Performance-Based Safety Evaluation on a Systemic Level: The Wisconsin Story

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SRF

Agenda

- Why performance-based practical design (PBPD)?
- What is PBPD?
- Application of PBPD
- Status of PBPD Implementation

Why PBPD?

Asset Management

"Asset": if you own it and spend public dollars to maintain, improve, or replace it, it's an asset that needs to be managed

How each public agency decides to manage those assets is a fundamental core responsibility

Renewed Focus on Efficient Asset Management

- Blend financial realities with analysis to prioritize improvements
- Goal is to be more efficient with transportation dollars
- Eliminate nonessential project design elements
- Focus on data-driven decision making
- Performance-based practical design (PBPD) approach to system preservation

Source:www.risla.com

What is PBPD?

Performance–Based Practical Design

- Breaks from traditional design by “fixing only what is broken”
- Substandard ≠ deficient
- Uses data to drive the decision making process
- Focus on cost-effective solutions
- Safety: relies on substantive safety instead of nominal safety

Substantive Safety vs Nominal Safety

Nominal Safety – Assumes if you utilize standard values published in reference resources (e.g. AASHTO "Green Book" and Roadside Design Guide), your roadway will be "safe"

Substantive Safety – relies on data-driven tools like databases and the Highway Safety Manual (HSM) to perform actual and predictive crash analysis of proposed highway safety improvements

FHWA PowerPoint (Every Day Counts) "Data-Driven Safety Analysis –Nominal vs. Substantive Safety" by John McFadden, P.E.

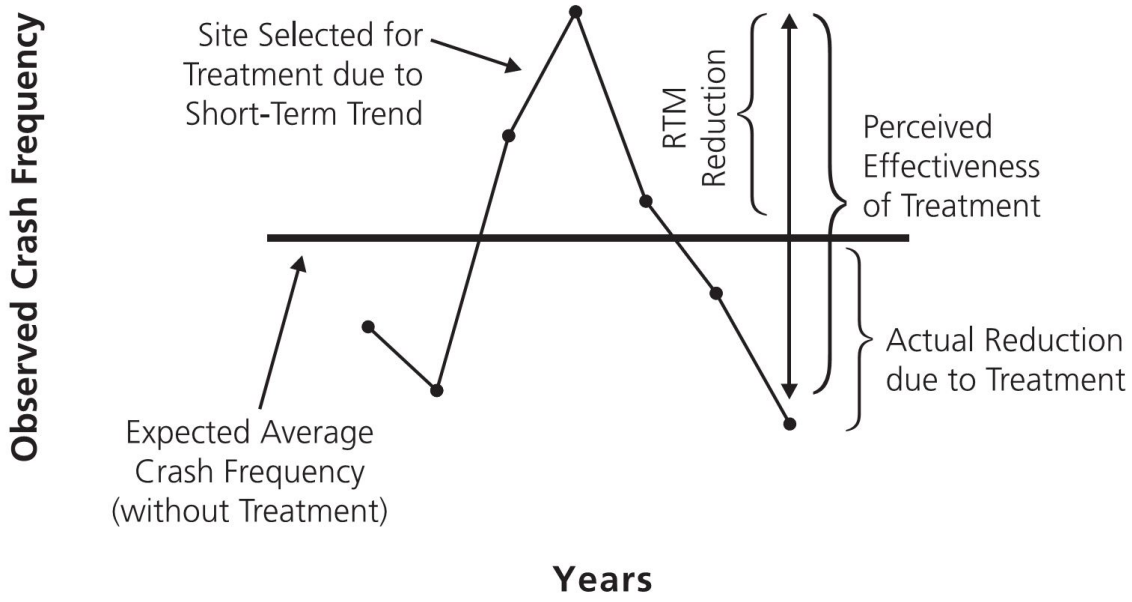
Analysis vs Standards

WisDOT moved from a standard-based (nominal safety) approach to an analysis-based (substantive safety) approach

