Safe System in Design

Quantification & tools

Ida van Schalkwyk, Ph.D., Safety and Assets Engineer
HQ Design
Development Division

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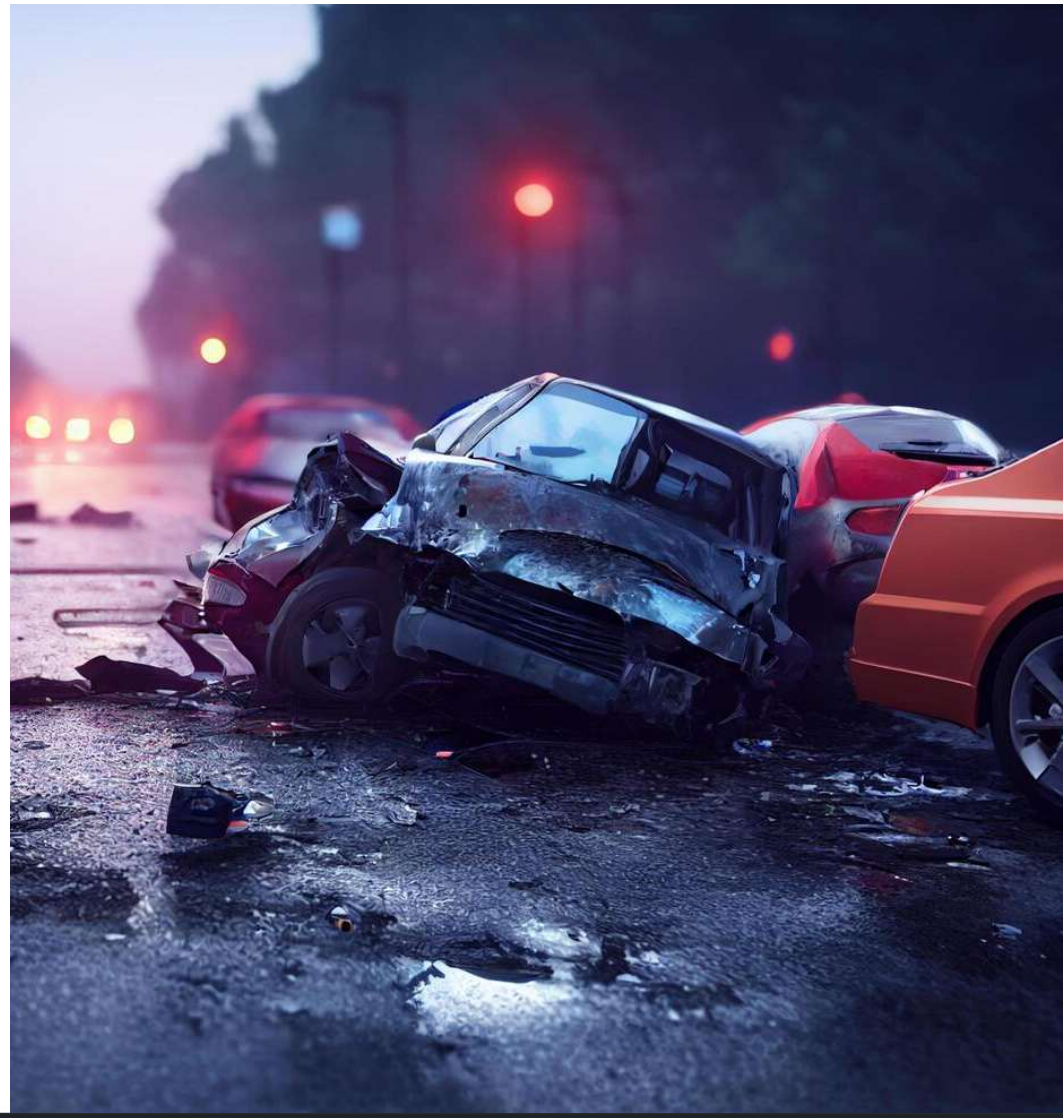
"The work you do is important. In other jobs their mistakes usually don't matter much, but when ***you*** make a mistake, people can die or get seriously hurt"

- Charlize, 9-yr old

Key items

- The Safe System Approach
- How to think about practical implementation
- Current and future efforts



The Safe System Approach (WA State)

- Principles
- Components
- Safety defined

Safe System Approach at WSDOT

Exposure

Which road users, in what numbers and for how long are using the road and are thus exposed to a potential crash

Likelihood

Factors affecting the probability of a crash occurring, e.g. conflict points, offset, separation, error rates

