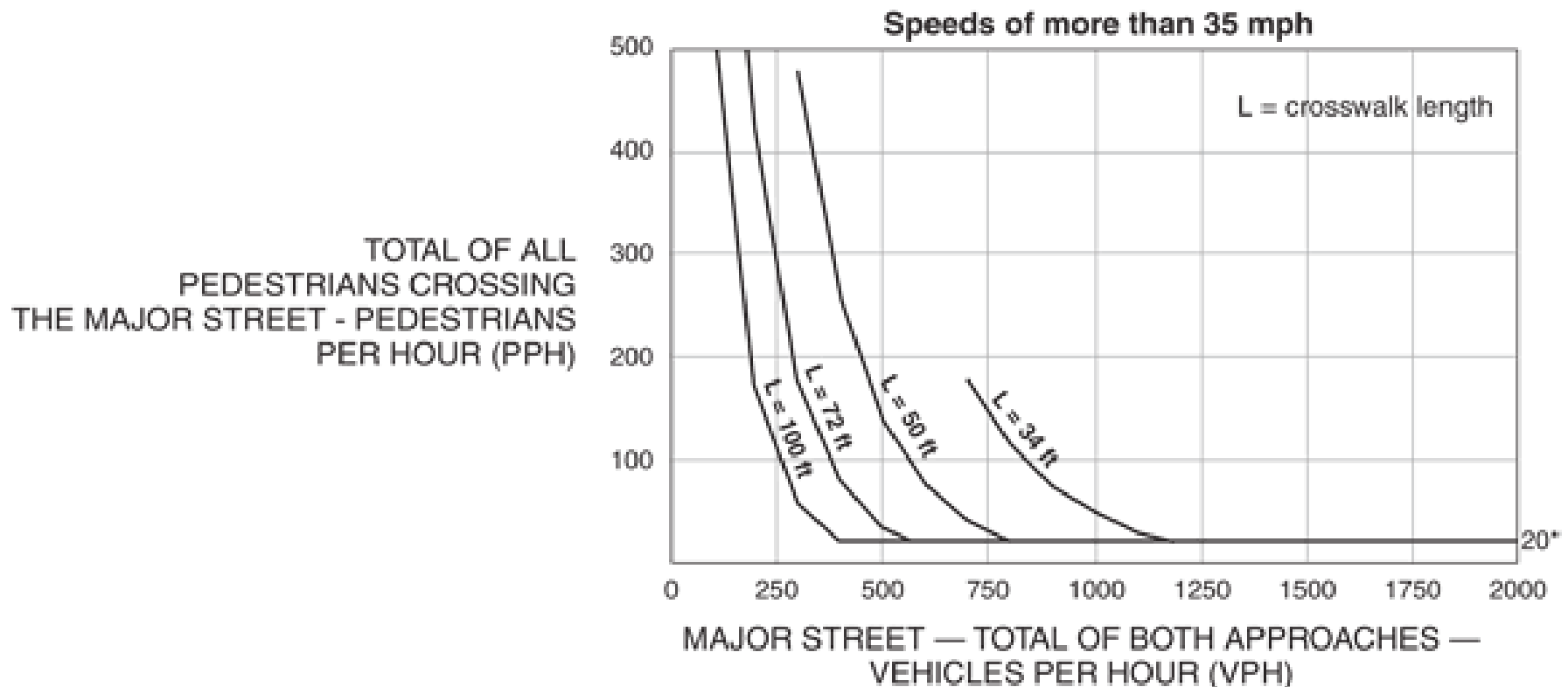
MUTCD PHB GUIDELINE – 35 MPH OR LESS

Figure 4F-1. Guidelines for the Installation of Pedestrian Hybrid Beacons on Low-Speed Roadways



