User Liaison Subcommittee

TRB ACS20 Safety Performance and Analysis

Marriott Marquis, Tulip (Mezz)

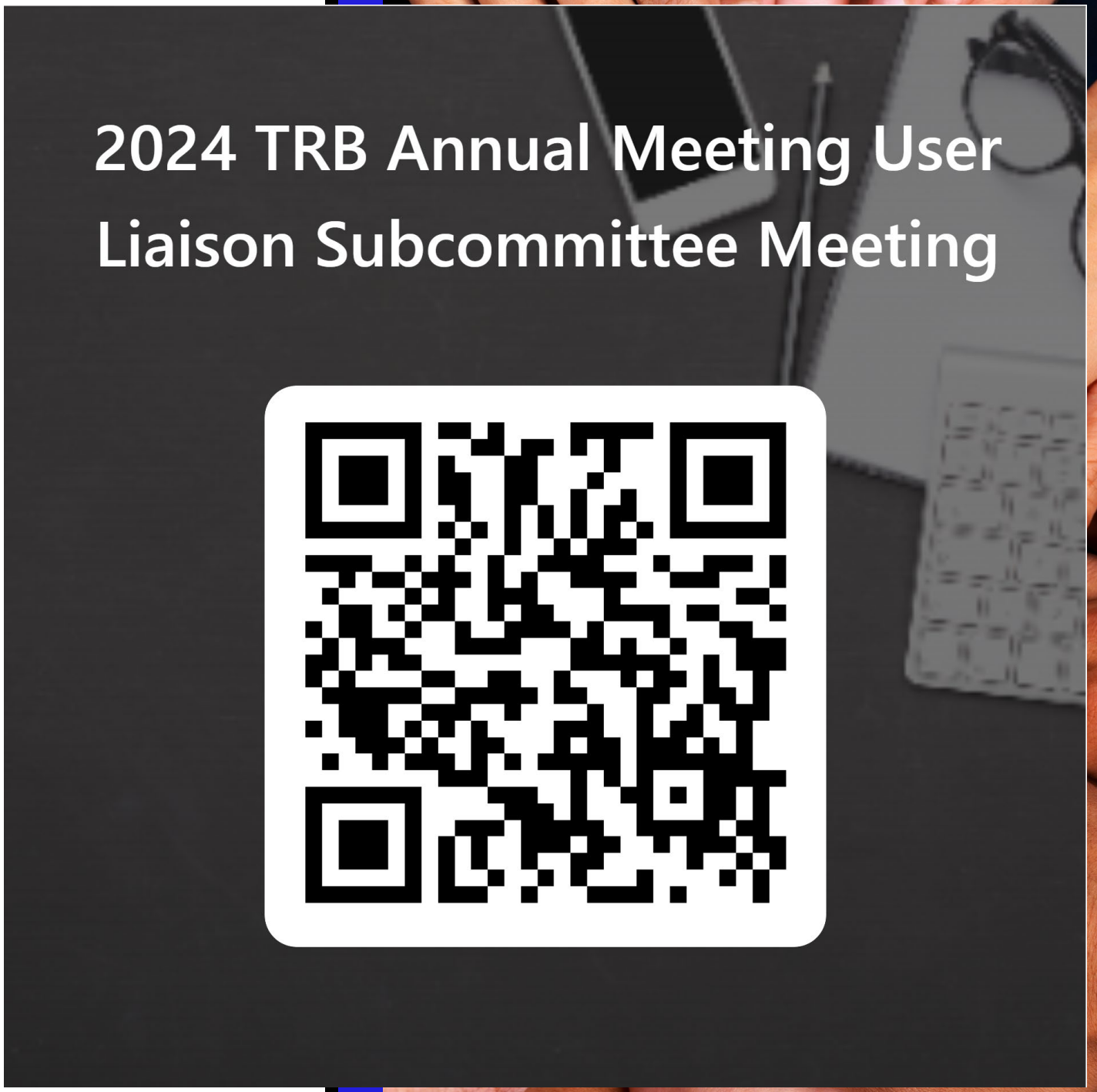
Wednesday January 10, 2024

11:15 AM to 1:15 PM

Agenda

Daniel Carter, Kim Kolody

- Welcome & Opening Remarks
- Committee Chair Update
- FHWA Update / Resources
- Guide For Research
- Interaction Between Manuals and Guides
- Crash Prediction Tools
- State Customization of HSM Methods
- HSM2 Single State Calibration
- HSM2 Outreach / Awareness
- Future Research Needs
- Future Workshops
- Closing Remarks



ASC20 Safety Performance and Analysis

Chair: Karen Dixon

TRB ACS20(2)) User Liaison Subcommittee

- Coordinates the activities of the Safety Performance and Analysis Committee
  - Related to the implementation (in terms of understanding and application) of the HSM and other future quantitative analysis methods and procedures approved by the Committee,
  - Gathering and disseminating of user feedback, and
  - Encouraging policy change to support the institutionalization of safety procedures.

- Coordinate efforts with other subcommittees, with the ACS20 Communication Coordinator, with other TRB Committees, with HSM users, and with the international safety research community.

TRB ACS20(2)) User Liaison Subcommittee

Working Groups:

- Legal Aspects & Policy - Priscilla Tobias
- International Research - Jennifer Ogle

Temporary Working Groups:

- Practical Approaches - Bonnie Polin, Tim Barnett
- Tools: Mike Dimaiuta, Bonnie Polin
- Local Roads: Tim Colling, Cong Chen
- Frequently Asked Questions: Jacob Farnsworth
- Discussion Forum: Tariq Shihadah, Daniel Carter
- HSM Website: Stephen Read
- Workshops: Mike Dimaiuta, Kim Kolody

FHWA Transportation Safety Practitioner Resources

Presented by: Matt Hinshaw, Jerry Roche, Derek Troyer

TRB 2024

FHWA Update

TRB ACS20 – Safety Performance and Analysis
January 11th, 2024

Matt Hinshaw, P.E.

FHWA Office of Safety

U.S. Department of Transportation
Federal Highway Administration

ZERO IS OUR GOAL
A SAFE SYSTEM IS HOW WE GET THERE

Topics

- HSM Implementation Transportation Pooled Fund Study Updates
- General FHWA DDSA updates

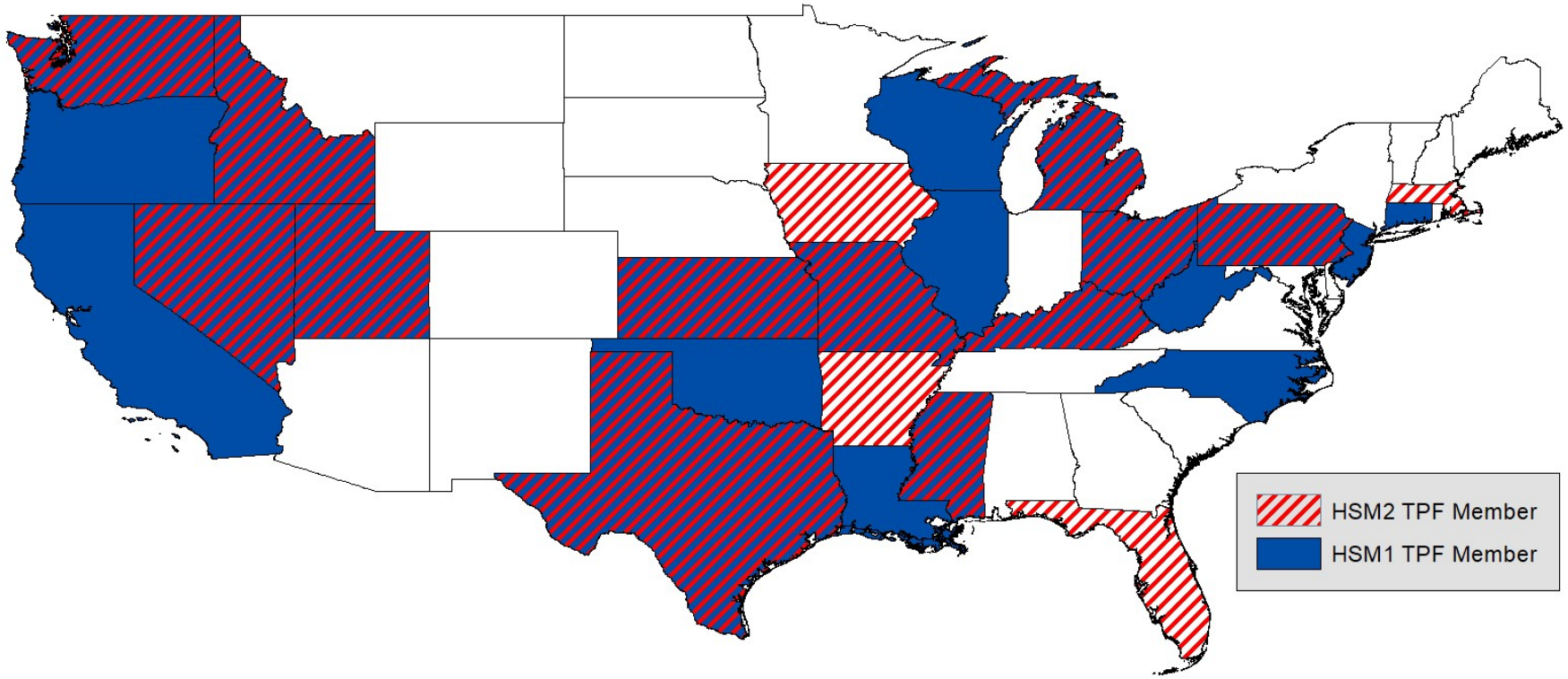
HSM Implementation Transportation Pooled Fund Study Updates

