Portland Bureau of Transportation

Safe Streets Opportunities Analysis methodology

November 13, 2025

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The Portland Bureau of Transportation's (PBOT) Safe Streets Opportunities Analysis comprised two phases. The first phase, Tiered High Injury Segments phase, defined a high injury network with segment lengths roughly half a mile to a mile. These lengths are at a scale appropriate for quick build or smaller capital projects. Additionally, segments that are adjacent to each other may be considered for larger capital projects. The second phase, the Safe Streets Opportunities Score phase, entailed an infrastructure assessment of missing safe street design features. Each of the high injury segments was scored based on safe infrastructure needs to meet PBOT guidelines. These guidelines were defined by PBOT groups in Planning, Engineering, Signals and Street Lighting, and speed limit guidance from the City Traffic Engineer.

The goal of the analysis is to prioritize interventions based on crash severity (Tiered High Injury Segments) and where the opportunities to improve safety are greatest (Safe Streets Opportunities Score). The methodology was developed by PBOT's Vision Zero team which includes a data analyst, traffic engineer, and transportation planners.

Tiered High Injury Segments

Definition

The high injury segments are defined by a weighted crash score. The top 150 miles of streets with the highest weighted crash scores make up the Tiered High Injury Segments. The highest weighted crash scores on the top 50 miles of segments are Tier I, followed by the next 50 miles for Tier II, and the last 50 miles for Tier III. Crashes were analyzed for the most recent five years of data available from the Oregon Department of Transportation (ODOT) and the most recent calendar year of fatal crashes.

Incorporating the fatal crash data for the recent calendar year is an interim solution to account for a 12- to 18-month delayed release of crash data from ODOT. A project that is underway to upgrade ODOT's Crash Analysis Reporting System will eliminate this delay in the future.

Segment creation

The roadway network in Portland was segmented by street name and number of lanes into lengths between 2000 and 6000 feet long. The number of travel and center turn lanes is a proxy for roadway width and safe streets design potential. For lengths more than 6000 feet, additional segmentation incorporated major intersections, rivers and/or bridges to reduce lengths. Some streets in which a bus lane or short stretch (<500 feet) of an additional travel lane approaching an intersection were merged to adjoining segments to create lengths of 2000 feet or more. Finally, segments shorter than 2000 feet were removed from further analysis. Separated highways, interstates, and interstate ramps were excluded from analysis. However, crashes at the intersection of interstate ramps and surface streets were evaluated and assigned to the intersecting surface streets.

Crash score weighting

Crash weighting (Figure 1) was selected after testing three weighting alternatives – the weighting selected and displayed in Figure 1, a weighting that also included motor vehicle/motorcycle injuries, and a weighting that also included property damage only crashes. The PBOT Vision Zero team selected the crash weighting in Figure 1 because it aligns with PBOT's Vision Zero-focus crash approach. Modeling of the other crashes did not improve identification of serious injury and deadly crash locations. Lastly, the weighting aligns with Oregon Metro (the local metropolitan planning organization) High Injury Corridor crash concentration weighting.