MUTCD PHB GUIDELINE >35 MPH

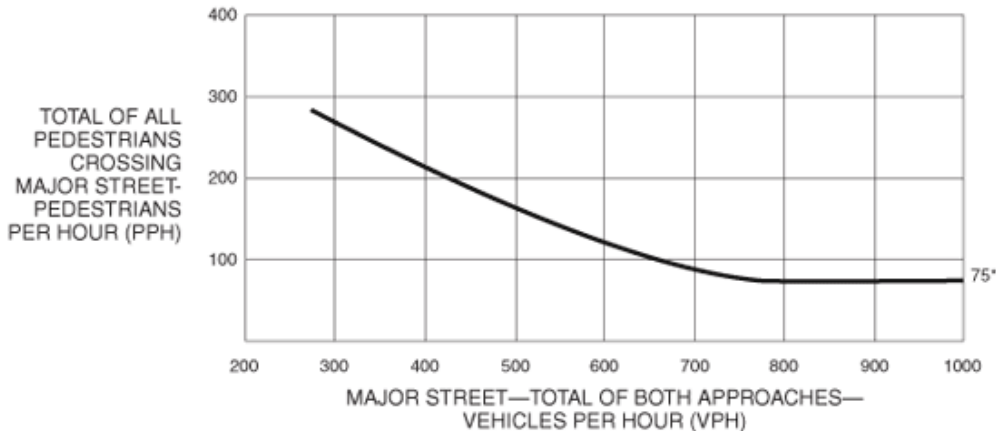
Figure 4F-2. Guidelines for the Installation of Pedestrian Hybrid Beacons on High-Speed Roadways



* Note: 20 pph applies as the lower threshold volume

SIGNAL WARRANT PEDESTRIAN VOLUME

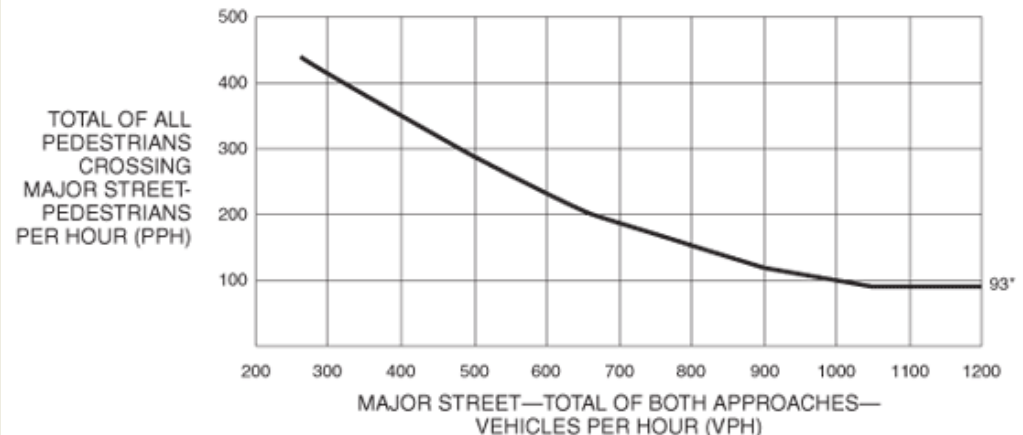
Figure 4C-6. Warrant 4, Pedestrian Four-Hour Volume (70% Factor)



*Note: 75 pph applies as the lower threshold volume.

If the posted or statutory speed limit or the 85th-percentile speed on major street exceeds 35 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, a 70% Factor can be used.

