A Score- and Traffic Gap–Based Alternative Warrant for PHBs

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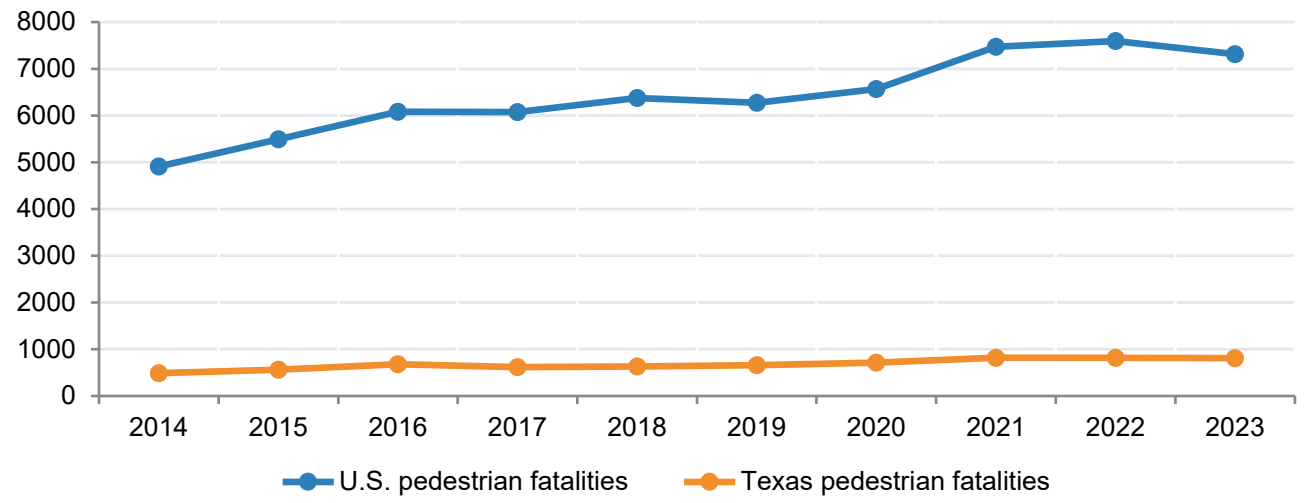
Pedestrian Fatality Trends and Risk Exposure

Pedestrian fatality trends (3)



U.S. pedestrian deaths (2023)
7,314

Texas pedestrian deaths (2023)
810

Key implication
Exposure is not the full story

Trip-level risk snapshot

Driving

~85% of trips
33,672 annual fatalities
~142 fatalities per 1B trips

1.0x baseline risk

Walking

~6.8% of trips (2)
7,318 annual fatalities
~383 fatalities per 1B trips

2.7x relative risk

Pedestrian Crossing Treatment Comparison

Treatment comparison

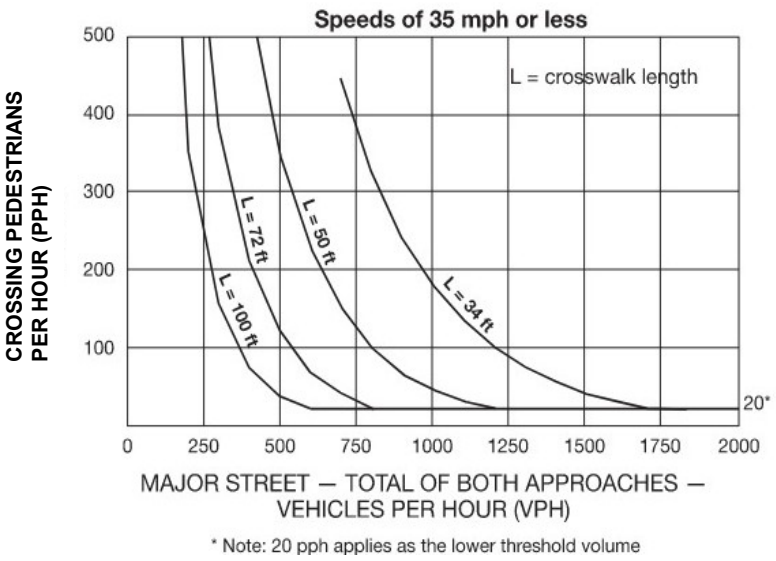
Crossing type	Driver compliance	Crash reduction factor
Uncontrolled Crosswalk	0% to 30% (4)	Not established
RRFB	32% to 96% (4)	7% to 47.4% (9)
PHB	**62% to 98% (4)**	**11.7% to 56.8% (4)**
Conventional Signal	93% to 100% (4)	15% to 65% (5) & (7)

