

Tucson BikeHAWK: Adapting the Pedestrian Hybrid Beacon to Assist Bicyclists in Crossing Arterial Streets 2024 Update

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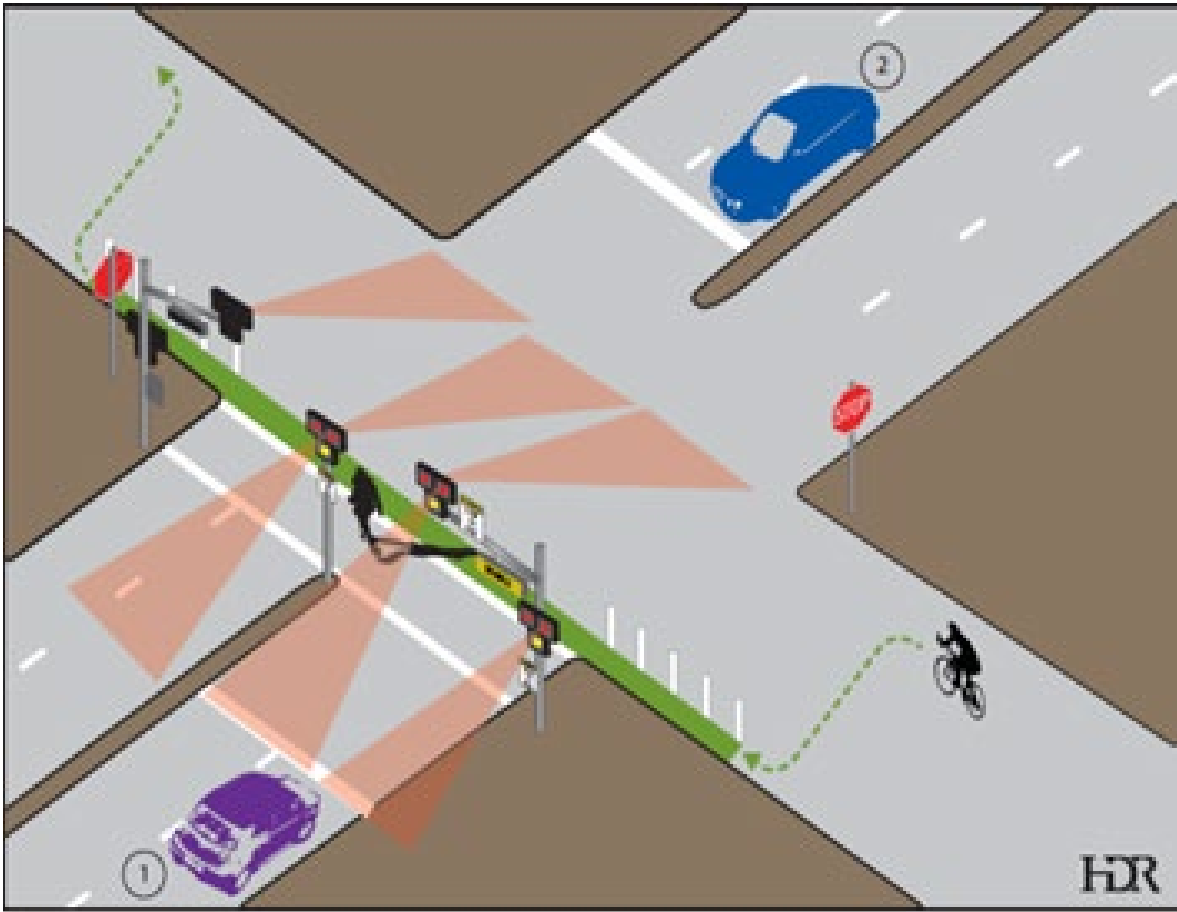
EXECUTIVE SUMMARY:

The operation of the Tucson BikeHAWK, crash history, usage, and compliance:

- *There have been NO cyclists related crashes over the last 6 years (even during the pandemic times) and 96% of the riders use the BikeHAWK as intended.*
- *Basically, 100% of family riders with children or children alone use the BikeHAWK as intended.*
- *94% of the crossers were bicyclists and 6% were pedestrians generally at Bike Boulevard crossings.*
- *The device was found to be easily understood by all users and bicyclists who followed the designated paths with ease. The high level of understanding was most likely because the BikeHAWK was designed based upon their natural behavior that was observed while crossing at HAWK controlled crosswalks.*
- *There continues to be the normal high level of driver compliance to the HAWK crossing device, especially at the higher-speed crossings. Driver yielding compliance still consistently remains within the range from 97% to 100% yielding at HAWKs and BikeHAWKs. A new technique has dramatically increased pedestrian compliance which increased from approximately 70% to over 90% with the “HOT” button operation with minimal loss in arterial LOS. “HOT” button operations have been recommended by FHWA at such pedestrian crossings that respond promptly to the pedestrian’s or cyclist’s call button for service. (Automated pedestrian activation was experimented with, however there were many missed or false calls. It was found, especially true during the hot Tucson summers, pedestrians do not wait at the curb, but in the nearest shade to wait for the HAWK beacon to activate when in coordination mode.)*
- *50% of riders using the BikeHAWK were males, 46% were females, and 6% were children. (This level of female ridership is significantly higher than the historical Tucson average regional percentage of 26%. The higher percentage is considered an indication of perceived safety by cycling experts)*

The key elements of the BikeHAWK design include:

- *A short, separated green protected two-way contra-flow bike lane to position bicyclists into an area delineated by flexible posts associated with the HAWK controlled pedestrian crossing.*
- *Placement of curbside signal detection buttons within easy reach of bicyclists and “HOT” button operation.*
- *Use of green pavement markings in a high-visibility crosswalk pattern adjacent to the high-visibility white crosswalk.*
- *Supplemental (CMS) illuminated sign to support the (R9-5) sign’s understanding and enforcement.*
- *MUTCD-approved signs and pavement markings reminding bicyclists to ride with traffic after the crossing has been completed and it is safe to make the maneuver (R5-1b and R9-3cP).*



One of the first BikeHAWKs serving Pima Community College and Medical/Social Services Facility at W. Speedway and N. 10th Avenue

HISTORY LEADING UP TO THE TUCSON BIKEHAWK

The Pedestrian Hybrid Beacon (PHB) or HAWK has been successfully used by communities around the nation to facilitate safe, convenient crossings of busy, high-speed roadways by pedestrians since its inclusion in the 2009 edition of the Manual on Uniform Traffic Control Devices (MUTCD). While not excluding their use, standard PHBs or HAWKs have never explicitly accommodated another vulnerable large user group in need of the same facilitation to cross arterials: bicyclists. In 2012, as part of the bicycle boulevard program, the City of Tucson began efforts to modify selected PHBs or HAWKs to allow for the clear and safe crossing of both user groups.

Starting in the 1980s, the City of Tucson shifted its focus from simply providing bike lanes along arterial and collector roadways to identifying existing residential streets that could be enhanced to provide a network of calm, low-stress bikeways. Having identified these routes (now termed bike boulevards), the city endeavored to improve this network by reducing intruding automobile traffic, encouraging bicyclist use, and most critically, addressing how to safely and conveniently cross major streets where they intersect these bike boulevards.

BACKGROUND OF TUCSON BIKEHAWK

The HAWK crossing was instituted by the city of Tucson as a pedestrian safety program of “Watching Over the Pedestrian Like a Hawk.” The hawk is part of local Indian lore that watches over the children and mother earth. The beacon light was developed to protect the pedestrian crosswalk, not operate an intersection. The first HAWK beacon pedestrian crossing was installed in early 2000. Later as bicycle boulevards were developed city wide, we found that cyclists were traveling along these residential streets using the HAWKs to cross the major streets, so the city developed modifications at the HAWKs to facilitate the bicycle crossings that matched their natural behavior patterns. Thus, the first BikeHAWK design modification in 2012 was in conformance with the 2009 MUTCD’s guidance and was connected to the HAWK’s controller’s pedestrian crossing’s signals. The BikeHAWK is a HAWK with an added two-way protected contra-flow bike lane, curb-side push buttons within easy reach to call the pedestrian phase along with MUTCD R9-5 signs and GREEN pavement high visibility stripes adjacent to the WHITE high visibility pedestrian crosswalk. Thus, the BikeHAWK facilitates the crossing of both cyclists and pedestrians. There are over two dozen currently in operation and more scheduled for installation.