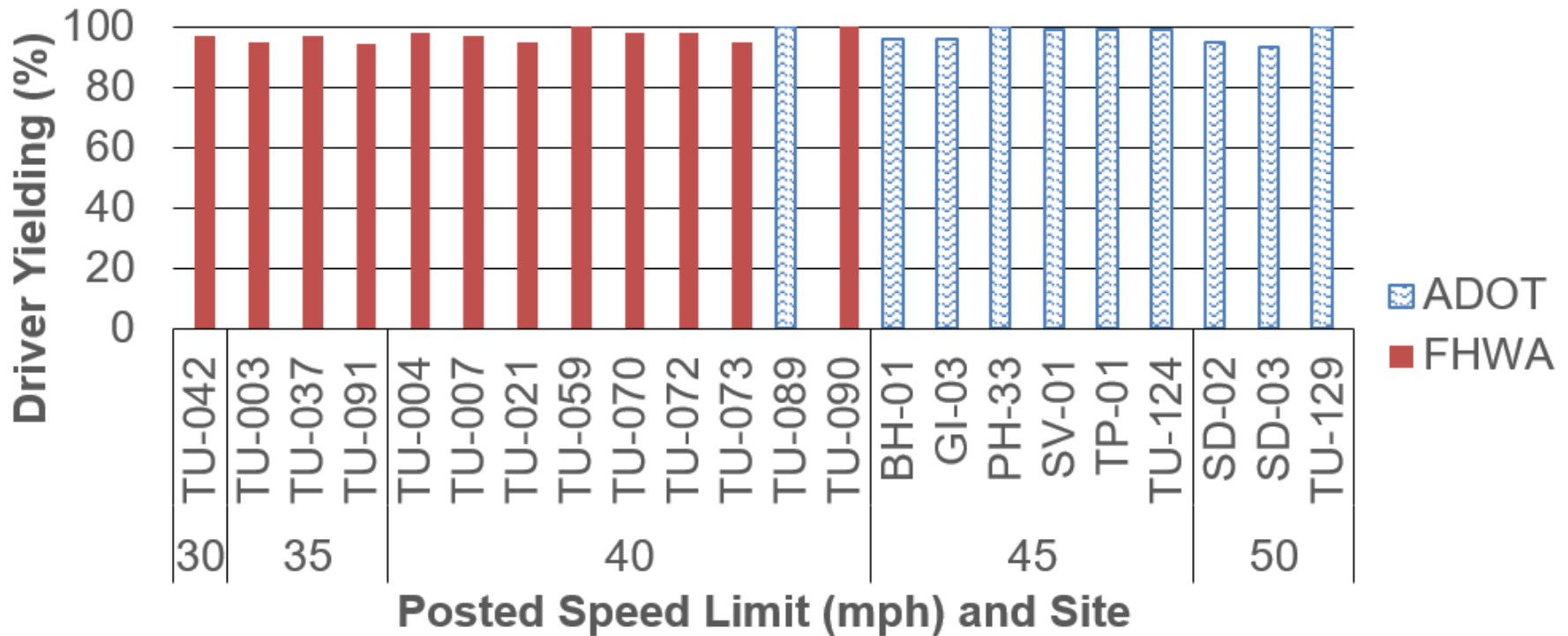
Figure 4C-8. Warrant 4, Pedestrian Peak Hour (70% Factor)



*Note: 93 pph applies as the lower threshold volume.

CAN PHBS BE USED ON HIGH SPEED ROADS?

FHWA and ADOT driver yielding studies



2019 ADOT PHB SAFETY STUDY (TTI)

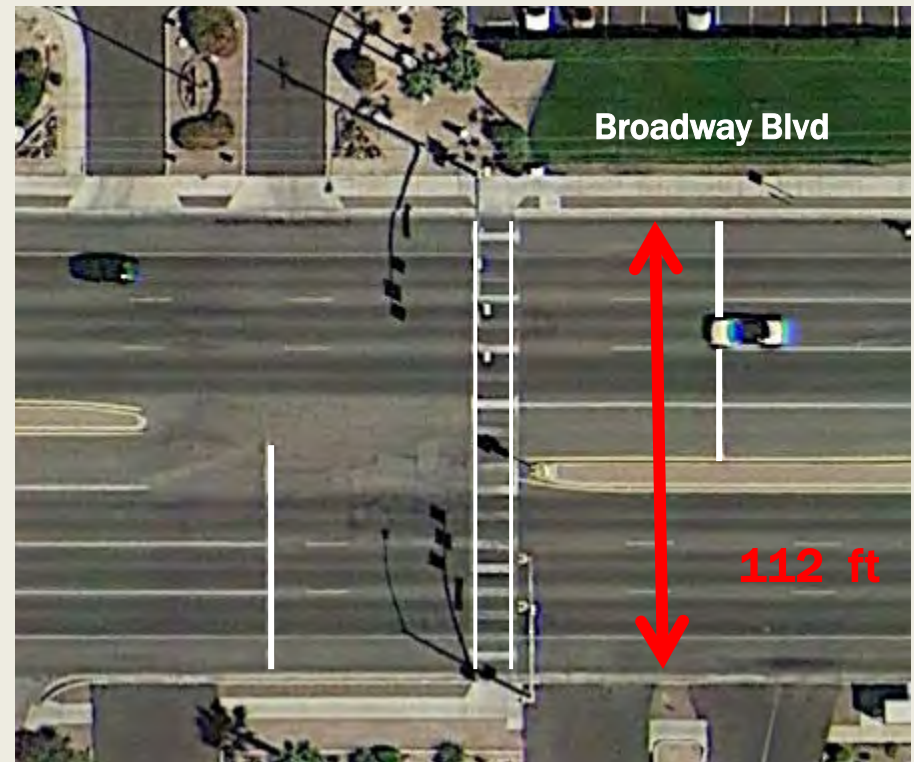
EB SAFETY – BEFORE/AFTER WITH COMPARISON SITES (SIGNAL AND NON-SIGNAL)

