Hypotheses on
Why Fewer People (per capita) Die in Traffic Crashes in Minnesota

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Office of Traffic Engineering

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DEPARTMENT OF TRANSPORTATION

mndot.gov

Agenda

Topic
Who Am I, Why am I here?
Basics between Minnesota and Delaware
Access Management and Land Development
Prioritizing Pedestrian Facilities
Secondary Rural Roadway Network
High Tension Cable Barrier
Roundabout, J-Turns, Intersections
TZD and TZD 2.0
Conclusion

# Who am I, Why am I Here?

Derek Leuer

Minnesota Department of Transportation

- Derek Leuer, Professional Engineer

- Minnesota Department of Transportation

- State Traffic Safety Engineer

- 10+ years in Traffic Safety

- Manage/Admin MN HSIP Project

- Help develop, implement, set strategy, educate, inform, present, discuss all things traffic safety!
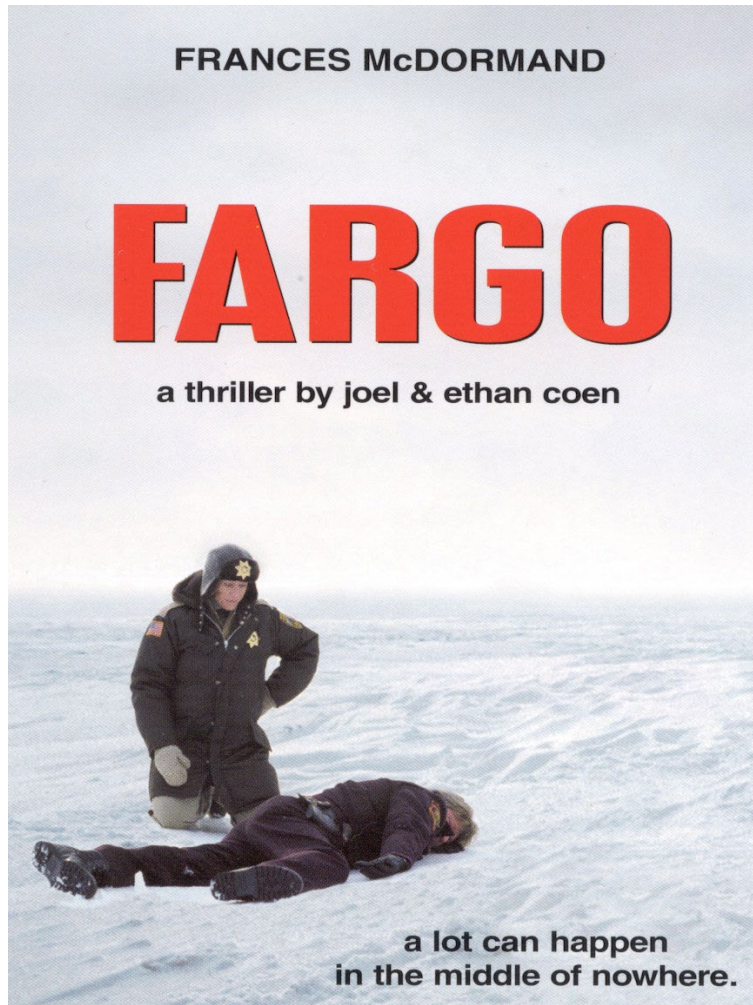
Why am I here?

5/2/2023

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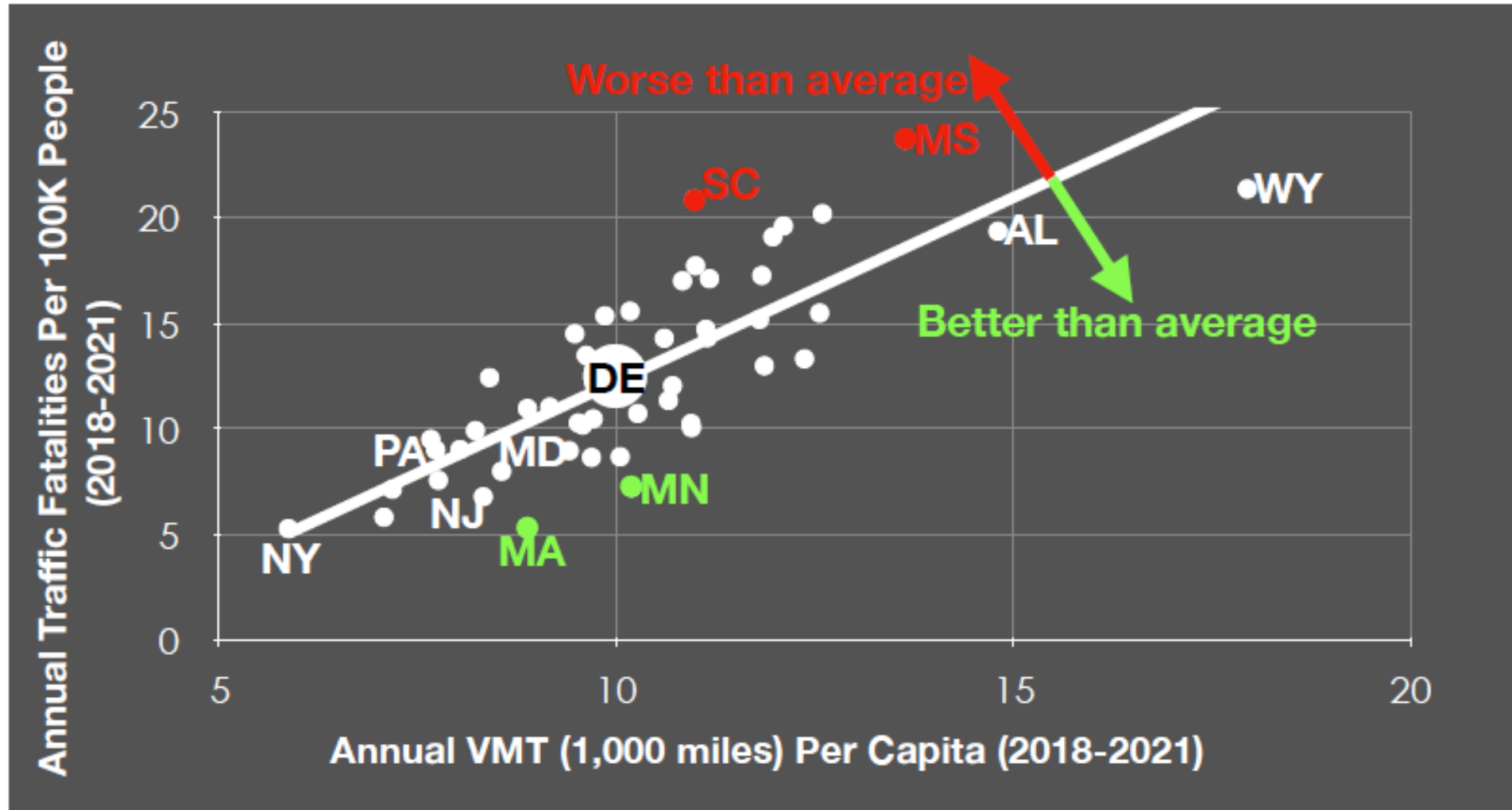
Minnesota versus Delaware!

Some Basics!

Category	Minnesota	Delaware
Population	5,707,000	1,003,000
Size	86,943 sq. miles	2,489 sq. miles
Admitted into the Union	32nd (1858)	1st! (1783)
Biggest City	Minneapolis (425,336)	Wilmington (70,926)
Motto	*L'Etoile du Nord (Star of the North)*	*"Liberty and Independence"*

Also called "Land of 10,000 Lakes"

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Minnesota versus Delaware!

Traffic Safety Comparison

| Category	Minnesota	Delaware
VMT per Capita	~10,000 miles	~10,900
Roadway Miles	~ 138,000 miles	~5,500 miles
Vehicle Miles Travelled	57,171 MVMT	~8,345 MVMT
DOT Ownership	(11,700 miles) ~8.7%	4,392 miles ~90%

Minnesota versus Delaware!

Traffic Safety Comparison

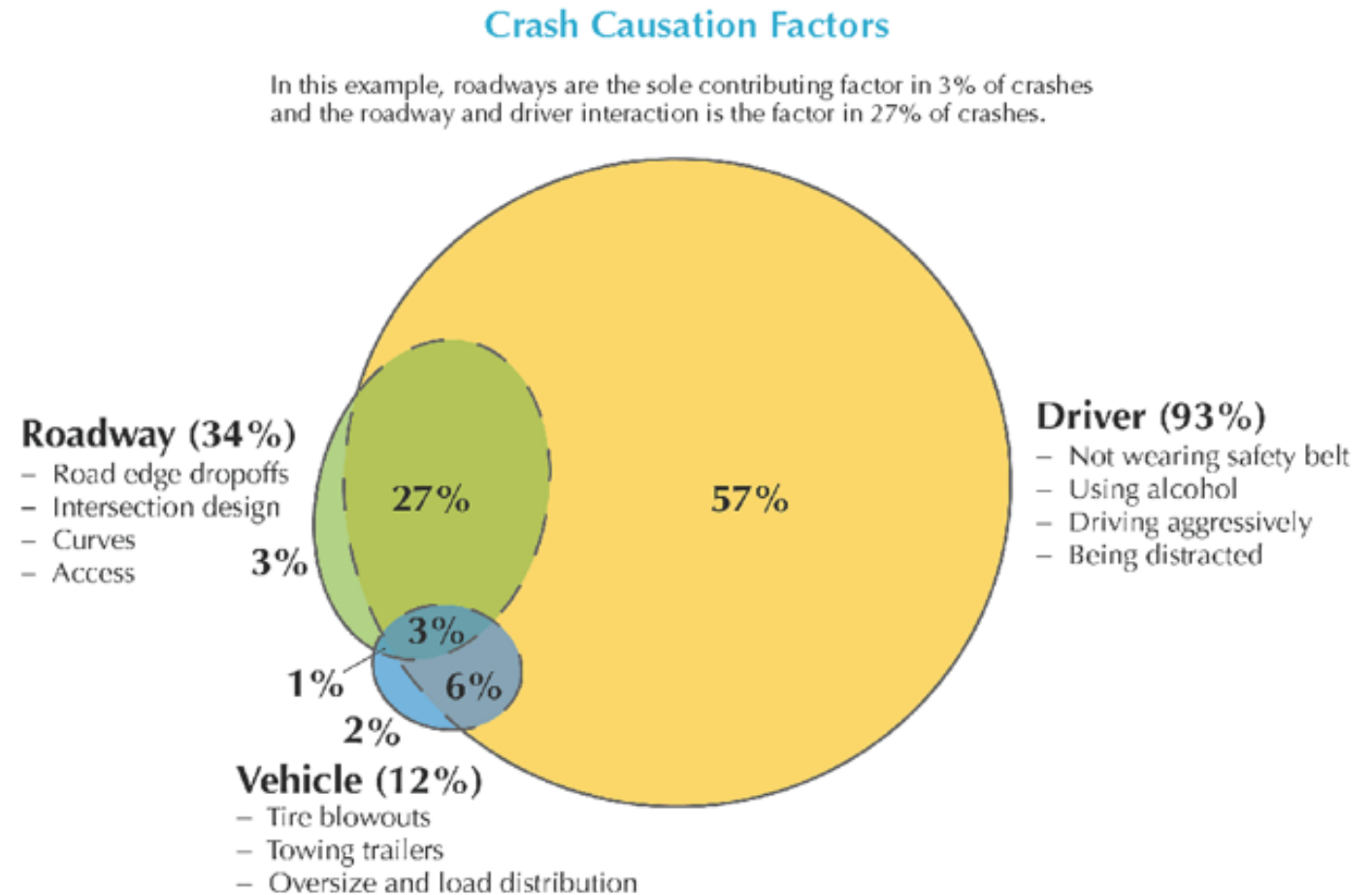| Category	Minnesota	Delaware
Fatalities (2022)	446 (preliminary)	165
Fatalities per Capita	78.2/million	164.5
Fatality Rate	0.78 Fatalities/100 MVMT	1.98 Fatalities/100 MVMT
Fatalities by Ownership	*Average ~ 50%*	*~93%*
DOT Ownership	(11,700 miles) ~8.7%	4,392 miles ~90%

