Safety Analysis for Vulnerable Road Users

June 30, 2026

ITE Western District Conference

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Introduction

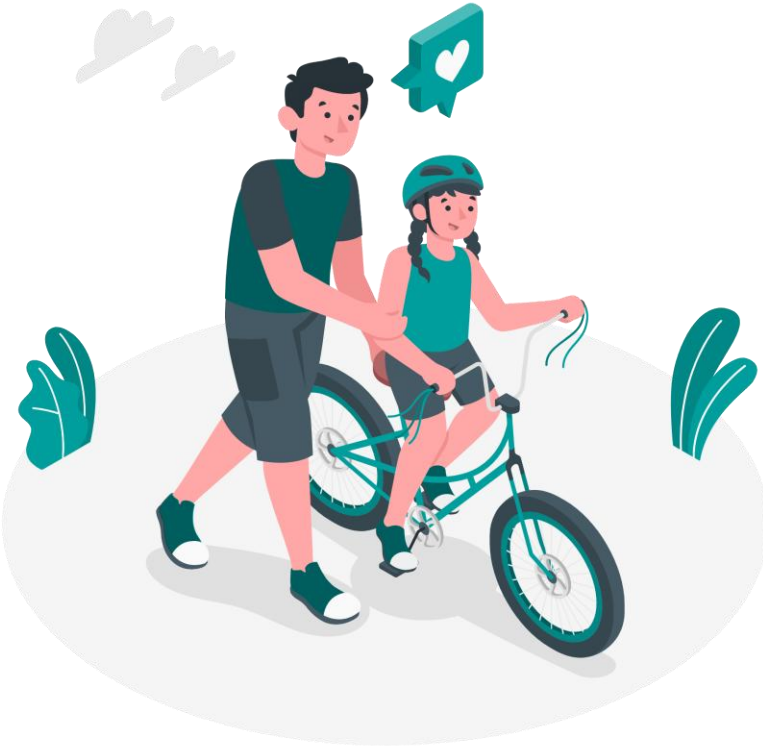
Why do we do Vulnerable Road User (VRU) safety analyses and what is our end goal?

Who are Vulnerable Road Users (VRUs)?

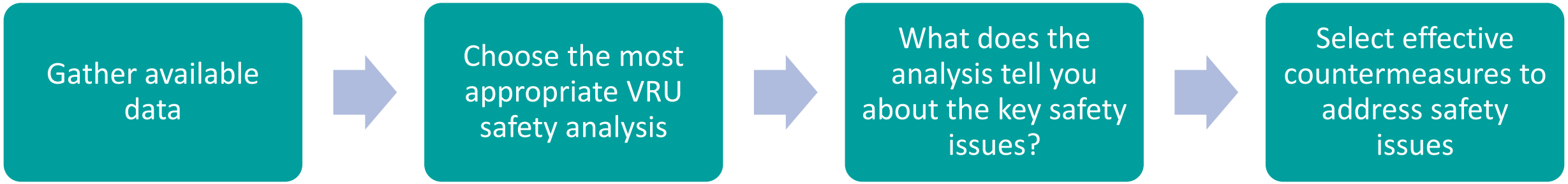
- People walking, biking and rolling
- Anyone not protected by a vehicle, but for VRU analysis, typically we do not include motorcycles

The Challenges of VRU Safety Analyses

- Relying solely on crash data: VRU crashes tend to be rare, especially in areas with limited bike/ped infrastructure or locations that feel unsafe for walking/biking
- Crash data is often incomplete
- Real safety risk versus perceived safety risk



The Steps of VRU Safety Analyses



Choosing the Right Safety Analysis

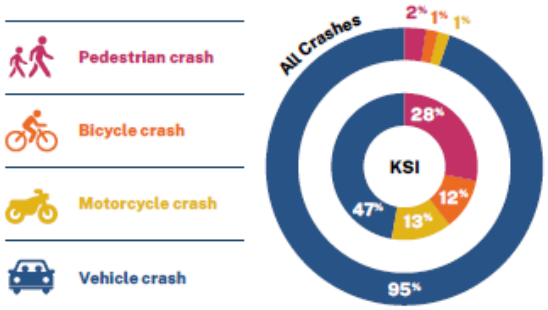
Choosing the Right Safety Analysis

Network Screening	Systemic	Site-Specific Evaluation	Non-Crash Data Analysis
• Crash Trends Analysis • High Injury Network	• Risk Factor Analysis • Crash Profiles	• Near Miss Analysis • Before/After Studies	• Level of Traffic Stress • Public Engagement and Crowdsourcing • Near Miss Analysis

Crash-Related Analyses

#1: Crash Trends Analysis

- Sets context regardless of sample size
- May need to combine bike + ped
- Qualitative review if crashes are sparse