Severity (Kinetic Energy)

$$\text{Kinetic Energy} = \frac{1}{2} \times \text{Mass} \times \text{Speed}^2$$

SAFE SYSTEM APPROACH

Key concepts for implementation

Assess objectives

Program/activity
Purpose
Scale
Depth

Project context

Project **objectives**
Function of road
Speed environment
Road users
Vehicles

Safe System Matrix

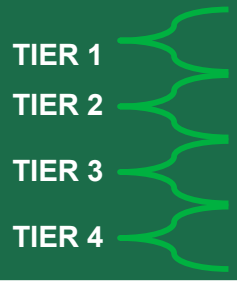
Exposure and conflicts
Likelihood
Severity

Safe System Pillars

Treatment Hierarchy

* Primary /transformational
* Supporting

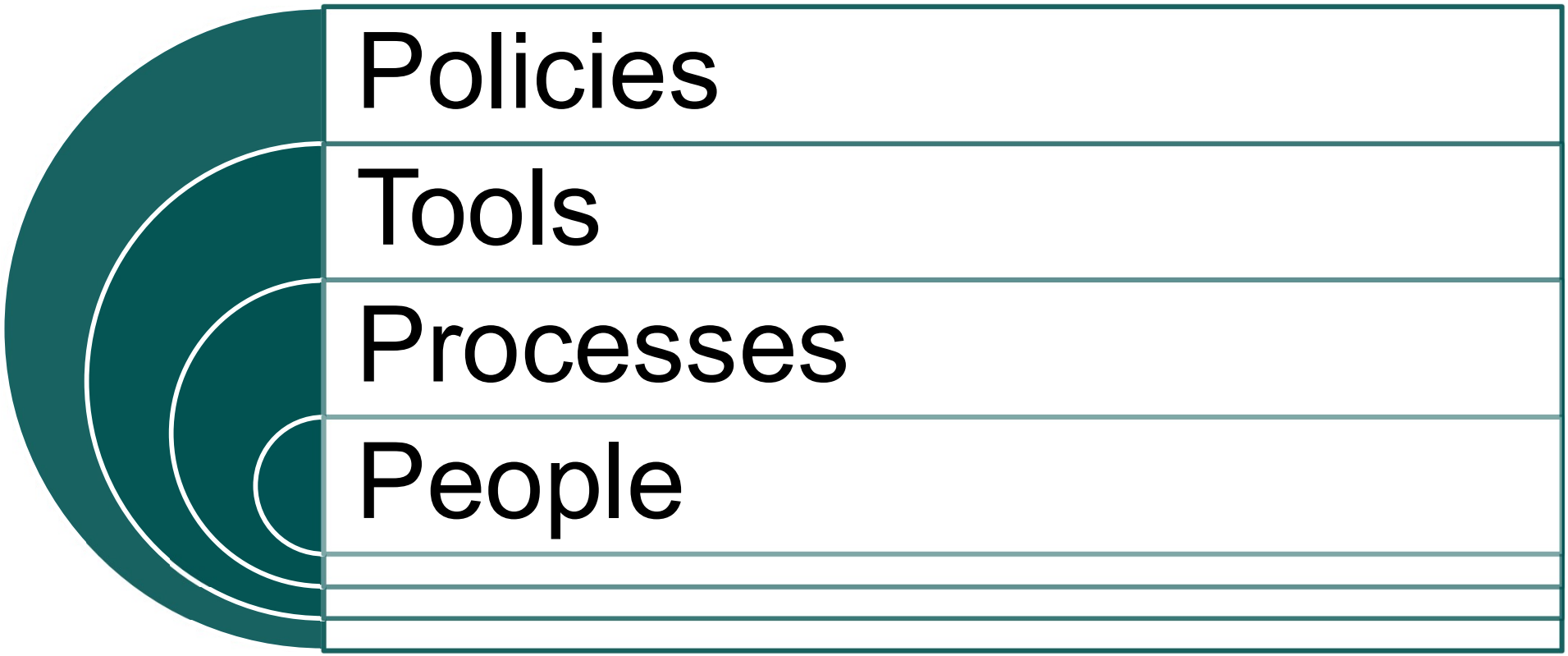
Roadway Design Hierarchy



- Remove severe conflicts
- Reduce vehicle speeds
- Manage conflicts in time
- Increase attentiveness and awareness