- **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)

CASE STUDY: PEDESTRIAN HYBRID BEACON (TUCSON, AZ)

Problem/Background

- Large percentage of residents 65 and older (retirement community)
- 6-lane divided arterial with transit lanes
- 40 mph speed limit
- More time needed to cross wide street
- Not appropriate for traffic signal



Source: Google Earth

CASE STUDY: PEDESTRIAN HYBRID BEACON (TUCSON, AZ)

Solution/ Details

- Installed PHB with PUFFIN detector logic
- PUFFIN able to detect if a pedestrian needs more time & lengthens the **red** signal
- Funded by sales tax focusing on elderly/ pedestrian safety improvements



Example of PUFFIN detector logic (circled)

CASE STUDY: PEDESTRIAN HYBRID BEACON (TUCSON, AZ)

Results

- Increased yielding rates & pedestrian safety
- Positive reception of the crosswalk
- As of June 2012, Tucson has 114 PHBs and 2 PUFFIN beacons



Pedestrian Hybrid Beacon at East Broadway Blvd.

WHERE MUTCD SECTION 4F.01

Standard:

- If used, PHBs shall be used in conjunction with signs and pavement markings to warn and control traffic.
- A PHB shall only be installed at a marked crosswalk.



MUTCD – PHB & INTERSECTIONS

- Section 4F.02, paragraph 04

Guidance:

“When an engineering study finds that installation of a pedestrian hybrid beacon is justified, then the PHB should be installed at least 100 feet from side streets or driveways controlled by STOP or YIELD signs.”

- “Guidance” not a “Standard”

- NCUTCD voted to remove that Guidance.

- **Standard** recommended for the next MUTCD by the NCUTCD:

“If a pedestrian hybrid beacon is installed at or immediately adjacent to an intersection with a side road, vehicular traffic on the side road shall be controlled by STOP signs.”

MUTCD - PHB & INTERSECTIONS

- “Guidance” not based on research from Tucson, AZ where PHB (HAWK) was developed
 - (HAWKs in TTI study were at local street intersections)
- Some State supplements have eliminated the “Guidance” statement (Arizona)
- Ultimate decision for next MUTCD up to FHWA

ADOT PHB STUDY (2019)

- 186 PHB study locations
- Cross-sectional Evaluation
- Up to 10.75 years of crash data
- **NO CRASH DIFFERENCES BETWEEN MIDBLOCK, 3 OR 4-LEG INTERSECTIONS**



SELECTION OF PHB LOCATIONS

- Prioritize warranted locations using a point system based on:
 - Traffic volume during the peak pedestrian crossing time
 - Peak hour pedestrian volume
 - Pedestrian crashes
 - Crossing width (number of lanes)
 - Distance to nearest controlled crossing
 - Posted speed
 - Presence of a raised median
 - Crossing is a designated trail, school crossing, or SRTS walking route
 - Presence of elderly or disabled pedestrians
 - Others (lighting, curved roads, other unusual road conditions, etc.)

SELECTION OF PHB LOCATIONS

- **Requires extensive data collection**
 - Pedestrian counts can be time consuming
- **Point weights and factors may vary from city to city**
- **Point weights and factors may be adjusted from year to year to fine-tune the process**
- **Ultimate selection of location(s) should be based on Engineering Judgment, not merely on points alone**

ARIZONA DOT

TGP 640 June 2015

- Ped crashes (5 yrs)
- Ped volume
- Distance to nearest signal
- Posted speed
- AADT
- Raised median
- Path/sidewalk
- Ped generator
- Crossing width