Why this matters:

- PHB compliance is well above uncontrolled crossings.
- Reported crash reductions support treatment consideration.
- Conventional signals set the ceiling; PHBs offer a strong middle ground.

Current MUTCD PHB Warrant and Kinetic Energy Relationship

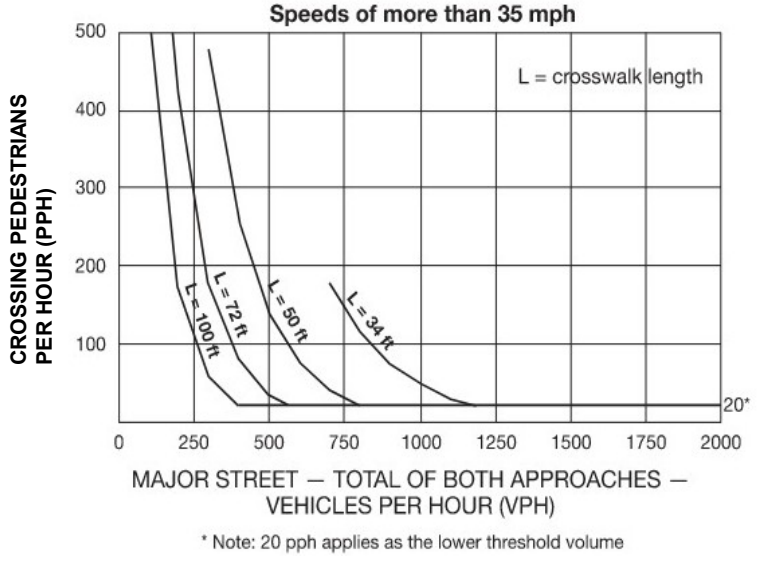
MUTCD PHB warrant guidance



Traffic volume alone is an imperfect proxy

Traffic gaps are a better indicator than traffic volume of pedestrian crossing opportunity and safety.

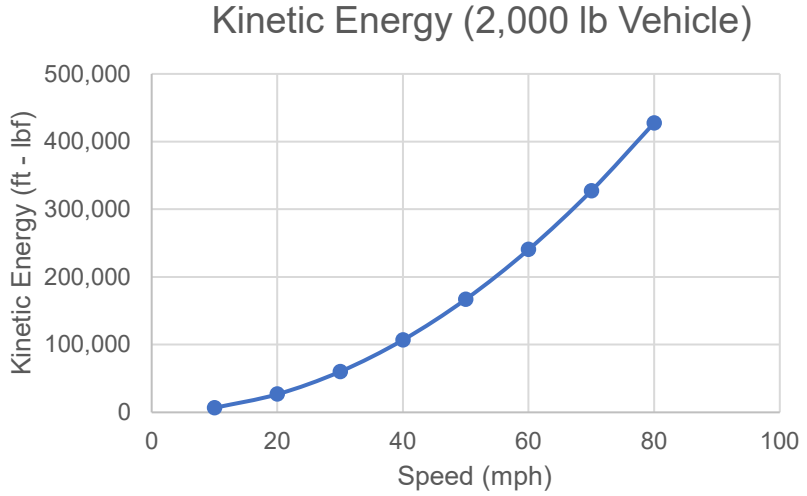
MUTCD PHB warrant guidance



Discouraged pedestrians are missed

The current curves do not account for pedestrians who choose not to cross because conditions already feel unsafe.

