ITE WESTERN DISTRICT ANNUAL MEETING · SESSION 9C

Advancing Vision Zero through Integrated Crash & Near-Miss Diagnostics

A Case Study of US-97 Intersections in Yakima County, Washington

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PART ONE

The Problem

Rural severity is lethal, sparse, and invisible to the tools built to find it.

Lethal but Sparse: The Rural Diagnostic Paradox

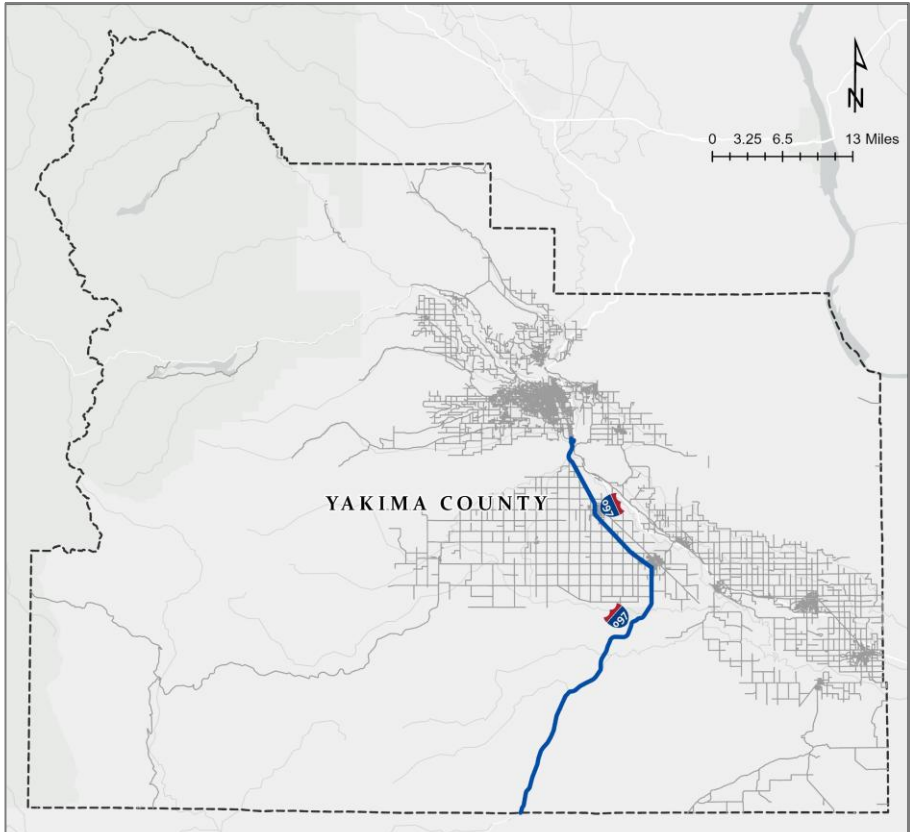
In rural corridors, KSI events are too rare for reliable site-level inference.

6.2%

KSI crashes per intersection over 5 years

KSI = killed or seriously injured

Too rare for a confident hotspot signal



US-97 within Yakima County

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community

THE PRACTICAL QUESTION

How do we decide where and when to monitor proactively?

POLICY MANDATE · VISION ZERO

Vision Zero Is a Severity-First Mandate

FROM PRACTICE TO PARADIGM

WSDOT Executive Order E 1085.01
Agency directive · daily practice

Target Zero (SHSP)
State plan · tied to HSIP funding

WA State Law · RCW 47.04.010
Legally defines Safe System

USDOT National Roadway Safety Strategy
Federal paradigm · Safe System as national framework

Severity-First Prioritization

Killed or Seriously Injured (KSI) outcomes are weighted over total crash counts.

Proactive Analysis

Surrogate measures are used alongside historical crash records before outcomes occur.

PROACTIVE DIAGNOSTICS · SURROGATE SAFETY

From Outcome Reaction to Proactive Diagnosis

REACTIVE · OUTCOME

Waiting for history to repeat

Crash records count fatalities only after they happen. A reliable site-level signal takes years to build. Rural corridors can't wait that long.

Lagging indicator

Needs years of data

Counts outcomes

PROACTIVE · MECHANISM

Diagnosing the margins of error

Surrogate measures take a different approach. Time-to-collision (TTC) and post-encroachment time measure how close vehicles come to colliding. They capture severity before the outcome occurs.