MENLO PARK
SCHOOL SAFETY ANALYSIS

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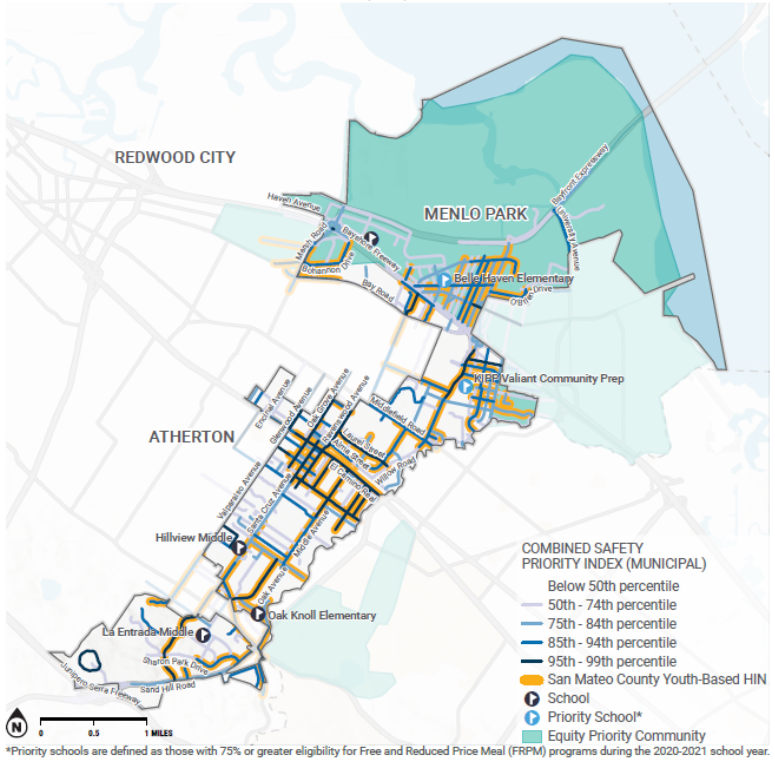
YOUTH-BASED HIGH INJURY NETWORK (HIN) - TOP CORRIDORS



*Priority schools are defined as those with 75% or greater eligibility for Free and Reduced Price Meal (FRPM) programs during the 2020-2021 school year.

TOP 5 SAFETY PRIORITY CORRIDORS

Number of Collisions

Corridor	All Collisions	Fatal or Severe (KSI)	Pedestrian-Involved	Bicyclist-Involved	Youth-Involved
Ravenswood Ave	0	1	0	0	0
Avy Ave	12	1	0	7	2
State Highway 82	59	2	3	8	14
Laurel St	20	3	1	6	9
Glenwood Ave	0	1	0	0	0

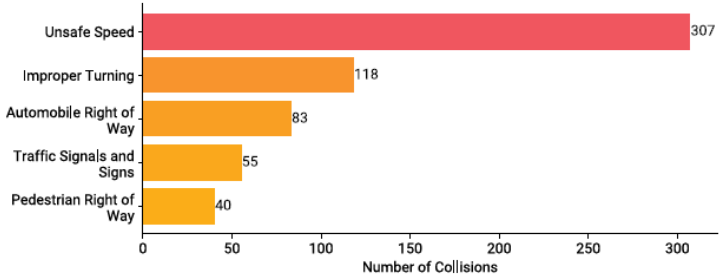
Methodology and definitions provided in accompanying San Mateo County SRTS High Injury Network (HIN) Report. Segments are sorted by their Combined Safety Priority Index scores.

Prepared 1/20/2022 10:31 AM

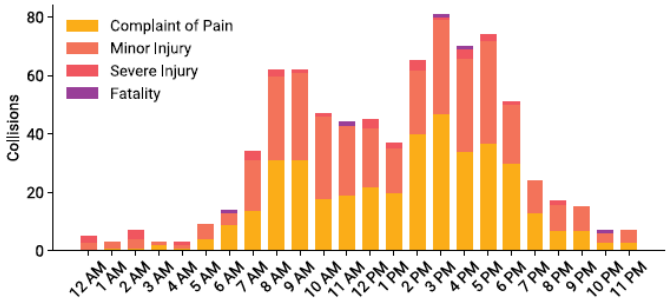
COLLISION TYPES BY LOCATION IN MENLO PARK

	City-Wide				Within 1/4 Mile of a School				Within 1/4 Mile of a Target* School			
	All	KSI	Youth	Active	All	KSI	Youth	Active	All	KSI	Youth	Active
All Collisions	786	34	198	258	111	4	36	45	69	1	24	31
Alcohol Involved	53	8	9	19	12	1	3	5	8	0	2	4
Speeding Involved	307	11	69	39	47	2	15	9	26	0	9	3
Mid-Block Collision	403	21	103	101	59	3	20	19	37	1	12	11