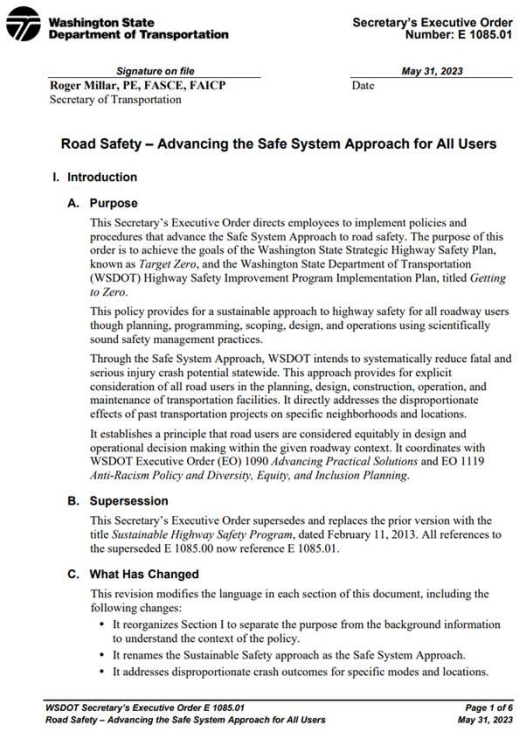
Policies are good but they are <u>nothing</u> without *implementation*

Key Components of Implementation



Legal and Policy Framework

- WSDOT
  - Safe System Executive Order – 1085.01 (PDF)
    - **Calls for adoption and integration** of the Safe System Approach
  - Design Manual
    - **Integrates** the Safe System Approach



Washington State Department of Transportation

Secretary's Executive Order Number: E 1085.01

Signature on file
Roger Millar, PE, FASCE, FAICP
Secretary of Transportation

May 31, 2023
Date

Road Safety – Advancing the Safe System Approach for All Users

I. Introduction

A. Purpose

This Secretary's Executive Order directs employees to implement policies and procedures that advance the Safe System Approach to road safety. The purpose of this order is to achieve the goals of the Washington State Strategic Highway Safety Plan, known as *Target Zero*, and the Washington State Department of Transportation (WSDOT) Highway Safety Improvement Program Implementation Plan, titled *Getting to Zero*.

This policy provides for a sustainable approach to highway safety for all roadway users though planning, programming, scoping, design, and operations using scientifically sound safety management practices.

Through the Safe System Approach, WSDOT intends to systematically reduce fatal and serious injury crash potential statewide. This approach provides for explicit consideration of all road users in the planning, design, construction, operation, and maintenance of transportation facilities. It directly addresses the disproportionate effects of past transportation projects on specific neighborhoods and locations.

It establishes a principle that road users are considered equitably in design and operational decision making within the given roadway context. It coordinates with WSDOT Executive Order (EO) 1090 *Advancing Practical Solutions* and EO 1119 *Anti-Racism Policy and Diversity, Equity, and Inclusion Planning*.

B. Supersession

This Secretary's Executive Order supersedes and replaces the prior version with the title *Sustainable Highway Safety Program*, dated February 11, 2013. All references to the superseded E 1085.00 now reference E 1085.01.

C. What Has Changed

This revision modifies the language in each section of this document, including the following changes:

- It reorganizes Section I to separate the purpose from the background information to understand the context of the policy.
- It renames the Sustainable Safety approach as the Safe System Approach.
- It addresses disproportionate crash outcomes for specific modes and locations.

WSDOT Secretary's Executive Order E 1085.01
Road Safety – Advancing the Safe System Approach for All Users
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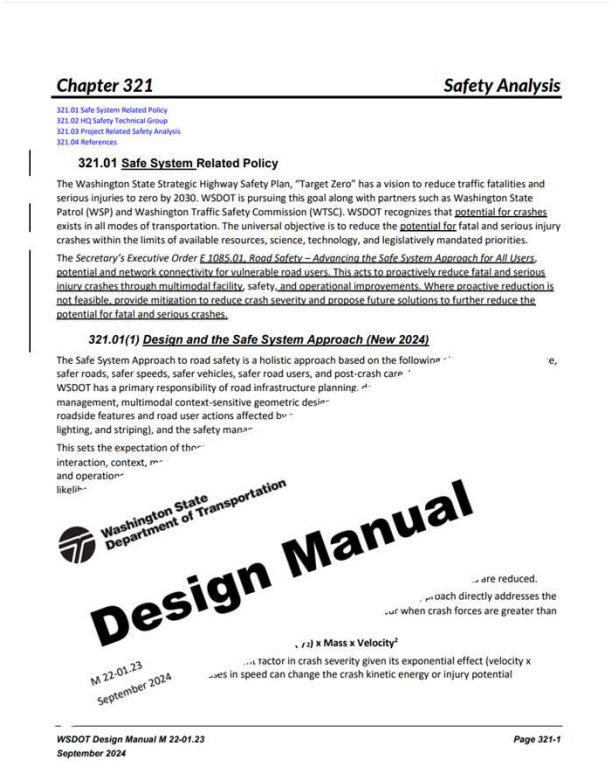