Leading indicator

Signal in hours, not years

Measures mechanism

FRAMEWORK

	Level 1 OUTCOME DIAGNOSTIC	**Level 2** MECHANISM DIAGNOSTIC
SOURCE	**WSDOT Crash Records** (PTCRs)	**AIWaysion Near-Miss Pilot**
TIMEFRAME	**5 years** · 2020–2024	**8 hours** · Feb 2026
MEASUREMENT	**Historical harm** (KSI crashes)	**Time-to-collision (TTC)** margins
SCALE	**Corridor-wide** · 80 nodes	**Site-specific** · Two Cameras
ROLE	Identifies **where & when** severity spikes	Identifies **how & when** interactions become dangerous

Crash records tell us where severe outcomes occurred.
Near-miss TTC tells us where severe outcomes may be emerging.

STUDY DESIGN · WORKFLOW

A Two-Level Diagnostic Workflow

How the pieces connect: from corridor-wide crash screening to an integrated, severity-sensitive diagnosis.

PHASE 1
WSDOT Crash Records
2020–2024 · risk screening

PHASE 2
Camera Coverage Overlay
Feasibility · site selection

PHASE 3
AIWaysion Video Sampling
TTC near-miss analysis

PHASE 4
Integrated Diagnostics
Severity-sensitive monitoring

Level 1 · Outcome / Severity

Level 2 · Mechanism

Integration

This study pairs five years of WSDOT crash history with a targeted AI near-miss pilot, bridging historical outcomes and proactive risk.

PART TWO

The Evidence

What five years of crash records and a two-site near-miss pilot reveal.

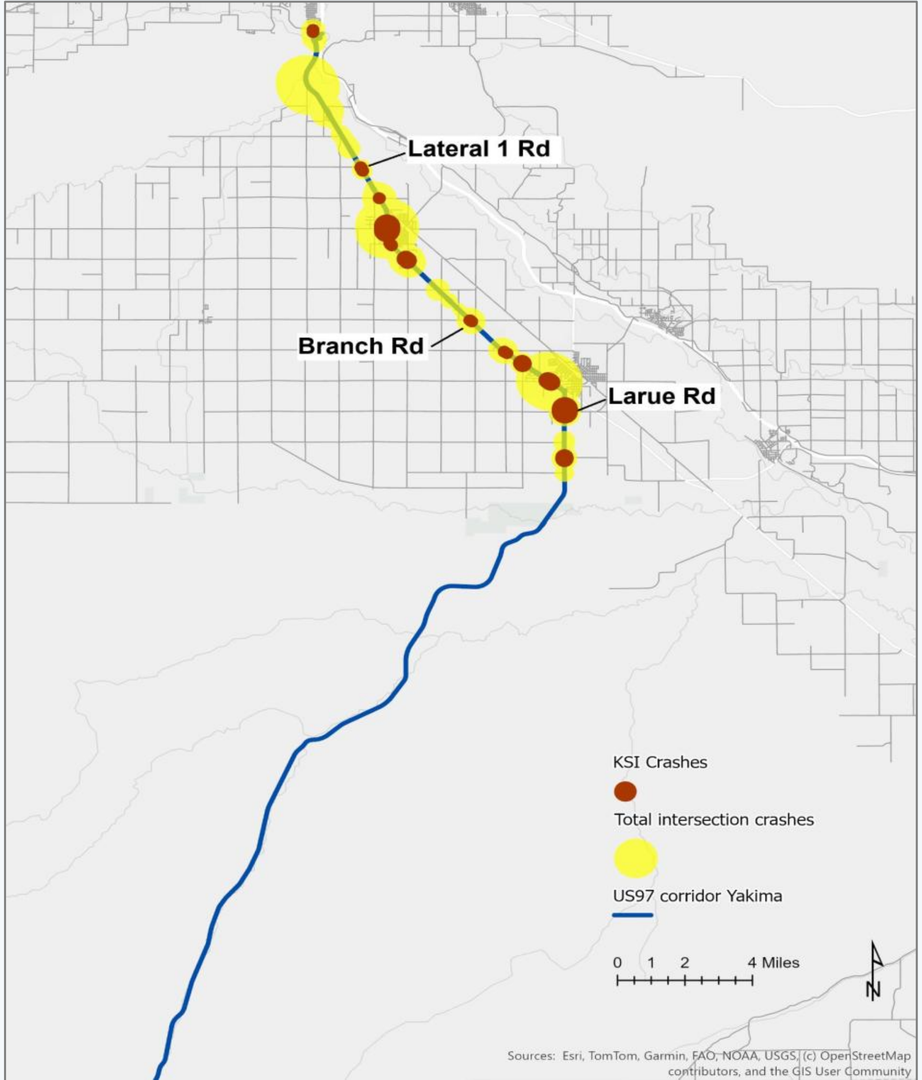
LEVEL 1 · STUDY AREA

Where Severe Crashes Cluster?