Traffic Safety Comparison
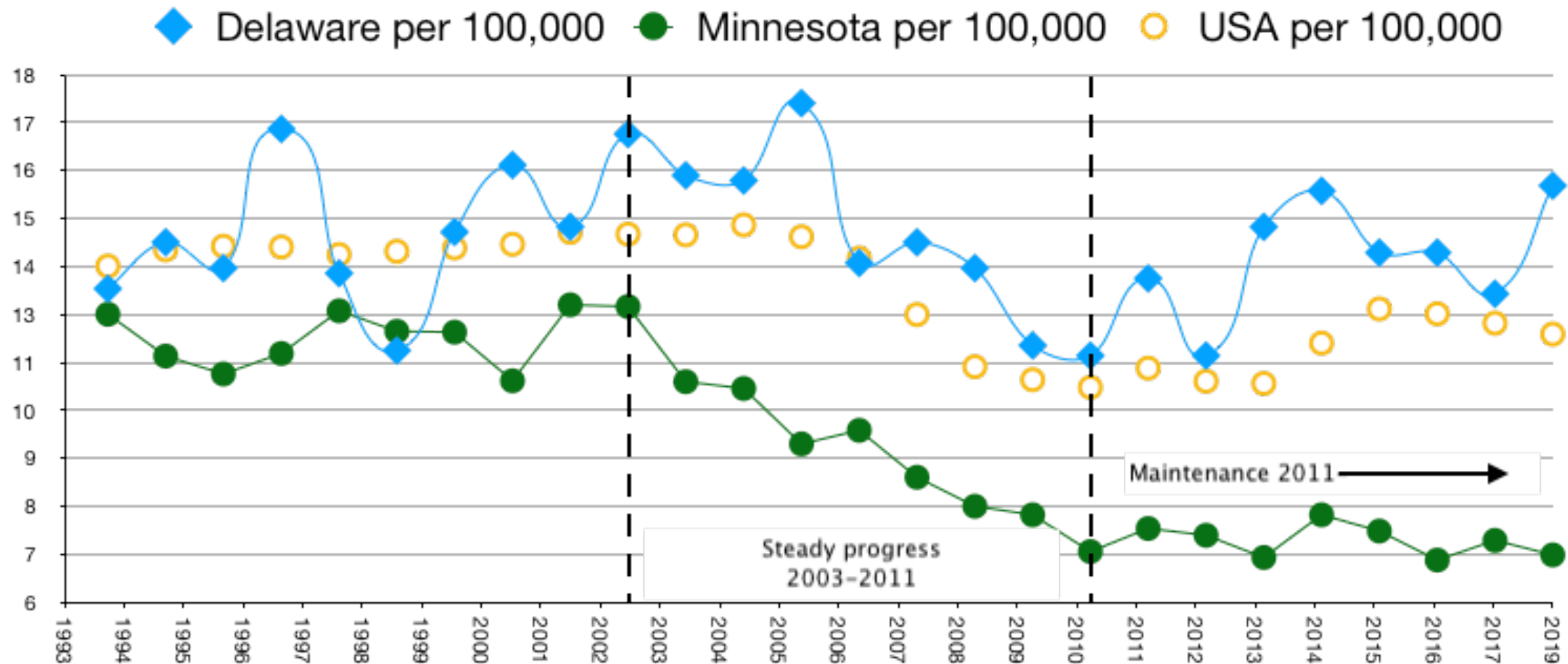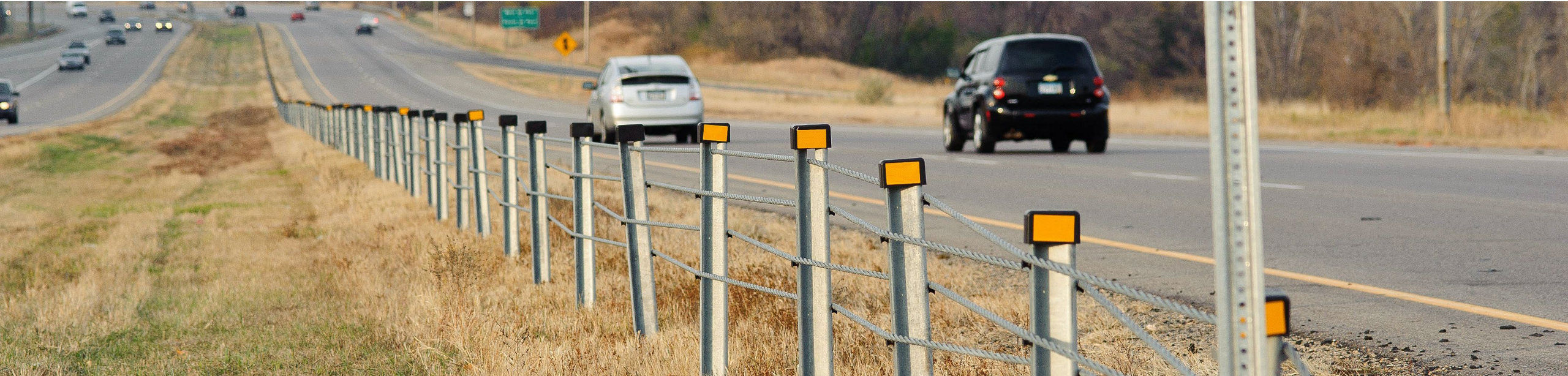
So Why could Minnesota be lower then Delaware?

- Using FARS Data, a few things stood out!

- Intersection fatal crashes are about 50% higher per capita

- Road Departure fatal crashes are about 40% higher per capita

- Pedestrian Fatalities per capita: Minnesota is 3 times safer

- But Why?

- Likely have similar drivers

  - Belts Rates are similar

- Likely Delaware have the same overall vehicle fleet

- Smaller State – Better EMS Times?

- Is the infrastructure different?

- But What about the infrastructure?

Crash Causation Factors

In this example, roadways are the sole contributing factor in 3% of crashes and the roadway and driver interaction is the factor in 27% of crashes.

Roadway (34%)
- Road edge dropoffs
- Intersection design
- Curves
- Access

Driver (93%)
- Not wearing safety belt
- Using alcohol
- Driving aggressively
- Being distracted

Vehicle (12%)
- Tire blowouts
- Towing trailers
- Oversize and load distribution

27%   57%   3%   3%   1%   6%   2%

So… some possible hypotheses….

Hypothesis #1

<u>Evidence</u>

Delaware averages ~30 fatal intersection crashes per year

Adjusted to Minnesota, this would result in 171 fatal intersection crashes per year

Minnesota averages ~115 fatal intersection crashes per year

Delaware is about 50% higher per capita with intersection fatalities

Delaware averages ~27 fatal pedestrian crashes per year

Adjusted to Minnesota, this would result in 153 fatal pedestrian crashes per year

Minnesota averages ~42 fatal pedestrian crashes per year

Delaware is about 300% higher per capita with pedestrian fatalities
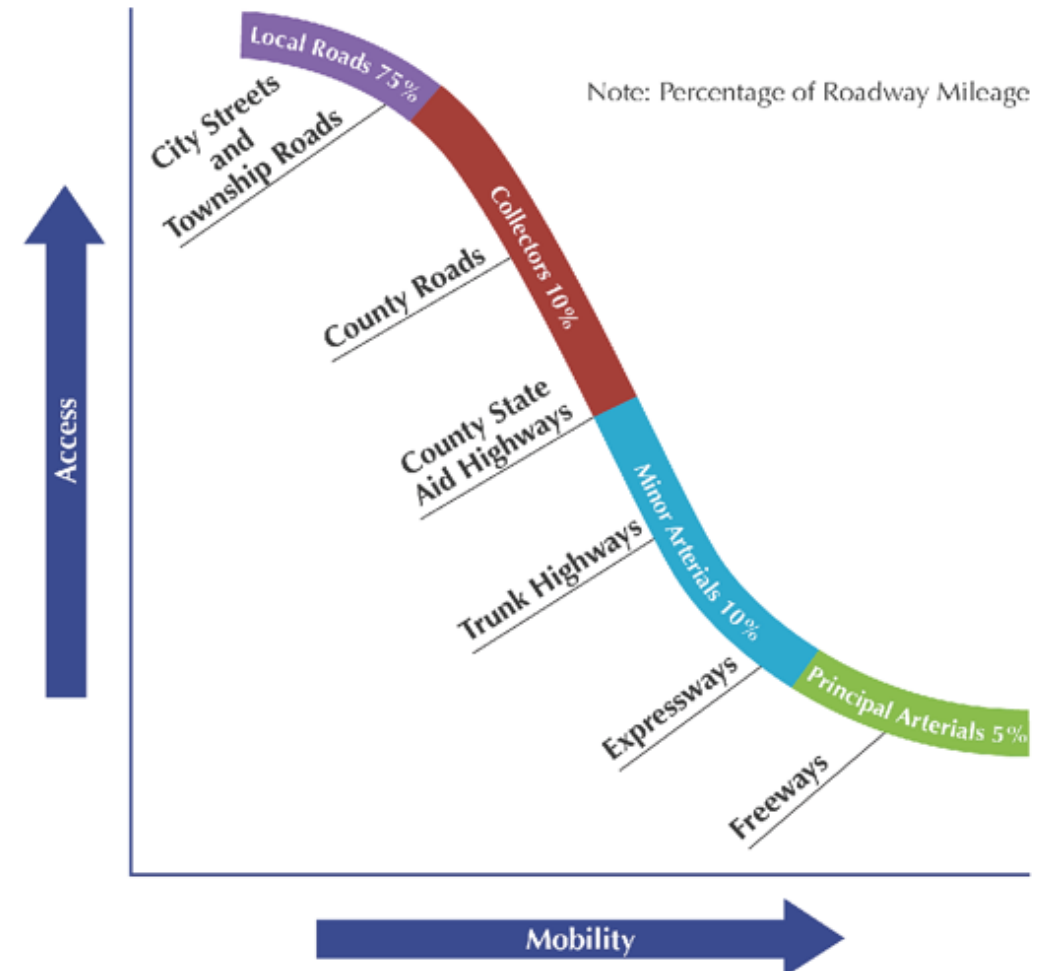
Hypothesis #1

Minnesota and Delaware have (historically) managed land development and access management differently.

This difference, has led to that higher rate of crashes and fatalities for intersections and pedestrians.

Access Management and Land Development

Some basic Transportation 101

- Transportation has two functions:
  Mobility and Access

- With Roads... these two directly conflict with each other.

  - As access goes up (residential neighborhood) mobility goes down (low speed)

  - If mobility is needed, access needs to be constrained (remove conflict, but increased speeds)

Note: Percentage of Roadway Mileage

Local Roads 75%

City Streets and Township Roads

County Roads

Collectors 10%

County State Aid Highways

Trunk Highways

Minor Arterials 10%

Expressways

Principal Arterials 5%

Freeways

Access

Mobility

Some basic Transportation 101

- All Mobility - Interstates (full access control) tend to be the safest (per VMT)

- All Access – residential streets also the safest

  - Function, Speed, Expectations

- When we mix access and mobility – we get more crashes!

