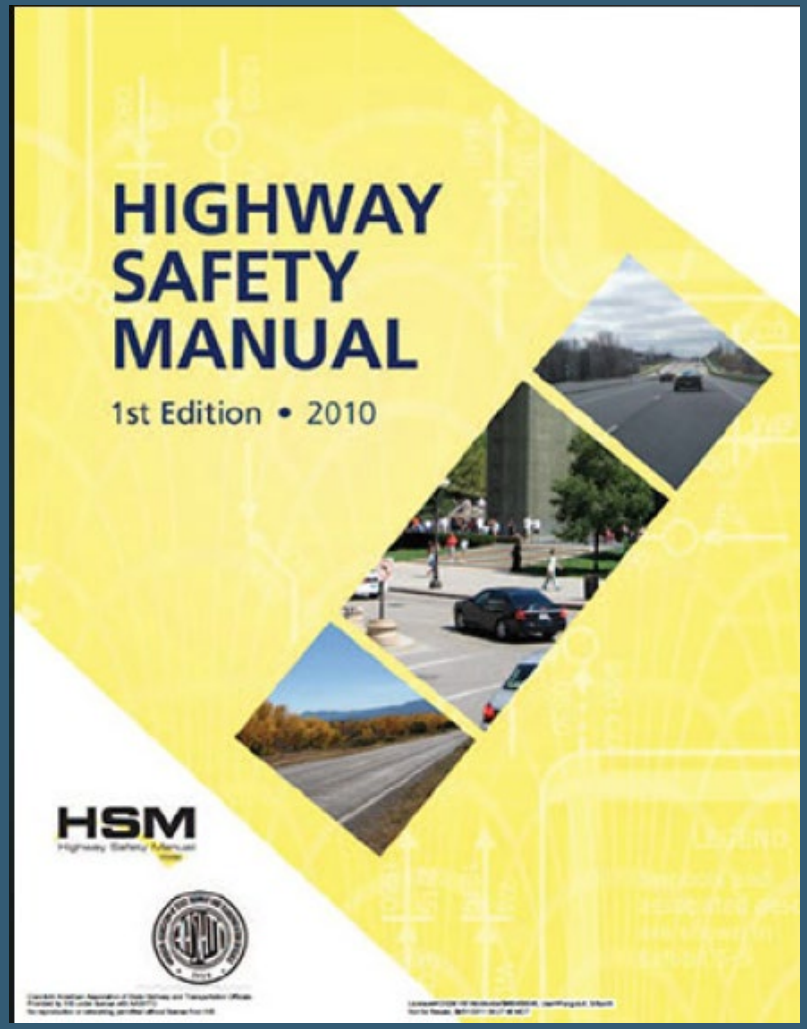
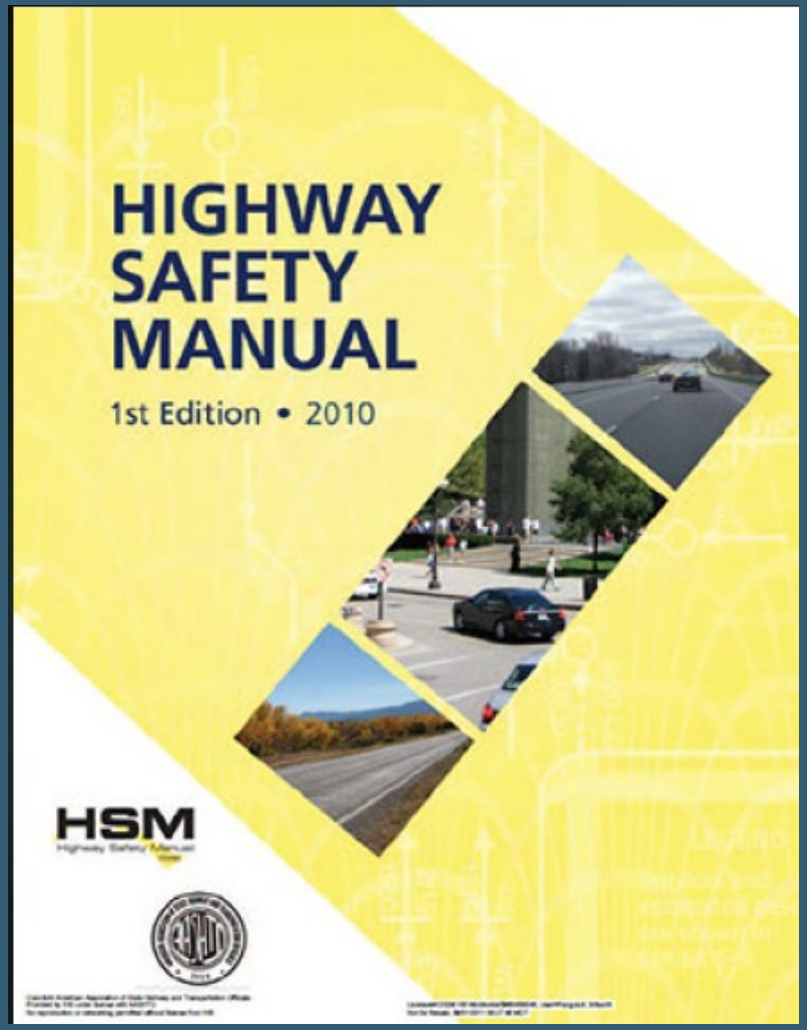
HIGHWAY SAFETY MANUAL – APPLICATION OVERVIEW