US-97 within Yakima County (MP 33.52–76.36), 2020–2024.

Brown = KSI crashes; yellow = total crashes (size ∝ count).

Pilot sites: Lateral 1 Rd & Branch Rd.



LEVEL 1 · SITE SELECTION

Where the Near-Miss Pilot Sampled

Yakima County, WA · MP 33.52–76.36 · 43 miles · 2020–2024

Rank	Node ID	Intersection	Crashes	KSI	KSI Share	Camera Infrastructure	Video Data
1	4	US-97 & Larue Rd	11	4	36.4%	Camera 25; calibration done	No
2	13	US-97 & Robbins Rd	6	2	33.3%	No cameras deployed	No
3	2	US-97 & Rocky Ford Rd	7	2	28.6%	No cameras deployed	No
4	57/60	**US-97 & Lateral 1 Rd ***	12	2	**16.7%**	Cameras 7/8/10; calibration done	Yes
5	16	US-97 & McDonald Rd	6	1	16.7%	No cameras deployed	No
6	78	US-97 & Main St	6	1	16.7%	No cameras deployed	No
7	39	US-97 & S Camas Rd	13	2	15.4%	No cameras deployed	No
8	23/24	**US-97 & Branch Rd ***	15	2	**13.3%**	Cameras 16/17/18; calibration done	Yes
9	41	US-97 & W 9th St	10	1	10.0%	No cameras deployed	No
10	45/46	US-97 & W Wapato Rd	31	3	9.7%	Cameras 39/40/41/42; pending calibration	No

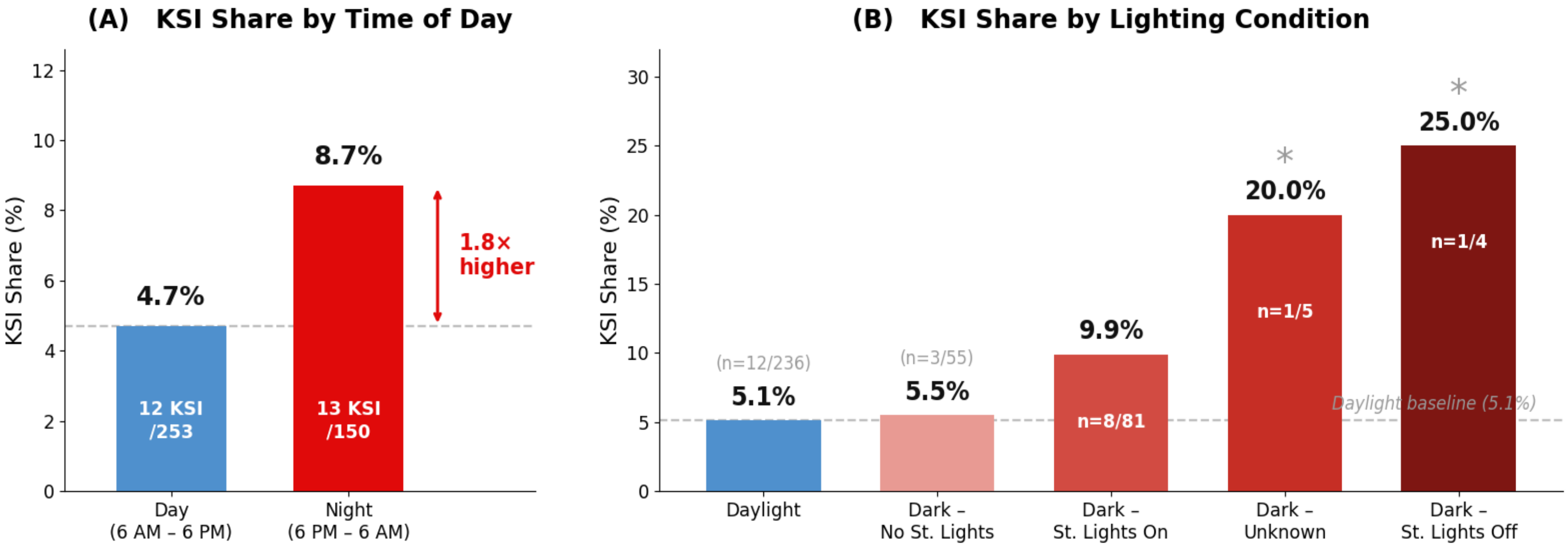
Stage 1 · KSI share screening → severity-first prioritization across 80 corridor nodes