  - More conflict, more speed, more distraction
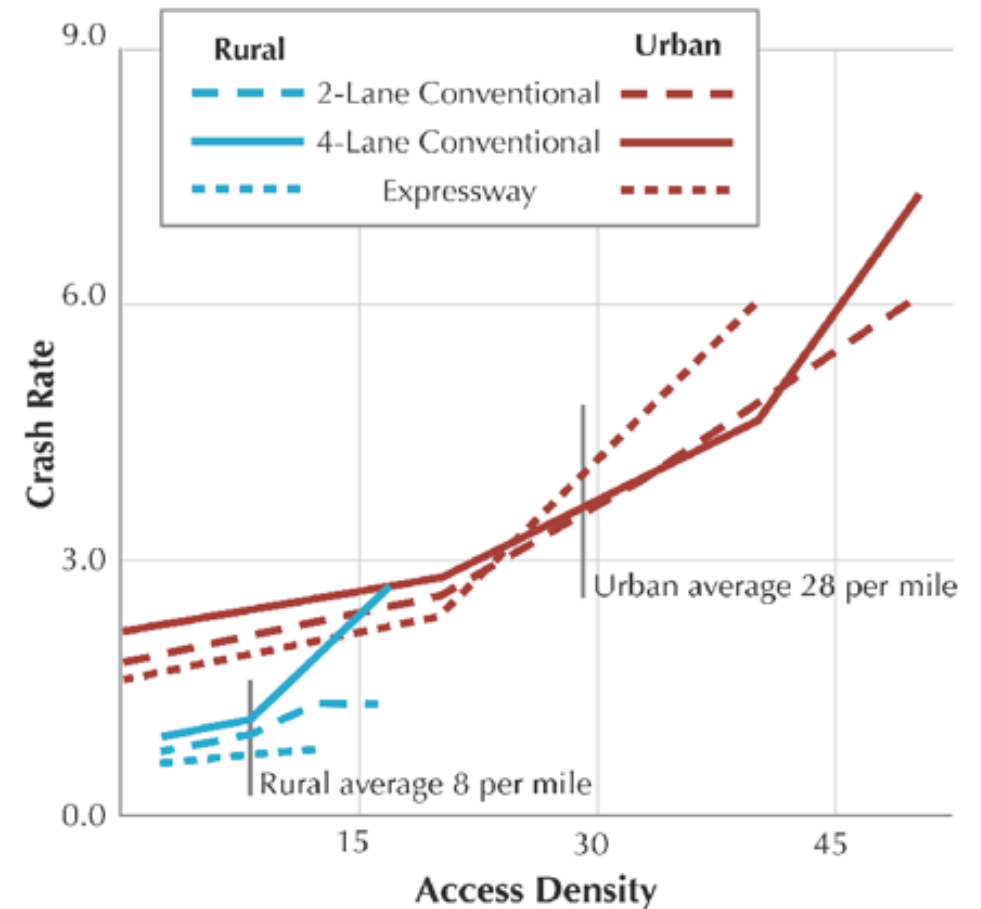
MnDOT Research Report 1998-27 *"Statistical Relationship between Vehicular Crashes and Highway Access"*

"Rural" refers to a non-municipal area and cities with a population less than 5,000.

Access Management and Land Development

Minnesota and Delaware developed differently; likely due to just time and history!

Delaware – a bit more random, cities built before cars

Minnesota has been able to work with local transportation and land development to ensure this hierarchy of transportation is followed (mostly).

Access Management Guide – Basic Classifications

Principal Arterial
Minor Arterial
Collector
Local Streets

FHWA Publication No. FHWA-RD-91-044 (Nov 1992)

MnDOT A-15 3

Access Management and Land Development

MnDOT – We can say "We are in the Mobility Business – get your access from the locals!"

Political Insulation - less direct influence from local elected officials

DelDOT – direct connection to local units; need to provide Mobility and Access!

Why Act Now?

Small, uncoordinated land use decisions…   create problems over time.   When problems become apparent…   the best solutions are no longer available.
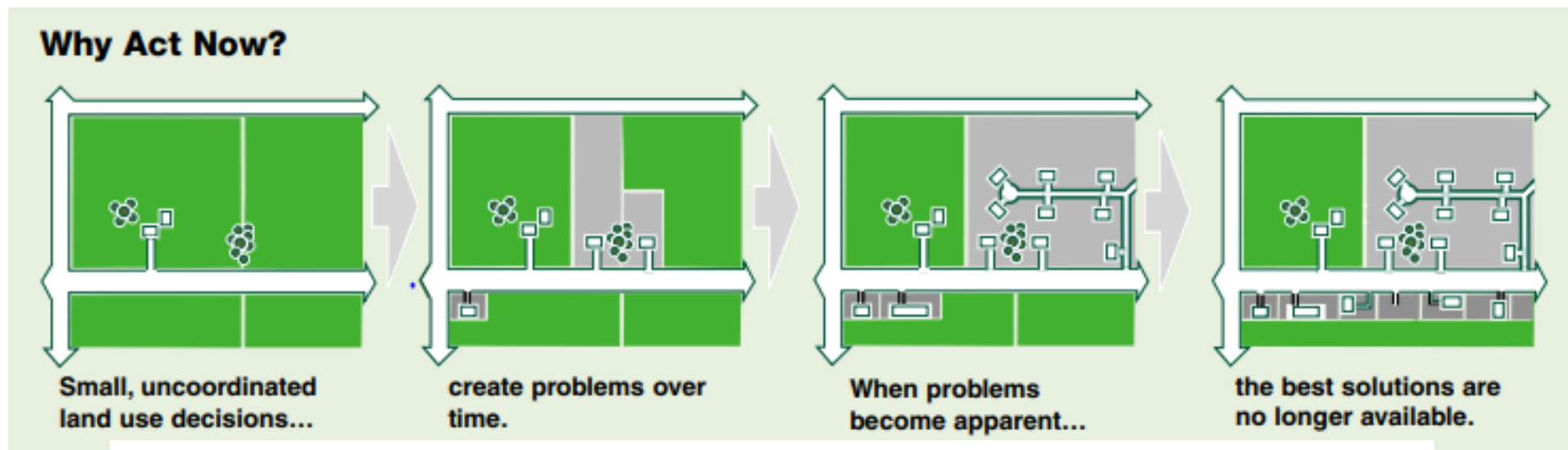
Category	Minnesota	Delaware
DOT Ownership	(11,700 miles) ~8.7%	4,392 miles ~90%

Access Management and Land Development

Access onto main arterials could account for some of the differences (~50% greater) in the intersection and the pedestrian fatal crash numbers.

No one street, no one access is causing the issues that manifest.

It is a systemic issue!

Access Management and Land Development

Why Act Now?

Small, uncoordinated land use decisions... create problems over time. When problems become apparent... the best solutions are no longer available.

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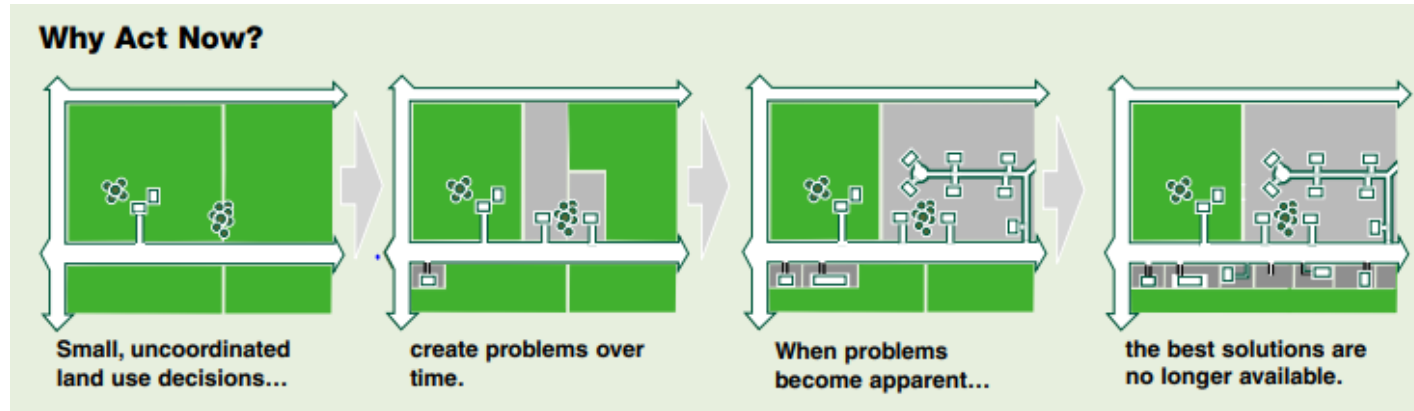
US 12 to I-394 Conversion Project

Major Project in the mid-1980's to Early 90's

Covert about 9 miles of mixed mobility/access into a full freeway

Took eight years of active construction

Traffic has grown from ~40,000 VPD to over 130,000 VPD

Corridor is now an "economic juggernaut"!

https://tinyurl.com/mm2spmft (written in 2006)

Table 2: Research Results Summary Table

Indicators	Direction Of Impact	Comments
Transportation		
Traffic Volume	Positive	Traffic doubled
Travel Speed	Positive	Peak travel speeds up
Traffic Safety	Very Positive	Large decline in serious crash rate
Economic and Demographic		
Land Use	Positive	Land developed more intensively
Population	Neutral to Negative	Slight population loss due to land use changes away from residential
Income	Neutral to positive	Area consumers more affluent
Retail Trade Activity	Neutral	Mixed trends
Employment	Positive	Large office jobs gain
Business Turnover	Neutral to Positive	Below state turnover rate
Commercial Land Values	Neutral	Trend similar to I-494 corridor
Business Types		
Office Buildings	Very Positive	Large increase in activity
Automobile Dealerships	Neutral	Remained viable after transition
Sit-Down Restaurants	Neutral	Remained viable with adjustments
Fast-Food Restaurants	Very Positive	Large increase in business
"Strip Commercial"	Neutral to Positive	Attractive location
General Retail	Neutral	Remained viable with adjustments
"Big Box Retail"	Very Positive	Very attractive customer base
Hospitality	Neutral	Insufficient data
Convenience Stores and Gas Stations	Neutral	Remained viable

US 12 to I-394 Conversion Project

The challenge with Access Management and Land Development

- I-394 Conversions Projects are costly (time, political might, staff, expertise, MONEY)

- Proactive "build it and they will come" often fails, or doesn't meet expectations

- Development wants to occur near existing infrastructure

Pedestrian Crashes and Facilities

- Pedestrian Facilities have often been an afterthought of planning, design, construction and maintenance.

- Often neglected as a priority/issue

- Most agencies were/are auto-centric

- Discourage Biking and Walking

- Cities built for cars, not people

- Discrimination?

Prioritizing Pedestrian Facilities

Issues Minnesota has dealt with:

- Multi-Lane Arterials are difficult

- Sidewalk gaps/poor maintenance/incomplete networks

- Origins/Destinations divided

- Unreliable/Incomplete Transit Network

- Hovers around 10% of total Fatalities

- Seem stuck for 20 years…..
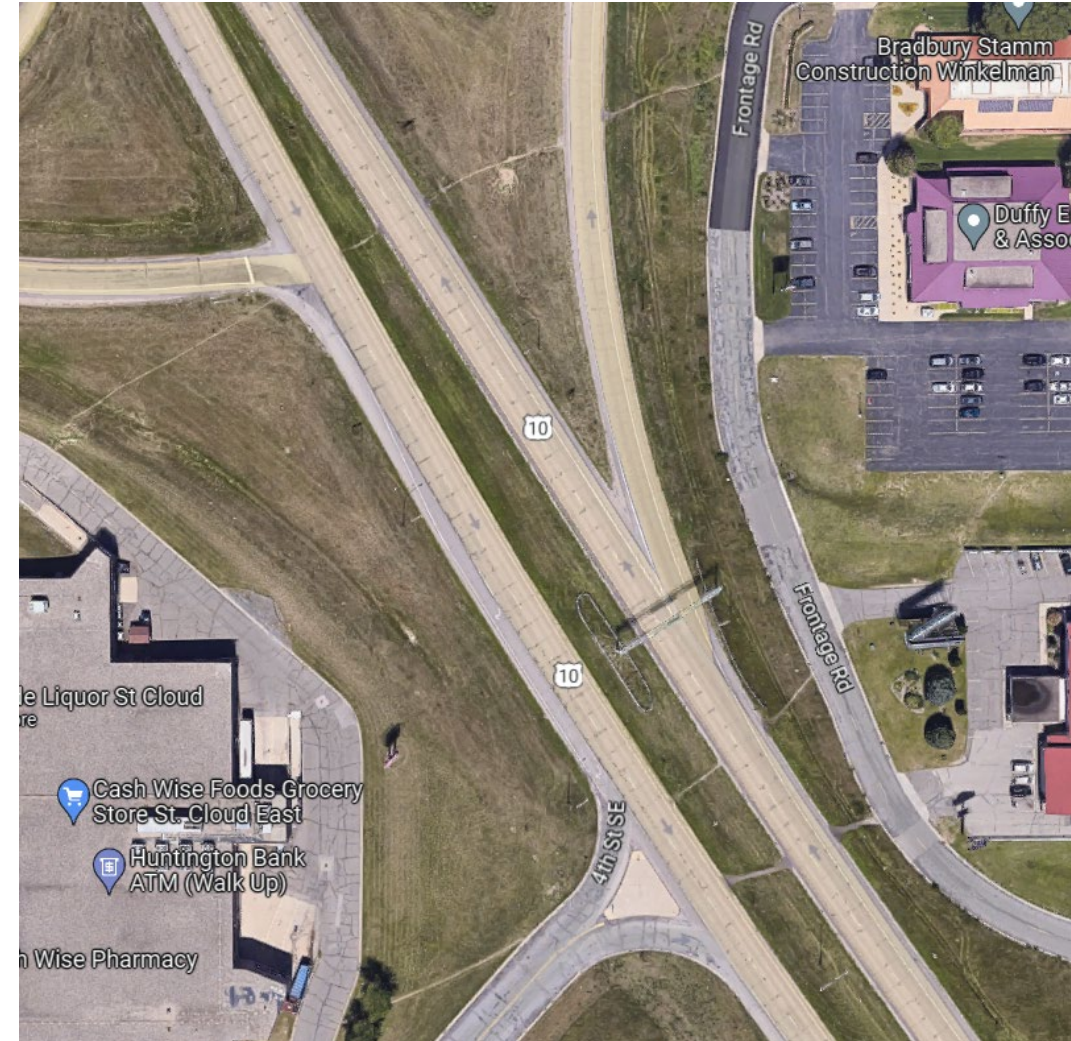
Prioritizing Pedestrian Facilities
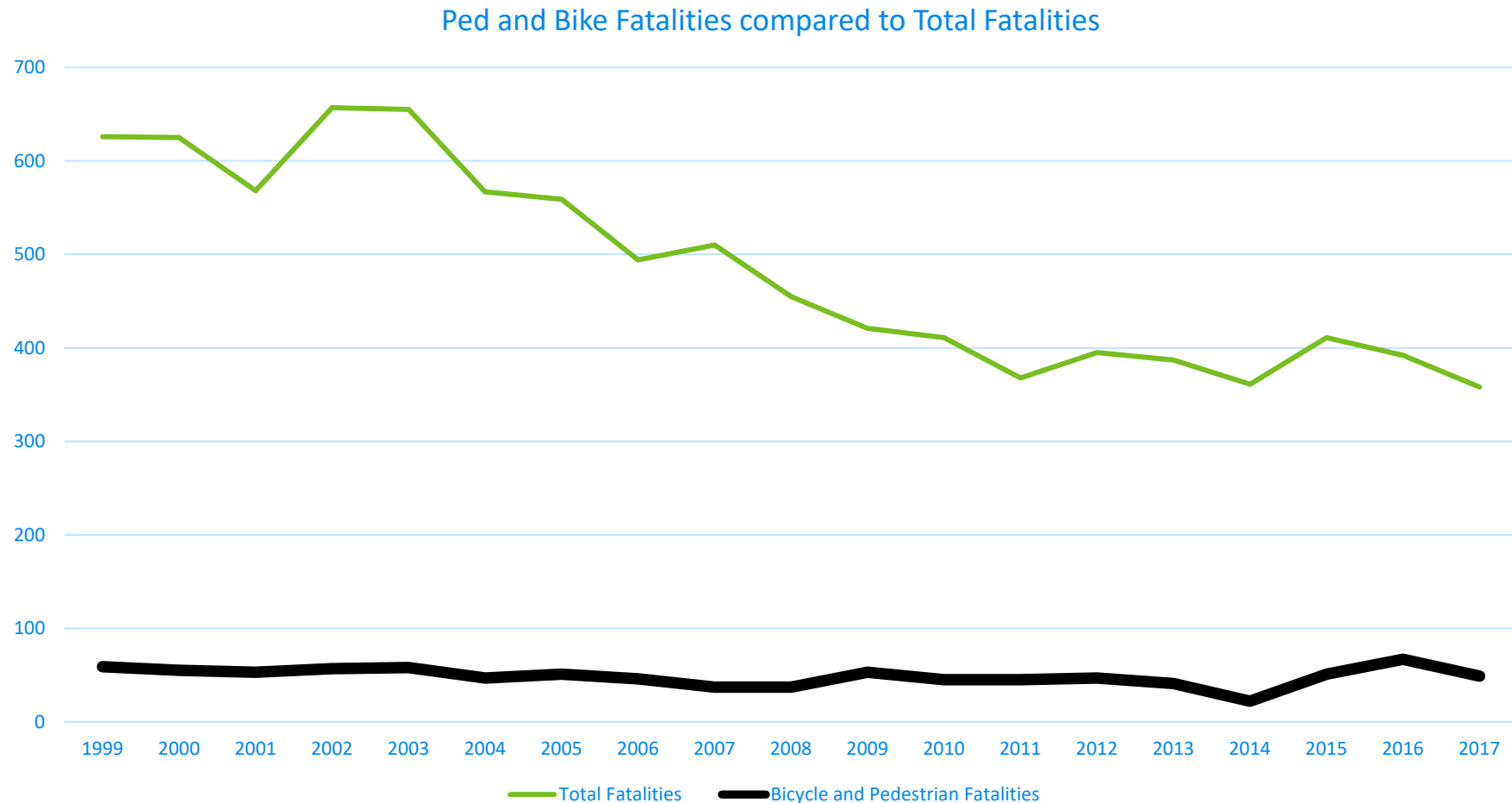
Ped and Bike Fatalities compared to Total Fatalities

Legend: Total Fatalities (green), Bicycle and Pedestrian Fatalities (black)

But change takes a long time!

- Lots of improvements in the last 5-7 years

- Many changes, like sidewalks and others take time

    - (and money!)

- Could take a generation to build out and improve

- Generational Projects

- Crash data can be slow to respond

- Active political action!

- Active counter-political action!

Rural Roadways and Safety

Hypothesis #2

Evidence

Delaware averages ~48 fatal road departure crashes per year

Adjusted to Minnesota, this would result in ~273 fatal road departure crashes per year

Minnesota averages ~192 fatal intersection crashes per year

Delaware is about 40% higher per capita with road departure fatalities

The Challenge with Rural Road Departure

- Broad challenge – many miles

  - Not one spot, systematic

- Multiple contributing factors

- Trees, Embankments, Rollovers, Roadside Hardware, Utility Poles, Etc.

- Public Sentiment

Hypothesis #2

Minnesota and Delaware have built rural roads and roadside safety differently since pre-great depression.

Minnesota started seriously addressing systemic issues in the late 90's and early 2000's. This continues to this day.

Minnesota's Solution

- Clear Zone establishment and maintaining

- Flatten Embankments, Ditches, Driveways

- State and State Aid Standards - 12' lanes

  - State Aid System (Counties)

  - 2-12' shoulders

- Rumble Strips, Striping, Safety Edge

  - Encouraged/promoted on local system

Exhibit 4A-28
Safety Edge Diagram

- Safety Edge – Required starting in 2007. Standard in 2022.

- Edgeline Rumbles – 2004 Required on Rural Roads. Revamped in 2011, 2016. Standardized in 2022

- Centerline Rumbles - 2007 Required on Rural Roads. Sinusoidal developed in 2016. Standardized in 2022.

- 6" Pavement Markings. Evaluated as effective in 2011. Standardized in 2021.

- County Safety Plans (Rural collector/arterial system) – 2009-Present.

Horizontal Curves

- Greatly Overrepresent in the Crash Data

- ~10% of the Mileage – 50% of Road Departure Crashes

- Chevrons/Delineators

- County Safety Plans– 2009-Present. Popular Project Type!

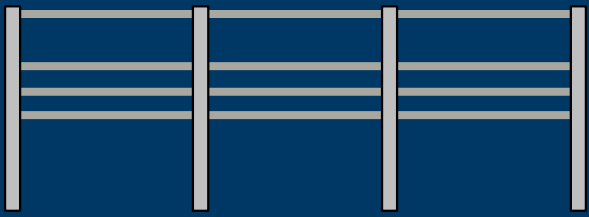- Clearzone, Shoulder Rumbles, Shoulder Paving
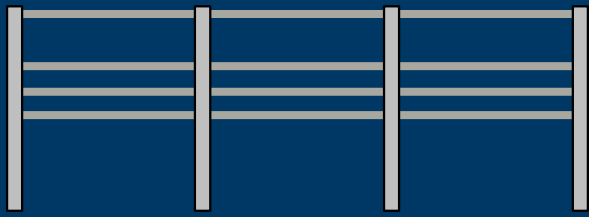
High Tension Median Cable Barrier (HTMCB)
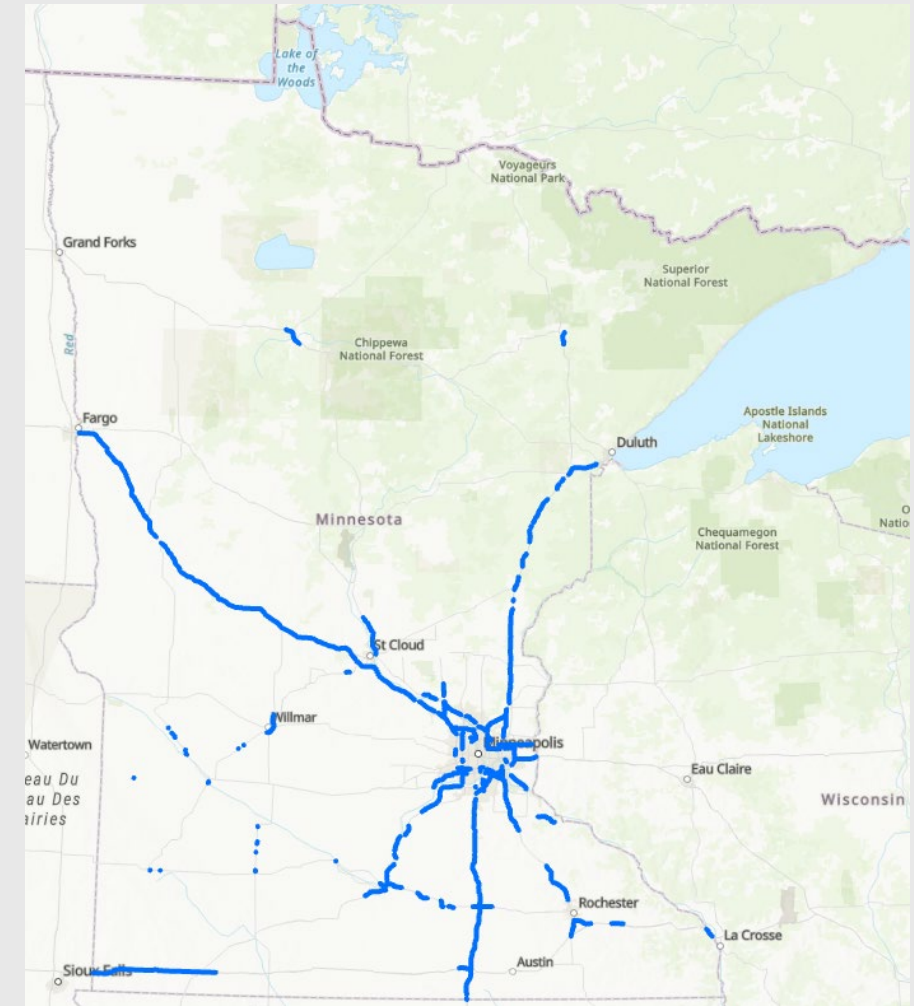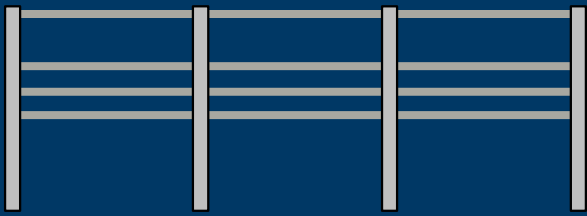
Goal: Prevent cross-median crashes

High Tension Median Cable Barrier (HTMCB)