MUTCD TEAM, RSA REVIEW and LEGAL OPINION

A MUTCD Team Member came to Tucson in June of 2015 to view the operation and examined one of the first BikeHAWK installations. There was an agreement that the design modifications were in substantial conformance with the 2009 MUTCD’s guidance. He also had further recommendations for consideration regarding a supplemental (CMS) illuminated bike informational sign, to supplement the R9-5 sign’s meaning to the crossing public.

As you know, late entries by pedestrians happen with the current pedestrian and countdown signals at traditional traffic signals as well as PHBs. We were concerned about the same late entries during the flashing red phase of the HAWK with bicycles. The city had spent extensive time monitoring bicycle activity at the existing HAWK crossings and bicycle usage. The cyclists were already crossing at HAWKs safely. There was a desire to try to further encourage safe crossings as part of the cyclist's natural behavior with the BikeHAWK modifications. We considered additional signing, doubling up on pedestrian signal heads, and/or bike signals. Additional oversize signing was installed. The doubling-up of pedestrian signals did not provide further explanation of the cyclists' responsibilities and the supplemental illuminated (CMS) sign focused upon that need. Bicycle signals were problematic. The FHWA Bicycle Facilities and the MUTCD, summary table in 2012-3 noted that FHWA has discontinued the approval of experiments with bicycle signals at PHBs and further noted that: *"Bikes can be assisted in crossing a roadway by a pedestrian hybrid beacon type of device at the present time."*ⁱ

The city then examined supplemental illuminated (CMS) sign design for the bicycle crossing in addition to the MUTCD pedestrian signals, that further explained the R9-5 sign's legal responsibilities upon cyclists. It was noted that the 2009 MUTCD allowed local jurisdictions to provide signs with special word messages to assist in enforcement and understanding of regulations. The 2009 MUTCD further provided guidance that (CMS) signs may be used as a supplement to conventional signs. The MUTCD Team Member suggested consideration of an illuminated one color (WHITE) expanded verbiage message for the supplemental CMS sign. The city considered the recommendation, hired an expert traffic engineering firm to complete an RSA, Road Safety Audit of the Tucson BikeHAWK technique.ⁱⁱ

The engineering study noted that the use of a two-color supplemental illuminated sign that would indicate when bikes must "WAIT" or when it was "OK" to proceed would be better understood than the suggested single (WHITE) color expanded message. There was a danger of a potential human factors failure by showing the "proceed" message and "wait" message in the same white color. It was felt that the two colors from the approved pedestrian signal would be better understood by the public. The MUTCD R9-5 sign says "BIKES (SYMBOL) USE PEDESTRIAN SIGNAL", The pedestrian signal displays an ORANGE indication for the wait message and WHITE indication for the proceed message thus the supplemental illuminated sign with the same colors will further emphasize the MUTCD R9-5 message. The RSAⁱⁱⁱ further recommended that, to accommodate bicyclists, the supplemental bicyclist changeable message sign (CMS) should be required, and the supplemental sign was powered in parallel with the pedestrian signal circuit insuring full coordination between all the traffic control devices.

o "A changeable message sign for bicyclists at the BikeHAWK should display a different color during the crossing or "go" time and the bicycle clearance interval (the displays both should not both be white – otherwise a bicyclist may confuse one message with the other or may not distinguish the two different messages. The use of different colors for different messages would also be a benefit for those who are proficient in English and for those with vision limitations."

o *“The amount of words on the changeable message sign should be minimized to make the sign more readable and minimize the size of the housing. The word message recommended by the FHWA Team Representative (“BIKES USE PED SIGNAL” during the WALK interval and a “BIKES WAIT AT CURB” message during the pedestrian clearance interval) may make a changeable message sign rather large or result in the words being too small to distinguish. Fewer words are better to see and comprehend.”*

o *“A bicycle signal is contraindicated for this BikeHAWK since it is located at an intersection crossing be the best option at an intersection crossing and there is a concern that a side street motorist may inadvertently confuse a red/yellow/green bicycle signal with a motor vehicle signal. The FHWA Interim Approval IA-16 (and current MUTCD) for bicycle signal faces prohibits the use of a bicycle signal face at a Pedestrian Hybrid Beacon, which is the design that a BikeHAWK is based upon. Since the BikeHAWK is used at a local street intersection where motorists approach from the side street, the FHWA prohibition in IA-16 has merit.” (It was noted that there can be an unintended consequence of side street driver violations of the STOP sign, conflicts with crossing pedestrians and cyclists when the GREEN light is seen by drivers on the residential street.)*