HSM2 Pooled Fund Study

Objectives

Accelerate implementation of HSM2 and related analytical tools to assess current and future safety performance of existing roadways and alternative designs, and help practitioners make more informed decisions, better targeted investments, and reduce fatalities and serious injuries on the nation's roadways. This includes activities before and after publication of HSM2.

HSM Pooled Funds Participating States



24 Member States between HSM1 and HSM2 pooled funds

Source: FHWA
Note: Alaska and Hawaii have not participated. Does not reflect all pending commitments.

HSM Pooled Funds – Current Projects

Advancing Application of DDSA Project Objectives

1. Explore the combination of predictive methods with and without EB adjustment for alternatives analysis (Task 2)
2. Develop an implementation approach for NCHRP 17-62 (Task 3)
3. Develop a communication guide for explaining HSM safety analysis to non-safety professionals (Task 4)

Task 2: Explore Validity of Combining Predictive Methods

Task is Complete

- Technical Memo, "*Explore the Validity of Combining Predictive Methods*," is final deliverable. Available at HSM1 pooled fund website soon.
- Scott Himes, VHB, gave presentation to ACS20 on 1/10/24 on overview of the memo's findings.
- Provides potential information for HSM2 alternatives analysis guidance (new Ch. 13).

Task 3: Develop an Implementation Approach for NCHRP 17-62 Models (In Progress)

Outline of Task 3 Guide

- Review projects completed since the HSM first edition (not just NCHRP 17-62).
- Summarize methods used in HSM for crash type and severity as well as recommendations from completed research.

Task 3: Develop an Implementation Approach for NCHRP 17-62 Models (In Progress)

Outline of Task 3 Guide

- Lay-out key findings and develop recommendations on implementation approaches.
  - Describe practical reasons for interest in more specific crash type and severity models, pros/cons.
  - Comparison of methods for crash type/severity models
  - Identify Potential applications beyond HSM Part C
  - Provide project team recommendations on applications

Task 4: *How-To Guide: Communicating Safety Analysis to Non-Safety Professionals* (In Progress)

Communication Guide and Handout

- Designed to help technical staff communicate complex safety analysis concepts to non-technical audiences.
- Guide is in final review for FHWA publication. Expected early 2024 on FHWA website.
- Next steps:
  - Design companion handout
  - Webinar

Source: FHWA

HSM Pooled Funds – Upcoming Projects

- Peer Exchange for member states during HSM2 balloting – later in 2024
- Update Part C Reference Guide (not Graphic Resource) – member states working with FHWA Geometric Design Laboratory assistance
- Data Dictionary for HSM Terminology

HSM Pooled Funds – Project Ideas

- Continue to watch for remaining needs from HSM2 finalization
- Two main calls for projects per year
- Track interest in project ideas; periodically meet to develop project idea statements
- Current top-rated ideas:
  - Culture Shift: Planning for Working Further with Designers after GB8 is Published
  - Open-Source Tools and Processes
  - HSM Screening Tool that can be used to determine if the HSM can be used on a project-level
  - Incorporating the Safe System Approach into HSM
  - Evaluating Impact of “Adoption” of the HSM Among the States

General DDSA Updates

DDSA How-To Guides

Under Development – Incorporating DDSA into Interstate Access Requests (IARs): How-To Guide

Purpose:

1. Describes the role of Data-Driven Safety Analysis in IARs.
2. Presents different safety analysis methods/options and tools that are adaptable to a range of project contexts and characteristics.
3. Illustrates DDSA to support IARs through multiple case studies.

New Safe System Resources

Safe System Roadway Design Hierarchy

Safe System Alignment Frameworks

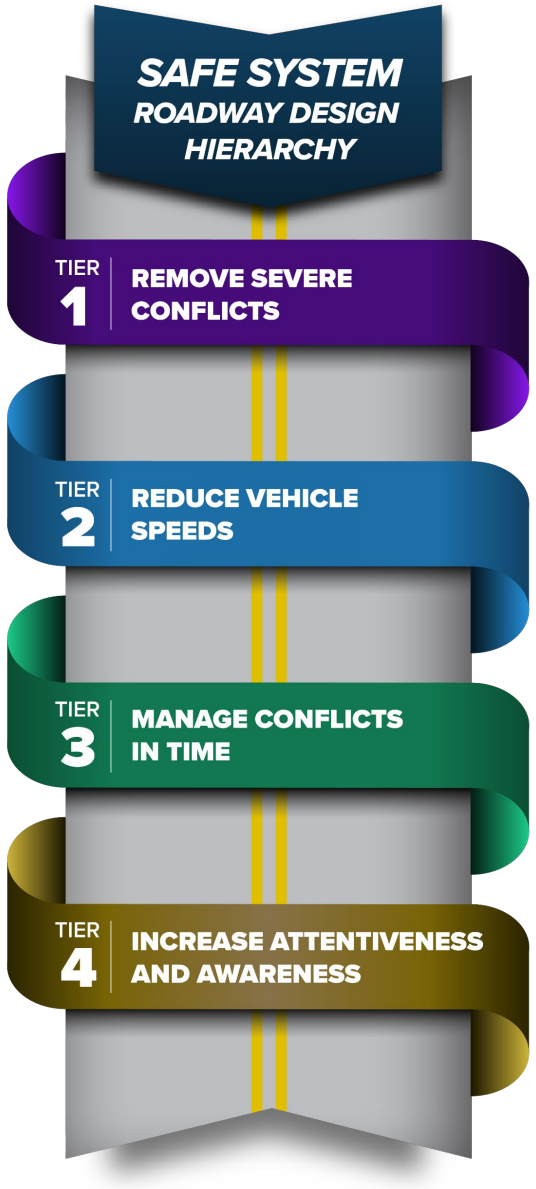
- Project-based
- Policy-based

Promotional materials

- Pilot application summaries
- Flyer: Overview of SS Alignment Tools
- Flyer: Guidance on when to use which SSA Tool
- Newsletter Articles

Outreach Activities

- Webinar (February TBD)
- Workshop (available upon request)



Update to the Systemic Safety Project Selection Tool

- Nearing completion, final reviews and publication (expected spring 2024).
- Updated methodologies and best practices, case studies.
- Updates to systemic safety training.
- Risk assessment framework and risk factor matrix.

Source: FHWA

Local Road Safety Plan DIY Site

Source: FHWA

Updated in 2023:

- More videos
- LRSP Template with added SS4A components
- Example Plan list (now table)

More updates in future!

https://highways.dot.gov/safety/local-rural/local-road-safety-plans

CMF Clearinghouse

- **Sarah Weissman Pascual is new manager of the CMF Clearinghouse.**
- **Updated CMF "Most Wanted" List!**
  https://www.cmfclearinghouse.org/most_wanted.php
- **Feedback always welcome to improve the Clearinghouse.**
- **Submit Your CMFs to the National CMF Clearinghouse!**
  Study submissions are welcome. Send a link to a published resource or include as an attachment. Submissions can include published research studies or State-specific CMFs that were developed as part of the Highway Safety Improvement Program. | Email Sarah Pascual

Caltrans usRAP Pilot Effort

In support of the Caltrans Road Safety Action Plan, Task 1.3:

- “Develop a statewide decision-making framework for proactively identifying, analyzing, and prioritizing roadway safety investment.”
- Caltrans seeks to “Pilot a state-highway safety rating system based on the safety assets and geometric features modeled on the usRAP system.”