CALTRANS DISTRICT 7/
ACEC LA CHAPTER LIAISON MEETING
20TH SEPTEMBER 2021
SUSAN CHAU

HIGHWAY SAFETY MANUAL (HSM)



State of California
DEPARTMENT OF TRANSPORTATION

California State Transportation Agency

Memorandum

Making Conservation
a California Way of Life

To: DEPUTY DISTRICT DIRECTORS, Traffic Operations
DEPUTY DISTRICT DIRECTORS, Design

Date: August 12, 2019

From: JASVINDERJIT S. BHULLAR
Chief
Division of Traffic Operations

JANICE BENTON
Chief
Division of Design

Subject: **PROJECT GUIDANCE FOR PERFORMANCE-BASED DECISION-MAKING USING HIGHWAY SAFETY MANUAL**

This memorandum provides project guidance on implementing performance-based decision-making processes for highway design using the American Association of State Highways and Transportation Officials Highway Safety Manual (HSM). The HSM is a nationally recognized reference that can be used to make informed performance-based decision-making on design solutions. The purpose of the HSM is to provide fact-based statistical information and proven data-driven analysis tools for collision frequency prediction. The HSM can facilitate the integration of quantitative collision frequency and severity performance measures into roadway planning, design, operations, and maintenance decisions. The primary focus of the HSM for the California Department of Transportation is to increase the use of analytical tools to assess the safety impacts of transportation projects and program decisions.

The HSM shall be used based on the project application guidelines in the Performance-Based Decision-Making Using Highway Safety Manual Project Application Guidelines document (attached). The HSM implementation shall apply to projects that meet the minimum criteria specified in the guidelines and have a Project Approval and Environmental Document date after June 30, 2020.

This guidance shall be effective until superseded by a subsequent memo or the appropriate updated project development guidance manuals.

"Provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability"

WHAT IS HSM?

- Guidance Document for Incorporating Quantitative Safety Analyses
- Scientific Methodologies for Estimating Safety Performance
- Published in 2010, Supplement in 2014 (Freeways)
- 2nd Edition expected to be published in 2023

WHY USE HSM?