Stage 2 · Camera feasibility overlay → select actionable sites with calibrated intersection views

LEVEL 1 · CRASH BASELINE

When Does Severity Spike?

Intersection-related crashes · US-97 · 2020–2024 · n=403

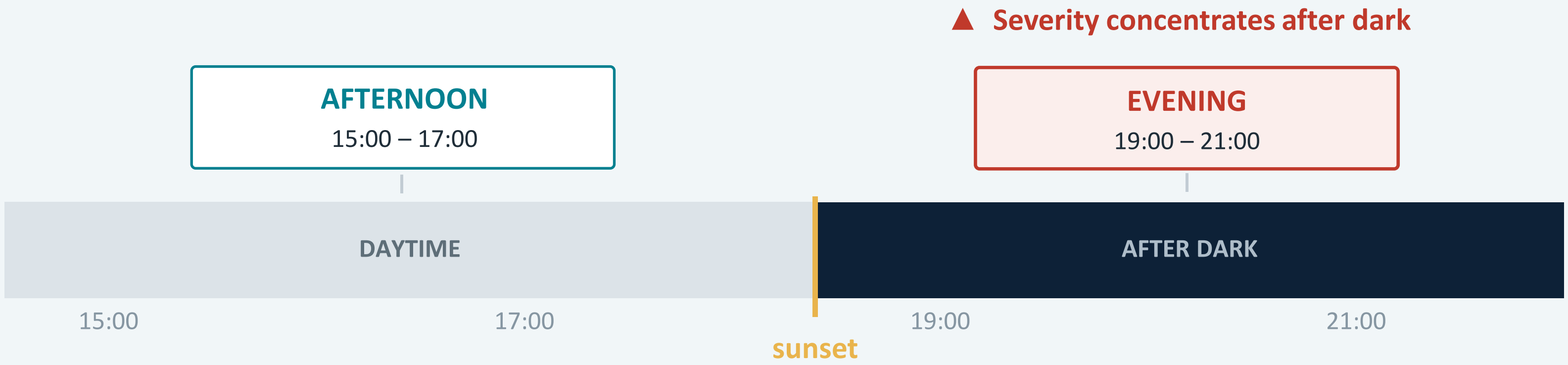


Night is only 37% of crashes, but 52% of KSI

LEVEL 2 · PILOT DESIGN

From Crash Signal to Observation Window

When we observed and what we held constant



Cam 8 · US-97 & Lateral 1 Rd (KSI #4) · Cam 18 · US-97 & Branch Rd (KSI #8)

Held constant across both windows in February 2026: sunny · dry pavement · no extremes · fixed detection

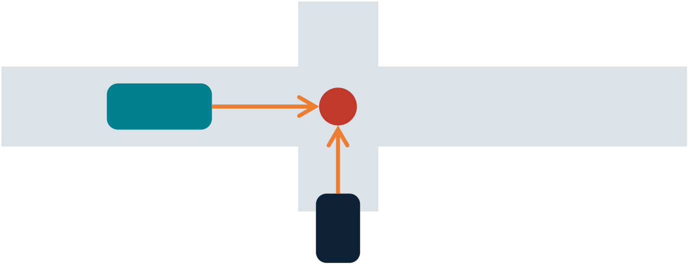
Contrast reflects time-of-day

LEVEL 2 · MECHANISM LAYER

Understanding Time-to-Collision (TTC)

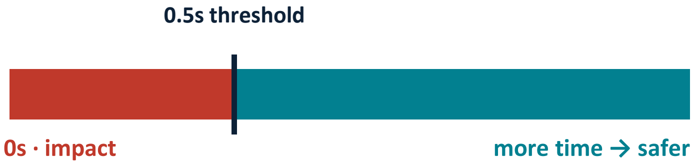
TTC is the time left before a collision if both vehicles keep their speed and path. It reads severity before any crash occurs.