Zero miles of high-tension median cable barrier
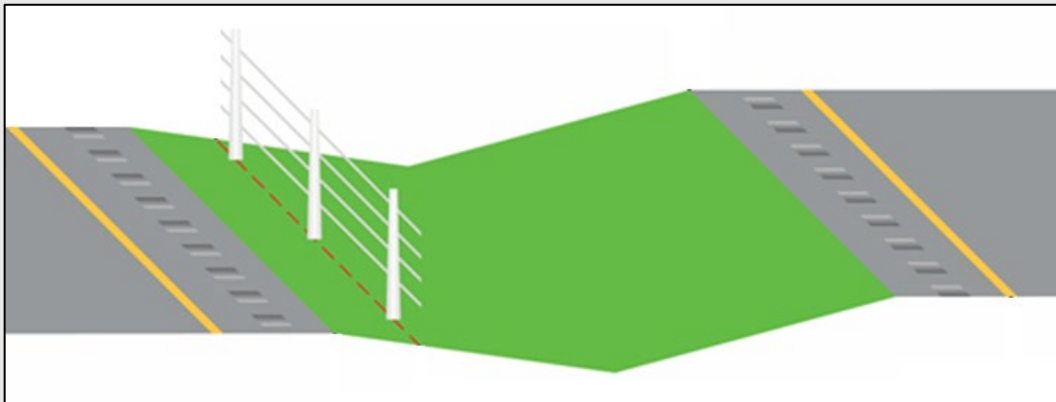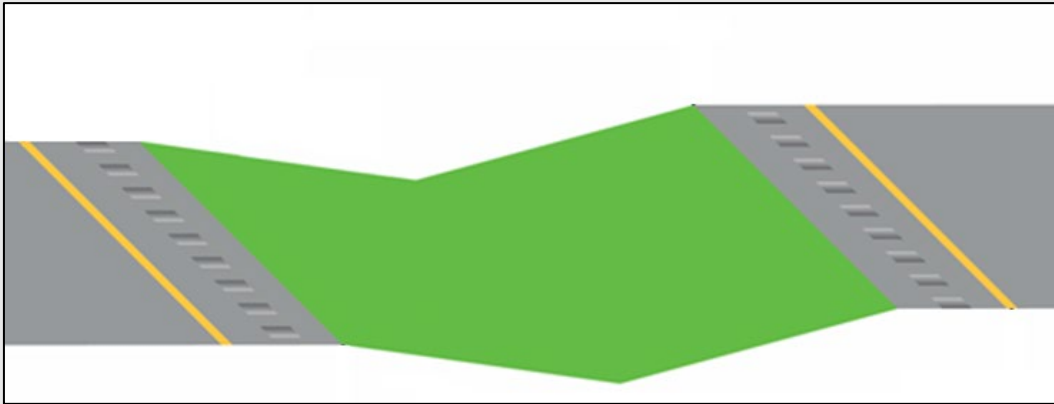(in 2003)

774 miles of high-tension median cable barrier
(through 2022)

HTCMB – New Installation Results

Installing HTCMB
Crash frequency & severity

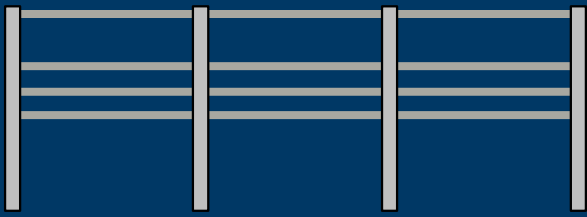

Naïve before-after evaluation

Total Crashes

32% Reduction in Crashes

Crash Type	CMF
Fatal & Serious Injury	**0.682**
Fatal & All Injury	0.819
All	1.288

Target Crashes

62% Reduction in Crashes

Crash Type	CMF
Fatal & Serious Injury	**0.377**
Fatal & All Injury	0.581
All	1.930
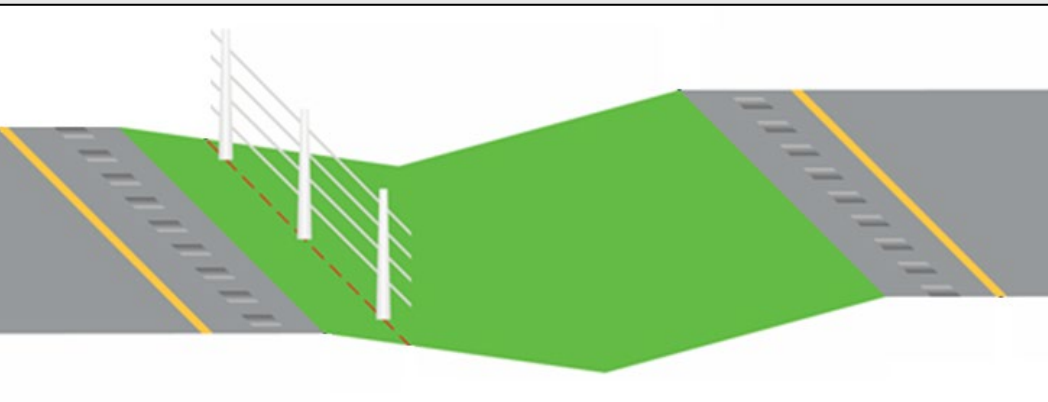
Reviewing the crash data since implementation in 2004 has shown:

- ***Likely over 400 lives saved across the near 20 years of planning, design, construction and maintenance!***

- Even higher numbers with seriously injured and injuries considered!

Roundabouts, J-Turns, and Intersection Lighting

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What is a Roundabout

Roundabouts are:

- Merely one type of intersection control made of concrete, asphalt, gravel, dirt, etc.

- One of the tools that transportation engineers can use to control traffic

- A tool that is becoming more accepted and more deployed in Minnesota and Nationally

Roundabouts are:

- Roundabouts – Yield on Entry.

- Traffic circulates in a counter-clockwise motion

- Pedestrians cross at intersection legs, not the middle

- Bicyclists can use either method

- No Parking

Roundabouts are NOT:

- A one-size-fits-all solution

- A Traffic Circle, nor Rotary

- "Social Engineering"

- The "Europeanization of America"

- The Solution to World Peace, Love, and Understanding

A Study of the Traffic Safety at Roundabouts in Minnesota

Office of Traffic, Safety, and Technology
Minnesota Department of Transportation

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DEPARTMENT OF TRANSPORTATION

October 30, 2017

Derek Leuer, P.E.

Office of Traffic, Safety, and Technology

But what are the actual results of installing Roundabouts in Minnesota?

Likely almost 500 installations in Minnesota

Over 50 installed on the TH Network

https://www.dot.state.mn.us/trafficeng/safety/docs/roundaboutstudy.pdf

- **An 89% reduction in Fatal Crashes**

- **An 83% reduction in Serious Injury Crashes**

- For the Minnesota Department of Transportation's Statewide Performance Measures, this marks an 86% reduction in severe crashes.

- Fatal and Injury Crashes (K, A, B, and C injury) decreased from 0.20 injury crashes to 0.08 injury crashes per 1,000,000 Vehicles Entering. This marks a 60% reduction in injury crashes.

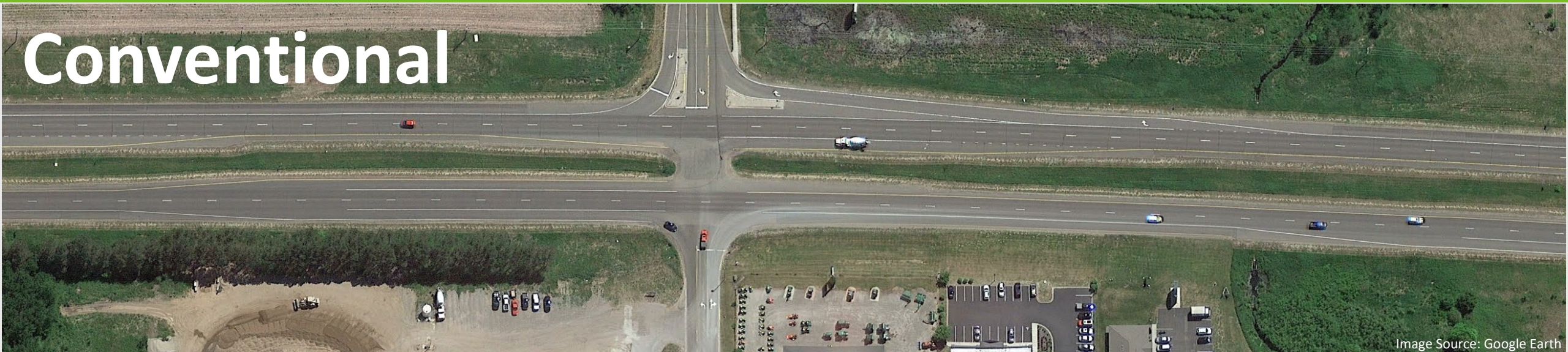- **Right Angle crashes, typically the most deadly type of crash in Minnesota, had a total reduction of 68% of all crash severities.**
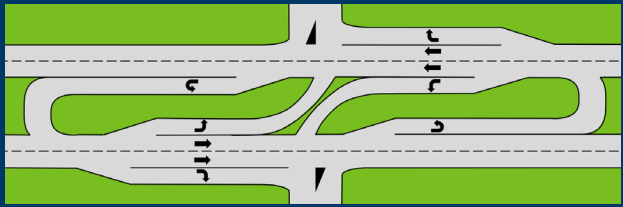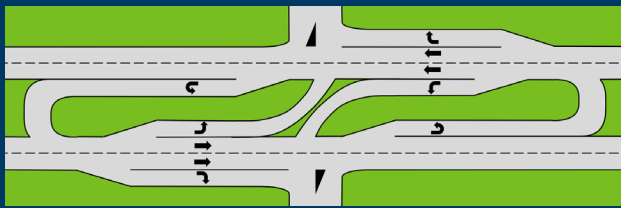
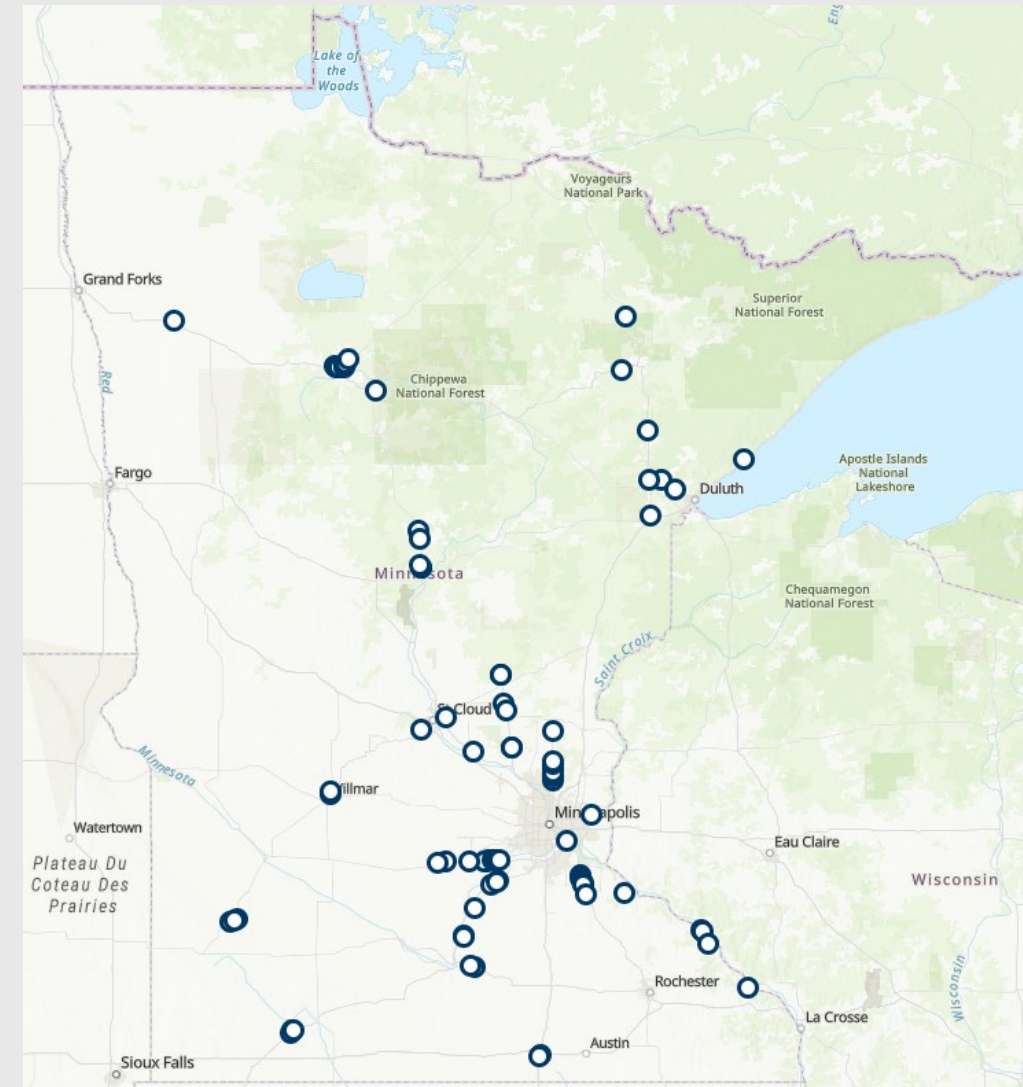Image Source: Google Earth