Performance Based Decision

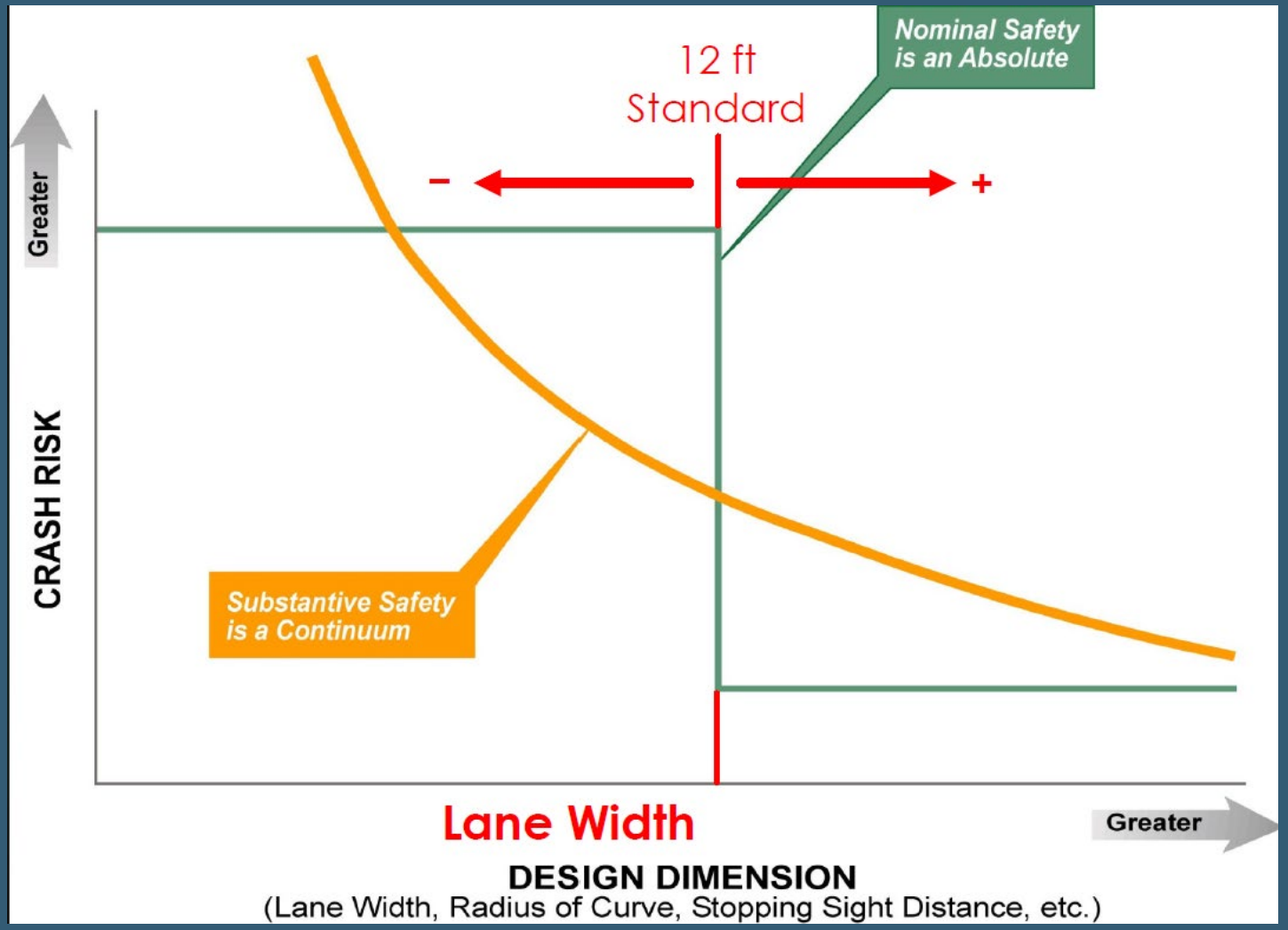
Improve Safety Analyses

Encourages a "science-based" technical approach to safety analysis

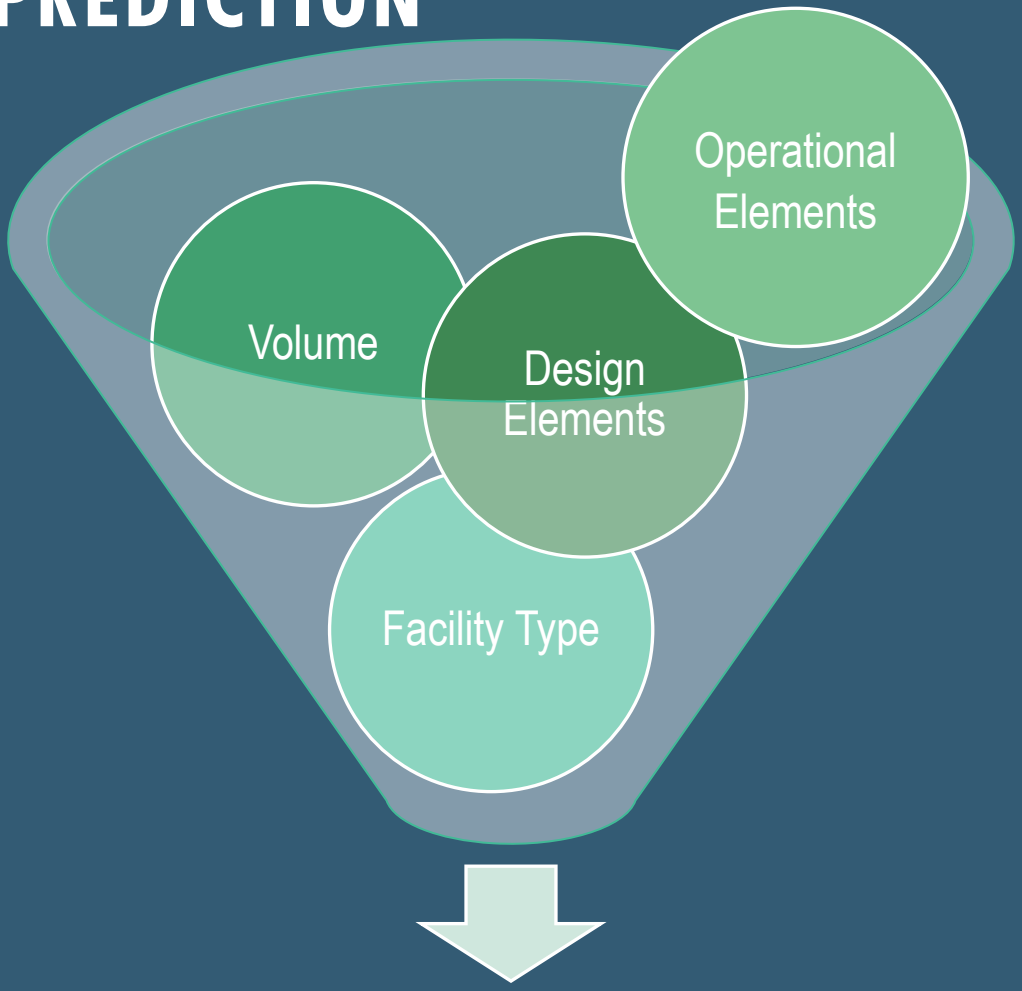
Minimizes biased results

Nominal vs Substantive Safety

NOMINAL VS SUBSTANTIVE

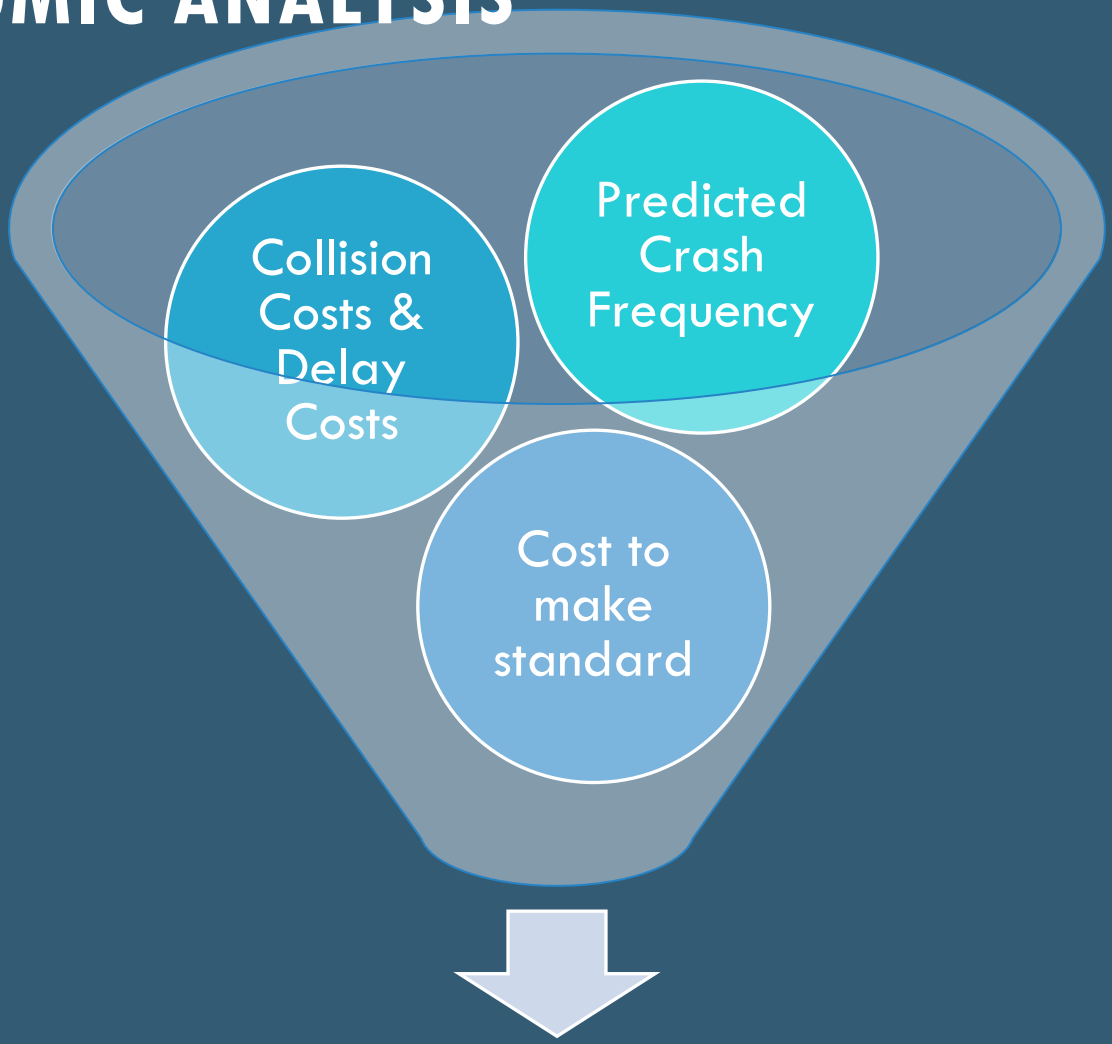


CRASH PREDICTION



Predicted Crash Frequency

ECONOMIC ANALYSIS



Safety Benefit to Meeting Standard, Benefit/Cost Ratio, and Cost to the State

WHAT THE HSM DOES NOT DO

HSM DOES NOT replace Engineering Judgement

CALTRANS HSM POLICY OVERVIEW

Provides Project Guidance

Minimum criteria specified in guideline and a PAED date after 6/30/20

Project Application Guidelines

PROJECT APPLICATION GUIDELINES
ROLES AND RESPONSIBILITIES

Different Roles

- Project Development Team (PDT)
- District Division of Traffic Operations/Traffic Safety
- District Division of Design

PROJECT APPLICATION GUIDELINES
PROJECT APPLICATION

Minimum Requirements for Project Selection to Implement HSM:

- Projects that change access on the Interstate System
- Projects that have:
  - Nonstandard Travel Lane Width
  - Nonstandard Shoulder Width
  - Geometric Curve Radius Upgrade

PROJECT APPLICATION GUIDELINES ANALYSIS

HSM Analysis can be used to:

- Compare between project alternatives
- Compare between geometric design variations
- Trade-off Analysis (finding the most effective combination of geometric elements that fit within identified constraints)

HSM USE BY PHASE

Planning Phase

- Often lack of detailed information to run a full analysis, may be possible

PA&ED Phase

- Alternative Analysis & Design Standard Decision Documents (DSDDs)