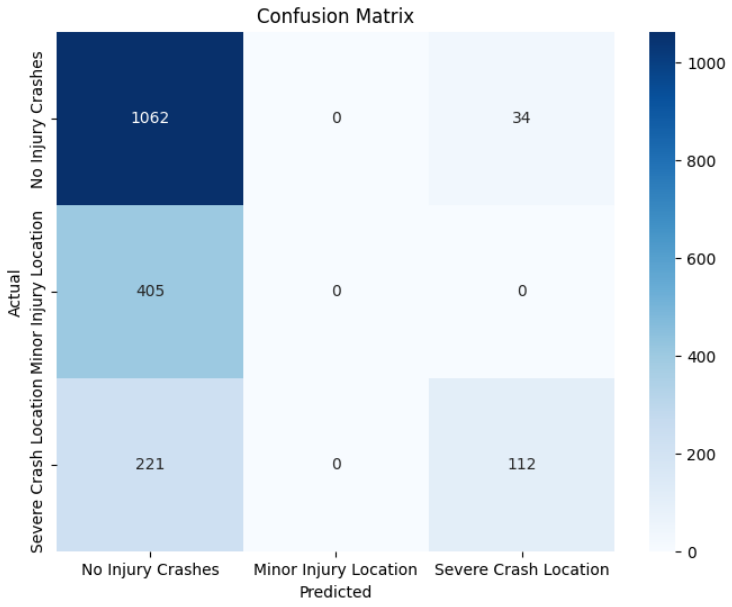
Figure 1 Crash weighting

Crash type	Weighting
Death	10
Serious Injury	10
Bike / Ped minor or moderate injury	3
Injury all other modes	-
Non-injury collisions	-

To understand the influence of non-injury crashes and low- and moderate-injury motor vehicle crashes, the Vision Zero team conducted additional intersection crash modeling.

Regression modeling showed that the number of property damage only crashes in Portland were not strongly correlated with deadly and serious injury crashes (r^2= 0.38). Minor injury crashes of all travel modes were also not strongly correlated (r^2 = 0.42). Logistic regression modeling using property damage-only crashes to predict severe crash locations resulted in a high rate of false negatives for labeling severe crash locations, Figure 2. Modeling used a 20-year crash dataset for the City of Portland. Crash data for 2003-2022 was sourced from the Oregon Department of Transportation (ODOT). With testing and predicted data split into two 10-year time periods, 2003-2012 and 2013-2022.

Figure 2 Confusion matrix of logistic modeling using PDO crash occurrence to label severe crash locations



Crashes within 80 feet of each segment centerline are tallied and scored based on the weighting in Figure 1. Crashes are evaluated as a one-to-many relationship, meaning a crash occurring at an intersection of two segments will be attributed to both segments.

Safe Streets Opportunities Score

The Safe Streets Opportunities Score evaluated six types of safety infrastructure on each of the segments:

- Pedestrian crossing distances
- Crossings near transit stops
- Sidewalk gaps

- Bicycle facility type match
- Lighting
- Street design supports vehicle speeds in line with target speed limits

Each of the safety infrastructure elements was evaluated on each segment based on whether it met guidelines, was slightly below guidelines, or substantially below guidelines. The "safe streets" element of the Safe System approach focuses on "designing roadway environments to mitigate human mistakes and account for injury tolerances, to encourage safer behaviors, and to facilitate safe travel by the most vulnerable users" (National Highway Traffic Safety Administration). In addition to assessing safe infrastructure to support travel of vulnerable users (pedestrians and people on bicycles), the high injury segments opportunities analysis also assessed driving speeds.

The safe streets design elements evaluated are linked to key factors for deadly crashes in Portland. They also reflect recent geospatial evaluations of infrastructure by teams across PBOT. The following evaluations and standards were part of the Safe Streets Opportunities Score:

- **PedPDX Plan**
    - Defined pedestrian access standards for crossing spacing, sidewalks, and pedestrian crossing proximity to transit based on land-use context.
    - Included a pedestrian infrastructure evaluation of those standards for roadways in Portland and prioritization for pedestrian access investments.
- **PBOT Traffic Design Manual**
    - Defined bicycle facility types by traffic volumes, roadway lanes, and target vehicle speeds. Based in NACTO's Urban Bikeway Design Guide.
- **Speed limit directive from City Traffic Engineer**
    - Defined target speeds based on a roadway's functional classification.
- Lighting needs for wide roadways
    - Lighting evaluation by Signals and Street Lighting team for roadways 48 feet or wider curb-to-curb.
    - Additional evaluation was done where lighting infill has occurred since the 48-foot-wide or wider roadways lighting evaluation. If the post-infill lighting

uniformity and illumination met PBOT's Lighting Level guidelines the segment was considered to have "two-sided" lighting.

