HIGHWAY SAFETY MANUAL IMPACTS ON PENNSYLVANIA

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What We'll Cover:

• DDSA

• SPF Development

• Network Screening

• Systemic Safety

• Analysis Tools

DATA DRIVEN SAFETY ANALYSIS

- Pennsylvania has made a lot of changes to safety analysis
- Old ways of data analysis
  - Crash rates
  - Average annual crash frequencies
  - Locations with the most crashes
  - Locations with the most fatal and serious injuries
  - Heat Maps

- Let's look at some old analysis methods

2018 to 2022 Crash Data

Top 10 Counties with most **Total Crashes**

1. Allegheny (9.8%)
2. Philadelphia (8.7%)
3. Montgomery (7.0%)
4. Bucks (4.8%)
5. Lancaster (4.7%)
6. Berks (4.1%)
7. Delaware (4.1%)
8. Lehigh (4.0%)
9. York (3.8%)
10. Chester (3.6%)

Top 10 Counties with Most **Fatalities**

1. Philadelphia (11.0%)
2. Allegheny (5.9%)
3. Lancaster (4.6%)
4. Bucks (4.5%)
5. Berks (3.8%)
6. Montgomery (3.6%)
7. York (3.2%)
8. Westmoreland (3.1%)
9. Chester (2.9%)
10. Luzerne (2.8%)
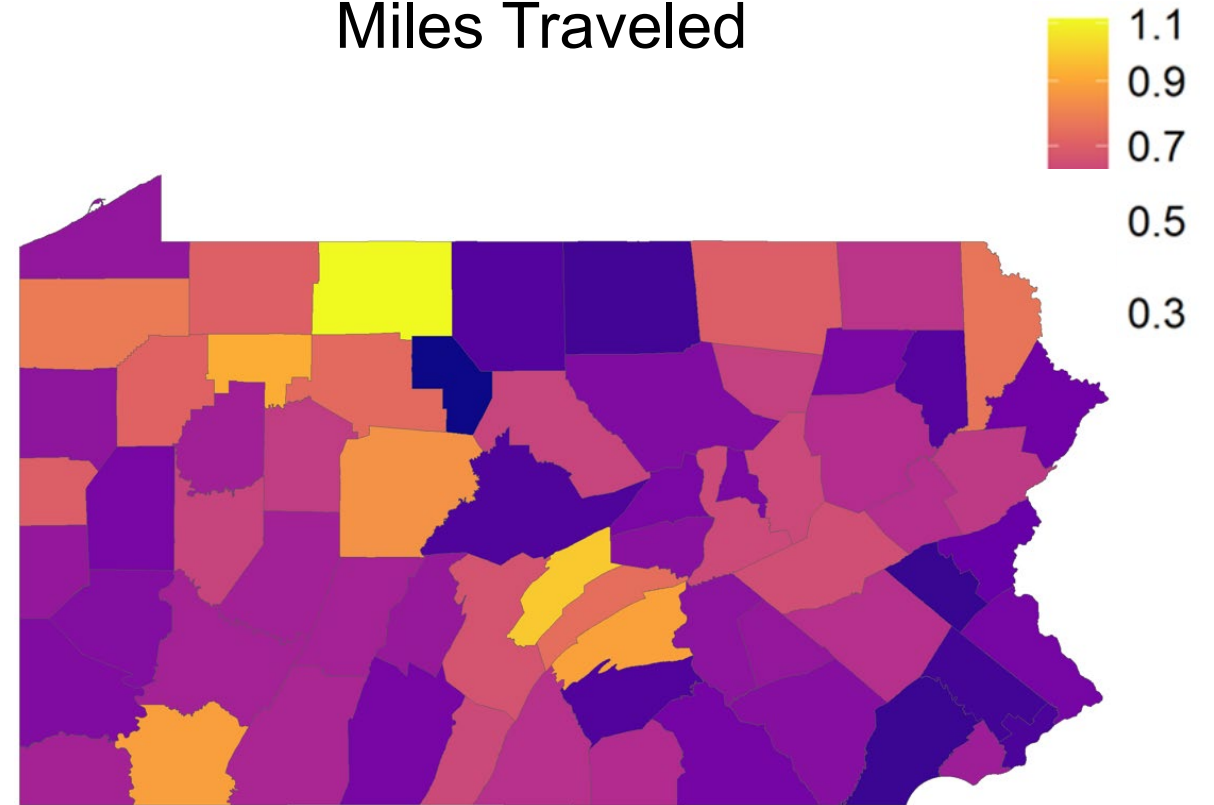
CRASH TYPES BY COUNTY

Unrestrained

Average Annual Frequency of Fatal+SSI

2018 - 2022

Unrestrained

Fatal+SSI per 100,000 Daily Vehicle Miles Traveled

2018 - 2022

CRASH TYPES BY COUNTY

SVROR

Average Annual Frequency of Fatal+SSI

SVROR

Fatal+SSI per 100,000 Daily Vehicle Miles Traveled
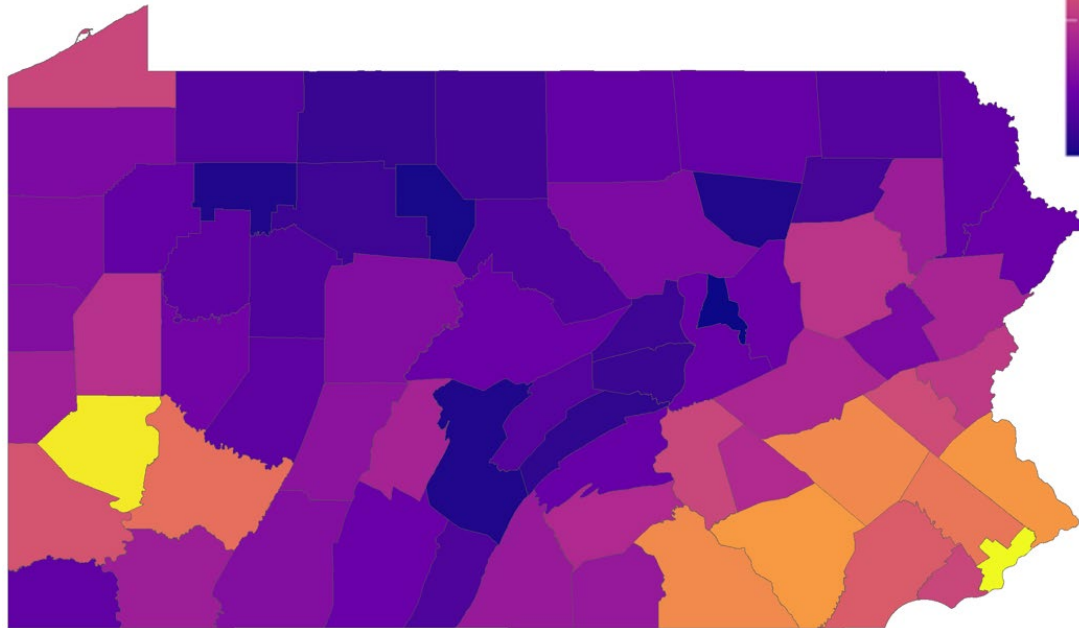