Caltrans Road Safety Action Plan

Caltrans usRAP Pilot Effort

FHWA is providing technical assistance to support the pilot effort for Caltrans Districts 1 and 2, including:

- usRAP Data Collection Training.
- Data Integration and Collection. In progress.
- usRAP Implementation (Optional).

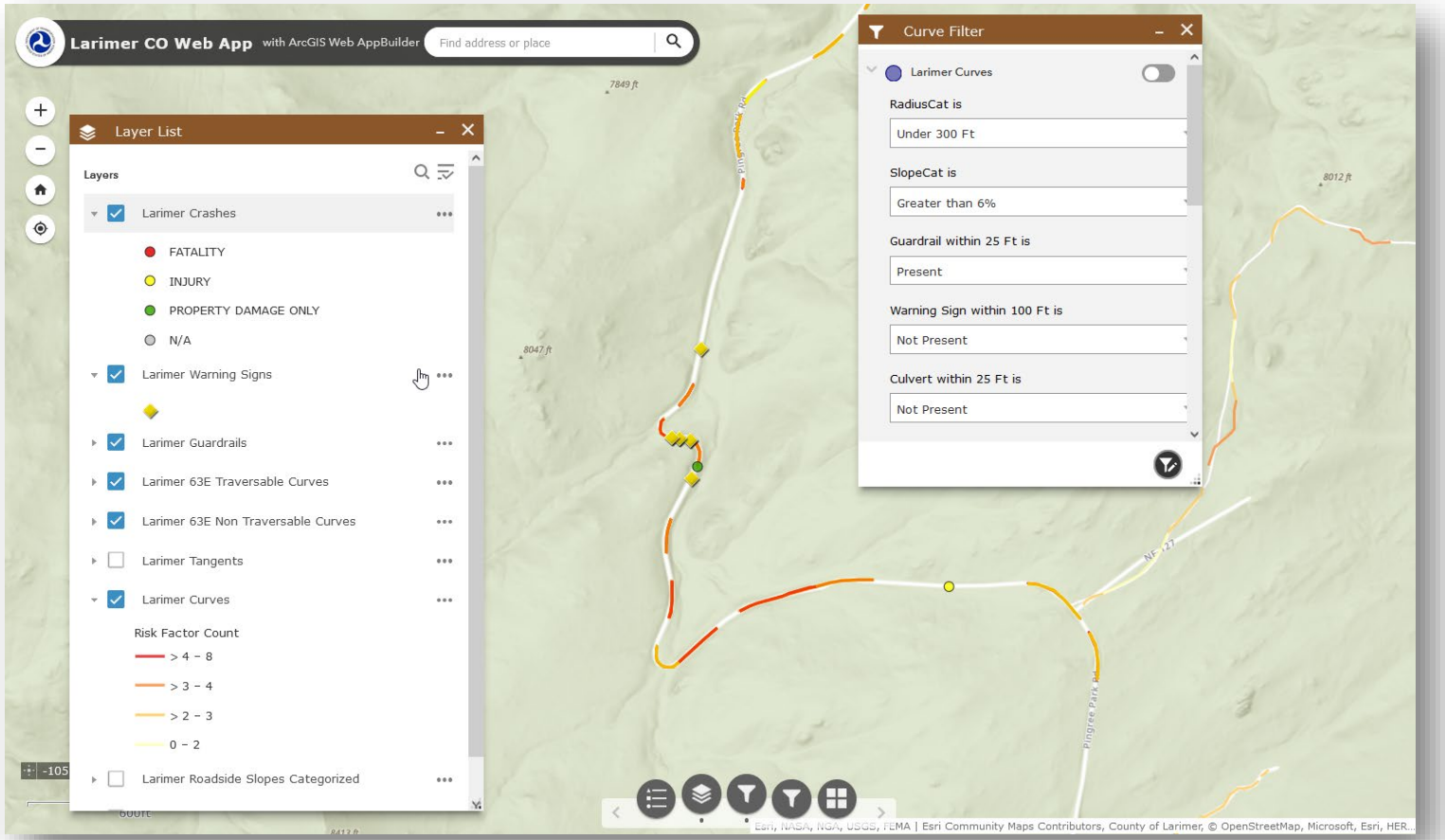
Federal Lands Highway – GIS and Systemic Safety

A Practical Framework for Safety Analysis in GIS – Methods for Assessing Safety in Limited Data Environments

Research project and case studies for agencies with limited existing data

Use open-source data and GIS methods to derive risk factors

[Report coming soon here.]



Source: FHWA

Federal Lands Highway – GIS and Systemic Safety

A Practical Framework for Safety Analysis in GIS – Methods for Assessing Safety in Limited Data Environments

- Several case studies with counties, MPOs, Tribes, FLMAs
- Potential for assisting rural agencies and SS4A
- Presentations at GIS-T, TRB Low Volume Roads conference, ITE Annual Meeting, Rural Road Safety Summit

Source: FHWA

Technical Assistance

FHWA may have opportunities to provide technical assistance for DDSA activities. Examples:

- Determining goodness of fit for a safety performance function,
- Systemic safety analysis including data summarization and crash tree development to identify focus crash type, facility type, and risk factors,
- Economic analysis of various countermeasures,
- Contacting agencies to ascertain information on their level of DDSA implementation,
- LRSP plan writing and editing support.

For any state, local, regional, Tribal partner

On the Horizon for DDSA?

- Emerging data sources, applications of big data and data science.
- Potential for open-source tools and processes.
- Risk factor, safety data clearinghouses?
- Promotion of systemic applications for efficient deployment of Proven Safety Countermeasures.
- Further integration of safety in the project development process.
- Incorporating kinetic energy transfer and speed into crash prediction modeling and other DDSA approaches.
- Preparing for GB8.

FHWA DDSA Contacts

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Guide for Research Resulting in Practical Application of the Highway Safety Manual

Presented by: Bonnie Polin, Stephen Read

Guide for Research Resulting in Practical Application of the Highway Safety Manual

- Objective is to foster improved research consistency and reproducibility that leads to a more practical application of highway safety research results.

  - Compatibility with existing research
  - Model scope, sensitivity testing and edge cases
  - Tools for performing calculations
  - Pilot testing of models and tools
  - Frequently asked questions
  - Implementation planning
  - Liability-neutral language

HSM Crash Prediction Tool Updates

Presented by: Stephen Read, Mike Dimaiuta, Bonnie Polin

AASHTO webinar: “Exploring HSM Crash Prediction Calculation Tools”

- October 12, 2023
- Presentations by North Carolina, Ohio, and Pennsylvania DOTs on their customized HSM crash prediction tools.
- John Ivan (Univ. of Connecticut) shared a researcher perspective on tool creation.
- Jacobs Engineering Group presented their Python-based crash prediction tool (HSM-Py)

AASHTO webinar: “Exploring HSM Crash Prediction Calculation Tools”

- Ohio DOT:
  - Economic Crash Analysis Tool (ECAT).
  - ODOT’s customized tool to complete Part C Predictive Method with Part C & D CMFs and crash history.
  - Complete a benefit/cost analysis as required for ODOT’s Highway Safety Program.

AASHTO webinar: “Exploring HSM Crash Prediction Calculation Tools”

- NCDOT:
  - Spreadsheet tools.
  - Includes HSM1 SPFs, and SPFs from NCHRP projects intended for HSM2: 17-70 (Roundabouts), 17-58 (one-way and 6+ lane urban/suburban arterials) and 17-68 (new intersection types).
  - Tools used by facility type:
    - Rural undivided – NCDOT custom spreadsheet.
    - Rural multilane – NCDOT custom spreadsheet.
    - Urban/suburban arterials - NCDOT custom spreadsheet (incorporates HSM1 SPFs and 17-58 SPFs).
    - Freeways – ISATe spreadsheet tool.
    - Roundabouts – have the 17-70 spreadsheets but have not yet used them.

AASHTO webinar: “Exploring HSM Crash Prediction Calculation Tools”

- PennDOT:
  - ICE: PennDOT Web Intersection Control Evaluation (ICE) Tool.
    - “SPICE/ICE Web Analysis Tool.”
    - Provides life cycle cost comparisons between different intersection treatments. Incorporates costs related to safety, vehicular delay, operations and maintenance, design and construction, and ROW.
    - Includes capacity analysis and safety benefit cost analysis.