TOP 5 COLLISION FACTORS IN MENLO PARK



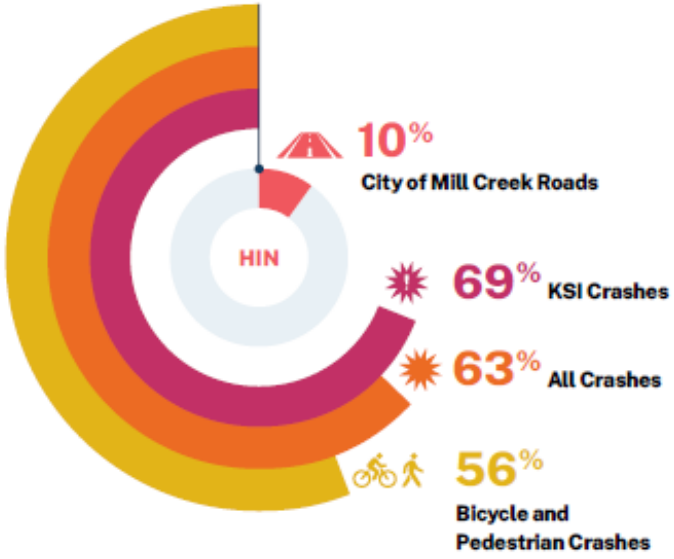
ALL COLLISIONS BY TIME OF DAY IN MENLO PARK

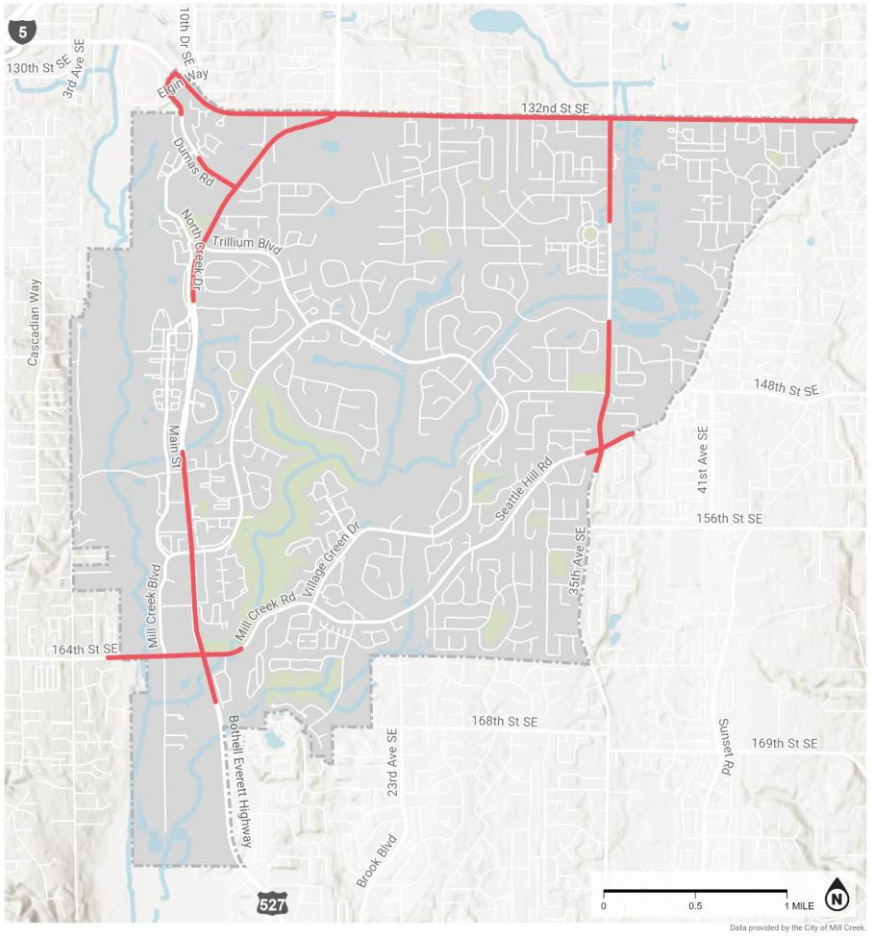


Collision data from 2014 to 2020 was downloaded from the statewide Transportation Injury Mapping System (TIMS) which reports all collisions resulting in an injury. 2020 data was provisional at the time of download.

#2: High Injury Network

- Identifies small portion of roads accounting for the majority of KSI crashes
- Need concentrations of VRU crashes for meaningful VRU HIN analysis