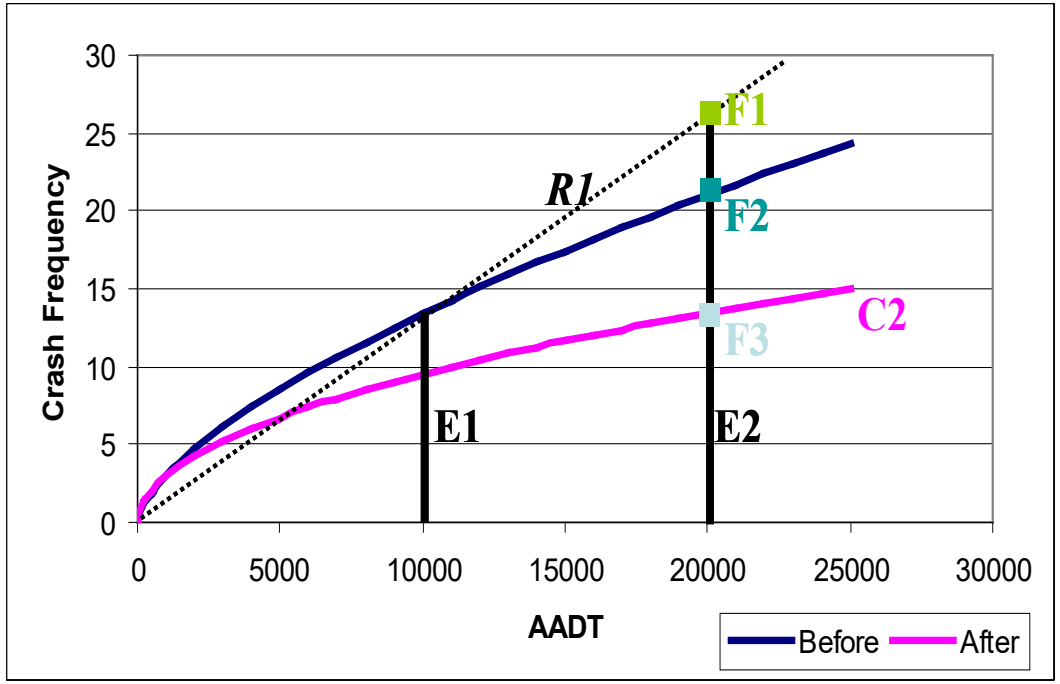
- No longer uses a “cook book” approach that starts with desirable design values
- Solutions will be specifically designed for individual situations to focus on meeting a project’s **specific** purpose and need

Challenges with Past WisDOT Safety Engineering Practices

- Regression to the mean bias

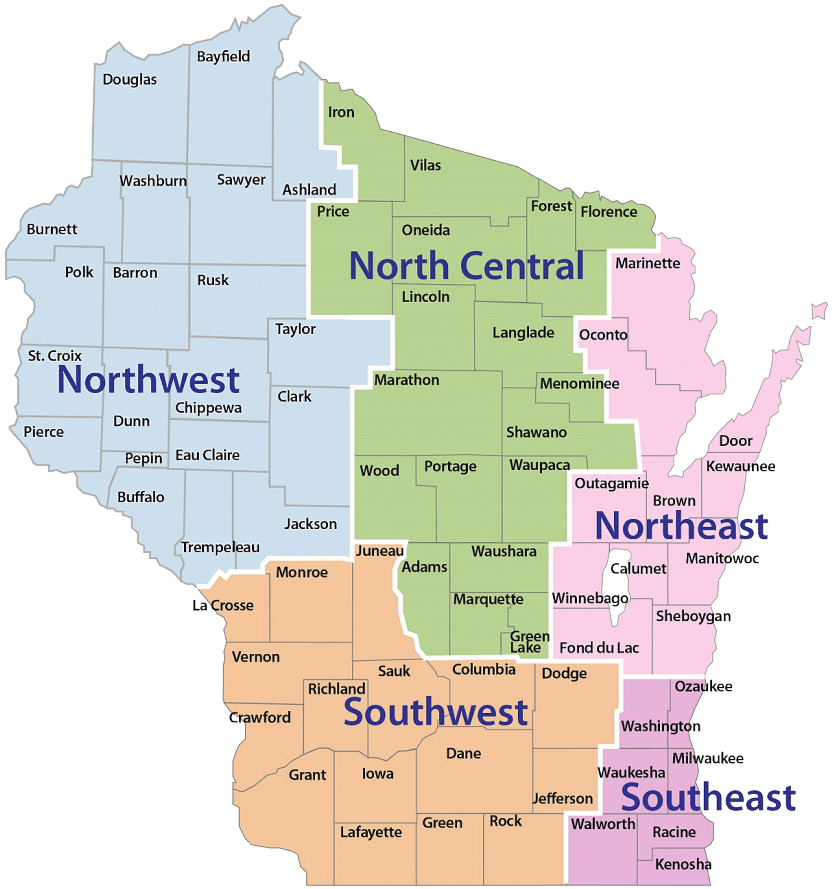


- Use of short-term rates and projects them into the future



PBPD Application

Wisconsin Department of Transportation



5 regions

72 counties

Maintains 1,600 CL miles of freeway

Maintains 10,200 CL miles of non-freeway roads

$1.2B annual construction budget

WisDOT Safety Certification Process (SCP)