2018 - 2022

2018 - 2022

CRASH TYPES BY COUNTY
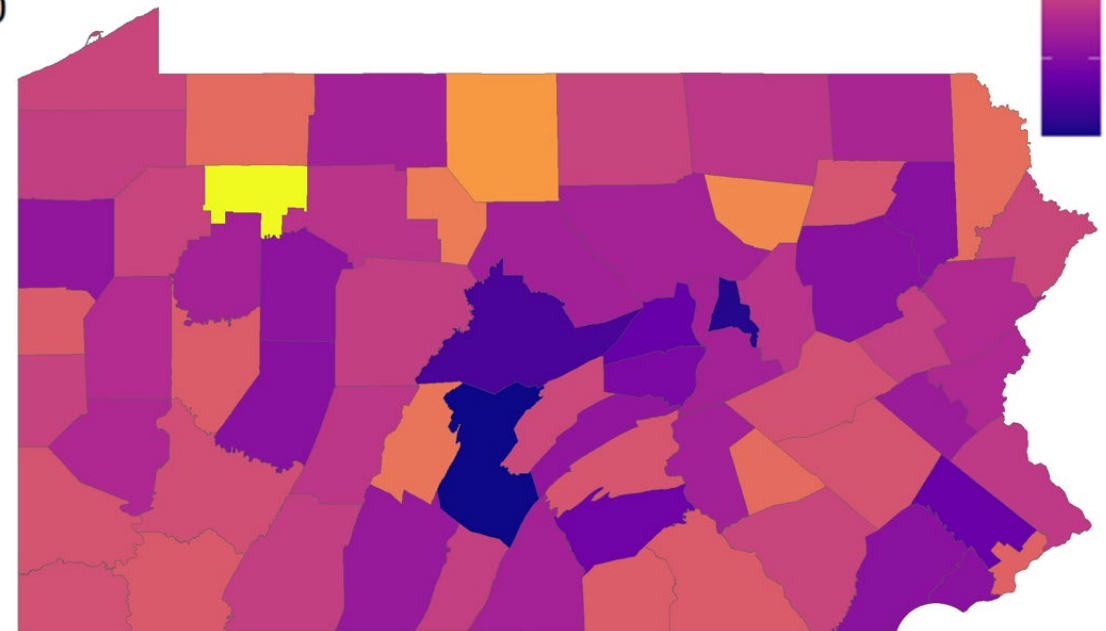
Motorcyclist

Average Annual Frequency of Fatal+SSI

2018 - 2022

Motorcyclist
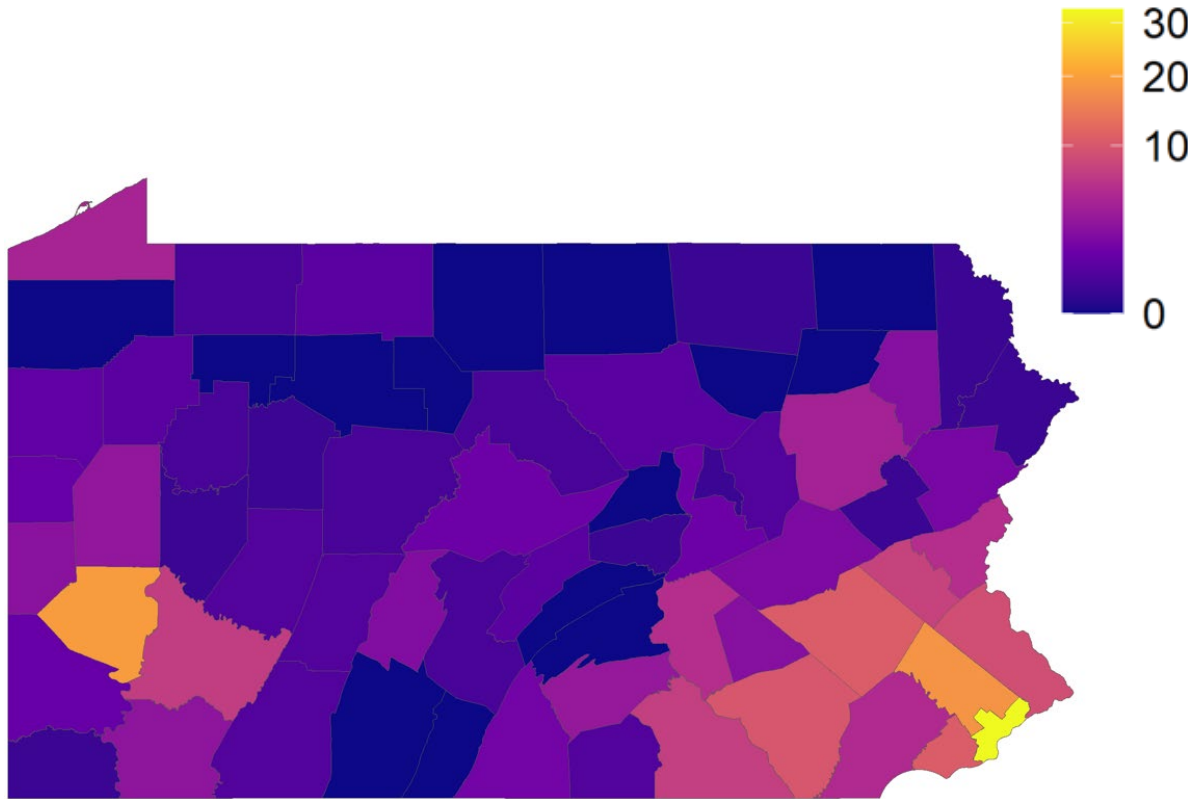
Fatal+SSI per 100,000 Daily Vehicle Miles Traveled