THE INTUITION



TTC = seconds until the two paths would meet.

THE SCALE



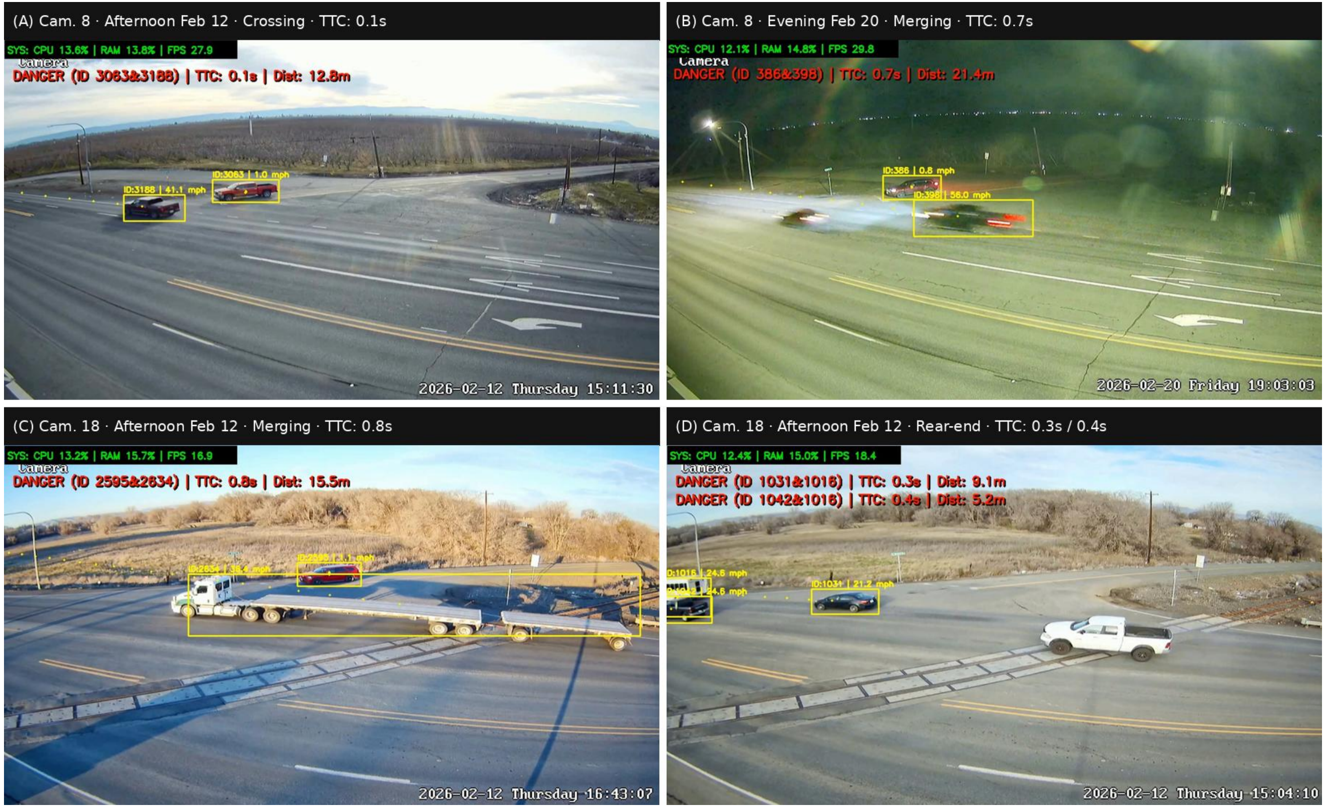
Tight margin
higher severity

Loose margin
safer interaction

Lower TTC means higher severity.
Fewer seconds to react means a more dangerous precursor, even when no crash occurs.