Determine potential safety concerns

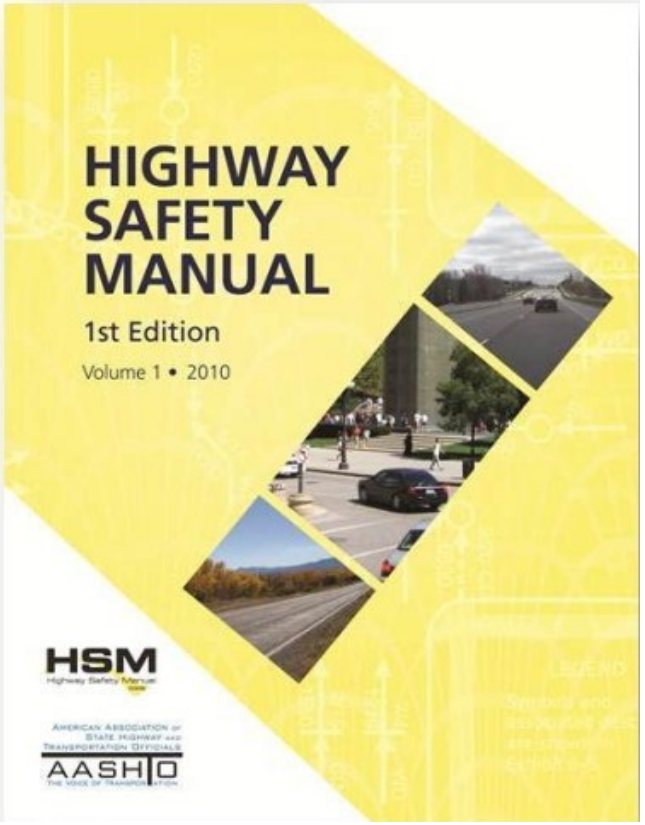
Crash vetting

Alternatives determination

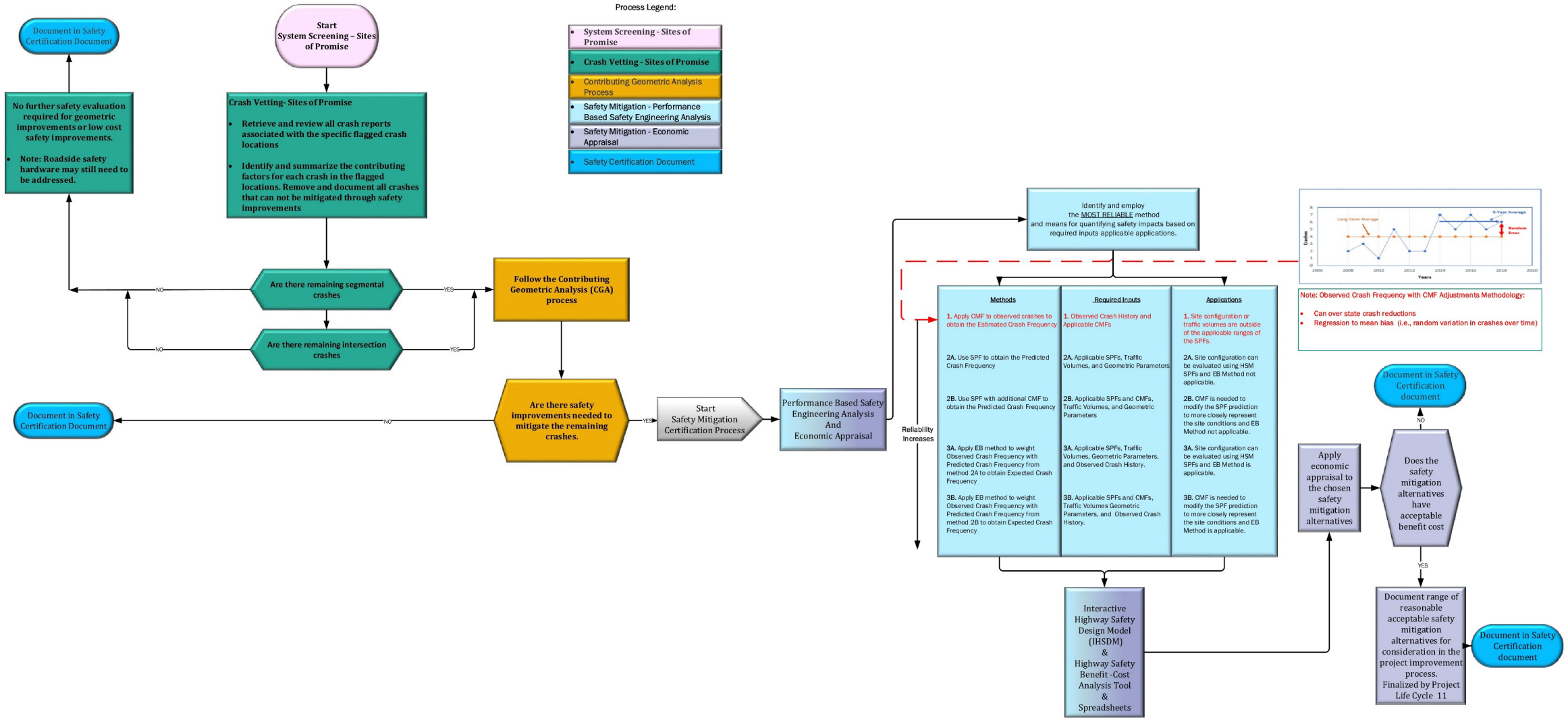
Evaluate safety performance

Economic appraisal

Documentation



WisDOT SCP Task Flowchart



WisDOT Safety Certification Process (FDM 11-38)

Facilities Development Manual
Chapter 11 Design
Section 38 Safety Certification Process

Wisconsin Department of Transportation

Created to outline WisDOT SCP processes and procedures

- Provides a walkthrough of conducting each SCP task
- Lists Wisconsin-centric inputs when performing safety and economic analysis
- Provides links and attachments for documents to aid in performing SCP tasks

Determine Potential Safety Concerns

Project segment(s) or intersection(s) that require crash data analysis due to statistically-significant high crash rates and/or high KAB rates

WisDOT – Meta-Manager database flags segments and/or spot locations

Meta Manager for Examples.xlsx - Excel

File Home Insert Page Layout Formulas Data Review View Developer Help JK Macros Tell me what you want to do

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	A	F	G	H	I	K	L	M	N	AI