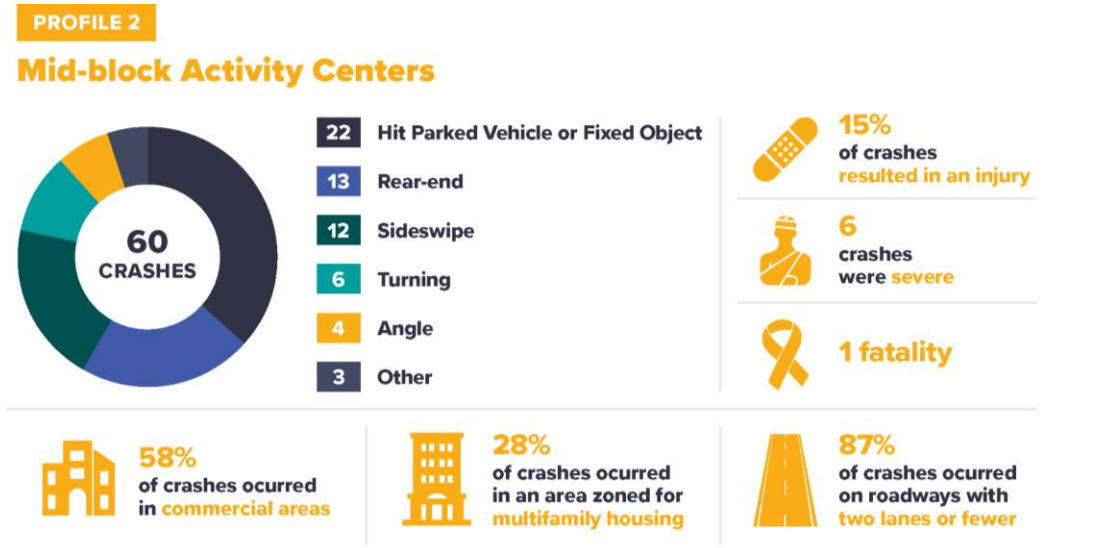
HIGH INJURY NETWORK

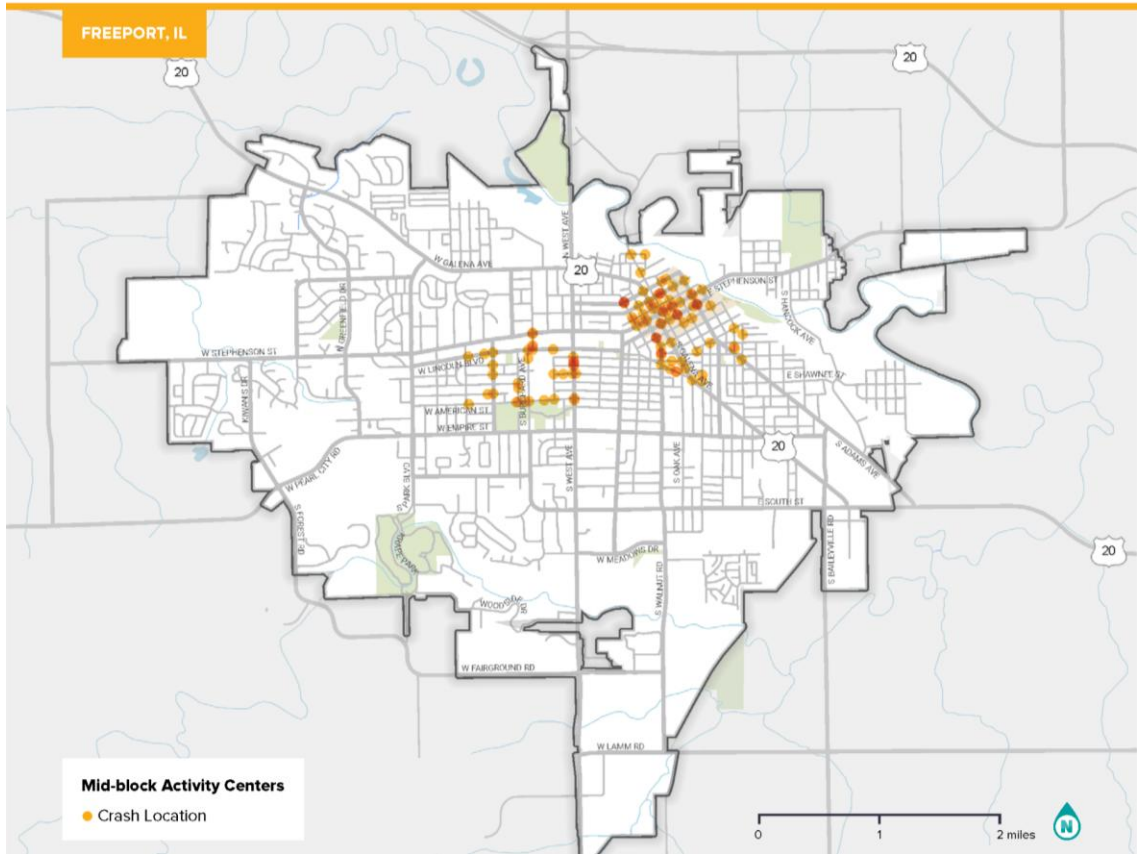
CITY OF MILL CREEK
SAFETY ACTION PLAN

High Injury Network

#3: Crash Profiles

- Identifies groups of crashes with similar crash and contextual characteristics
- Help with countermeasures selection
- High degree of contextual data necessary