Study-developed kinetic energy graphic



Impact energy 'rises' with the square of speed

Crash impact energy is proportional to $\frac{1}{2} * mass * velocity^2$, so speed can dominate risk even when other inputs look moderate.

Bottom line: gap quality, suppressed pedestrian demand, and crash severity support a more explicit scoring framework than the current warrant alone.

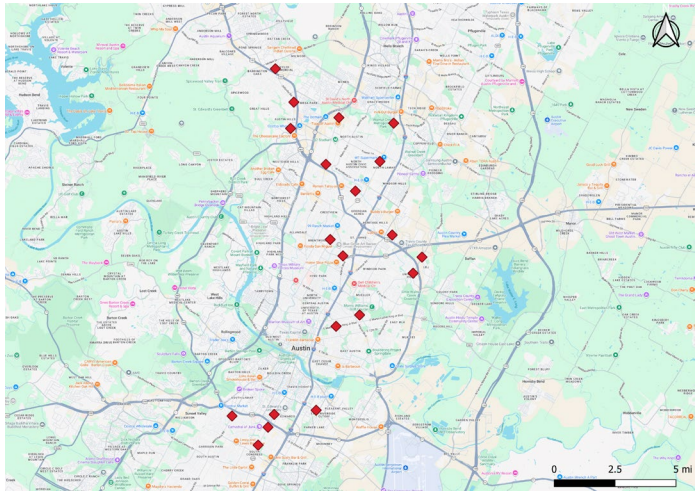
Study Design and Data Collection

Study frame

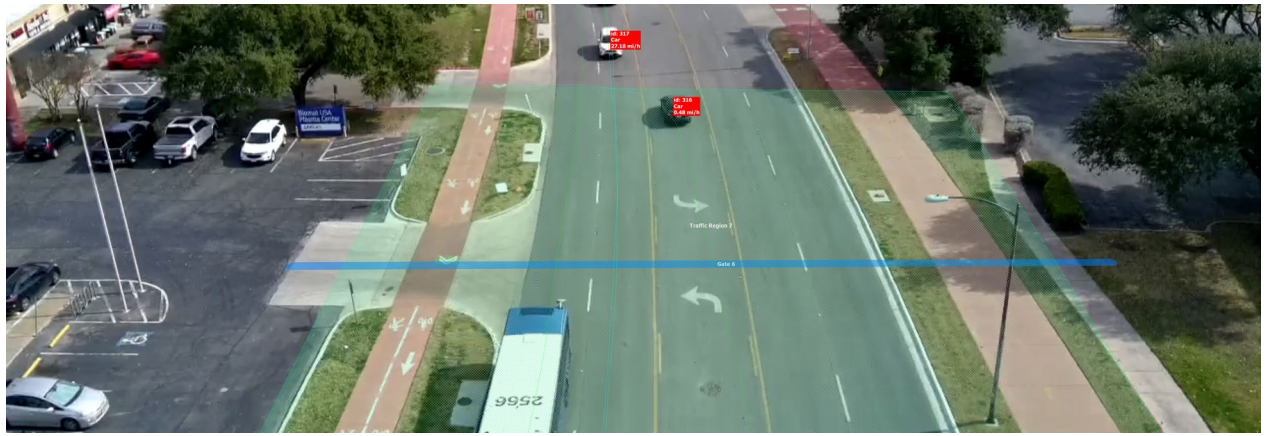
City	Sample	Window	Crash history
Austin	**n = 20 sites**	**60 min**	**10 yrs**

- Study focus: midblock pedestrian crossings in Austin
- Sample size: 20 one-hour observation sites
- Collected per site: 60-minute traffic volume and available traffic gaps
- Site selection: at least one pedestrian crash in the past 10 years