1	PDP_ID	PDP_FRM	PDP_TO	PDP_MILE	ACSI_INTS_NM	HWY&DIR	PPROJ_GRP_DESC	RATE	RATEFLAG	HSTL_AADT_5_YR
89	425	008E174 000	008E175 000	0.76	CTH Y	008E	PRENTICE - BRADLEY	155.888	1.29	3700
90	426	008E175 000	008E176M000	0.60	CTH U	008E	PRENTICE - BRADLEY	138.370	1.03	2640
92	428	008E177K000	008E178G000	0.70	CTH L	008E	PRENTICE - BRADLEY	234.165	1.99	4680
93	429	008E178G000	008E178G042	0.42	CTH A	008E	PRENTICE - BRADLEY	230.229	1.68	3400
3630										

Crash Vetting

Focus on crashes that can be mitigated with engineering solutions

Review crash data for each flagged site to determine crash causation

- Remove crashes without engineering solutions

Identify crash trends and patterns

Alternatives Determination

Focus on practical mitigation alternatives

Evaluate how geometric features may contribute to crash history

- Functions as a secondary crash vetting

Determine practical mitigation alternative(s) to evaluate

Evaluate Safety Performance

Quantify future safety performance for comparison of the base (no-build) condition to the identified mitigation alternatives

Use predictive crash modeling methods when applicable

Concentrates on long-term average crashes rather than short-term trends (regression-to-the-mean bias)