Chapter 321 *Safety Analysis*

321.01 Safe System Related Policy
321.02 HQ Safety Technical Group
321.03 Project Related Safety Analysis
321.04 References

321.01 Safe System Related Policy

The Washington State Strategic Highway Safety Plan, "Target Zero" has a vision to reduce traffic fatalities and serious injuries to zero by 2030. WSDOT is pursuing this goal along with partners such as Washington State Patrol (WSP) and Washington Traffic Safety Commission (WTSC). WSDOT recognizes that potential for crashes exists in all modes of transportation. The universal objective is to reduce the potential for fatal and serious injury crashes within the limits of available resources, science, technology, and legislatively mandated priorities.

The *Secretary's Executive Order E 1085.01, Road Safety – Advancing the Safe System Approach for All Users*, potential and network connectivity for vulnerable road users. This acts to proactively reduce fatal and serious injury crashes through multimodal facility, safety, and operational improvements. Where proactive reduction is not feasible, provide mitigation to reduce crash severity and propose future solutions to further reduce the potential for fatal and serious crashes.

321.01(1) Design and the Safe System Approach (New 2024)

The Safe System Approach to road safety is a holistic approach based on the followin… safer roads, safer speeds, safer vehicles, safer road users, and post-crash car… WSDOT has a primary responsibility of road infrastructure planning, … management, multimodal context-sensitive geometric desi… roadside features and road user actions affected b… lighting, and striping), and the safety mana…

This sets the expectation of the… interaction, context, … and operation… likeli…

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Design Manual

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…are reduced.
…oach directly addresses the
…ur when crash forces are greater than

… x Mass x Velocity²

… factor in crash severity given its exponential effect (velocity x …es in speed can change the crash kinetic energy or injury potential

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Objectives for a Safe System in Design Tool

1. How the project or strategy support the Safe System.
2. Degree to which the project or strategy align with the Safe System.
3. Areas for improvement/adjustment for better alignment.
4. Alternatives comparison.
5. Straightforward and easy

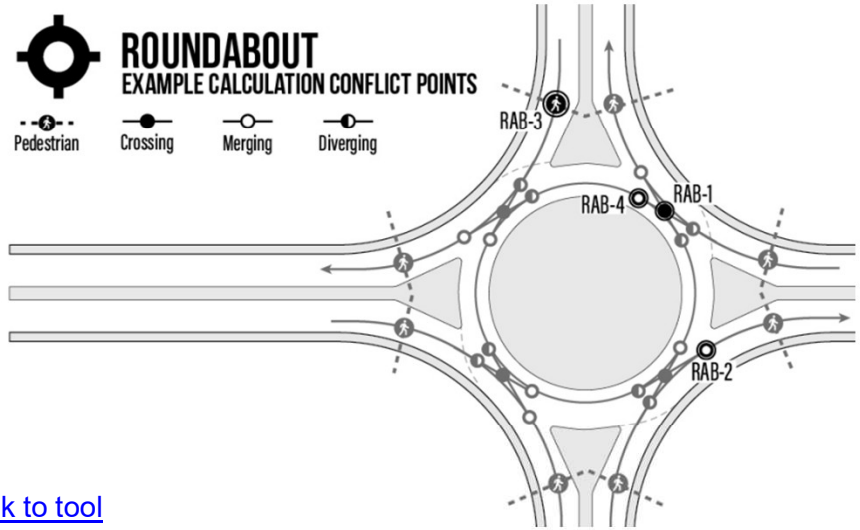
FHWA

1. Safe System Project-Based Alignment Framework For Project Locations

- Link to tool
- Scoring sheets for exposure, likelihood, factors for drivers and VRU, severity scoring sheet, summary scoring sheet
- Tool evaluation: promise but complex to complete

2. Safe System for Intersections (SSI)

- Intersection Control Evaluation (ICE)
- Kinetic Energy Management Model (KEMM) by Corben et al. (2010)