Near-Miss Detection in Action

Representative conflict events · AIWaysion video analytics platform · two pilot intersections · February 2026

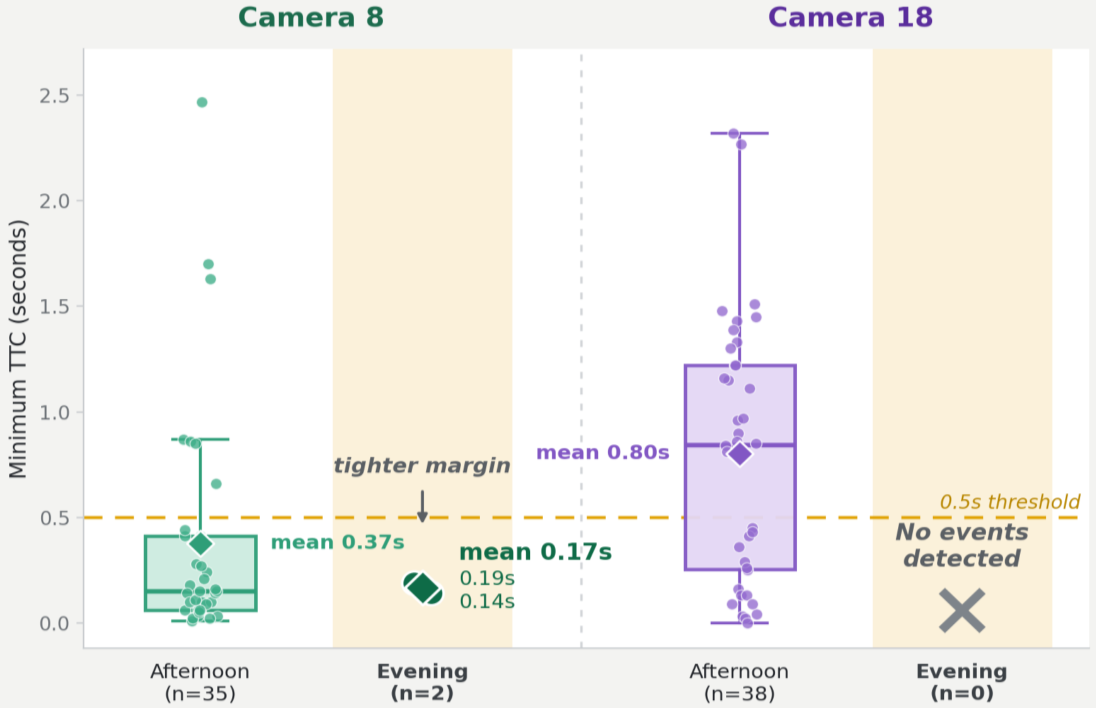


Yellow boxes, vehicle IDs, speeds, and red DANGER + TTC alerts are generated in real time by the platform.

LEVEL 2 · RESULTS

Frequency-Severity Divergence

(A) TTC Distribution by Camera and Observation Window



(B) Summary Statistics

Camera / Window	n	Mean	≤0.5s
Cam 8 · Afternoon	35	0.37s	80%
Cam 8 · Evening	2	0.17s	100%
Cam 18 · Afternoon	38	0.80s	42%
Cam 18 · Evening	0	—	—

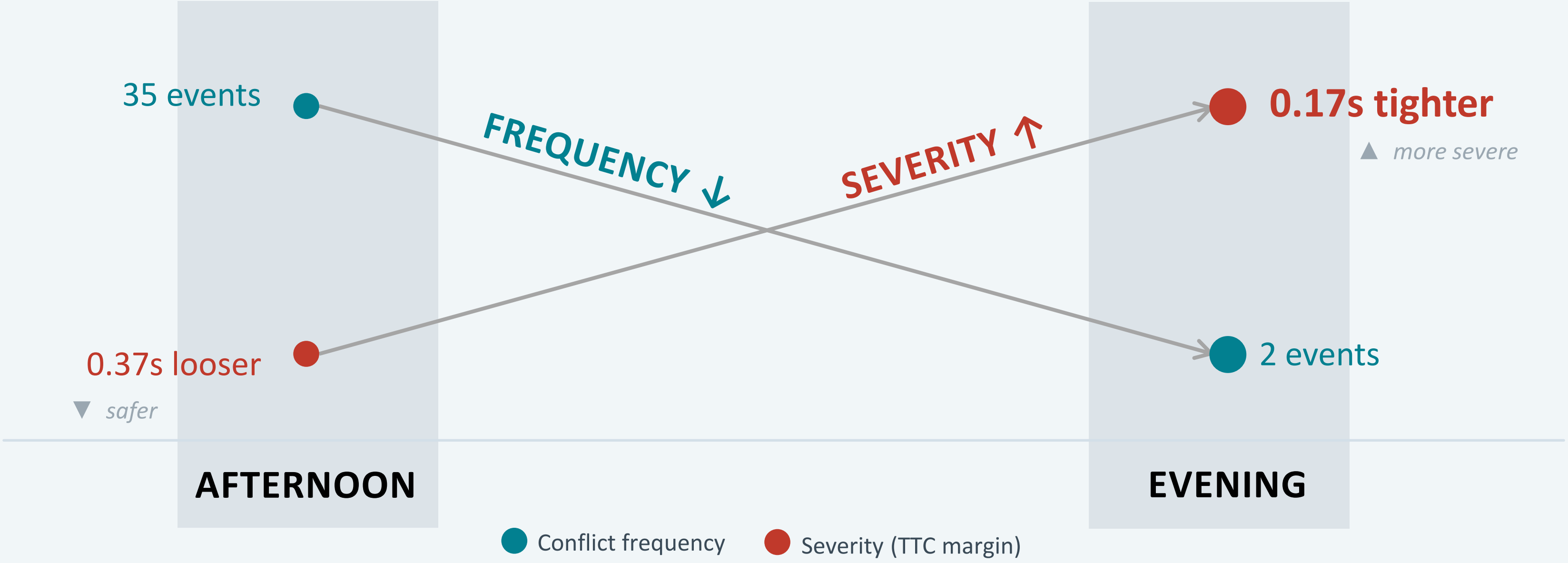
Camera 18 evening: 0 events
→ consistent with Camera 8 evening
→ rarity confirmed across both sites