Existing Conditions

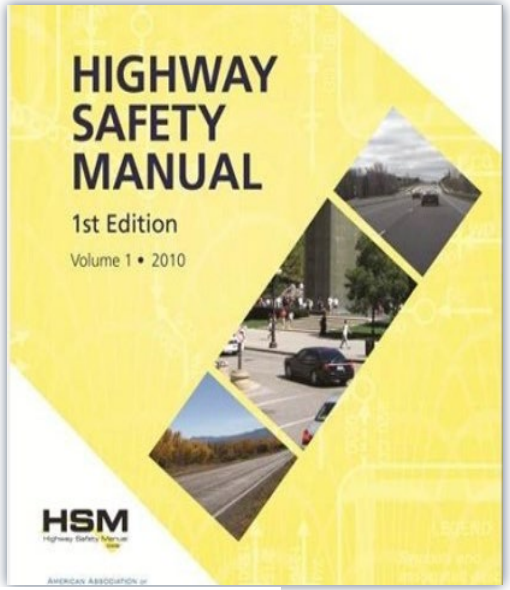
Alternative 1

Alternative 2

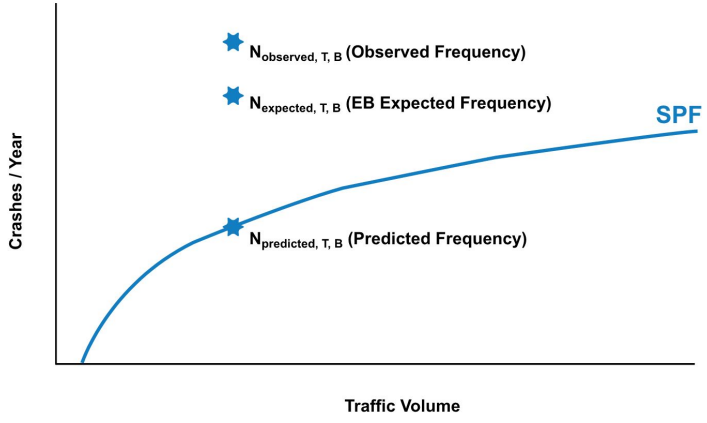
Evaluate Safety Performance

Use HSM methodologies to perform safety engineering analysis

- Use IHSDM to perform base and mitigation alternative crash prediction evaluations
- Estimated vs predicted vs expected crash frequency
- When CMF adjustments can be used and how they are applied to IHSDM results
- When to use Empirical Bayes method



IHSDM
Interactive Highway Safety Design Model



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Economic Appraisal

Quantify monetary change of crash frequency and severity changes

Quantify benefit-cost of proposed safety mitigation alternatives

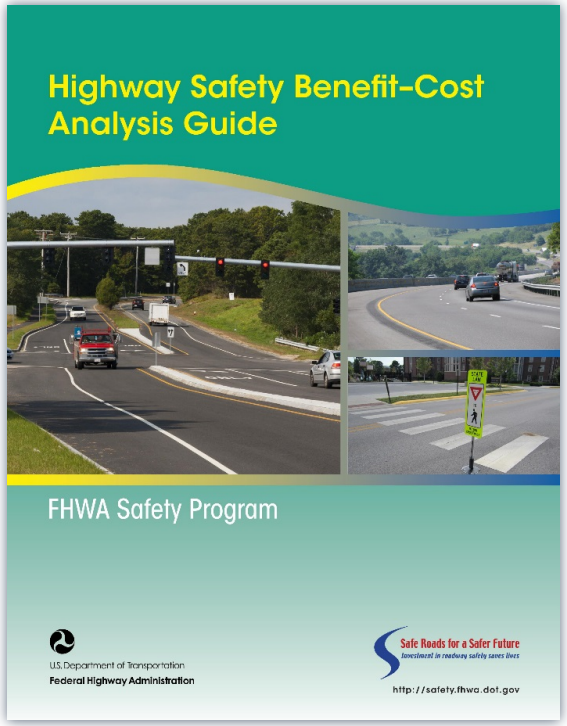
Allows understanding of the cost-effectiveness of mitigation alternatives from a safety standpoint

Economic Appraisal

Crash benefit calculations determine the monetary benefit of reducing crash frequency and severity

Project costs include construction and right of way costs

Tools for economic analysis include IHSDM software or spreadsheets



IHSDM

Interactive Highway Safety Design Model

Table 8. Case Summary

Is Base Case	Title	Present Value of Crash Cost ($)	Present Value of Other Cost ($)	Net Present Value of Benefits (B) ($)	Net Present Value of Costs (C) ($)	Present Value of Net Benefit (B-C) ($)	Benefit Cost Ratio (B/C)
Yes	Base	3,868,872.47	1,000,000.00				
	Mitigation	3,477,460.33	1,250,000.00	391,412.13	250,000.00	141,412.13	1.5656

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Status of PBPD Application

PBPD Use by WisDOT

Rollout of WisDOT FDM 11-38 – November 2018

PBPD training to WisDOT staff – November 2018

All Regions are currently using PBPD at the scoping level for programmed projects

Many Regions are currently using PBPD to study corridors for future project needs

PBPD Use by WisDOT

Safety (via SCP) is not absolute in decision-making process

- Traffic operations
- Feasibility / constructability

Improvements studied further in environmental process to determine preferred alternative

Thank you very much!

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