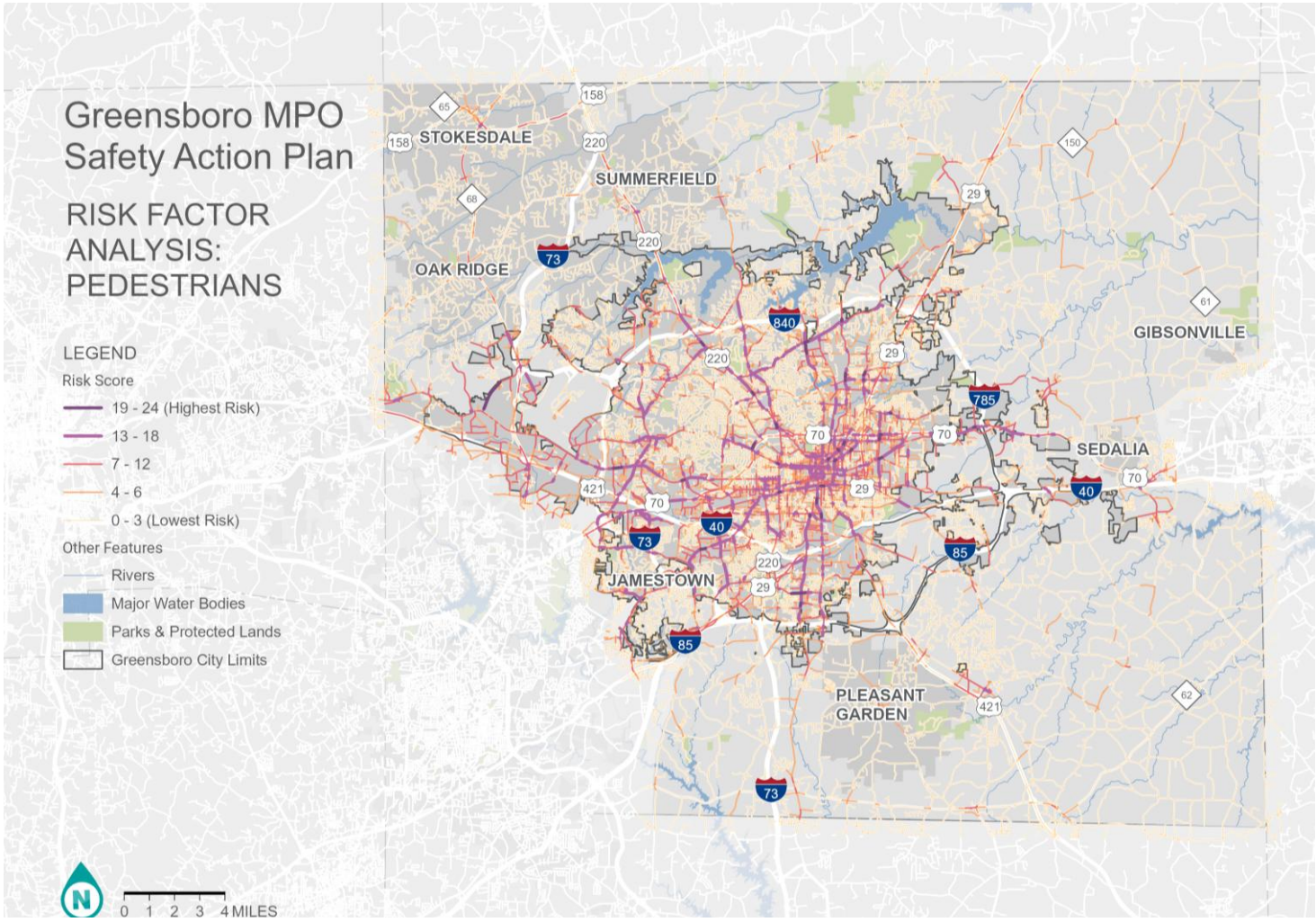




#4:

Risk Factor Analysis

- Uses existing crash data to determine the type of roadways where crashes are happening
- Then identifies other roadways with those characteristics and assigns points
- Need enough crash data for a given mode; easier in a large region
- Working on ways to control for exposure