Exhibit 640-A. PEDESTRIAN HYBRID BEACON (PHB) EVALUATION

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	0

SELECTION OF PHB LOCATIONS

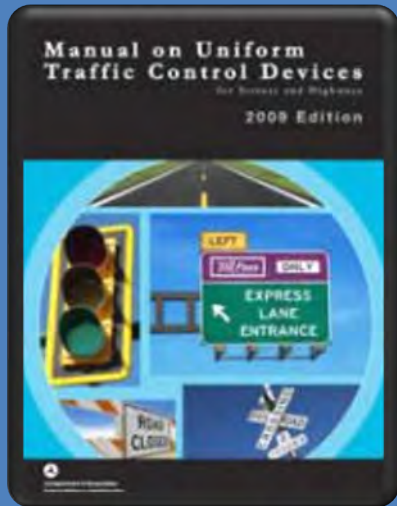
- **How long of a count is needed?**
 - **The peak crossing hour(s) must be counted.**
 - Recommend 2- to 4-hour count over the peak crossing time
 - **Determine the peak crossings hours & day for each individual crossing. Crossings fluctuate daily and the peak hour(s)**
 - May be different based on location (school vs. trail vs. CBD)

SELECTION OF PHB LOCATIONS

- Video observations can be for longer durations and may be viewed at higher speeds to reduce data collection times
 - Provide a record of the crossings and other behaviors
 - Equipment security can be an issue
- Some video equipment can do automated pedestrian counts (Miovision)

MIOVISION





DESIGN CRITERIA



MUTCD

Design &
Operation
Issues

Special
Provisions

MUTCD 4F.02

When an engineering study finds that installation of a PHB is justified, then:

- A. Install at least two PHB faces for each major street approach
- B. Install a stop line for each approach to the crosswalk



MUTCD 4F.02 CONT.

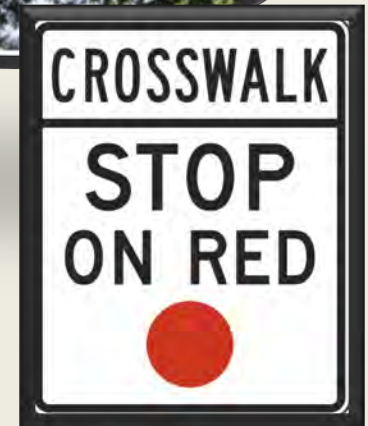
- C.** Install a pedestrian signal head at each end of the marked crosswalk, and
- D.** The PHB shall be pedestrian actuated



Mike Cynecki

2009 MUTCD MANDATED SIGN

- **Standard:**
A **CROSSWALK STOP ON RED** (symbolic circular red) (R10-23) sign shall be mounted adjacent to a PHB face on each major street approach.
- **Option:**
State MUTCD's may allow other appropriate MUTCD approved ped, bike or school crossing signs in addition to the standard R10-23 sign

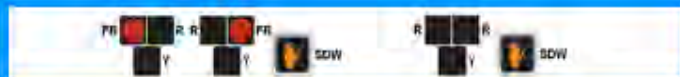


MUTCD 4F.03 CONT.

Except at roundabouts:

- **Steady DON'T WALK shall be displayed:**
 - ✓ **During PHB Blank-out**
 - ✓ **Flashing or steady CIRCULAR yellow**
- **Solid WALK shall be displayed during steady CIRCULAR RED indications**
- **Flashing DON'T WALK shall be displayed during alternating flashing CIRCULAR RED**

FHWA INTERPRETATION



FHWA August, 2011: It is our Official Interpretation that:

1. A steady RED clearance interval, in which the faces for the major street are steady RED and the pedestrian signal face are steady ORANGE UPRAISED HAND, may be inserted in the sequence of a PHB between the end of the steady YELLOW change interval and the start of the WALK interval for the pedestrian crosswalk
2. The alternating flashing RED display on the PHB faces for the major street may be extended beyond the end of the flashing ORANGE UPRAISED HAND pedestrian change interval for a brief buffer interval before the major street faces return to the dark (non-illuminated) condition .

Recomm: Use this FHWA language.



ONE OR TWO CROSSING(S) AT INTERSECTIONS

- If used at an intersection or driveway, the PHB crossing and signal equipment should only control one crossing
 - ITE Traffic Control Devices Handbook



DESIGN AND OPERATION ISSUES

- Vehicle signal indications only face major street
- STOP signs face the minor road.
- Side street indication is NOT recommended. Experience suggests that drivers will most likely abuse a dynamic signal's indication (such as a signal or illuminated no turn sign) to push their way into the major street. (TCDH 2013)