Study locations



Example site view

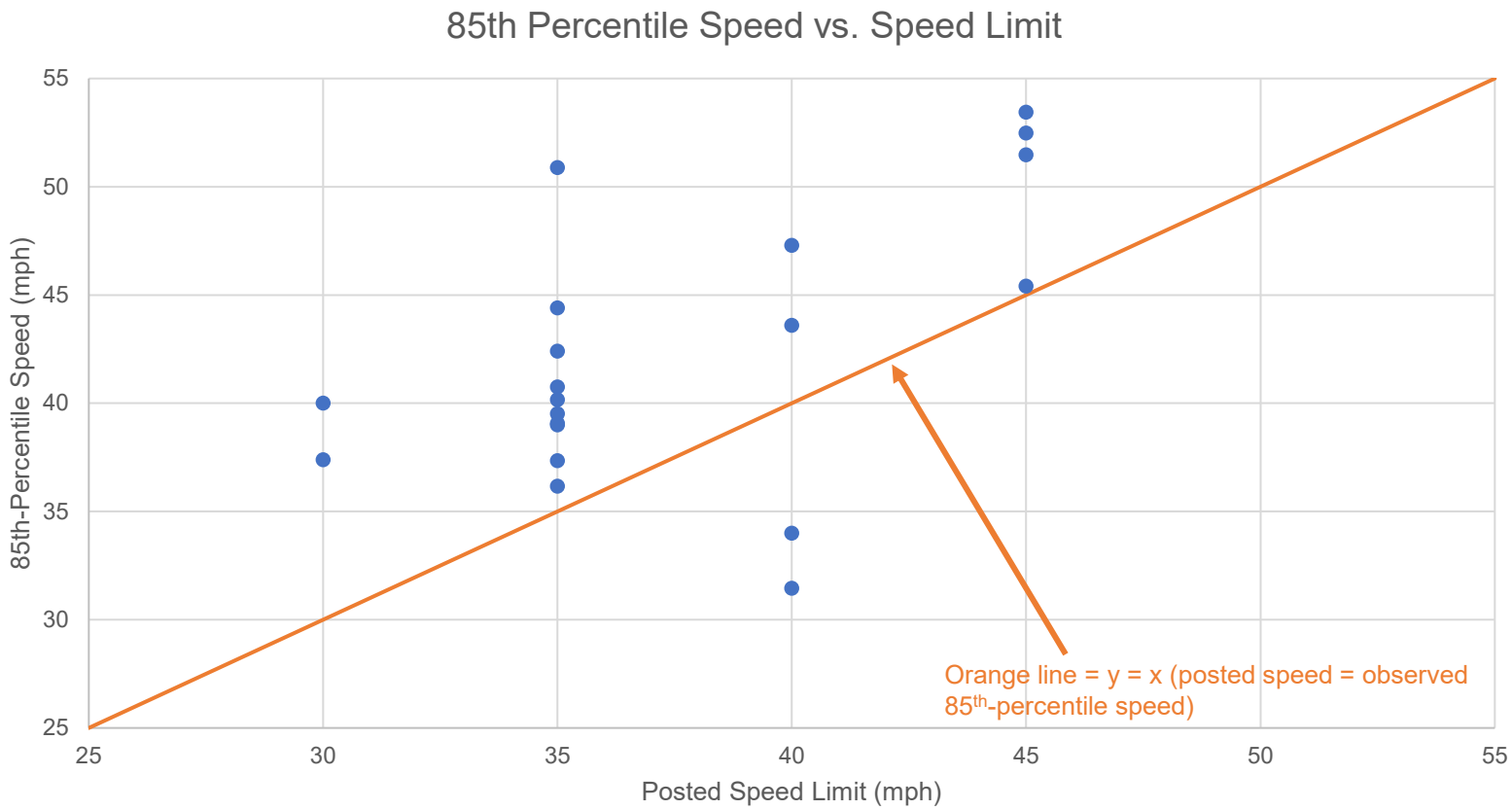


85th Percentile Speed vs. Speed Limit Summary Statistics (paired speed comparison)

Key statistics

Metric	Result
Sample size (n)	**20**
Wilcoxon signed-rank statistic (W)	**183**
Two-sided p-value	**0.0023**
One-sided p-value (85th-percentile > posted)	0.0012
Mean difference (85th - posted, mph)	**+4.81**
Median difference (85th - posted, mph)	**+5.46**
Difference range (mph)	−8.55 to 15.88
Interpretation	Observed 85th-percentile speed significantly exceeds posted speed