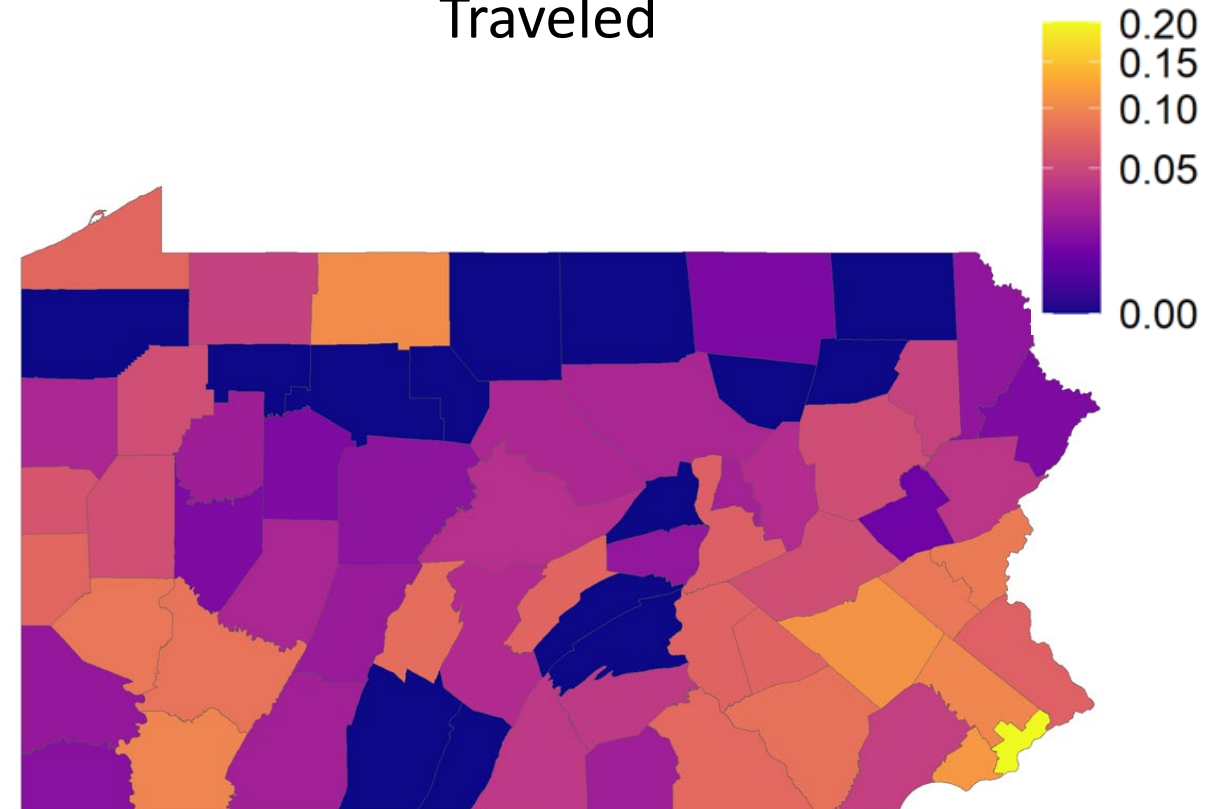2018 - 2022

CRASH TYPES BY COUNTY

Red Light Running

Average Annual Frequency of Fatal+SSI

30
20
10
0

2018 - 2022

Red Light Running

Fatal+SSI per 100,000 Daily Vehicle Miles Traveled

0.20
0.15
0.10
0.05
0.00

2018 - 2022

❑ Old Data Analysis Methods
- Good for summary reports
- Used by the USDOT for reporting metrics
- Not helpful in finding the best locations for safety improvements

❑ So, what should we do?

❑ What are we doing that is better than this?

Safety Assessment Methods

Table 1. Primary Analysis Application for Safety Assessment Methods

Application	Site Evaluation or Audit	Historical Crash Data Evaluation	CMF Applied to Observed Crashes	CMF Relative Comparison	AADT-Only SPF	SPF with CMF Adjustment	SPF with CMF Weighted with Observed Crashes
	Basic				**Intermediate**		**Advanced**
	Observed Crashes				*Predicted Crashes*		*Expected Crashes*
Performance of an Existing Road	1	1, 2	1, 2, 3	1, 3	1, 4	1, 3, 4	1, 2, 3, 4
Future Impact of Minor Geometric Changes to Existing Road			1, 2, 3	1, 3		1, 3, 4	1, 2, 3, 4
Future Impact of Major Geometric Changes to Existing Road						1, 3, 4	
Future Performance for a New Facility					1, 4	1, 3, 4	

Note: AADT = average annual daily traffic. CMF = crash modification factor. SPF = safety performance function.
Basis for Analysis: 1 = site characteristics, 2 = crash history, 3 = CMF values, and 4 = AADT.

What we were doing in the past

What is now required
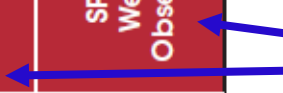
*SPF >> Safety Performance Functions

NEW SAFETY PERFORMANCE FUNCTIONS

- Currently use Pennsylvania Regionalized SPFs for conventional roadways
  - Developed SPFs that were not available in AASHTO
  - Doesn't require users to break crashes into single and multi-vehicle
  - Urban/Suburban Collector Roads
  - Intersections
  - Has adjustment factors not in the AASHTO SPFs
    - Speed Limits
    - Total Curve Density over a segment (not curve by curve)

- Currently use calibrated Freeway and interchange SPFs
  - Will need to revise the Freeway Calibrations due to 2-way

- We also use calibrated roundabout SPFs from NCHRP Report 888.

SAFETY PERFORMANCE FUNCTIONS UPDATES

Data Used For Developing Regional SPFs Segments

- Linear Reference data (county, route, segment)
- Segment length
- AADT
- Paved Roadway Width
- Number of travel lanes
- Turn Lanes (including TWLTL)
- Posted Speed Limit
- Parking Lanes
- Passing Zones
- Divisor Type (painted lines, barrier, etc.)