PS&E Phase

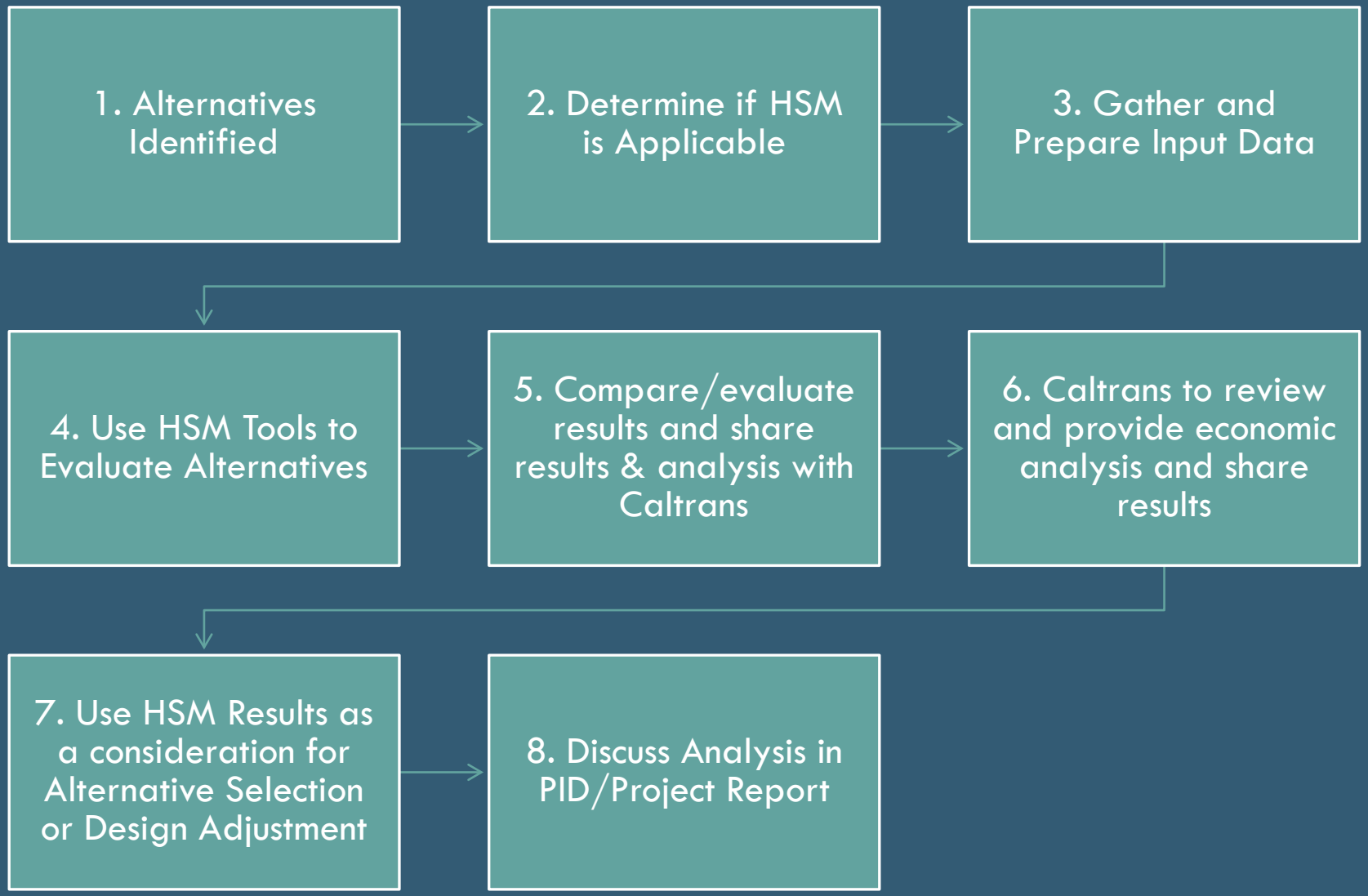
- Supplemental Design Standard Decision Documents (SDSDDs)