RETROREFLECTIVE BORDERS ON BACKPLATES

- 2009 MUTCD -
4D.12, Paragraph 21
Option

<http://mutcd.fhwa.dot.gov/htm/2009/part4/part4d.htm#section4D12>

- FHWA 9 proven
countermeasures

http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_007.htm

- CRF 15%



HIGH VISIBILITY MARKINGS

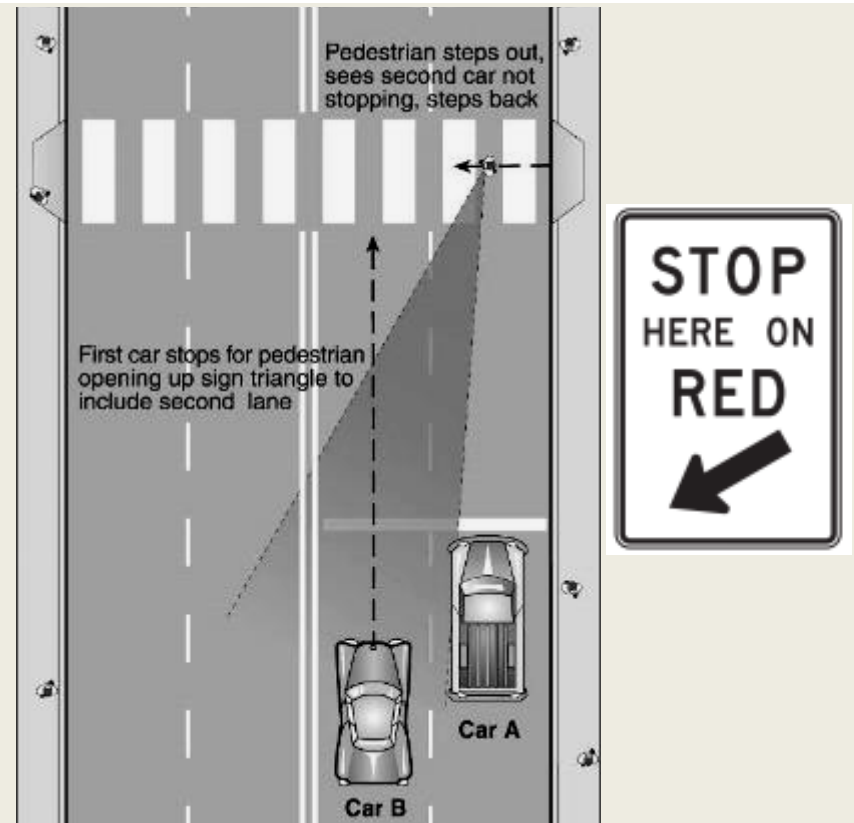
Use Ladder or Continental crosswalk markings (more visible)

- Consider advance PED XING pavement stencils
- Consider advance Ped warning signs (W11-2 or W11-15)
- Consider advance solid lane line on approach to stop line (approx. 250 ft)



DESIGN AND OPERATION ISSUES

- Place advance stop lines 50 to 65 ft in advance of the PHB mast arms along with **STOP HERE ON RED** sign
- Remove broken lane lines between advance stop line & crosswalk
 - Improves conspicuity of stop line & crosswalk



ADA

Use APS buttons for universal accessibility (PROWAG-compliant)

- Make sure ramps exist and crossing is fully accessible



Click to play 3 sample
locator tones



Click to play crossing
message

DESIGN AND OPERATION ISSUES

- **Minimum desirable WALK - 7 seconds:**
 - Consider longer WALK interval during school arrival & dismissal times if used at a school
- **Provide minimum vehicle “Go” time between PHB activations**
 - Some agencies use 50 seconds of “blank-out” time between PHB activations (Background cycle)
 - 2013 ITE TCDH: recommends 15 to 45 seconds
 - Minimum “blank-out” time between activations can be shorter during peak crossing times
 - Example: school arrival & dismissal times

DESIGN AND OPERATION ISSUES

Consider multiple timing plans if used at schools or other facilities with unique crossing patterns and peaks



PHB AS A PUFFIN: PEDESTRIAN USER FRIENDLY INTERSECTION

- PUFFIN is newer version of PHB
- Flashing **RED** can be held longer to allow slower pedestrians to cross
- Sensors connected into the system monitor pedestrian crossing movements in crosswalk
- Pedestrian clearance time for PHB based on 3.5 fps walking speed. PUFFIN timing is set for 4.0 fps; but, controller can extend the clearance time up to 3.0 fps crossing time