Observed relationship



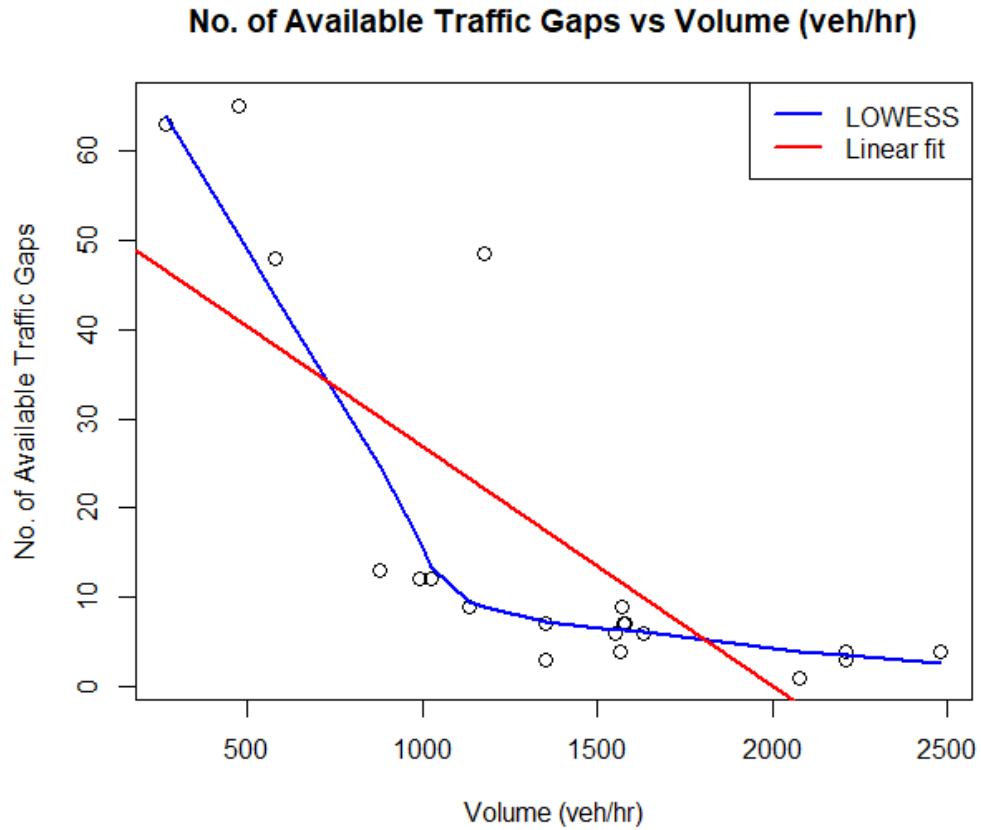
Mean difference (mph)	One-sided p-value	Wilcoxon W
+4.81	**0.0012**	**183**

Available Traffic Gaps vs. Traffic Volume Summary Statistics (Linear Associations)

Key statistics

Metric	Result
Sample size (n)	**20**
Pearson correlation (r)	**−0.759**
95% CI for r (Fisher)	[−0.899, −0.476]
p-value for r (H_0: ρ = 0)	**(p < 0.001)**
Linear slope, β_1 (gaps per veh/hr)	−0.0268
95% CI for slope	[−0.0381, −0.0154]
R^2 (Adj. R^2)	0.576 (0.552)
RMSE of linear fit (gaps)	13.23

Observed relationship



Correlation (r)	p-value	Adj. R^2
−0.759	**< 0.001**	**0.552**

Proposed Warrant Overview: Categories and Variables

Analysts select one range for each measured variable. The total score then rolls up to a single warrant category for consistent comparison across crossings.