IMPLEMENTATION

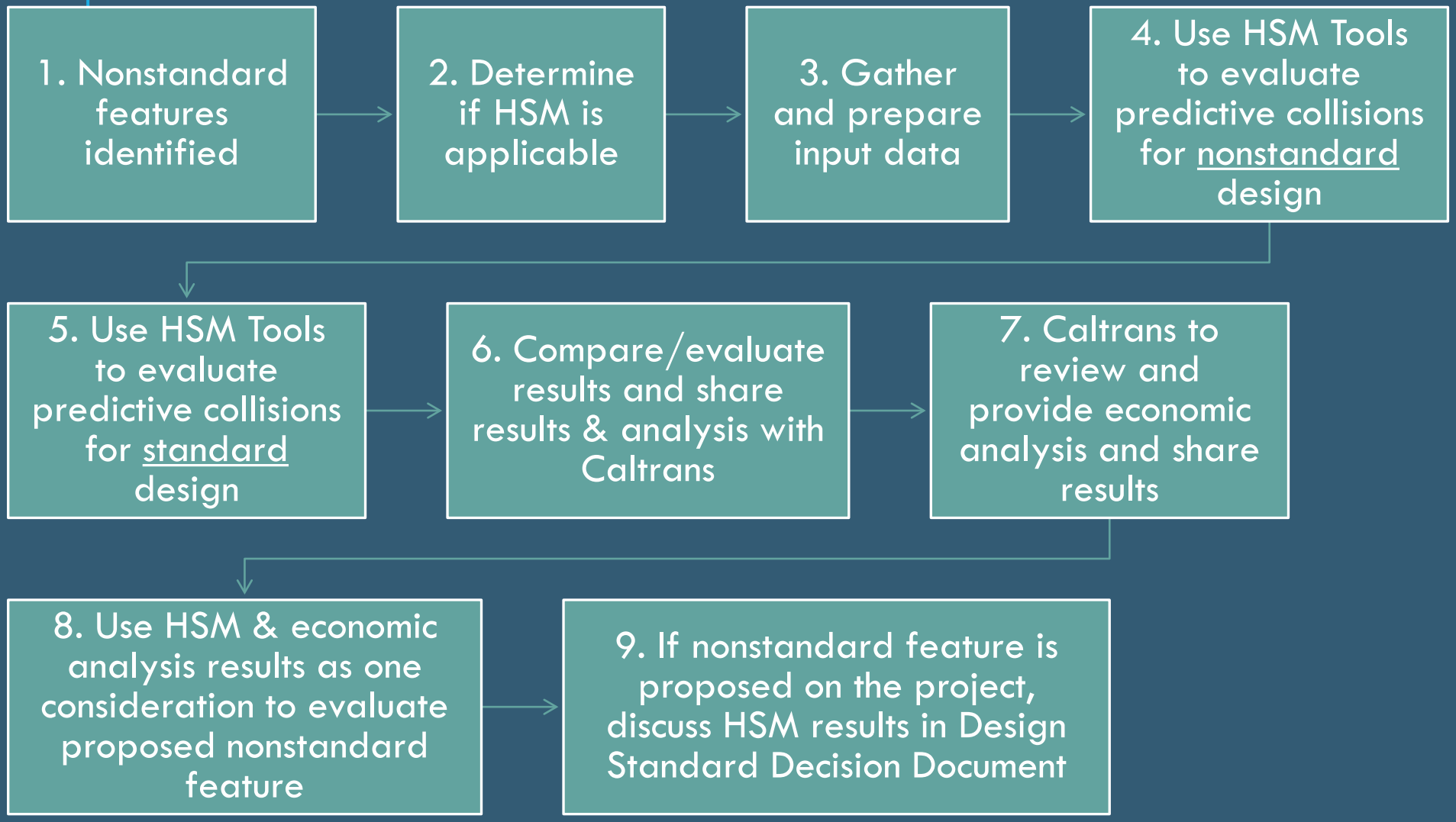
1. Rural 2-lane highways and intersections (Required)
2. Rural multilane highways and intersections (Required)
3. Urban & Suburban Arterials (Required)
4. Freeways:

   Implementation: Required if PAED completion date of or after January 1, 2022

OVERVIEW – ALTERNATIVE ANALYSIS

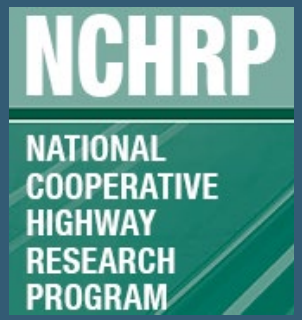


OVERVIEW – NONSTANDARD FEATURES



TOOLS AVAILABLE

Interactive Highway Safety Design Model (IHSDM)