PHB AS A PUFFIN: PEDESTRIAN USER FRIENDLY INTERSECTION

- Microwave sensors (or video detection) aimed at crosswalk to track pedestrians and extend crossing time if needed



FLASHING RED

How to encourage drivers to proceed on flashing **red** after pedestrians have crossed:

- Public education
 - Media (newspapers, traffic PSAs)
 - Pamphlets distributed or posted on websites
 - Video (PSAs or posted on agency websites)
- Special signs posted on PHB

■ New Jersey's First PHB

- Drivers don't understand the flashing **red**
- [Video credit: njbikeped](#)
- <https://www.youtube.com/watch?v=bQdZqLDrhjc>



ENCOURAGING DRIVERS TO PROCEED

Phoenix Sign*



*No Longer Needed in Tucson after many years of Service

COORDINATION WITH ADJACENT SIGNALS

- Long delays for WALK signal may create pedestrian compliance issues
- Relatively quick WALK increases pedestrian compliance & encourages use of PHB
- If the pedestrian crosses “early”, the motorist will be stopped for no reason. This will diminish respect for PHB

Note: D.C. DOT syncs PHB with traffic signals

MAST ARM; SPAN WIRE; SIDE MOUNT



Motorists tend to run signals or beacons when not directly over the roadway

EDUCATION

AZDOT - HOW TO USE A PEDESTRIAN HYBRID BEACON - LIVE ACTION



SPECIAL PROVISIONS PRIOR TO ACTIVATING THE PHB

■ Educate users

■ Pedestrians

- Schools
- Nearby senior centers & apartment complexes
- Neighborhood associations and nearby HOAs
- Community in general

■ Motorists

Use of HAWK beacons in Alexandria

The City of Alexandria received permission from the Federal Aviation Administration (FAA) in June 2008 to experiment with HAWK beacons in more than a dozen locations identified by city traffic engineers. Data on the HAWK signal installed on Van Dorn Street – which is a pilot location for the citywide program – will be gathered by the City and provided to the FAA in accordance with the FAA's concerns.

Citizen Questions & Concerns

The City takes its role in pedestrian and traffic safety very seriously. However, the ultimate burden rests with you – motorists and pedestrians.

If you have questions, requests, or suggestions concerning traffic, contact the Transportation Division of the Department of Transportation & Environmental Services at 703-678-6411 or visit www.alexandriava.gov/HAWK.

HAWK Beacons

What you need to know

City of Alexandria
Department of Transportation & Environmental Services
703-678-6411
www.alexandriava.gov/HAWK

SPECIAL PROVISIONS PRIOR TO ACTIVATING THE PHB CONT.

■ Educate Police

- Most have never seen a PHB before & do not understand how they work
- Police must know what constitutes a violation and relevant ordinance/law
- Invite Police to activation for training
- Use Police to train other officers



SPECIAL PROVISIONS PRIOR TO ACTIVATING THE PHB CONT.

- Use local media - reporters always love a good story or breaking issue
- Videos played on agency websites or TV PSAs - mostly local cable
- Engage students and community groups in education effort
 - School class project



COST (2013)

Infrastructure	Description	Median	Average	Minimum	Maximum	Cost Unit	No. of Observations
Pedestrian Hybrid Beacon	Pedestrian Hybrid Beacon	\$51,460	\$57,680	\$21,440	\$128,660	Each	9 (9)

Source: *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public, October 2013*

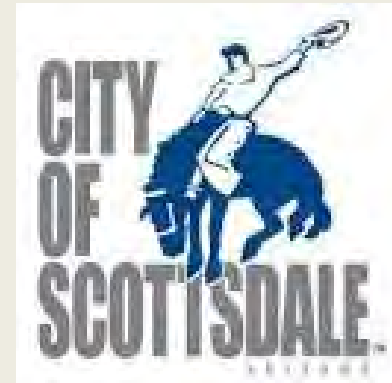
TWO-STAGE PHB

**DOUBLE HAWK
PEDESTRIAN CROSSING
(AKA PTERODACTYL)**

SCOTTSDALE CASE STUDY

TWO-STAGE PHB

- Two-stage PHB used to reduced overall stopped time for crossing a wide street.
- Each crossing requires a far shorter clearance
- Can coordinate with two-direction traffic
- Requires fencing in the median to corral peds to both crossings