AASHTO webinar: “Exploring HSM Crash Prediction Calculation Tools”

- NCHRP 17-85: Development and Application of Crash Severity Models for the HSM (John Ivan):
  - R-Shiny App chosen for implementation.

AASHTO webinar: “Exploring HSM Crash Prediction Calculation Tools”

- HSM + Python Tool = ***hsmpy*** tool
  - Developed by Jacobs.
  - An internal Python package that includes HSM Part C calculations.
  - First developed in 2013 as part of an HSM calibration project and has been used/ modified/ QC’ed / appended for multiple projects since then.
  - QC’ed against HSM and AASHTO spreadsheets.
  - ***hsmpy*** provides core HSM calculations which can be easily adjusted, upgraded and used.
  - Python - Backend: GIS data are easily accessible in Python; provides a reference for HSM calculations that can be easily integrated and used by agencies, contractors and practitioners.
  - Python – Front end (user interface): ***hsmpy*** can be used in web-based applications; stand-alone applications; Excel-based tools; Esri-based tools.

AASHTO webinar: “Exploring HSM Crash Prediction Calculation Tools”

- HSM + Python Tool = ***hsmpy*** tool
  - Potential next steps:
    - A Github repository for HSM.
    - An open-source Python version of HSM1 and HSM2.
    - Potentially adding sample problems and their solutions in Python format, solved using ***hsmpy***.
    - Having one reference (QC’ed) version of HSM calculations that can be used by developers and advanced users to either perform analysis or to build easy-to-use applications for practitioners.

FHWA's Interactive Highway Safety Design Model (IHSDM)

Software

- Concluded software development in Sept. 2021 (IHSDM 2021; v. 17.0.0)
- Tech Support by FHWA Geometric Design Lab (GDL) will continue through at least September 2024, but essentially as long as agencies are still using the IHSDM software
- See "*FHWA's Future Plans for the Interactive Highway Safety Design Model (IHSDM)*": https://highways.dot.gov/sites/fhwa.dot.gov/files/FHWA-HRT-23-017.pdf

Training (FHWA-NHI-380100)

- Virtual training in a blended web-conference training format (self-paced modules + instructor-led modules via webinar)
- Est. course length is 14 hours
- Cost is $175
- LINK

Also, GDL plans to offer free training webinar(s) to walk users through how to use IHSDM to apply HSM2 models (including limitations).

FHWA's Plans for Assisting IHSDM Users in Applying Future HSM2 Part C Methods

IHSDM Version 17 fully implements HSM1 Part C (and more).
What about future HSM2 Part C methods?

- Some changes can be addressed via IHSDM configuration (config) files.
- Some changes can be addressed via workarounds.
- Some changes cannot be addressed (tool(s) external to IHSDM must be used).

FHWA's Plans for Assisting IHSDM Users in Applying Future HSM2 Part C Methods

HSM1 versus HSM2:

1. For changes that can be addressed via IHSDM configuration ('config') files:
   - FHWA will prepare config files to reflect the changes~~;~~ and post to IHSDM website for users to download (with instructions).

2. For changes that can be addressed via workarounds:
   - FHWA will provide detailed instructions for workarounds and post to the IHSDM website for users to access.

3. For changes that cannot be addressed (tool(s) external to IHSDM must be used):
   - FHWA will prepare documentation regarding these cases and post to the IHSDM website for users to access.

FHWA's Plans for Assisting IHSDM Users in Applying Future HSM2 Part C Methods

- IHSDM User Group Technical Support Webinar Series on ***"Applying HSM2 Part C Methods using IHSDM"***
  - To be held in advance of—and after—HSM2 publication.
- FHWA will post config files, workarounds, etc., to IHSDM website when HSM2 is published.

Discussion

HSM Crash Prediction Tools Considerations:

- What features/capabilities are most desirable?

NCHRP Synthesis 20-05 / Topic 54-10
State Customization of HSM Methods

Presented by: Vikash Gayah

Synthesis project objectives

- Document the state of practice regarding how states apply and/or customize the methods in the HSM, particularly related to state transportation agency practice on calibration factors and development of jurisdiction-specific SPFs
  - Are states calibrating or developing own SPFs?
  - What drives this decision?
  - How often are these updated?

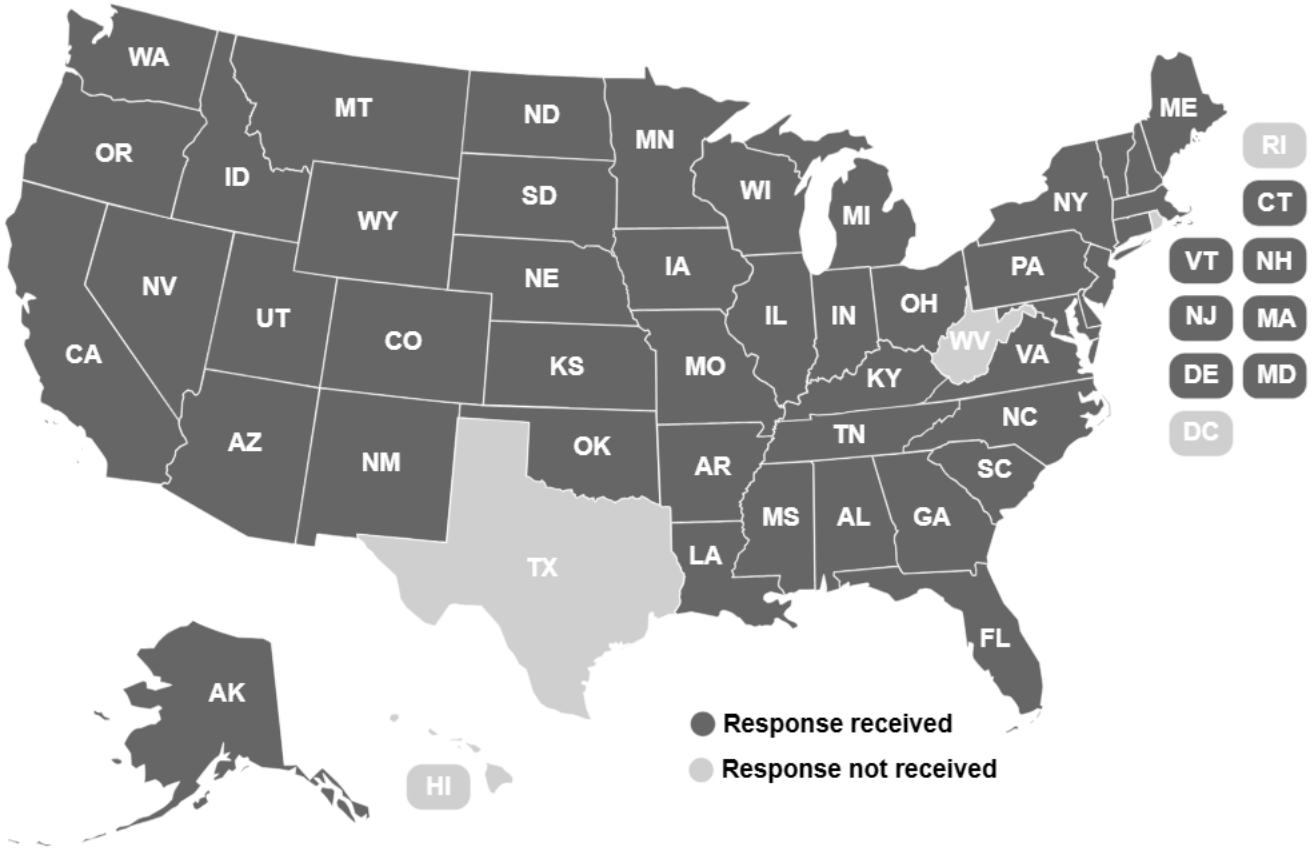
Literature review

- Identified documentation from as many state transportation agencies on SPF calibration/SPF development
  - **Focused on state-funded research reports**
  - Excluded academic articles with no mention of state DOT funding or that seemed to not be developed for DOT purposes