HSM Spreadsheet Tools – NCHRP

Crash Modification Factors Clearinghouse

Reference: http://www.highwaysafetymanual.org/Pages/Tools.aspx

DSDD APPLICATION

1. Initial Steps
2. How to Apply
3. Economic Analysis
4. What to include
5. Who concurs and approves

1. INITIAL STEPS

- ✓ Are the project AADTs within the HSM model thresholds (e.g. Design Period traffic volumes)?
- ✓ Can the non-standard feature be modeled?
  - ✓ Does the facility type account for the specific geometric feature that is non-standard?
  - ✓ If yes, is the difference between the standard and non-standard feature large enough to be modeled?

2. HOW TO APPLY

Only model the area (segment(s)/intersection) that contains the non-standard feature

Model two separate conditions: non-standard feature and minimum standard (HDM)

- Compare the number of collisions for each condition

HSM analysis must include all years up to and including the Design Period AADT

- Sum up all of the years analyzed to obtain the <u>total number of collisions</u>

3. ECONOMIC ANALYSIS

Results of HSM Analysis should be provided to Caltrans for review and Caltrans will provide an Economic Analysis

Results of Economic Analysis will provide a monetary value of safety benefit to meeting standard, benefit/cost ratio, and cost to the state.

4. WHAT TO INCLUDE IN DSDD

Limit the HSM analysis to a summary within the justification section for non-standard feature

- Include any assumptions made

DO NOT include spreadsheets/tables from the models within the DSDD or as an attachment to the DSDD

HSM outputs are part of the non-standard justification, not the sole justification

5. WHO REVIEWS AND APPROVES?

HQ Traffic/Safety and Design SMEs

- Assists by providing reviews and comments on the methodology (optional)
- Economic Analysis (tentatively)

District Traffic and Design Oversight Engineer & HSM SMEs

- Review and Concur on HSM methodology, design life, projected AADTs but NOT the nonstandard feature itself
- Decides how to use the model outputs

EXAMPLE

A Part C 2010 Highway Safety Manual (HSM) cost-effectiveness analysis was conducted to calculate the total predicted collisions over a 20-year period for both a standard shoulder width and the proposed non-standard shoulder width. Using the predictive method, providing the standard shoulder width would reduce the Fatal and Injury (F&I) collisions by 0.084 and Property Damage Only (PDO) collisions by 0.179 over the 20-year analysis period compared to the proposed nonstandard shoulder width. Converting the total predicted collisions to a monetary value (using the Caltrans Collision Cost Worksheet v2 results, provided by Headquarters), amounts to a $58,904 of safety benefit to meet the standard. With a $1,318,000 cost to meet the standard, means that the project spent $1,259,096 more to meet the standard than the standard design will reduce cost of collisions. The benefit to cost ratio (benefit of meeting standard/cost to meet standard) results in a ratio of 0.04. The benefit in collision reduction due to meeting the standard shoulder width is not economically justifiable compared to the cost of making the standard shoulder width.

Summary of HSM Analysis Outputs and Economic Analysis over 20-year analysis period

	HSM Outputs- Number of Predicted Collisions by Severity	
	F&I	PDO
Non-Standard Shoulder	0.751	1.588
Standard Shoulder	0.666	1.409
	Economic Analysis Summary	
Safety Benefit of Meeting Standard		$58,904
Cost to make Standard		$1,318,000
Net Value		-$1,259,096
Benefit/Cost Ratio		0.04

OTHER CONSIDERATIONS

Fatal and Injuries vs Total Collisions

Qualitative Analysis

RESOURCES

Performance Based Decision-Making Memo using HSM:

- https://dot.ca.gov/-/media/dot-media/programs/design/documents/performance-based-decision-memo-8-14-2019_a11y.pdf

AASHTO - HSM:

- http://www.highwaysafetymanual.org/Pages/default.aspx

HSM Training:

- http://www.highwaysafetymanual.org/Pages/training_sub.aspx#1

QUESTIONS?