Safe Streets Opportunities Score

The Safe Streets Opportunities score (Figure 3) is based on the guidelines linked above. High priority needs are locations that are substantially outside of guidelines or were defined as priorities by prior infrastructure evaluations. For example, high priority sidewalk gaps are based on locations that are priorities defined by PedPDX. Substantially outside of guidelines are instances when infrastructure conditions were more than twice the guidelines.

If there was no bicycle facility and the street was more than four lanes or existing speed limits at or above 30 mph an additional point was added to the score. This captured arterials in the analysis where Portland has seen 53% of deadly crashes occurring on streets with four or more lanes.

Speed study data over the past five years was available for 70% of the segments analyzed. Where data gaps existed, the current posted speed limit was used in the evaluation. Thirty miles per hour and above was the threshold set, given research showing the likelihood of death or serious injury for pedestrians increases to 50% at that speed.

Figure 3 Guidelines and scoring rubric (points in parentheses)

Safe Streets guideline	**Meets guidelines**	**Medium Priority**	**High Priority**	**Additional Points**	**Maximum score**
Pedestrian crossing distances	Meets PedPDX guidelines. **(0)**	Distance between crossings less than 2x distance specified in PedPDX **(1)**	Distance between crossings is greater than 2x distance specified in PedPDX **(2)**	None	2
Crossings near transit stops	Marked crossing within 100 feet of stop **(0)**	Marked crossing within 101 – 200 feet **(1)**	Marked crossing > 200 feet **(2)**	None	2
Sidewalk gaps	No gap per PedPDX -or- adjacent land use industrial/railroad **(0)**	PedPDX priority 3 -5 gaps **(1)**	PedPDX priority 1 & 2 gaps **(2)**	None	2
Bicycle facility type match	Meets NACTO guidelines based on ADT, lanes, target speed limit **(0)**	Below guidelines **(1)**	No facility **(2)**	Street with > 4 lanes -or- speed limit >=30 mph (+1)	3
Lighting	Any zoning < 48' curb-to-curb: 1-sided or 2-sided lighting >= 48' curb-to-curb: 2-sided lighting **(0)**	Low-density zoning < 48': no lighting -or- >= 48': 1-sided lighting **(1)**	Mid/high-density zoning < 48': no lighting -or- >= 48': 1-sided lighting **(2)** Any zoning >=48': no lighting **(3)**	None	3
Street design supports vehicle speeds in line with target speed limits	Prevailing speed (85th percentile) <= target speed limit guidance -or- if missing speed study data, the posted speed limit < 30 mph **(0)**	Prevailing speed is within 5 mph of target speed limit. E.g. 30 mph target speed limit but 85th percentile is 35 mph. -or- if missing speed study data, the posted speed limit > =30 mph **(1)**	90th percentile speed > 10 mph over target speed limit (top-end speeding) -or- prevailing speed more than 5 mph higher than target speed limit **(2)**	None	2
Maximum possible points for a segment					14

The Tiered High Injury Segments were analyzed in GIS for their overlapping infrastructure conditions and then analyzed using a Python script to calculate the Safe Streets Opportunities Score. If a segment had different conditions along the corridor, the worst condition was used to develop the final score. For example, if a mile-long segment had areas where sidewalks are complete and sidewalk gaps, the latter condition was assigned to the segment and a higher Safe Steets Opportunities Score applied.

Next Steps: Resource Development

This analysis, the creation of the Tiered High Injury Segments and the Safe Streets Opportunities Scores, will inform the development of the following resources:

1. Cost estimation of funding required to bring all 150 miles of Tiered High Injury Segments up to PBOT's safe streets guidelines.
2. High Injury Segment Safety Program that will identify projects annually to enhance safety on a portion of the segments.
3. Annual update of the Tiered High Injury Segments using new crash data.

PBOT's Vision Zero team intends to use both the Tiered High Injury Segments and the Safe Streets Opportunities score to inform project prioritization for future safety investments.