Afternoon: more events, wider TTC; Evening: fewer events but tighter TTC
The same inversion appears in the crash record

KEY FINDING · 1 OF 2

More Conflict Events ≠ More Severe Risk

Tested at Camera 8 near miss detection · afternoon vs evening · fixed parameters



In the evening pilot, conflict frequency and severity crashes move in opposite directions.

A Few Hours Mirror Years

Two independent sources reached the same verdict.

CRASH RECORD

5 years

n=403 crashes · 2020–2024

Night KSI share is 1.8× daytime.

NEAR-MISS PILOT

8 hours

two cameras · Feb 2026

Evening TTC tightens after dark.

Same verdict: after dark is more severe.

Years of crashes, or hours of video.

PART THREE

What It Means

From one rural corridor to a method any of us can run.

THE TAKEAWAY FOR EVERYONE

Conflict Frequency ≠ Conflict Severity

THE REFLEX

Monitoring counts events: more events, more attention.

THE CORRECTION

But severity, not frequency, costs lives. The rarest events can carry the most harm.

THE RURAL STING

Where crashes are sparse, the deadliest places never rank. Frequency hides them.

Across every road, agency, and dataset: stop letting counts stand in for harm.

FROM PRESCRIPTION TO PRACTICE

Designing Severity-Sensitive Monitoring

Three operational shifts for rural corridor safety programs.

01

Calibrate for severity, not counts

Set alert thresholds on minimum Time-to-Collision (or post-encroachment time), not interaction volume.

02

Observe the empty hours

Sample high-risk, low-volume windows on purpose (post-sunset, dark with streetlights on), even when event yields look low.

03

Look beyond total counts

Rank sites by the share of events with TTC < 0.5s, not totals. Never read AI counts without anchoring them to historical KSI.

Severity-sensitive monitoring is essential for rural highway safety

LIMITATIONS · SCOPE

Limitations & Scope

What this pilot can defend, and what it cannot.

SAMPLE SIZE

Directional, not statistical

Camera 8 evening n=2, Camera 18 evening n=0. The result points in a direction; it is not a statistical inference.

SPATIAL COVERAGE

A temporal test, not a hotspot map

The pilot covers 2 of 80 corridor nodes. It validates the method in time, not in space.

METHOD

Parameters held fixed

Detection settings were held constant for baseline consistency, not tuned per site.

A strong hypothesis, not an absolute law.
Findings reflect this rural corridor; the framework is what transfers.

TOWARD PROACTIVE VISION ZERO

> Use **crash data** to target monitoring.
>
> Use **near-miss data** to see risk emerging.

Together, they help us intervene before the next severe crash.

Acknowledgments

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Project Team

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Data & Context

I also acknowledge the Washington State Department of Transportation (WSDOT) for the crash data. The Yakama Nation context informed our corridor-specific interpretations.

THANK YOU !

Read the Full Paper

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