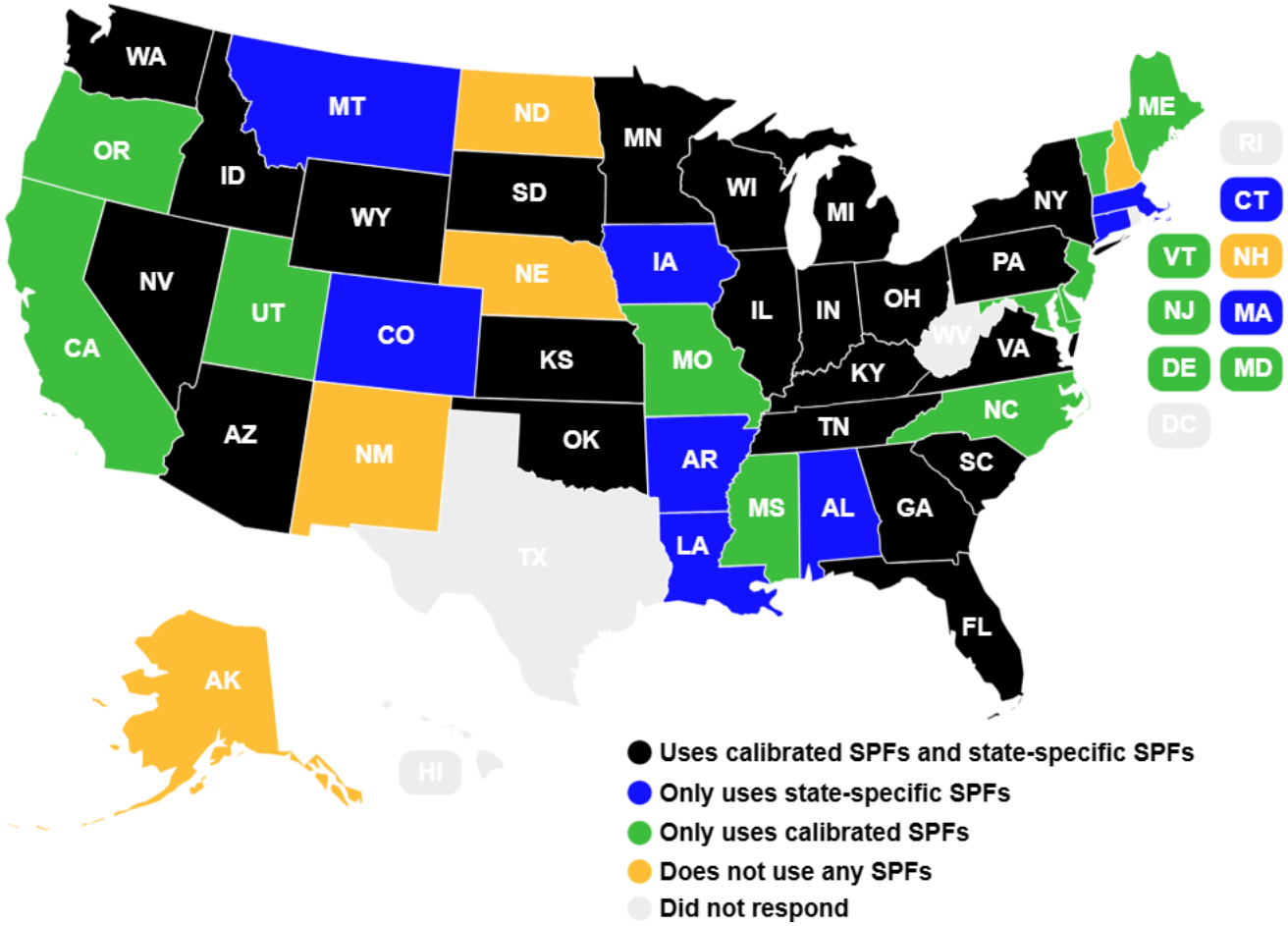
Survey of state agencies

- Sent to all members of AASHTO Committees on…
  - Safety
  - Traffic Engineering
  - Design

Survey received from 46 of 51 state transportation agencies that were contacted…



Results showed how state agencies customize SPFs to reflect state-specific conditions



Detailed “case studies” done with several state agencies

- California
  - Applied SPFs without calibration
- Florida
  - Used calibrated HSM SPFs and state-specific
- Nebraska
  - Does not apply SPFs
- North Carolina
  - Used calibrated HSM SPFs and state-specific(?)
- Washington State
  - Applied SPFs without calibration and developed state-specific

Findings

- Calibration factors

Table 32. Calibration factors for North Carolina from Srinivasan and Carter (2011)

Facility type	Calibration factor
Roadway segments	
Rural 4-lane Divided (R2D)	0.97
Urban 2-lane Undivided (U2U)	1.54
Urban 2-lane with TWLTL (U3T)	3.62
Urban 4-lane divided (U4D)	3.87
Urban 4-lane Undivided (U4U)	4.04
Urban 4-lane with TWLTL (U5T)	1.72
Intersections	
Rural 2-lane, minor-stop controlled 3-leg (3ST)	0.57
Rural 2-lane, signalized 4-leg (4SG)	1.04
Rural 2-lane, minor-stop controlled 4-leg (4ST)	0.68
Rural 4-lane, signalized 4-leg (4SG)	0.49
Urban arterial, signalized 3-leg (3SG)	2.47
Urban arterial, minor-stop controlled 3-leg (3ST)	1.72
Urban arterial, signalized 4-leg (4SG)	2.79
Urban arterial, minor-stop controlled 4-leg (4ST)	1.32

- State-specific SPFs

Table 39. Summary of adjustment factors included in Pennsylvania SPFs in Donnell et al (2014)

Facility type	Adjustment factors
4-leg signalized intersections	• Posted speed limit on major approach • Posted speed limit on minor approach • Presence of exclusive right-turn lane on either major approach
3-leg signalized intersections	• Posted speed limit on major approach • Presence of a crosswalk on the major approach • Presence of a crosswalk on the minor approach
4-leg all-way stop controlled intersections	• Posted speed limit on major approach
4-leg minor stop-controlled intersections	• Intersection skew angle
3-leg minor stop-controlled intersections	• Presence of exclusive right-turn lane on major approach • Presence of exclusive left-turn lane on major approach

Findings

- States evenly split between calibration and SPF development
  - Calibration
    - Design-level more common
  - Development
    - Network-screening level SPFs more common
  - For both…
    - Two-lane rural road segments/intersections
    - Multi-lane rural roadway segments/intersections
    - Urban-suburban arterial roadway segments/intersections
  - No information found at city/MPO level
    - Did not reach out to local agencies directly due to NCHRP staff direction

Findings

- Primary drivers of calibration vs SPF development
  - Level of precision
  - Data availability
  - Resource constraints
- Calibrated SPFs provide predictions that are “good enough” and provide best value for resources
- Agencies that developed own SPFs wanted additional predictive accuracy and had associated resources to support data collection efforts

Findings

- HSM calibration factor definition dominates
- Calibration function used by some states (15%)
- 20% of agencies use FHWA calibrator tool
- Most calibration factors not updated since initial development
  - State-specific SPFs updated more frequently but likely due to lower data requirements (network screening level)

Findings

- Regionalization considered by less than half of agencies
  - Some tried but found no differences/value
  - Limited sample size also hinders regionalization
- Sample sizes
  - Driven by HSM recommendations
- Second edition of HSM clouding additional customization

Suggestions of future research

- Additional guidance on when to update calibration factors or state-specific SPFs
- Data-driven evidence for sample size determination
- Repository of calibration factors or state-specific SPFs
  - Similar to CMF Clearinghouse

Thank you!

Vikash V. Gayah

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HSM2 Single State Calibration
Crash Prediction Comparison and Implications

Presented by: Darren Torbic

NCHRP Project 17-71A

Proposed AASHTO Highway Safety Manual, Second Edition

ACS20 Annual Meeting
2024

Texas A&M Transportation Institute

HDR

Exponent

Harwood Road Safety, LLC

Mr. Brelend C. Gowan

Ogle Research, LLC

Part C
Single State Calibration and Sensitivity Analysis

Single-State Calibration

- Single-state calibration for many of the Part C models was performed in NCHRP Project 17-72

- Conducted sensitivity analysis in which we plotted:
  - Original models from the underlying research projects
  - Calibrated models using single-state calibration from Project 17-72

- Comparisons were made between the plotted models to assess whether:
  - The models make sense in absolute terms
  - The models make sense relative to one another
  - The original or calibrated models should be used