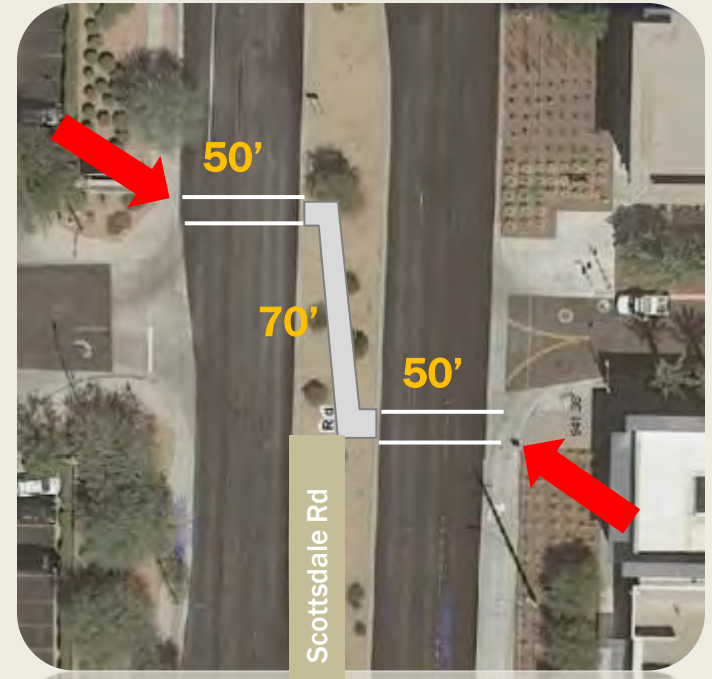


LATENT CROSSING DEMAND

- Connects two retail developments across a very busy 6-lane median divided arterial
 - 47,000 ADT
 - 6 thru lanes, 2 Right turn lanes, median
- Peak-hour “before” count was **23 crossings** during time when “NO PEDESTRIAN CROSSING” signs were in place

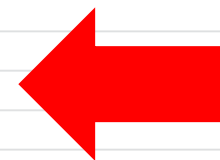


DOUBLE HAWK PEDESTRIAN CROSSING (AKA PTERODACTYL)



CASE STUDY: “AFTER” COUNTS IN 2011 WITH PHBS

HAWK CROSSING OBSERVATIONS - SCOTTSDALE					
ROAD					
Date	Hour	East to West	West to East	Total Per Hour	
Thursday, Dec. 8	9:00-10:00	11	13	24	
	10:00-11:00	15	22	37	
	11:00-12:00	28	34	62	
	12:00-1:00	72	75	147	
	1:00-2:00	82	68	150	
	2:00-3:00	72	56	128	
	3:00-4:00	69	57	126	
	4:00-5:00	47	36	83	
	5:00-6:00	34	39	73	
	6:00-7:00	32	48	80	
	7:00-8:00	47	32	79	
	8:00-9:00	31	26	57	
	9:00-10:00	3	7	10	
10:00-11:00	10	2	12		
Total		553	515	1068	Avg. = 76 Peds per/hr
Saturday, Dec. 10	11:00-12:00	72	79	151	
	12:00-1:00	112	112	224	
	1:00-2:00	164	122	286	
	2:00-3:00	201	190	391	
	3:00-4:00	167	187	354	
	4:00-5:00	166	139	305	
5:00-6:00	115	134	249		
Total		997	963	1960	Avg. = 280 Peds per/hr



ROUNDABOUTS & PHB

PHB AT ROUNDABOUT

HAWK signals

High-intensity Activated cross-Walk



PHB AT ROUNDABOUTS: OPTION

■ Option:

- If installed at a roundabout and an engineering study determines that pedestrians without visual disabilities can be allowed to cross the road with out actuating the PHB, the pedestrian signal may be dark (not illuminated) when the PHB faces for motorists are dark



**PHB BIKE APPLICATION
EXPERIMENTAL
(BIKE HAWK)**

PHB AS BIKE CROSSING

- Move bicycles to one side of the street for the crossing (if at an intersection)



BIKEHAWK CROSSINGS

Normal PHB with Bike Facilities and R9-5 for cyclists to use pedestrian signals



BIKEHAWK CROSSINGS

Provide actuation devices that are accessible to bicyclists
with R9-5 sign



Compliance is in the 90% range & near 100% with families and children

BIKEHAWK CROSSINGS

Communicate to bicyclists with R9-5 sign



QUESTIONS