- Left and Right Shoulder type
- Left and Right Shoulder paved width
- Left & Right Shoulder total Width
- Functional Classification
- Access Control
- Historical Crash Data
- Others

SAFETY PERFORMANCE FUNCTIONS

New RMS data will be available for use in early 2024.

- Collected through Video Log Contractor
    - Horizontal Curves
    - Vertical Curves
   - Grades & Cross slopes
    - Rumble strip inventory

Future collection options:

- Intersection Sight Distance with LiDAR

SELECTING THE BEST SAFETY PERFORMANCE FUNCTIONS

- Since PA uses regionalized SPFs, it is important to accurately apply the appropriate regionalized SPFs.

- There can be a major difference in values between the AASHTO, State, District, and County level SPFs.
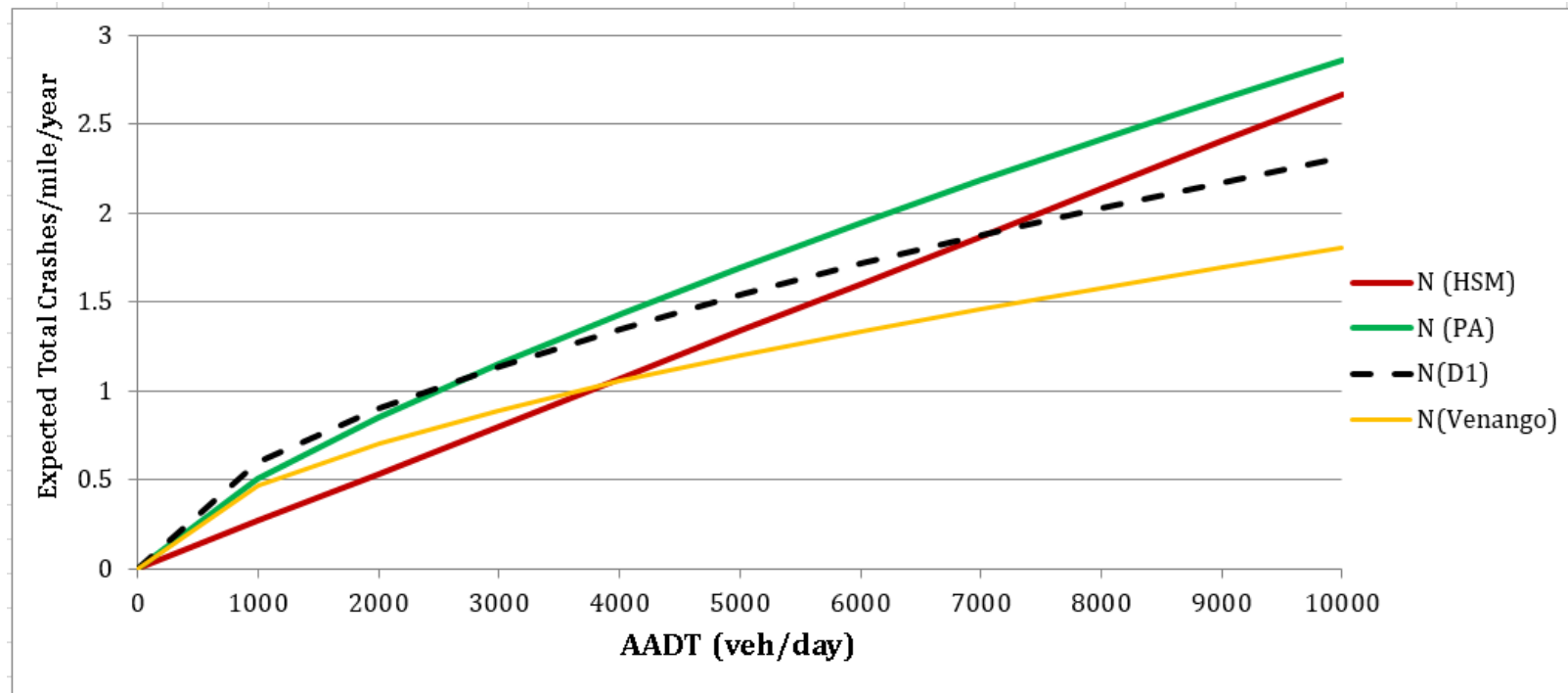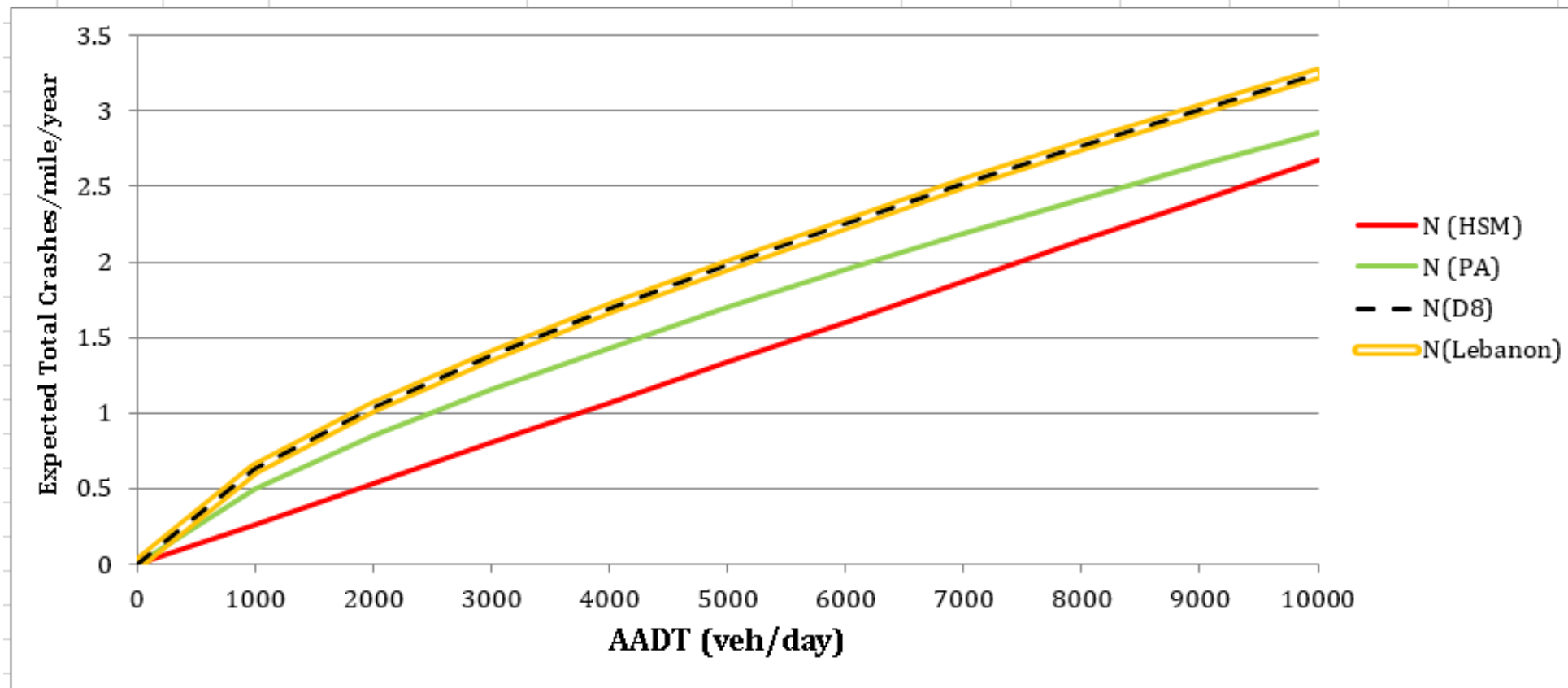