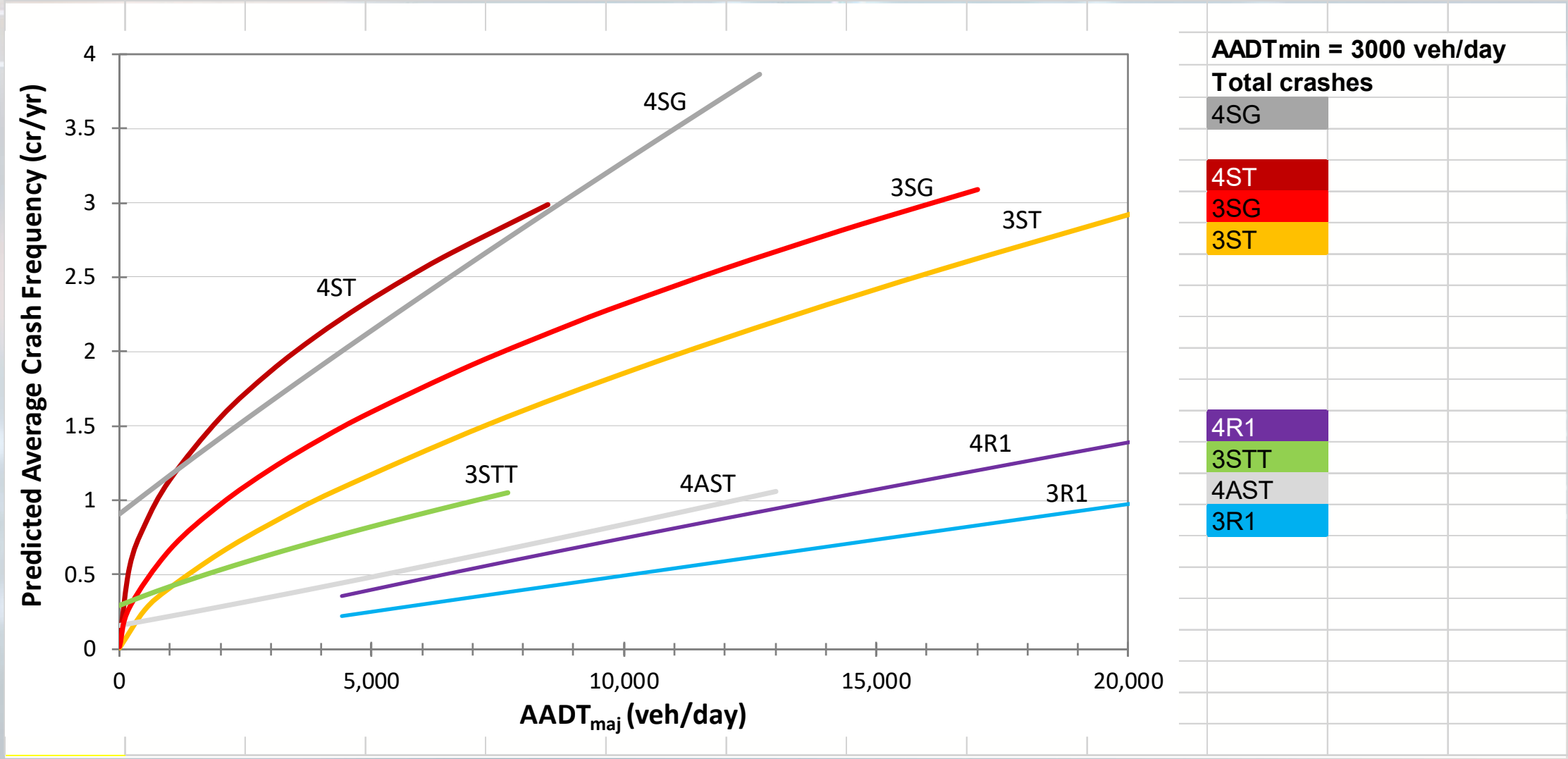
Sensitivity Analysis

- Every candidate HSM2 Part C model was plotted:
  - Crash frequency vs. AADT for roadway segments
  - Crash frequency vs. major-road AADT for intersections for separate curves for various representative values of minor-road AADT
- Comparisons were made:
  - Total vs. KABC vs. PDO models
  - Multiple-vehicle vs. single-vehicle crashes, where relevant

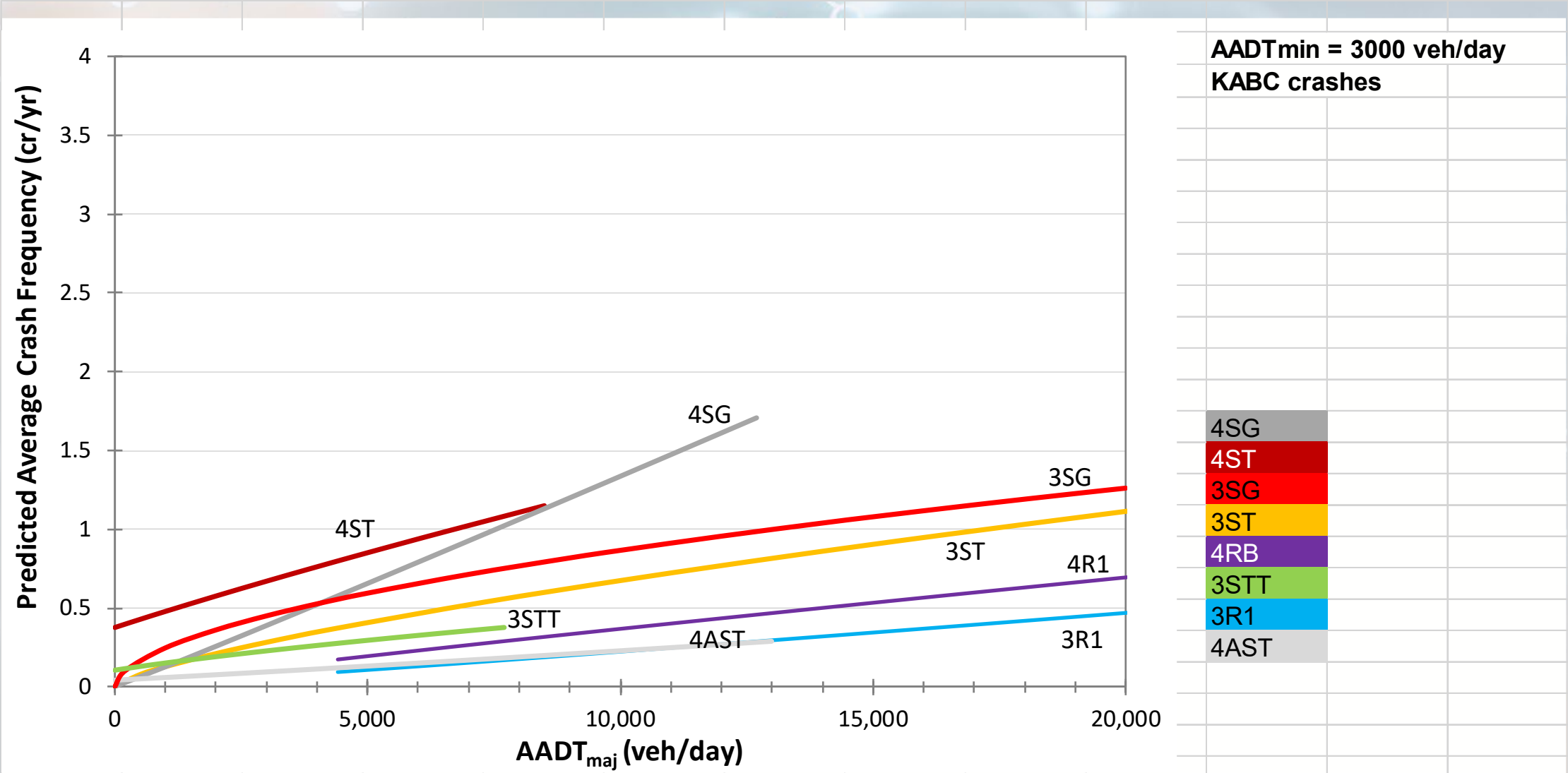
Sensitivity Analysis

- Issues identified:
  - Most (but not all) roundabout models predicted more crashes than comparable signalized and minor-road stop-controlled intersections
  - One all-way stop-controlled intersection model predicted more crashes than comparable signalized or minor-road stop-controlled intersections
- Adjustments to roundabout and all-way stop-controlled intersection models were made using appropriate CMFs (from the CMF clearinghouse)
- After some final checks, the final SPFs were selected for Chapters 14, 15, and 16