Analyses without Crash Data

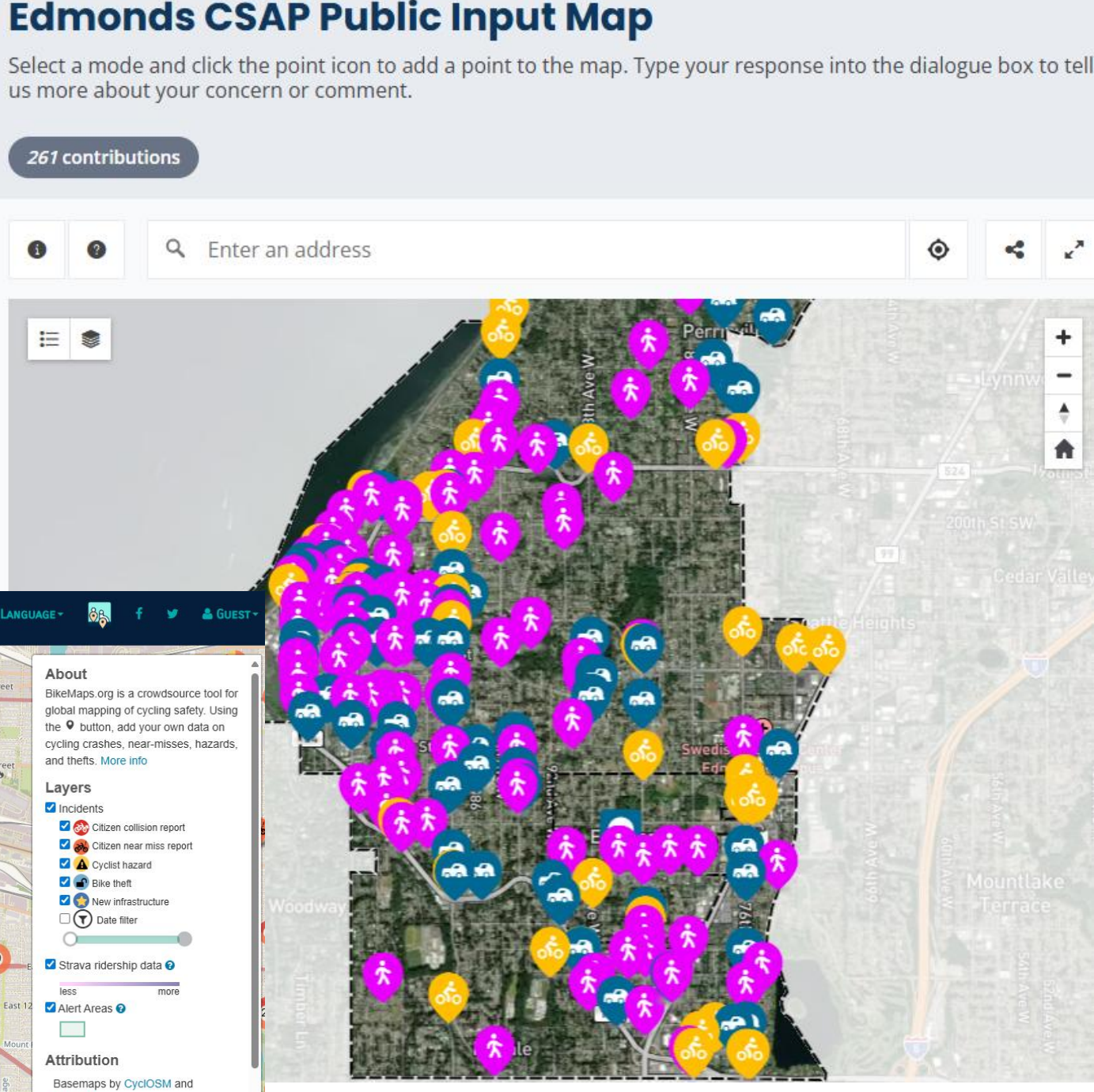
#5: Level of Traffic Stress

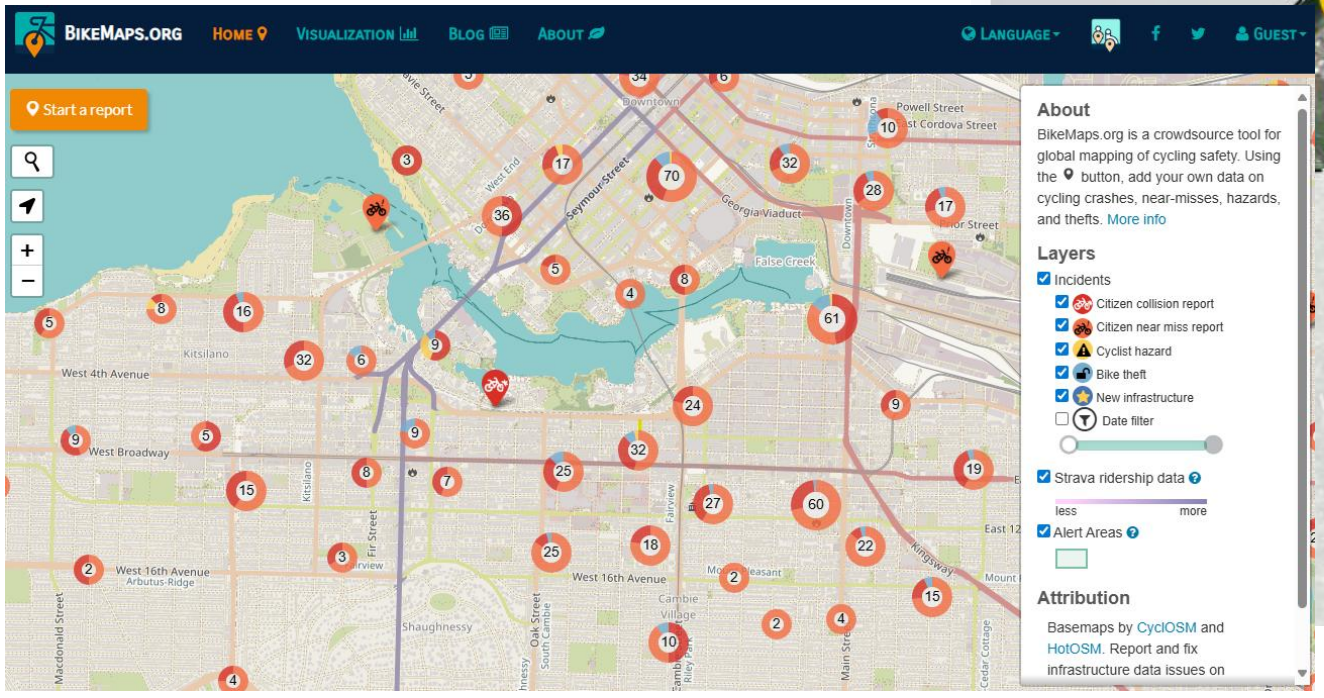
- Measures comfort, not actual safety
- Shows where people feel more or less safe, which influences behavior
- Calculated separately for bicycles and pedestrians