Note : Calibration Factor for Venango County=.78 There is a decrease of 22% in the yealy crash rate with respect to District (1-0)
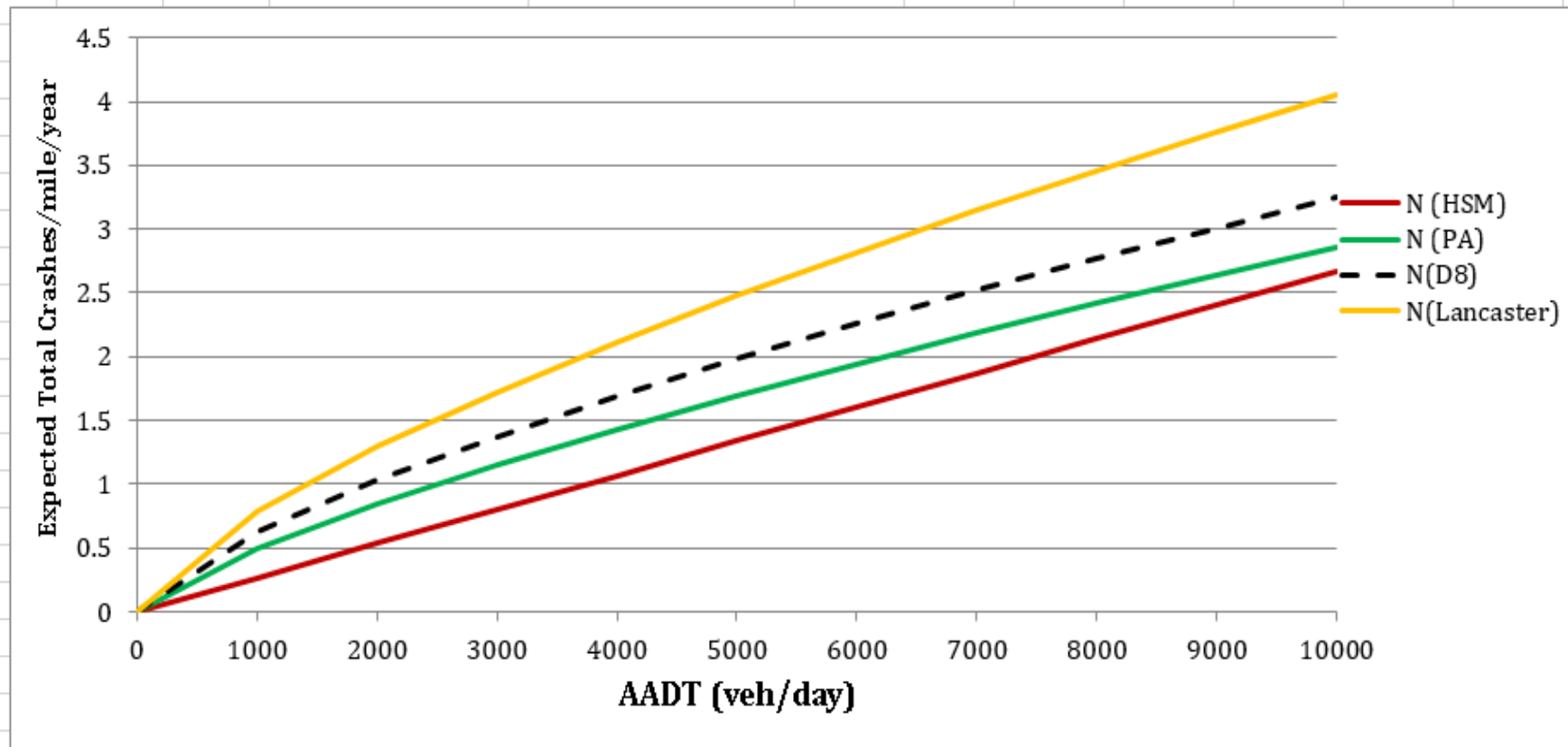
SAFETY PERFORMANCE FUNCTIONS

- District Rural Two Lane Highway Example
- Calibration Factor for Lebanon, Cumberland, & Franklin Counties=1.0 These are the <u>baseline counties for D-8</u>. There is no change in the yearly crash rate with respect to District 8-0