J-turns

Conventional
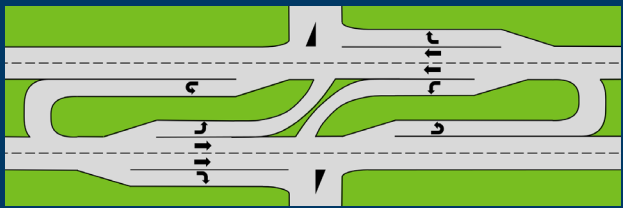
J-turn

Image Source: Google Earth

Image Source: Google Earth

J-turns in Minnesota
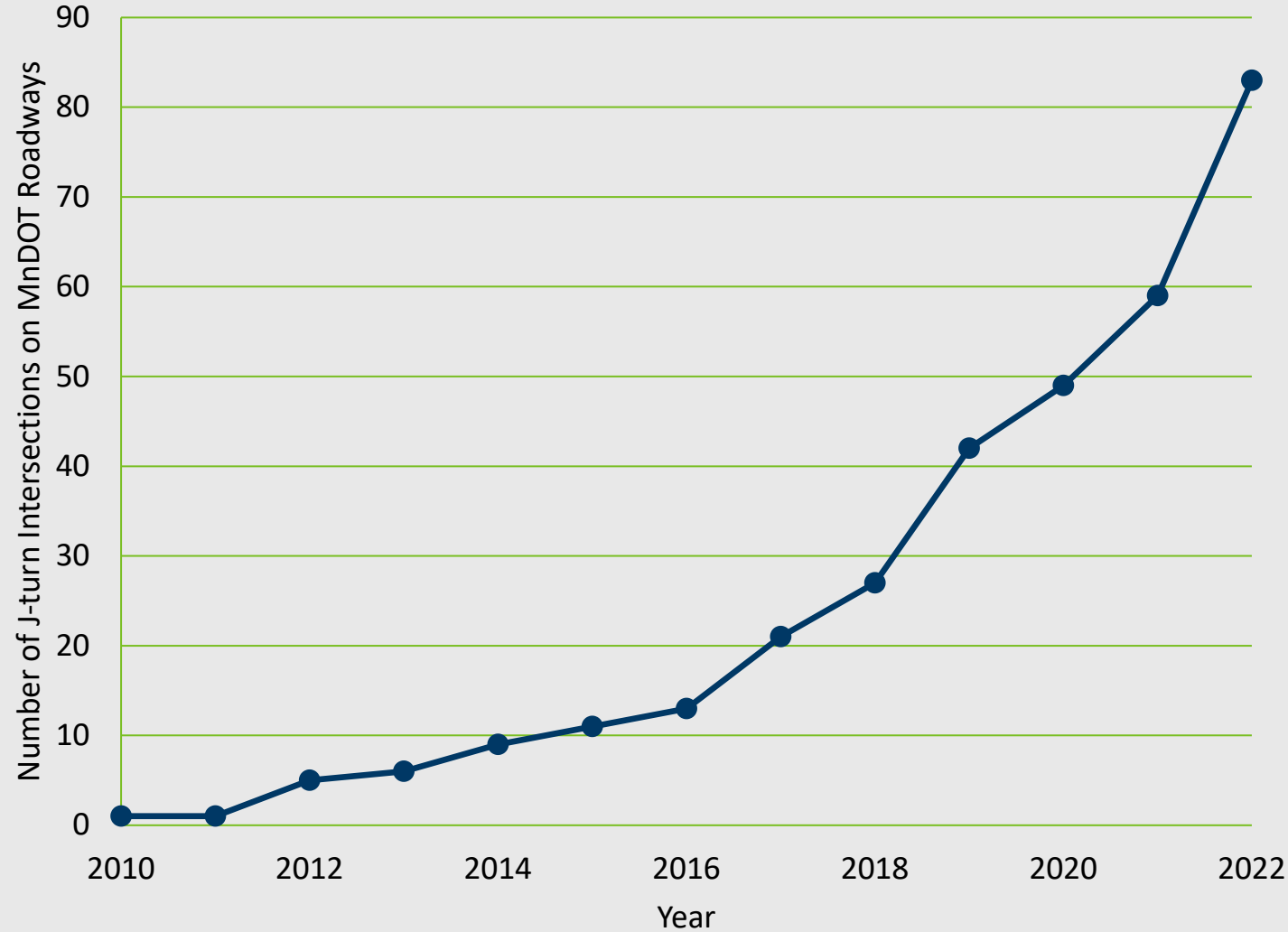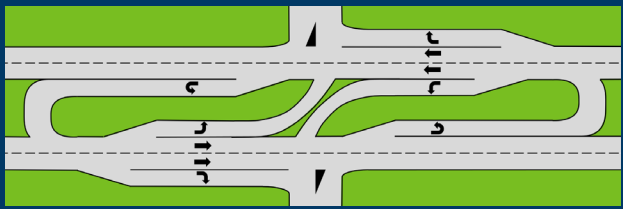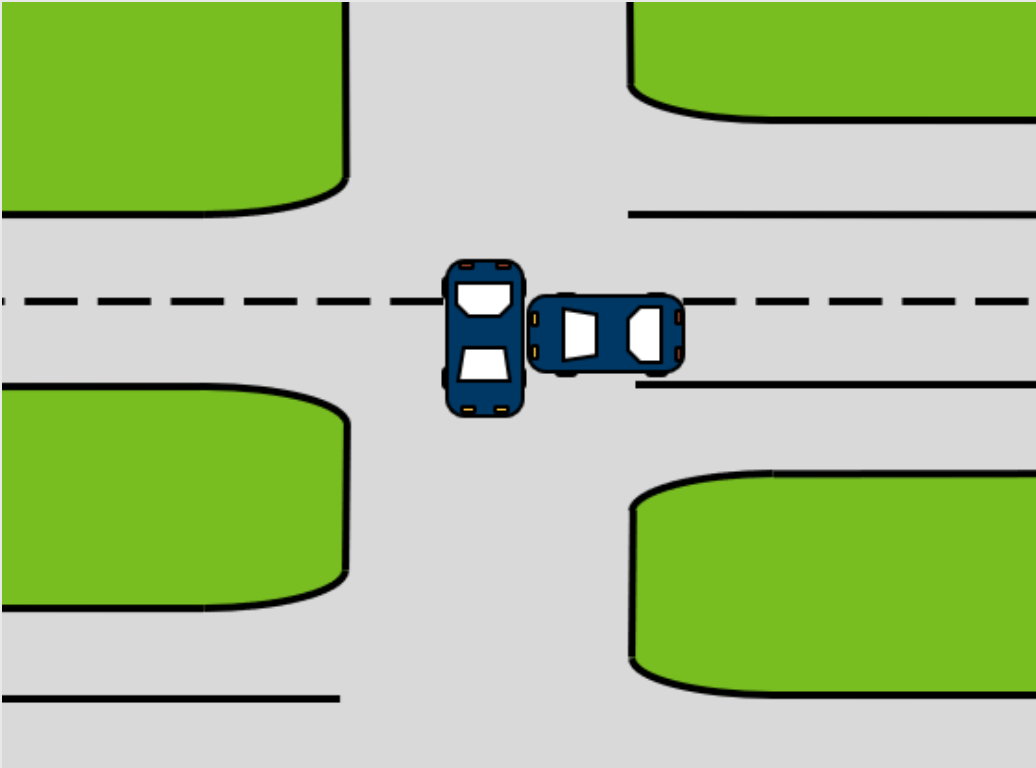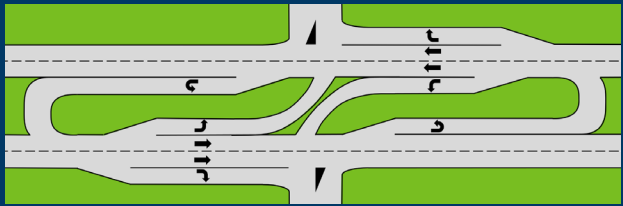
J-Turn – Results of Before-After Analysis

	Change in Crash Rate with J-Turn Added	Statistically Significant at α=.05?
Fatal & Serious Injury Crashes	**-69%**	**Yes**
Angle Crashes	**-70%**	**Yes**
Fatal & Serious Injury Angle Crashes	**-87%**	**Yes**
Total Crashes	-7%	No

Crash data is through 2019.

Similar results were found in the cross-sectional analysis.

Crash Reduction Factor

- 25% to 40% of nighttime crashes

Typical Installation Costs

- $6,000 per light

Statewide, District, and County Plans have led to recommendations at over 1,000 sites, with 100's built to date!

Looking at urban and pedestrian scale sites next for funding and implementation!

The Traffic Safety Pyramid!

Highway Safety Investment Program (HSIP) Impact Pyramid

Statewide Impact

Cost per Site (mile, intersection, curve)

Interchanges, Highway Expansions, Overpasses

Reconstruction, New Guardrail, ITS Technologies, Guardrail End Treatment (upgrades), Pedestrian Hybrid Beacons, Off-System Trails
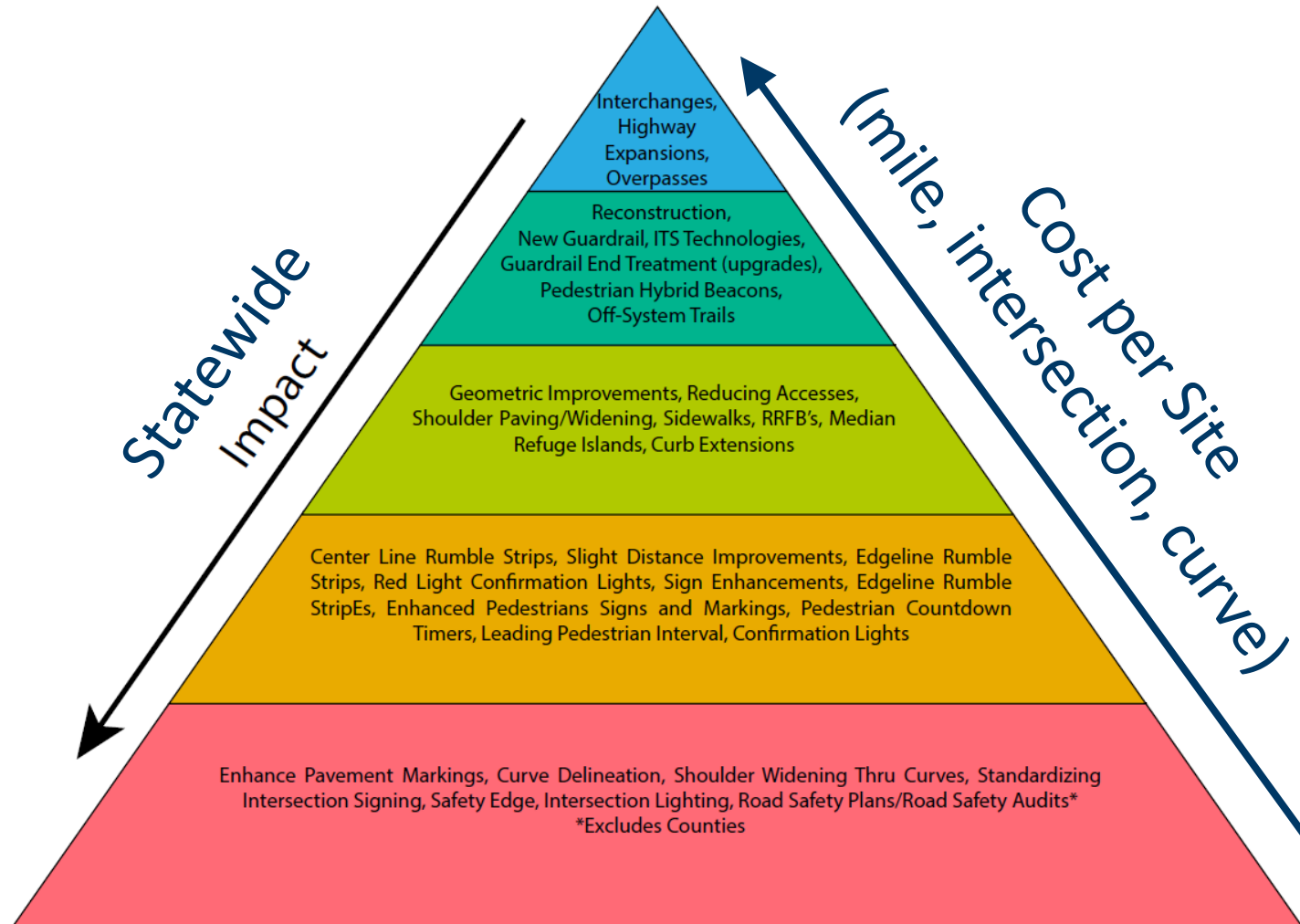
Geometric Improvements, Reducing Accesses, Shoulder Paving/Widening, Sidewalks, RRFB's, Median Refuge Islands, Curb Extensions