Optional	Recommended	Critical
0–44	45–74	75–100

Measured variables

Available traffic gaps
60-minute available traffic gap band

Pedestrian crossing volume
Peds + bikes + scooters; 60 min; 500 ft

Pedestrian generator/attractor density level
Density and cross-road balance within 500 ft

Proximity to nearest signalized crossing
Distance band to nearest signalized crossing

85th-percentile speed
Operating-speed band

Crash history
5 years; 500 ft

Percent trucks (%)
60-minute truck share

Lighting
Nighttime lighting condition

Warrant category

The three warrant categories are intentionally simple:

- Optional
- Recommended
- Critical

That makes the framework easier to explain to analysts, reviewers, and decision-makers.

One scorecard per crossing

Scoring Weights and Override Logic

Maximum points by Variable

Pedestrian generator/attractor density level	**25**
Available traffic gaps	**22**
Pedestrian crossing volume	**20**
85th - percentile speed	8
Crash history	8
Lighting	8
Proximity to nearest signalized crossing	6
Percent trucks (%)	3

Overrides

Critical override A

0–10 available traffic gaps + 16 or more pedestrians + (85th-percentile speed of 46 mph or higher, or 1 or more crashes) → Critical even if total score is below 75.

Recommended override B

0–10 available traffic gaps + (6 or more pedestrians, or pedestrian generator/attractor density level is Moderate or High) → At least Recommended even if total score is below 45.

Decision flow

Select one range per Variable → **Add points** → **Assign preliminary warrant category** → **Check override A or B** → **Set final warrant category**

Pedestrian Generator/Attractor Density Level

Scoring classes

Major	**7 pts**	School, university, grocery, hospital, major park
Moderate	**4 pts**	Transit stop, library, daycare, shopping strip
Minor	**1 pt**	Single retail, restaurant, office, convenience use

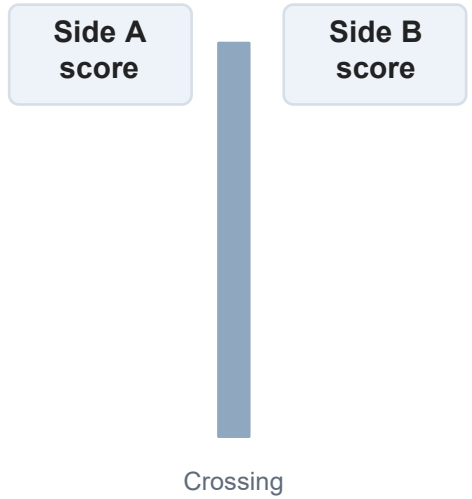
How to quantify it

1. Inventory qualifying generators/attractors within 500 ft on Side A and Side B.
2. Count activity nodes—not every tenant or building.
3. Score each node as 7, 4, or 1.
4. Sum Side A and Side B separately, then cap the combined raw score at 25.

Raw total = min[(Side A score + Side B score), 25]

Side-balance check

Crossing demand should reflect activity on both sides of the roadway.



High density requires meaningful activity on both sides—not just a high total on one side.

Density-Level Conversion

Low

Raw total: 0–5, or one side = 0

Cannot rate above Low if activity is effectively one-sided.

5 / 25

Moderate

Raw total: 6-11, or 12-25 with lower side = 1–3

Both sides contribute, but the lower side does not qualify for High.

14 / 25

High

Raw total: 12-25 with lower side ≥ 4

Use High only when total activity is strong and both sides are meaningfully active.

25 / 25

Suggested analyst rule: score Side A and Side B separately, then assign the density level from the combined total and the lower-side minimum.

Measuring Available Traffic Gaps over a 60-Minute Period

Screening equation

$$Required\ traffic\ gap\ (s) = \frac{curb - to - curb\ distance\ (ft)}{walking\ speed\ ft/sec} + 3s \quad (10)$$

Count a traffic gap as usable when the observed gap is at least as long as the required crossing time.

HCM-Based Guidance

- Use an HCM-based pedestrian crossing-time threshold for unsignalized crossing screening.
- Use 3.5 ft/s for the general pedestrian population.
- Where older pedestrians are expected, 3.0 ft/s is the value most directly aligned with FHWA/HCM-related guidance.
- A more conservative local assumption such as 2.5-3.0 ft/s may be used if site context or policy justifies it.