CURRENT SPFS

- A Rural Two Lane Highway Example
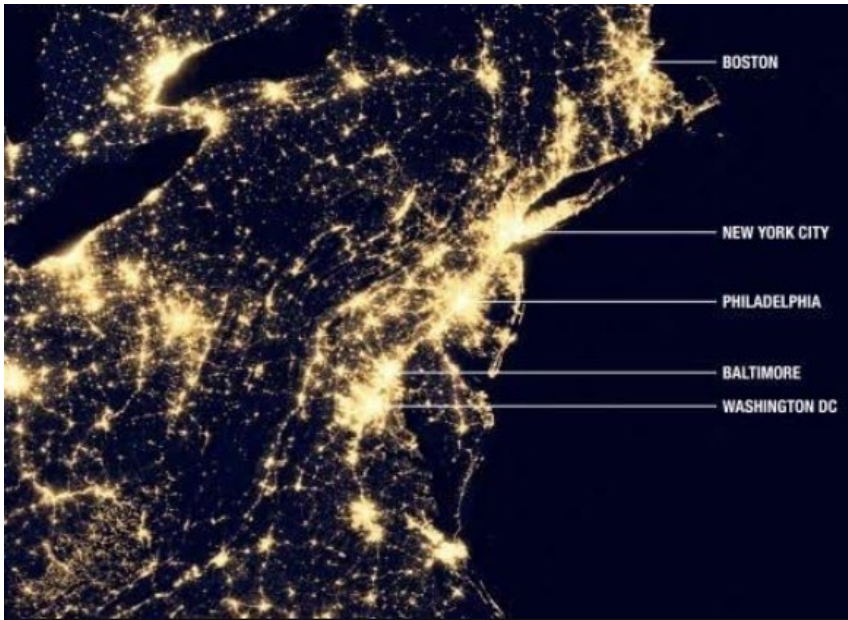
- Calibration Factor for Lancaster County=1.25 There is an increase of 25% in the yearly crash rate with respect to District (8-0)

- Between 51% to 195% difference between County and AASHTO

SAFETY PERFORMANCE FUNCTIONS

New Aspects to Consider

- Megalopolis SPFs for Northeastern Large Cities
  - Boston
  - New York City
  - **Philadelphia**
  - Baltimore
  - Washington D.C.
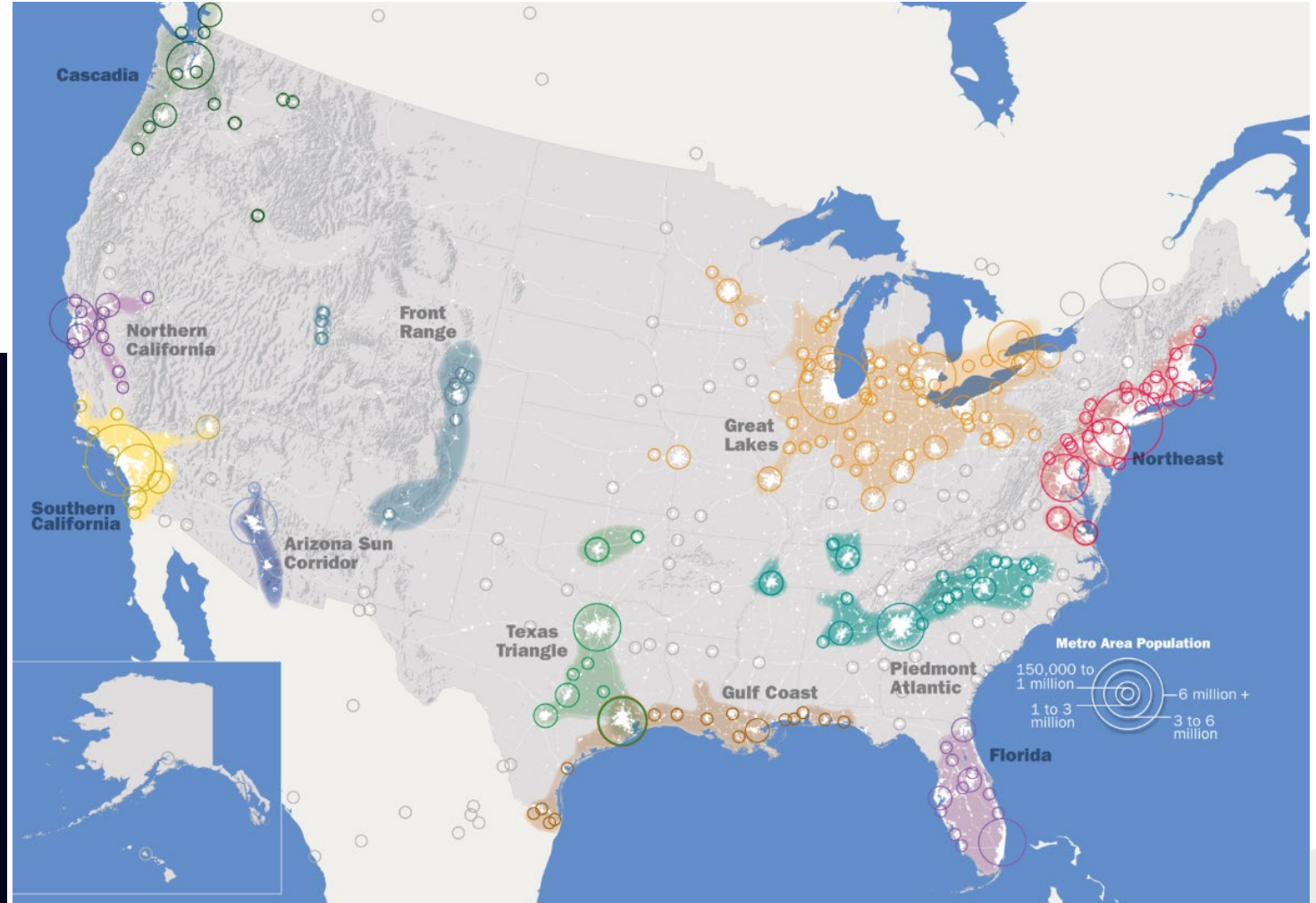
Northeast Megalopolis SPFs

- Will Benefit Philadelphia County
  - Will compare the City of Philadelphia to other large Atlantic Port Cities in the Northeast
  - Will not compare to the rest of Pennsylvania
  - Possible national interest in this study and SPF Development
  - Could spill into a neighboring metropolitan county like Delaware County

SAFETY PERFORMANCE FUNCTIONS

New Aspects to Consider
- One-way Streets
  - Segments
  - Signalized Intersections
    - One-way road major with one-way road minor
    - one-way major with 2-way road minor
    - two-way road major with one-way road minor

- Stop Except Right Turn Intersections
  - Lots of data already collected for this type of intersection for national study under NCHRP 17-68