Center Line Rumble Strips, Slight Distance Improvements, Edgeline Rumble Strips, Red Light Confirmation Lights, Sign Enhancements, Edgeline Rumble StripEs, Enhanced Pedestrians Signs and Markings, Pedestrian Countdown Timers, Leading Pedestrian Interval, Confirmation Lights

Enhance Pavement Markings, Curve Delineation, Shoulder Widening Thru Curves, Standardizing Intersection Signing, Safety Edge, Intersection Lighting, Road Safety Plans/Road Safety Audits*
*Excludes Counties

Minnesota versus Delaware!

Traffic Safety Comparison

Legend: ◆ Delaware per 100,000 ● Minnesota per 100,000 ○ USA per 100,000

Minnesota begins TZD

Steady progress 2003–2011

Maintenance 2011 →

Minnesota was heading in the wrong direction!

- Started in 2003

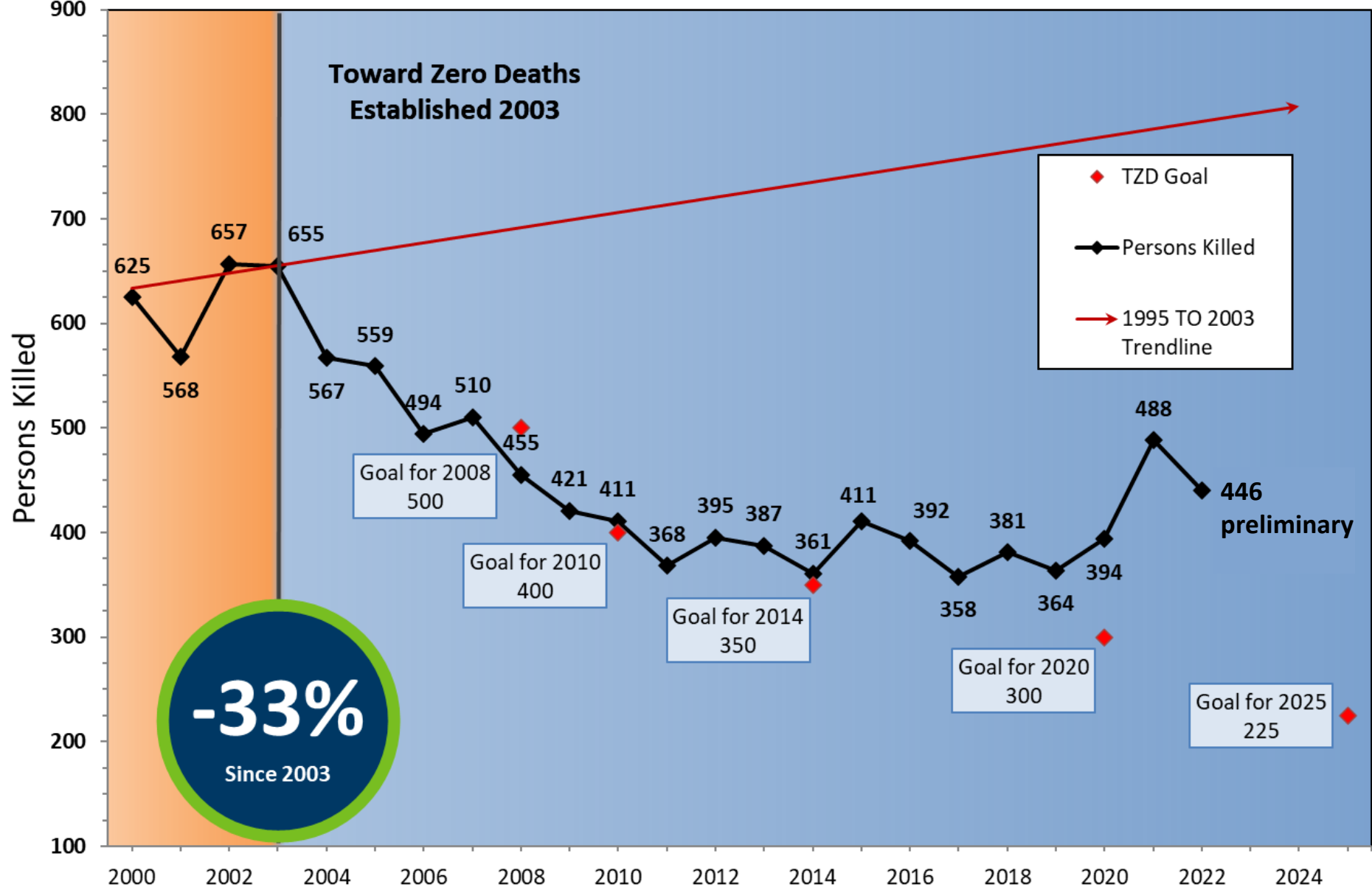- MnDOT and Dept. of Public Safety
  - Later Health and Education added

- Focused, multi-agency effort

- Local Governments, Private Business, Schools, Hospitals, Legislature, etc.

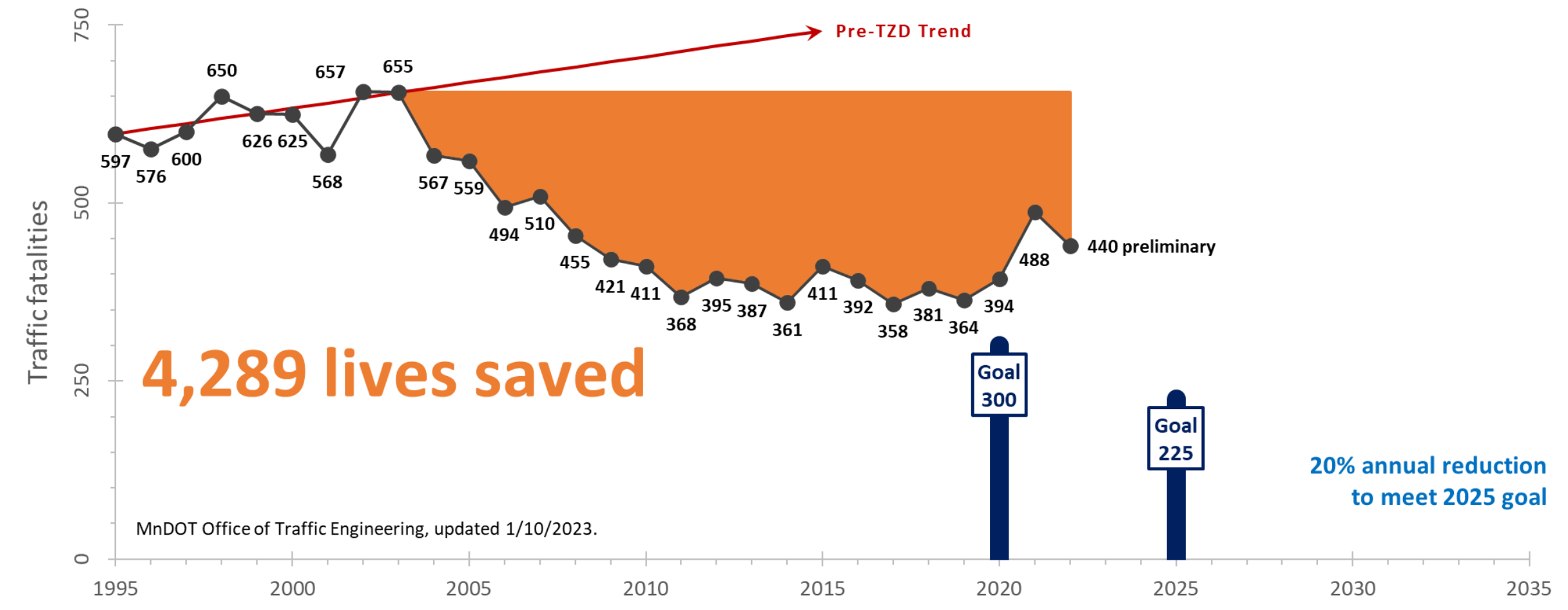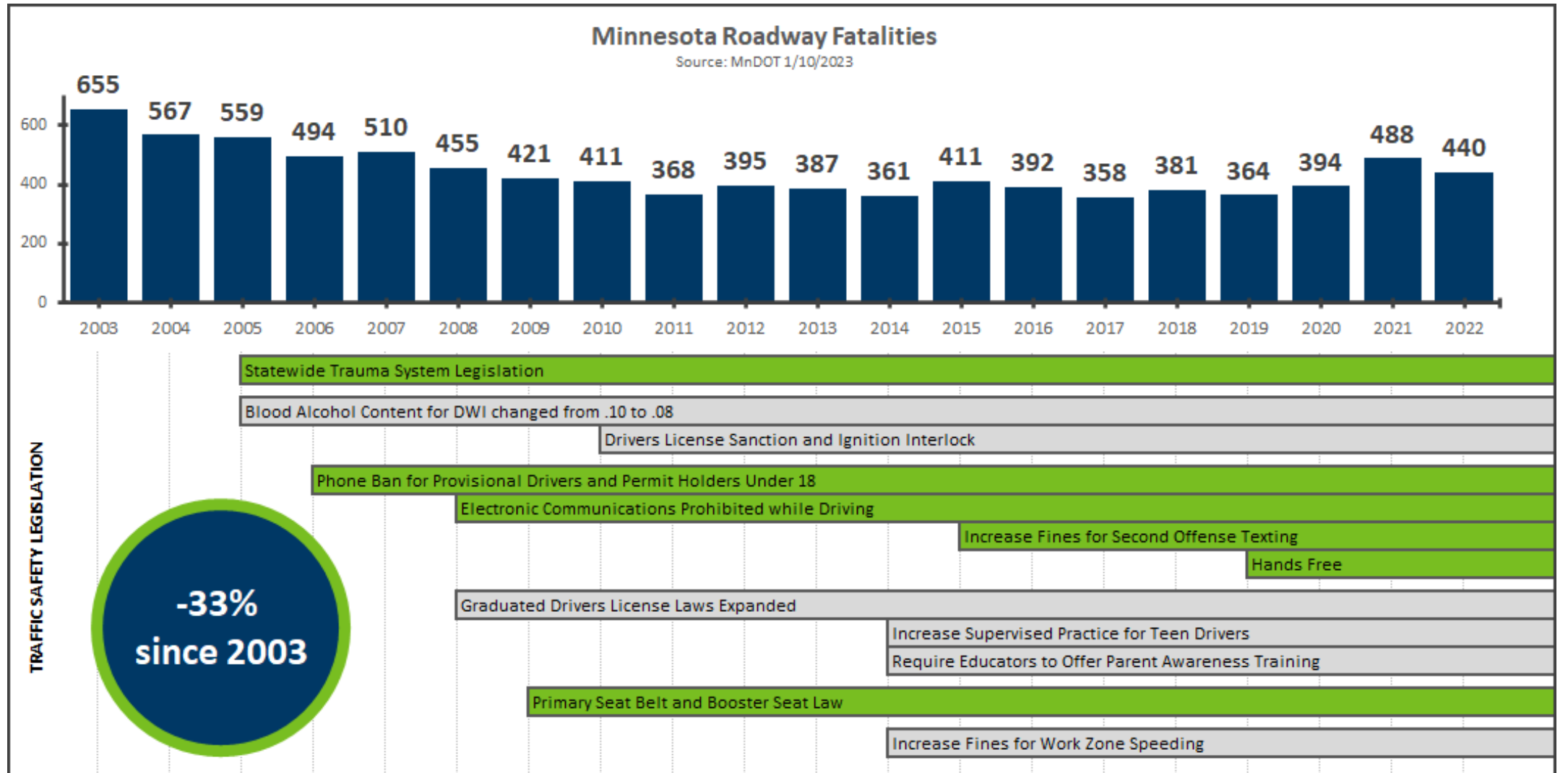- Roadway deaths are unacceptable (and preventable)