Roadway Characteristics		Bicycle Facility Components: Guideline to Achieve Intended Level of Service/Level of Traffic Stress					
Speed Limit	Arterial Traffic Volume	No Marking	Sharrow Lane Marking	Striped Bike Lane	Buffered Bike Lane (Horizontal)	Protected Bike Lane (Vertical)	Physically Separated Bikeway
</=25	<3k	1	1	1	1	1	1
	3-7k	3	3	2	1	1	1
	>/=7k	3	3	2	2	1	1
30	<10k	3	3	2	2	1	1
	10-25k	4	4	3	3	2	1
	>/=25k	4	4	3	3	3	1
35	<25k	4	4	3	3	3	1
	>/=25k	4	4	4	3	3	1
>35	Any	4	4	4	4	3	1

#6: Public Engagement and Crowdsourcing

- Engagement tools like Social Pinpoint tells us where people feel unsafe
- Crowdsourcing like bikemaps.org





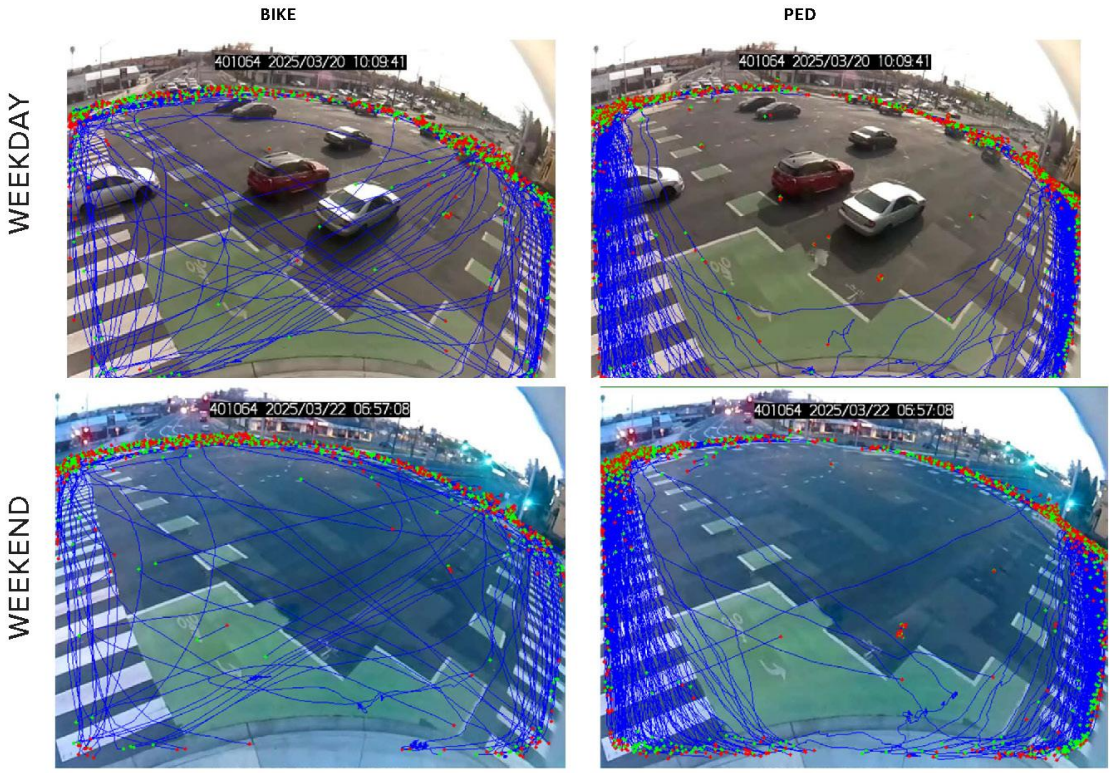
#7: Near Miss Analysis

- Detects conflicts before they become crashes
- Collect many data points quickly
- Immediately responsive to changes in built environment
- Pay by the intersection. Does not scale to the whole city.