- Trail Crossing Locations
  - Important for VRU analysis

- Pedestrian Traffic Signals adjustment factors

- Location's Distance to Hospitals or ambulance stations

- Bump-outs/bulb-outs at intersections and other pedestrian crossings

- Include the Calibrated Roundabout SPFs from NCHRP Report 888

SAFETY PERFORMANCE FUNCTIONS
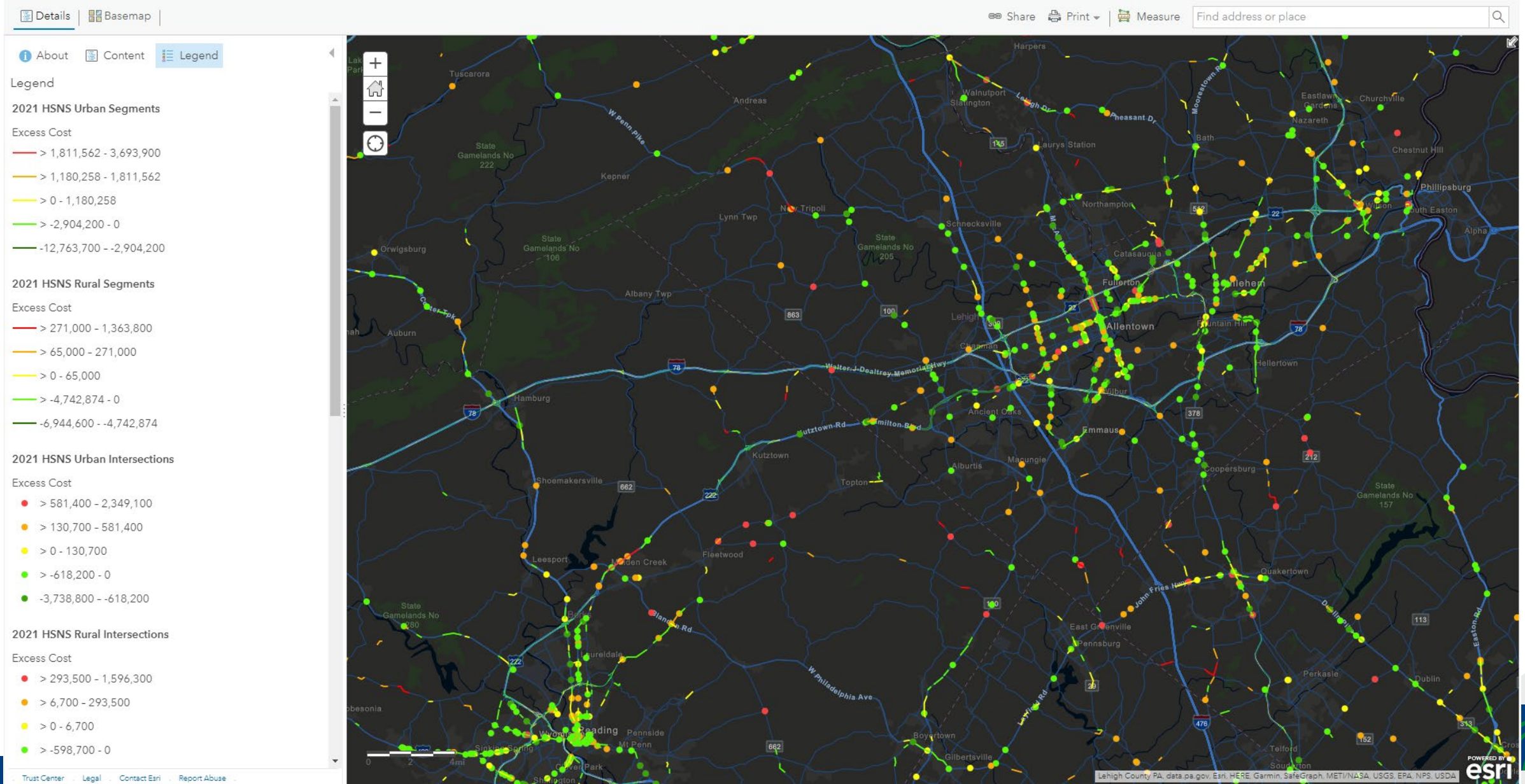
New Aspects to Consider

- Update crash severity, collision type, and illumination tables for all SPFs to allow for better Part D analysis

- Flexible Segment Lengths for SPFs or standard PennDOT segments?
    - Which is better and what can be accomplished with data?

- Jug Handle Intersections
    - Use PennDOT inventory of SR 9000s to identify jug handle locations (about 153 locations)
    - This is necessary as PennDOT has built more jug handle intersections for high-speed multi-lane divided highways as safety projects