Minnesota Roadway Fatalities
Source: MnDOT 1/10/2023

Minnesota Towards Zero Deaths

Minnesota Roadway Fatalities
Source: MnDOT 1/10/2023

Year	Fatalities
2003	655
2004	567
2005	559
2006	494
2007	510
2008	455
2009	421
2010	411
2011	368
2012	395
2013	387
2014	361
2015	411
2016	392
2017	358
2018	381
2019	364
2020	394
2021	488
2022	440

-33% since 2003

TRAFFIC SAFETY LEGISLATION

- Statewide Trauma System Legislation
- Blood Alcohol Content for DWI changed from .10 to .08
- Drivers License Sanction and Ignition Interlock
- Phone Ban for Provisional Drivers and Permit Holders Under 18
- Electronic Communications Prohibited while Driving
- Increase Fines for Second Offense Texting
- Hands Free
- Graduated Drivers License Laws Expanded
- Increase Supervised Practice for Teen Drivers
- Require Educators to Offer Parent Awareness Training
- Primary Seat Belt and Booster Seat Law
- Increase Fines for Work Zone Speeding

Minnesota Towards Zero Deaths

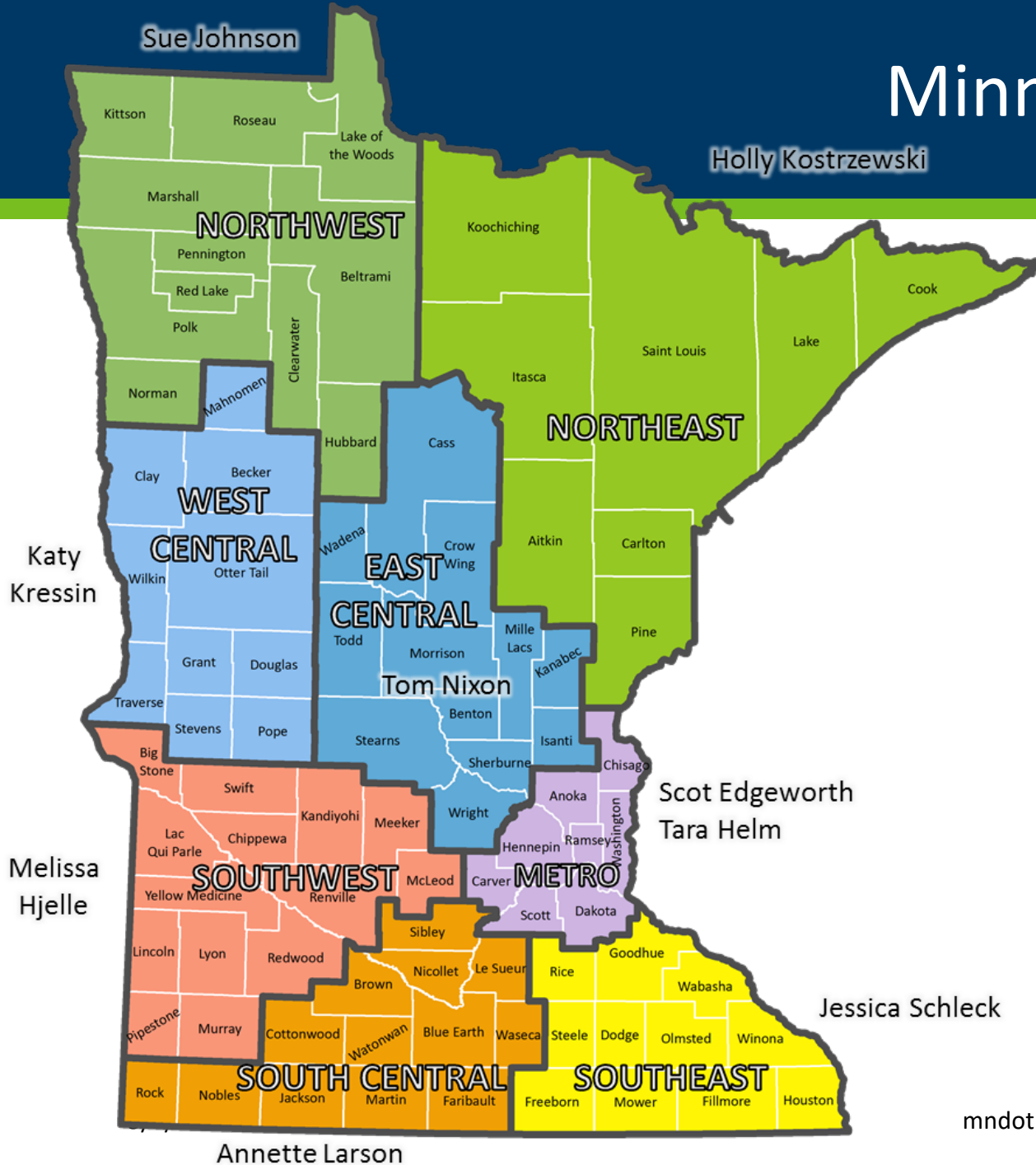| Category	2004 Fatalities	2019 Fatalities	Change
Road Departure	175	105	**-40%**
Head-On	107	61	**-43%**
Intersection Related	174	154	**-11%**
Trunk Highways	292	178	**-39%**
County Owned	207	130	**-37%**
Other Owner	68	45	**-33%**

Grassroots Engagement
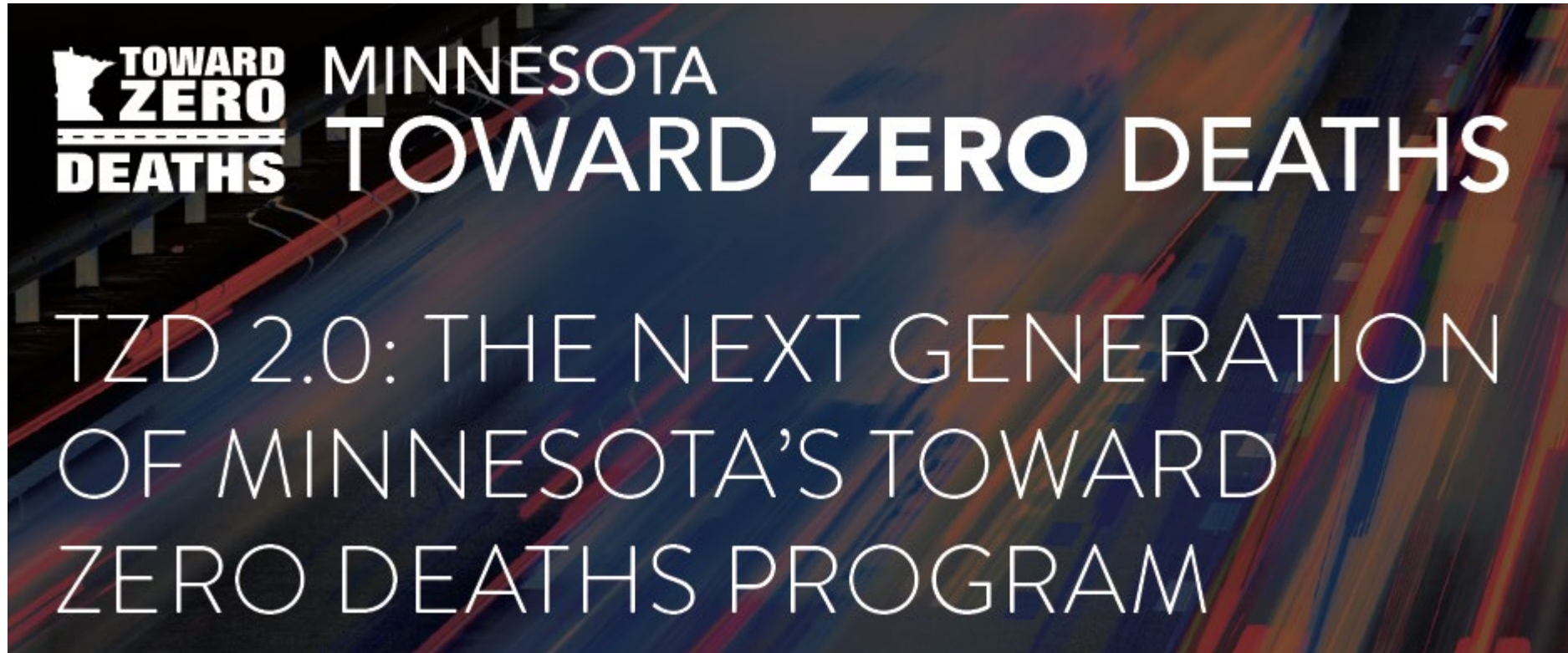
The best time to plant a tree was 20 years ago. The second best time is NOW!
-Chinese Proverb

*(But keep it out of the clear-zone!)*

Building a Culture of Traffic Safety

A traffic safety culture is created through Positive Community Norming

A Social Ecological Approach

Using the environment to create lasting changes to beliefs and behavior

- Uses proven principles of Positive Community Norming

- Founded on the principle that the solutions exist

- Engages community and organizations to help drive individual behavior and beliefs

- Driven by hope from a strengths-based orientation and concern for critical issue

- Part of MN Strategic Highway Safety Plan

Individual

Family & Friends

Work, School, Community

State or Region
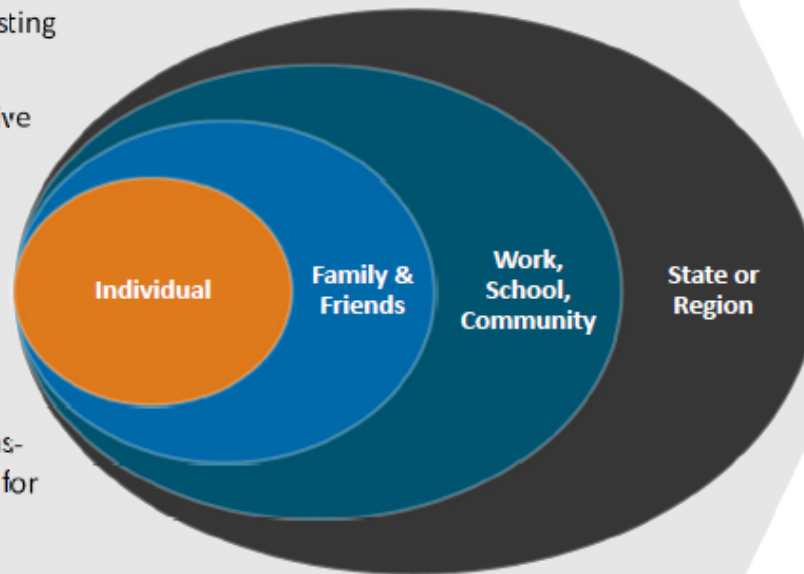
True, Lasting Transformation to Traffic Safety Culture

Designing and Operating a Safe System

Safe System provides a safety net when things go wrong

Safe System Approach

Designs and operates traffic systems and structures to protect against human mistakes and injury tolerances and avoid death and serious injuries

Focus of Federal Highway Administration Approach

"Safety net" to protect people when mistakes happen/they make poor choices

Thank you again!

Derek Leuer

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651-234-7372

mndot.gov