Link to tool

Corben, B., Van Nes, N., Logan, D. & Archer, J. (2010). Kinetic Energy Management Model and Safe Intersection Design Principles [Report No. 316c]. VicRoads, Victoria, Australia

WSDOT Safe System in Design Tool

Intersection Scoring Sheet

Project:	
Intersection Location:	
Number of Legs:	**4**

Exposure	**Select option**	**Generated score**
a) Vulnerable Road Users		
How many people are walking and rolling?	Less than 10	1
What is the maximum number of lanes those walking and rolling are crossing?	Two Lanes	4
	Exposure score for VRU	***5***
b) Motor Vehicle Occupants		
What is the AADT?	Greater 15,000	10
What is the maximum roadway width in feet?	Less than 30	1
	Exposure score for motor vehicle occupants	***11***

Likelihood

a) Vulnerable Road Users		**Scaling conditions for site characteristics**	
Pedestrian Space Separation:	Northbound approach	High Emphasis Raised Crosswalk on Approach or Grade Separated Crossing	0
	Eastbound approach	Crosswalk Marking (decorative or material) on Approach	0.75
	Southbound approach	Crosswalk marking (high emphasis or ladder marking) on Approach	1.5

WSDOT Safe System in Design Tool

Intersection Scoring Sheet

Summary		
a) Vulnerable Road Users	Exposure Score	5
	Likelihood Score	12
	Severity Score	20
	Mode Subtotal	***1200***
b) Motor Vehicle Occupants	Exposure Score	11
	Likelihood Score	15
	Severity Score	9
	Mode Subtotal	***1485***
c) Total Intersection Score		**2685**

WSDOT Safe System in Design Tool

Segment Scoring Sheet

Project:	
Segment Location:	

Exposure	**Select option**	**Generated score**
a) Vulnerable Road Users		
How many people are walking and rolling?	Less than 10	1
What is the maximum number of lanes those walking and rolling are crossing?	Two Lanes	4
Exposure score for VRU		***5***
b) Motor Vehicle Occupants		
What is the AADT?	Greater 15,000	10
What is the maximum roadway width in feet?	30 - 35	4
Exposure score for motor vehicle occupants		***14***

Likelihood		
a) Vulnerable Road Users	**Scaling conditions for site characteristic**	
Pedestrian Space Separation:	Buffered (4 feet or more) sidewalk (width greater than 5 feet)	0.75
Bike Space Separation:	Buffered Bicycle Lane (unprotected)	1.5
Pedestrian/Bike Time Separation:	No Marked Crossing	3
Lighting Conditions:	Lighting provided but not substantial	1.5
Sight distance:	1/2 or more of the driveways or sidestreets with obstructed sight	3

WSDOT Safe System in Design Tool

Segment Scoring Sheet

Summary		
a) Vulnerable Road Users	Exposure Score	5
	Likelihood Score	12
	Severity Score	15
	Mode Subtotal	***900***
b) Motor Vehicle Occupants	Exposure Score	14
	Likelihood Score	18
	Severity Score	18
	Mode Subtotal	***4536***
c) Total Segment Score		**5436**

WSDOT Safe System in Design Tool

Crash type scoring for segments & intersections

And in addition, for segment and intersection worksheets (just an example):

Crash Types	Run-off-road	Head-on & Right Angled	VRU-involved	Other
Exposure	1.6 /4	1.6 /4	0 / 4	3 / 4
Likelihood	4 /4	2 / 4	2 / 4	4 / 4
Severity	1 / 4	4 / 4	2 / 4	1 / 4
Product	6.4 / 64	12.8 / 64	4 / 64	12 / 64
				35.2 / 448

WSDOT Safe System in Design Tool

- Under development
- Leverages work by FHWA supplemented by
  - Additional areas of evaluation for
    - Guidance
    - Context and land use
    - Post-crash care
  - Scoring for crash types across exposure, likelihood, and severity
    - Run-off-road crashes
    - Head-on and right-angled crashes
    - VRU (ped/bike) involved
    - Other
  - Incorporating roundabouts, limited access freeways, additional ped/bike aspects

Implementation Tool(s): Current efforts and moving forward

- Assessment spreadsheet under development
- Pilot testing with a few regions
- Update to reflect feedback
- Roll out with training

- What's next? Additional tools and guidance to help support Safe System Approach integration and implementation.

QUESTIONS?

Ida van Schalkwyk
(eda fun skulk vake)
Safety and Assets Engineer
Washington State
Department of Transportation
ida.vanschalkwyk@wsdot.wa.gov
360-705-7119