- Identify geometric road features and traffic operations that signify a systemic need for safety improvements
    - High risk characteristics for rural road segments
    - High risk characteristics for rural intersections
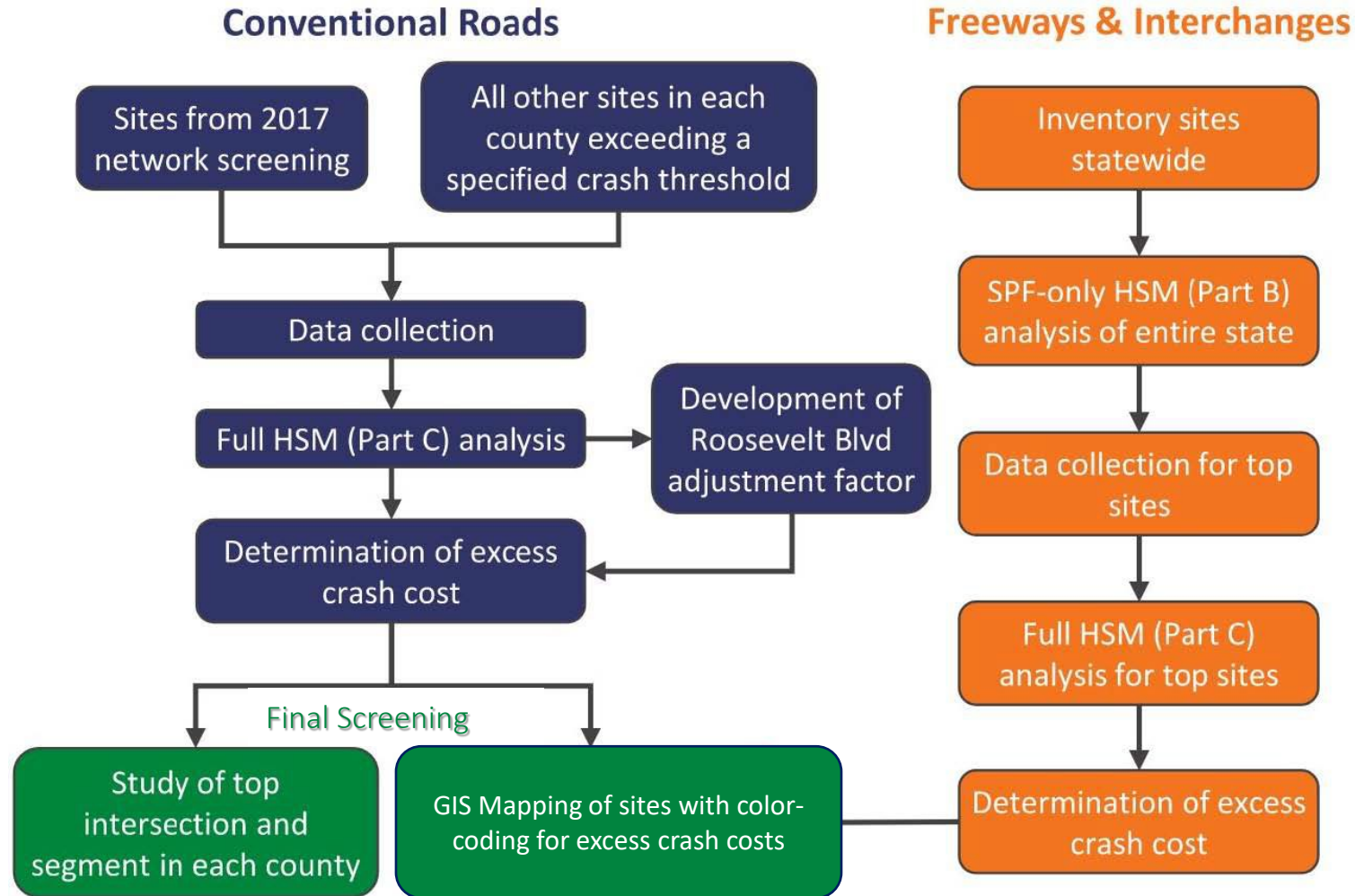   - High risk characteristics for urban intersections

NETWORK SCREENING

NETWORK SCREENING

Conventional Roads

- Sites from 2017 network screening
- All other sites in each county exceeding a specified crash threshold

→ Data collection

→ Full HSM (Part C) analysis → Development of Roosevelt Blvd adjustment factor

→ Determination of excess crash cost

Final Screening

- Study of top intersection and segment in each county
- GIS Mapping of sites with color-coding for excess crash costs

Freeways & Interchanges

- Inventory sites statewide
- SPF-only HSM (Part B) analysis of entire state
- Data collection for top sites
- Full HSM (Part C) analysis for top sites
- Determination of excess crash cost

Statewide HSIP Spending: Spot vs Systemic

Type of Projects	HSIP Funds Spent ($M)	Before F+SSI Crashes	After F+SSI Crashes	Cost per F+SSI Reduction ($M)
Spot Improvements	$439.1	507	490	$25.8
Systemic	$297.8	2,178	2,109	$4.3
Total	$737.0	2,685	2,599	$8.6

The performance data shows we need to implement more systemic safety projects

DDSA & SYSTEMIC OPTIONS

- Lane Departures
  - Push for less than 1,000 fatalities

- VRUs
  - Federal law to invest HSIP funds into VRU projects

- Stop Controlled Intersection Fatalities
  - Review every fatal crash at a stop-controlled intersection
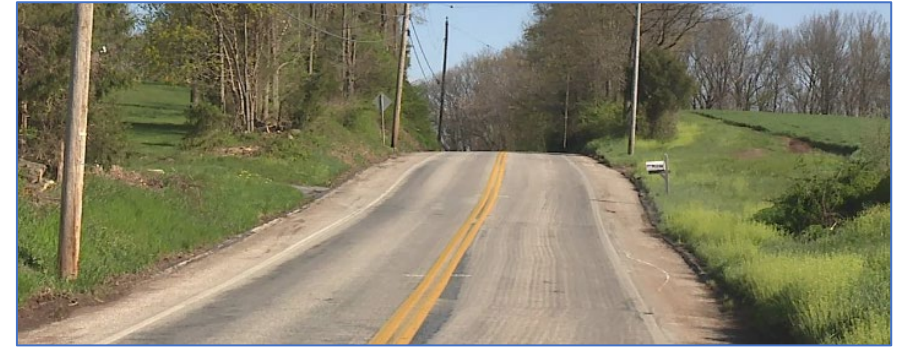
SAFETY ANALYSIS TOOLS & HSM SUPPORT

- CDART
  - Provides access to crash data
  - The ability to create several different reports and crash maps
  - Year-end crash cluster lists
  - Homogenous Reports
  - Network Screening Map
  - Regularly updated to allow new crash flags, reports, and other options

- Highway Safety Manual Support
  - Developing more tutorial videos
  - On-demand support for project specific questions

- Develop & Maintain Tools for HSM Analysis
  - Tools A & B
  - Screening Spreadsheets
  - BCA Tool
  - CMF spreadsheet
    - Intersection Sight Distance
    - Intersection Skew
    - Lane and Shoulder Width

- Future Tools
  - Web based
    - Our new ICE Tool
  - Python coded
  - Move away from spreadsheets w/ VBA
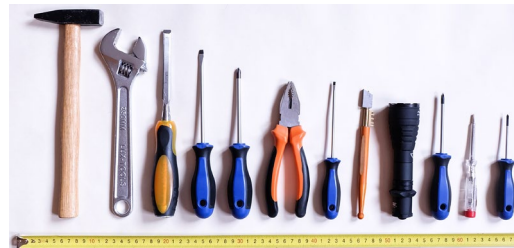
EFFECTIVENESS EVALUATIONS

In Depth Project Location and Countermeasure Analysis

- Advance Curve Warning Pavement Markings
  - Low cost and effective at reducing crashes
- Adaptive Traffic Signals
  - Showed these were not a good investment of safety funds
- High Friction Surface Treatments
  - Evaluated over 500 HFST locations Pennsylvania
  - CMFs for curves and intersections
- High Tension Cable Median Barriers
  - Greatly reduced fatal and serious injuries due to median crossover crashes
  - Does increase PDO crashes
- Others to come

QUESTIONS