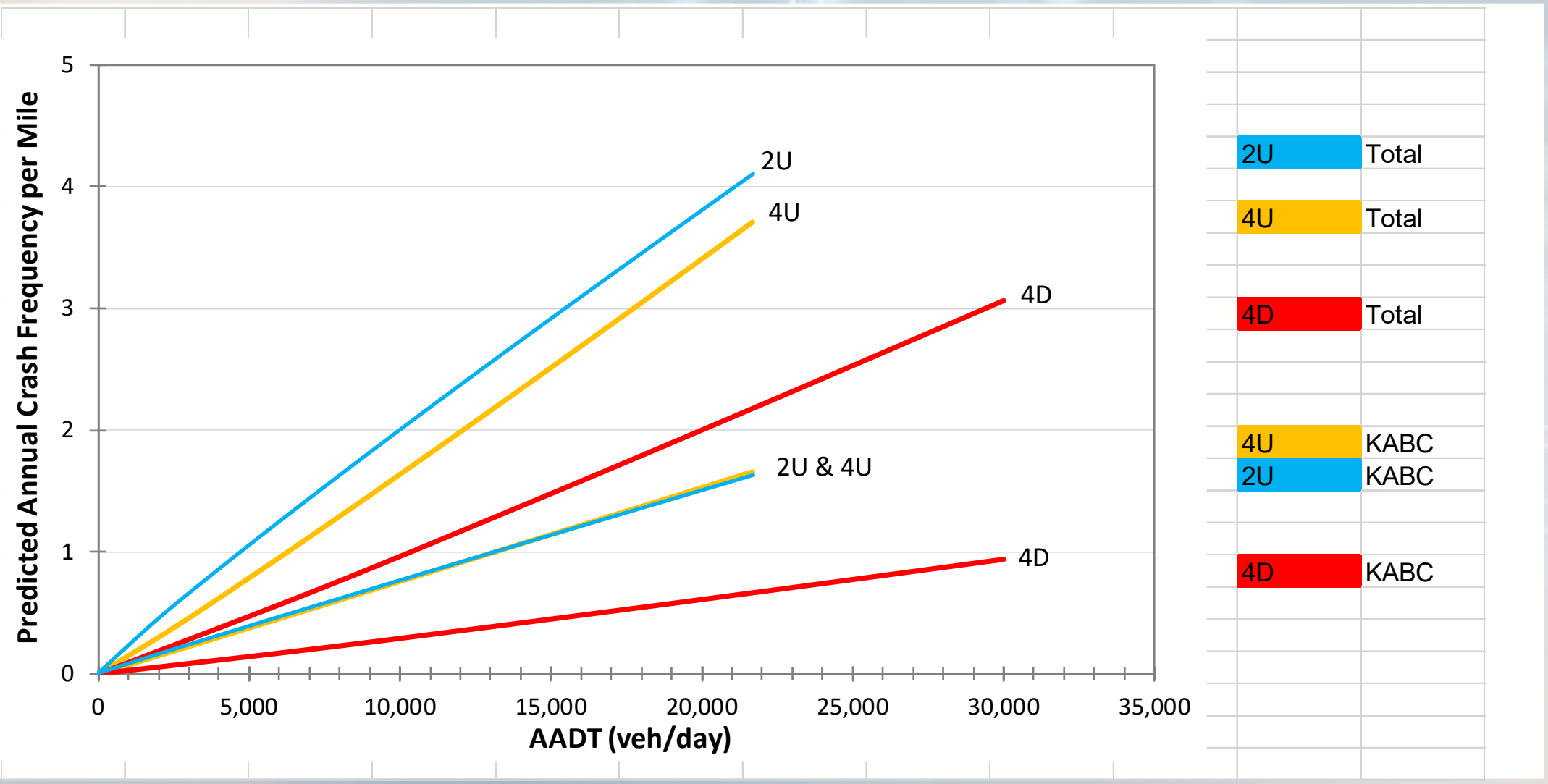
Ch 14. Rural 2-Lane (Intersections)
Total Crashes



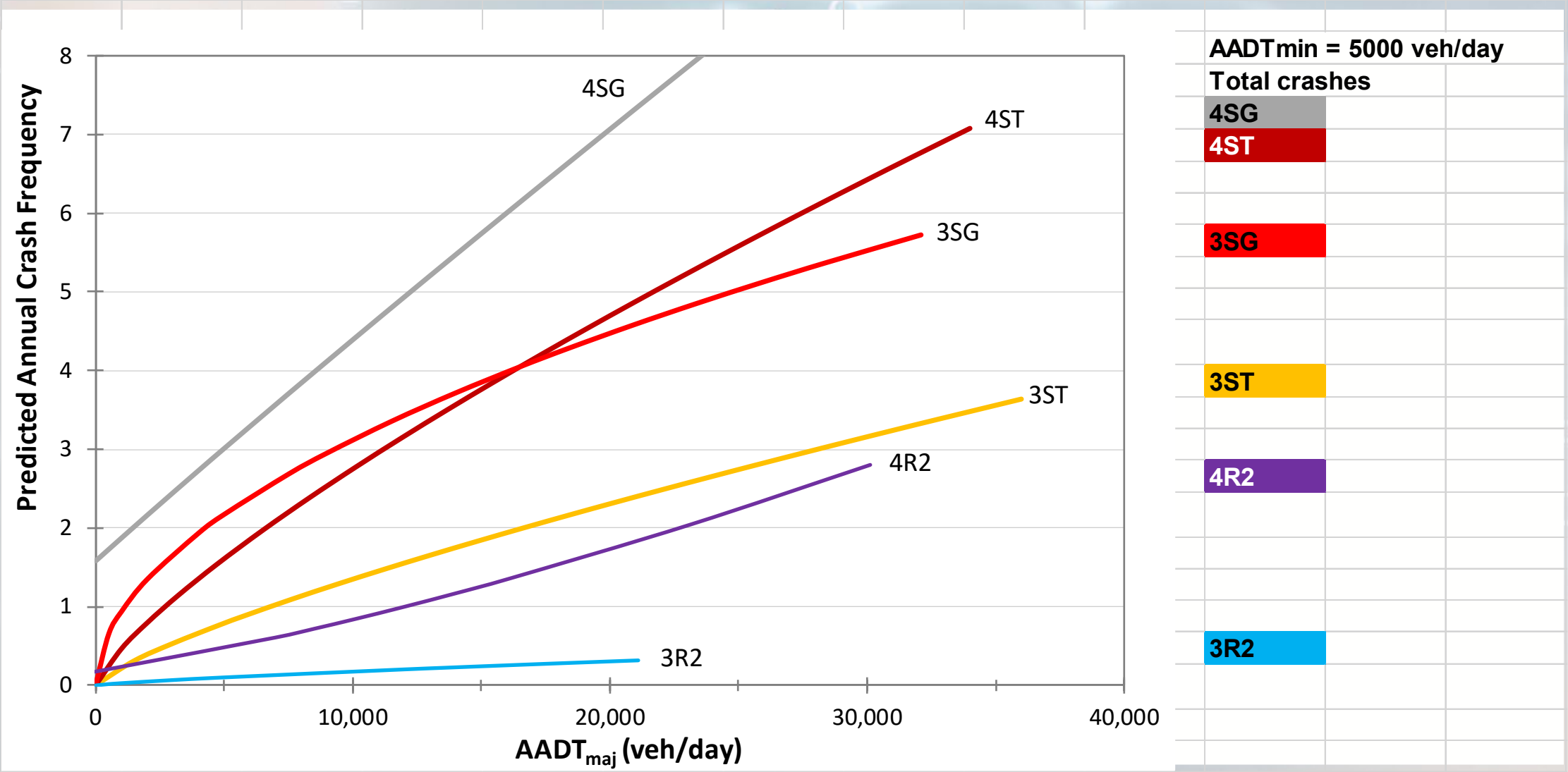
Ch 14. Rural 2-Lane (Intersections)
KABC Crashes