The flashing of the BIKES WAIT change interval was considered for the supplemental illuminated (CMS) sign and engineering judgement/human factors supported the use of the MUTCD approved flashing interval to call attention to the change interval just as is done with the pedestrian signal to further supplement and support the R9-5 sign’s meaning.

Review by the Tucson City Attorney’s Office reaffirmed the engineering study’s recommendations supporting the supplemental illuminated (CMS) sign to explain and enforce the regulatory sign. The police department’s review indicated they needed the regulatory supplemental (CMS) sign to enforce the R-5 sign in accordance with state law,^{iv} since cyclists’ responsibilities are silent in the statutes regarding pedestrian signals.

11th Edition MUTCD (2023)

The language in the new 11th Edition of the MUTCD further supports the concept of a supplemental illuminated TCD to educate the cyclists as to the R9-5 sign’s meaning and assist in the enforcement the crossing since pedestrian indications are silent concerning cyclists’ legal responsibilities.

The need for the additional supplemental illuminated sign traffic control device has been further emphasized in the MUTCD Bicycle part. Section 9E.08 discusses Counter-Flow Lanes and has a standard that requires appropriate traffic signaling oriented toward the cyclists in the counter-flow lane, including a method for cyclists to actuate the phase for the counter-flow movement. However, in section 4H.02 bicycle signals are specifically prohibited from use at PHB or HAWK crossing beacons.

Thus, the next possible alternative presents itself in section 2A.02 Design of Signs, where state and local agencies may develop special word legends signs in situations where engineering judgement determines roadway conditions make it necessary to provide additional regulatory or

warning information about a situation that might not be readily apparent. Part 2L, Changeable Message Signs notes, users of (CMS) are expected to consult the other chapters in this Manual for criteria on how to develop effective messages that comply with this Manual and that meet the expectancy and limitations of the road user. The 11th Edition of the MUTCD further lists under a support section that the purpose of the (CMS) is to provide real-time traffic regulatory, warning, or guidance messages as clearly identified under letters G and H. The development of the supplemental illuminated sign (CMS) at the Tucson BikeHAWK falls well within the concepts in the new MUTCD and the need to educate and enforce the safe use of the crossing, especially the MUTCD R9-5 sign regulations.

CRASH EXPERIENCE

The city of Tucson recently forwarded a crash summary for HAWKs, and BikeHAWKs, covering 2018 to 2023, including the meteoric rise in crashes during the pandemic. There has only been one fatal crash at a BikeHAWK crossing. **It is critical to note that the pedestrian failed to activate the signal beacon, was crossing against the light, NO cyclist was involved, and the driver complied with his legal duties.**

Witnesses told the police the pedestrian was attempting to cross a six-lane divided arterial (posted at 40 mph) at night. Unfortunately, the pedestrian **did not activate** the PHB or HAWK beacon system and entered the crossing against all of the traffic control devices. Even though the street was lit, the approaching driver did not notice the pedestrian in time to avoid a crash. See the following crash summary table from the city with the specific crash highlighted.

Thus, the most recent crash records show the design is very safe and there have been **(0) zero** cyclist related crashes over the last 6 years at the Tucson BikeHAWKs, even including the unprecedented spike in pedestrian and bike crashes nationwide during the pandemic years as well as Tucson.

The Pima County medical examiner noted an abnormal increase in drugs or alcohol involved in the region's pedestrian crashes.^v Pima County just like other regions of the nation encountered a significant increase in traffic crashes. The County Medical Examiner noted: homelessness, gender, time of day and substance abuse were all factors involved in many, if not all of the crashes.

There.have.been.
ZERO.cyclist.
related.crashes.
over.the.last.②
years.at.the.
BikeHAWKs

At.one.BikeHAWK.crossing.
a.fatal.pedestrian.crash.
occurred;.No.cyclist.was.
involved.™.the.signal.
beacon.had.not.been.
activated.by.the.crossing.
pedestrian.who.crossed.
against.the.light.at.night;.