Field use in the 60-minute count

1. Measure curb-to-curb crossing distance.
2. Select the walking-speed assumption (3.5 ft/s by default; 3.0 ft/s where older pedestrians are expected; 2.5 ft/s if using a more conservative local assumption).
3. Compute the required available traffic gap.
4. Count all observed traffic gaps in the 60-minute period that meet or exceed that threshold.

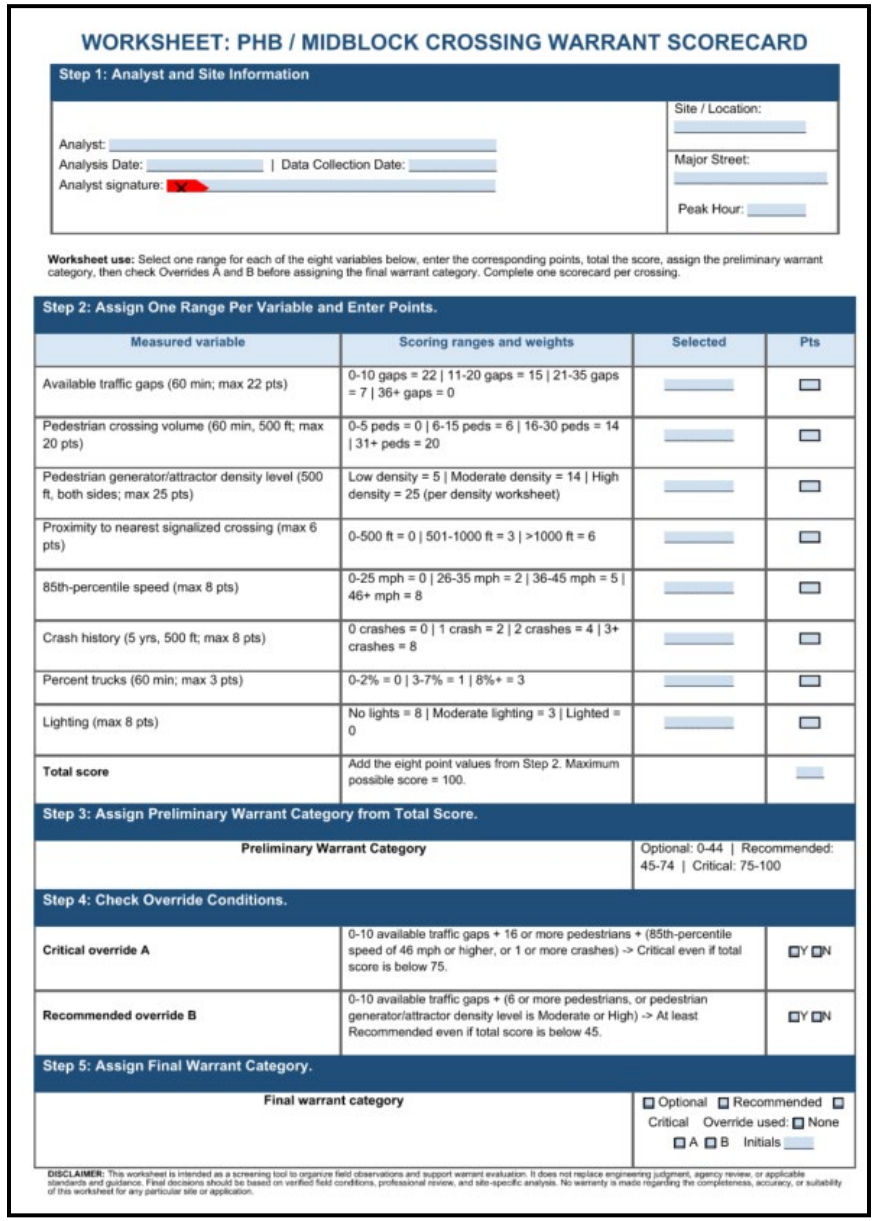
Quick example

Example: 40-ft curb-to-curb crossing

- At 3.5 ft/s: 40/3.5 + 3 = 14.4 s
- At 3.0 ft/s: 40/3.0 + 3 = 16.3 s
- At 2.5 ft/s: 40/2.5 + 3 = 19.0 s

Use 3.0 ft/s for older populations if you want to stay closest to current official guidance.