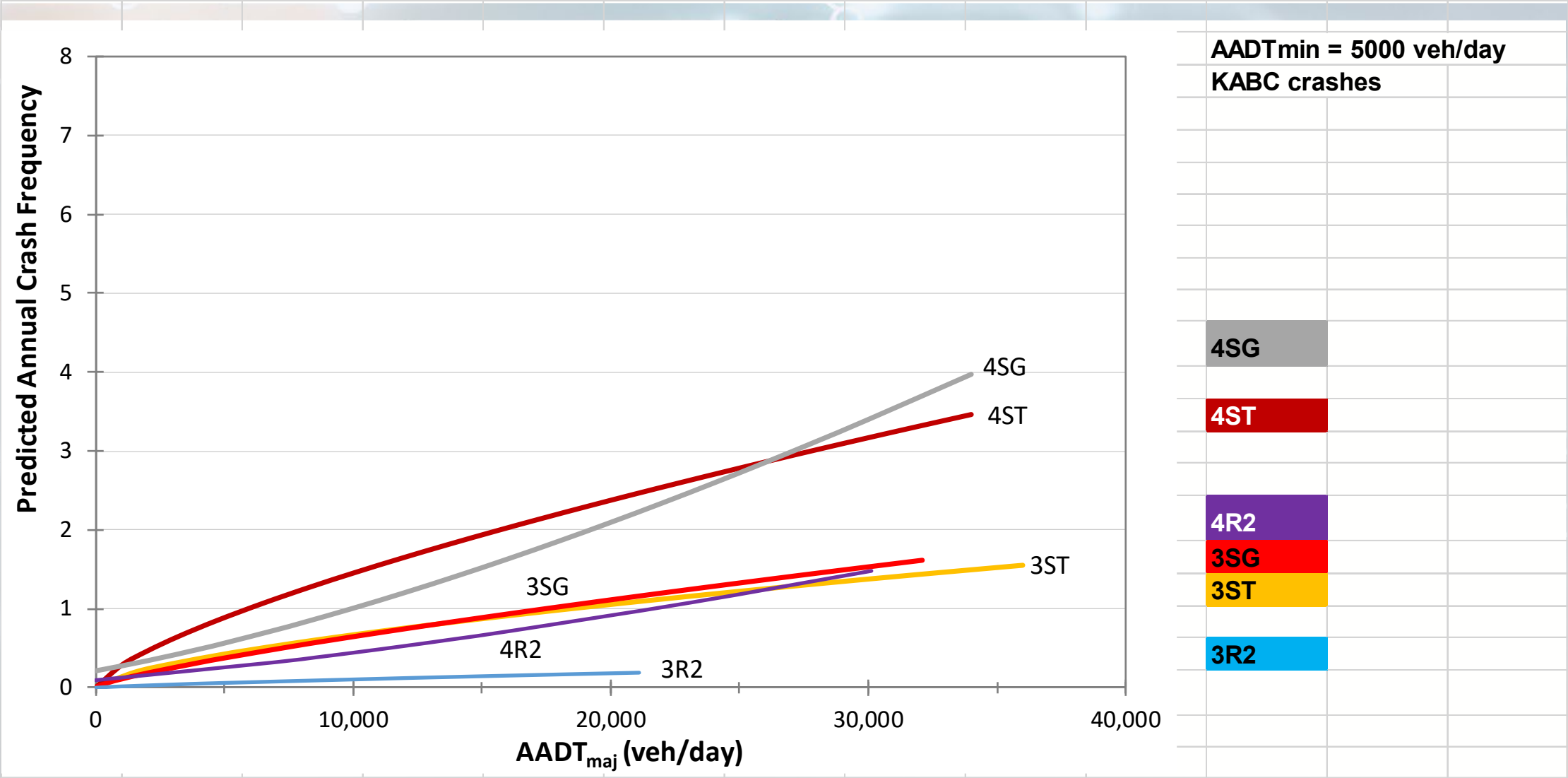
Ch 14. Rural 2-Lane & Ch 15. Rural Multilane (Segments) Total & KABC Crashes



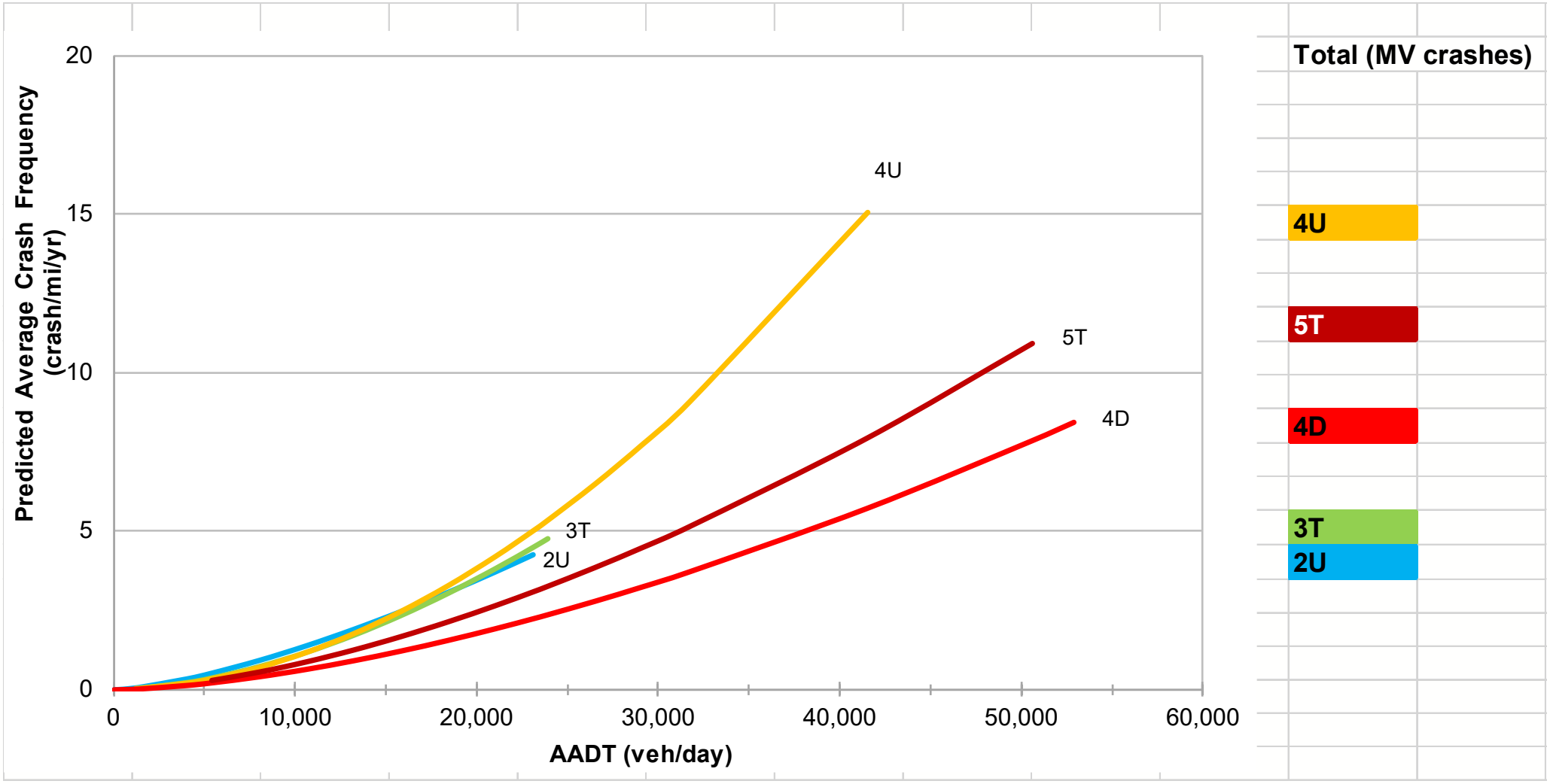
Ch 15. Rural Multilane (Intersections)
Total Crashes



Ch 15. Rural Multilane (Intersections) KABC Crashes



Ch 16. Urban and Suburban Arterials (Segments) Total Multiple-Vehicle Crashes



Calibration and/or Development of Jurisdiction-Specific SPFs

- The need to calibrate Part C SPFs to local conditions or develop jurisdiction-specific SPFs cannot be stressed strong enough!!!

HSM Outreach, Awareness, Training

Presented by: Tim Colling, Cong Chen, Mohamad Banihahemi, Kelly Hardy

HSM Outreach, Awareness, Training

- Local Road Safety
  - Synthesis
  - LTAP June 2024 HSM2 Presentation
  - LTAP Summer 2025 HSM2 Workshop

HSM Outreach, Awareness, Training

- Institute of Transportation Engineers

HSM Outreach, Awareness, Training

- NCHRP
  - 20-123 Highway Safety Manual Development and Roadmap
  - 17-127 Guide for Applying Quantitative Highway Safety Analysis Methods
- FHWA
- AASHTO
  - Listserv, User Groups

Interaction Between HSM and Other Guides / Manuals

Presented by: Ingrid Potts

Interaction Between HSM and Other Guides / Manuals Discussion

- AASHTO Green Book, 8th Edition
- Human Factors Guide
- Manual of Uniform Traffic Control Devices
- Others

Workshops

Presented by: Mike Dimaiuta, Kim Kolody

TRB Workshop Ideas

- HSM and GB8
- HSM Bike Ped Models
- Others

Research Needs

Presented by: Stephen Read

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