Hesperian Blvd & West A St

BICYCLE & PEDESTRIAN CONFLICT ANALYSIS / MARCH 20 & 22, 2025

LOOKING SOUTHEAST



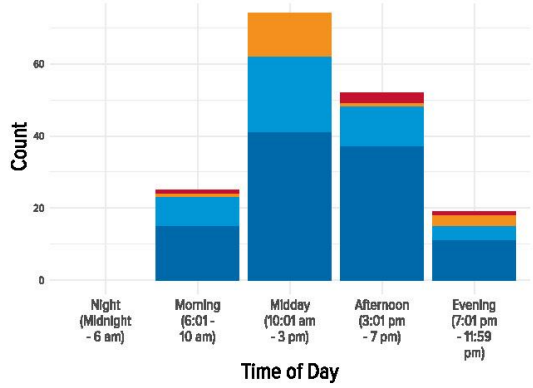
Indicators	Weekday		Weekend	
	Pedestrian	Bicyclist	Pedestrian	Bicyclist
Total Counts	601	164	678	133
High Risk Conflicts with Vehicles	4	3	13	2
Total Conflicts with Vehicles	54	24	67	25
Conflicts per 100 Bikes/Pedestrians	8.99	14.63	9.88	18.80

Notes:
A high-risk conflict is any situation with a post-encroachment time (PET) < 1.5 seconds, with PET representing the gap between the first road user passing the conflict point and the second crossing the same point.

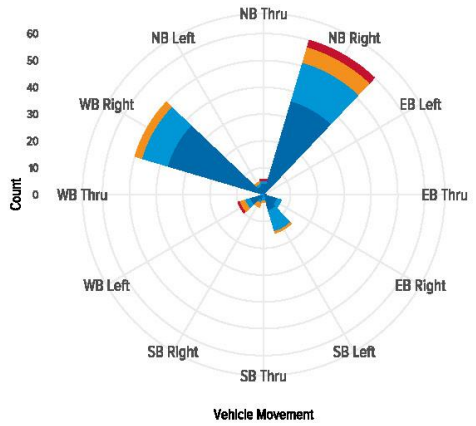
- High Risk – Bicycle
- High Risk – Pedestrian
- Moderate Risk – Bicycle
- Moderate Risk – Pedestrian

BIKE/PED CONFLICTS (ALL DAYS)

By Time of Day



By First Vehicle Movement



Conclusion: Choosing the Right Safety Analysis

Analysis	VRU Crash Data Needs	Other Data Needs	When/Why to Use	Level of Effort
Crash Trends			Set context	$
High Injury Network			Identify corridors with clusters of VRU crashes	$
Crash Profiles			Identify common characteristics of VRU crashes	$$
Risk Factor Analysis			Proactive approach to identifying VRU risks	$$
Level of Traffic Stress			Understand why people might not walk or bike	$$
Public Engagement			Find areas of concern not reflected in crash data	$$
Near Miss Analysis			Proactively evaluate areas of concern; before and after analysis	$$$

The End Result: Selection and Prioritization of Countermeasures

What is the data telling you about the key safety issues? How can we address these issues?

CRASH PROFILE 3: PEDESTRIAN/BICYCLIST-RELATED CRASHES IN COMMERCIAL AREAS ALONG ARTERIALS

This factor analyzes crashes that resulted in death or serious injury to a person walking within 200 feet of a commercial land use area along an arterial roadway in the City of Knoxville. The countermeasures address both pedestrians and bicyclists, even though bicyclist serious injuries or deaths did not occur in this crash profile, because people bicycling are vulnerable in this context as well.

OWNERSHIP

34% on local roads

66% on TDOT maintained roads

MODE: WALKING & BIKING

SERIOUS AND FATAL CRASHES

56

POTENTIAL COUNTERMEASURES

- Access management
- Add sidewalk
- Prohibit right turn on red
- Driveway improvements, including sight distance improvements
- Adding midblock crossings and improvements
- Pedestrian hybrid beacon (PHB) or Rectangular Rapid Flashing Beacon (RRFB)
- Pedestrian refuge islands
- Raised crosswalks and high-visibility crosswalks
- Road diets (cross-section reallocation)
- Bike facilities; including bike paths, protected bike lanes, cycle track, depending on context
- Lighting
- Speed management strategies

North Broadway & West 5th Avenue

Magnolia Avenue & Castle Street

Countermeasures for VRUs

U.S. Department of Transportation
Federal Highway Administration

Pedestrian/Bicyclist


Bicycle Lanes


Crosswalk Visibility Enhancements


Leading Pedestrian Interval


Medians and Pedestrian Refuge Islands in Urban and Suburban Areas


Pedestrian Hybrid Beacons


Rectangular Rapid Flashing Beacons (RRFB)


Road Diets (Roadway Reconfiguration)


Walkways

CMF CRASH MODIFICATION FACTORS CLEARINGHOUSE

Conclusion

Gather available data

Choose the most appropriate VRU safety analysis

What does the analysis tell you about the key safety issues?

Select most appropriate countermeasures to address safety issues

Corridor-wide Safety Concerns	Corridor-Wide Safety Recommendations
Speeding	Construct medians
	Lower speed limit
Distant pedestrian crossings	Enhanced pedestrian crossings
Uncomfortable bike lanes	Separated/ protected bicycle lane
Indistinct bike lane crossings	Bicycle conflict striping
Non-bicycle-safe storm drains in bike lane	Roadway surface improvements
Signalized intersection conflicts	See summary of safety improvement options for signalized intersections (on page 31)

Site Specific Recommendations

- Raised crosswalk across right turn slip lane
- Right on red restriction
- Intersection geometry reconfiguration
- ADA improvements

thank you!