Scorecard Worksheet



WORKSHEET: PHB / MIDBLOCK CROSSING WARRANT SCORECARD

Step 1: Analyst and Site Information

Analyst: _____

Analysis Date: _____ | Data Collection Date: _____

Analyst signature: _____

Site / Location: _____

Major Street: _____

Peak Hour: _____

Worksheet use: Select one range for each of the eight variables below, enter the corresponding points, total the score, assign the preliminary warrant category, then check Overrides A and B before assigning the final warrant category. Complete one scorecard per crossing.

Step 2: Assign One Range Per Variable and Enter Points.

Measured variable	Scoring ranges and weights	Selected	Pts
Available traffic gaps (60 min; max 22 pts)	0-10 gaps = 22 | 11-20 gaps = 15 | 21-35 gaps = 7 | 36+ gaps = 0		☐
Pedestrian crossing volume (60 min, 500 ft; max 20 pts)	0-5 peds = 0 | 6-15 peds = 6 | 16-30 peds = 14 | 31+ peds = 20		☐
Pedestrian generator/attractor density level (500 ft, both sides; max 25 pts)	Low density = 5 | Moderate density = 14 | High density = 25 (per density worksheet)		☐
Proximity to nearest signalized crossing (max 6 pts)	0-500 ft = 0 | 501-1000 ft = 3 | >1000 ft = 6		☐
85th-percentile speed (max 8 pts)	0-25 mph = 0 | 26-35 mph = 2 | 36-45 mph = 5 | 46+ mph = 8		☐
Crash history (5 yrs, 500 ft; max 8 pts)	0 crashes = 0 | 1 crash = 2 | 2 crashes = 4 | 3+ crashes = 8		☐
Percent trucks (60 min; max 3 pts)	0-2% = 0 | 3-7% = 1 | 8%+ = 3		☐
Lighting (max 8 pts)	No lights = 8 | Moderate lighting = 3 | Lighted = 0		☐
Total score	Add the eight point values from Step 2. Maximum possible score = 100.		____

Step 3: Assign Preliminary Warrant Category from Total Score.

Preliminary Warrant Category	Optional: 0-44 | Recommended: 45-74 | Critical: 75-100

Step 4: Check Override Conditions.

Critical override A	0-10 available traffic gaps + 16 or more pedestrians + (85th-percentile speed of 46 mph or higher, or 1 or more crashes) -> Critical even if total score is below 75.	☐Y ☐N
Recommended override B	0-10 available traffic gaps + (6 or more pedestrians, or pedestrian generator/attractor density level is Moderate or High) -> At least Recommended even if total score is below 45.	☐Y ☐N

Step 5: Assign Final Warrant Category.

Final warrant category	☐ Optional ☐ Recommended ☐ Critical Override used: ☐ None ☐ A ☐ B Initials ____

DISCLAIMER: This worksheet is intended as a screening tool to organize field observations and support warrant evaluation. It does not replace engineering judgment, agency review, or applicable standards and guidance. Final decisions should be based on verified field conditions, professional review, and site-specific analysis. No warranty is made regarding the completeness, accuracy, or suitability of this worksheet for any particular site or application.

Strengths and Limitations of the Proposed Warrant

Strengths

- Ranks crossings by priority
- Captures speed, crash, and gap risk
- Adds context from nearby signals and generators
- Provides a transparent, repeatable screen
- Supports phased funding implementation

Limitations

- Data collection can take time
- Field work and analysis add cost
- Some inputs still require judgment
- Site conditions can change over time
- Local calibration may still be needed

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Thank you!

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