City of Tucson Fatal and Injury Crashes at HAWK and BikeHAWK Locations 2018 - 2023

| Year | Location | Manner* | Activated |
|-------------|------------------------------------|---|------------------|
| 2018 | NONE | N/A | NA |
| 2019 | 3333 N Flowing Wells Rd | In crosswalk. HAWK not activated | NO |
| 2020 | 8111 E. Broadway Blvd | Family of three crossing in activated HAWK. Two children struck. One dies. | YES |
| 2021 | S Sahuara Av & E 22nd St | Pedestrian crossing in activated HAWK struck and killed | YES |
| 2021 | N Alvernon Wy & E Flower St | Pedestrian crossing in activated HAWK struck and killed | YES |
| 2021 | W Valencia Rd & S San Fernando Ave | Pedestrian crossing in diagonal green bike marking portion of crossing struck and killed. BikeHAWK not activated | NO |
| 2022 | E Grant Rd & N Palo Verde Av | In crosswalk. HAWK not activated | NO |
| 2022 | E Broadway Bl & E Old Spanish Tr | Pedestrian crossing in activated HAWK struck and killed | YES |
| 2022 | E 26th St & S Craycroft Rd | Pedestrian crossing 20-feet north of HAWK not activated struck and killed | NO |
| 2023 | E Speedway Bl & N Dodge Bl | Pedestrian (70 y/o Female) crossing south to north in activated HAWK crossing struck and killed | YES |

**Most of the fatal crashers at activated HAWKs involve hit and run crashes*

If the HAWK and BikeHAWKs are properly installed to manage a crossing and not a full intersection they can be a very successful traffic safety tool when they are activated by the crossers and drivers obey the RED beacon lights.

PROFESSIONAL PUBLICATIONS and OUTREACH

The city continues to provide outreach to the profession concerning the success of this project. For your informational files, the Tucson BikeHAWK has been published for the transportation professions' information in the:

- FHWA and UNC Highway Safety Research Center's, Pedestrian and Bicycle Information Center, https://www.pedbikeinfo.org/resources/resources_details.cfm?id=4950
- Rob Sanders, the creator, and host of Road Guy Rob, prepares a video series in which he strives to show "today's cutting-edge developments in transportation engineering." The BikeHAWK operation can be seen in, "*Stop Lights can Ruin the street for bicycles*" https://www.google.com/search?q=BikeHAWK+and+TOUCAN+stop+light+can+ruin+a+street&rlz=1C1ONGR_enUS1087US1088&oq=BikeHAWK+and+TOUCAN+stop+light+can+ruin+a+street&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIJCAEQIRgKKGKABMgkIAhAhGAoYoAEyCQgDECEYChigATIJCAQQIRgKKGKAB0gEKNjA5NTRqMGoxNagCALACAA&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:38ee1019,vid:Dk8uhfCtM0,st:0
- The BikeHAWK was recently again recognized in the NCUTCD, Journal of Traffic Control Device Research, in 2023. <https://ncutcdjournal.org/index.php/jtcd>
- The Mountain Section of ITE and ISMA has the Tucson BikeHAWK and TOUCAN presentation scheduled for the 2024 Spring session.

ⁱ Bicycle Facilities and the Manual on Uniform Traffic Control Devices 2009, Tabular summary of bicycle and pedestrian projects, www.fhwa.dot.gov/bicycle_pedestrian_guidance/design

ⁱⁱ Pima Association of Governments, Mini-RSA Broadway Blvd at Treat Avenue BikeHAWK Crossing, Final Report, January 22, 2016, by Lee Engineering, Phoenix, Arizona

ⁱⁱⁱ Ibid page 23-24

^{iv} Legal Opinion Re: HAWK Bicycle Signing, City of Tucson Attorney's Office, A0117558

^v Arizona Daily Star, Pima County, Medical Examiner: An in-depth look at fatal pedestrian accidents in 2022, <https://www.kold.com/2022/12/31/medical-examiner-an-in-depth-look-fatal-pedestrian-accidents-2022/>