Flexible Design at Washington State DOT

How WSDOT's Moving Washington approach leads to better performance

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Washington State Transportation Commission
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Washington State Department of Transportation

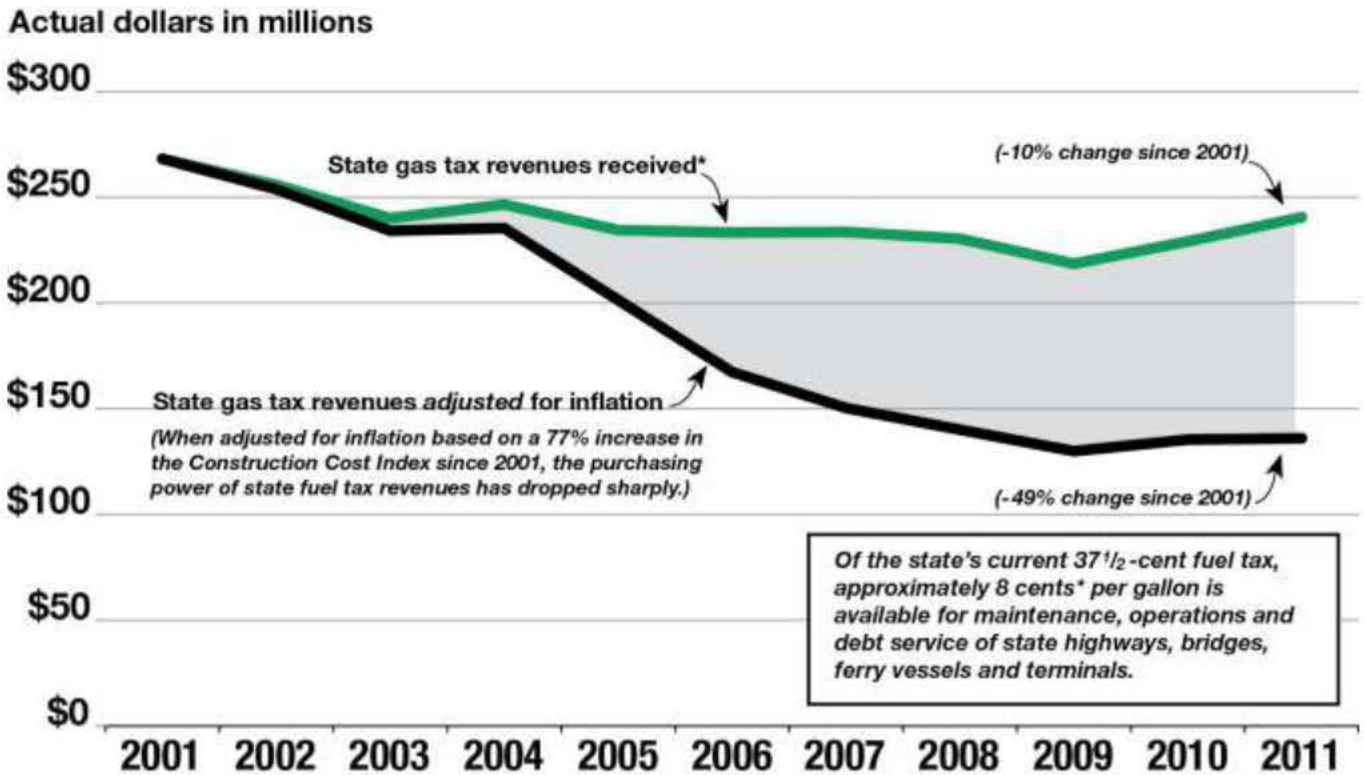
Gas tax purchasing power declines over time

Gas tax not indexed to inflation

…and compelling communication is more important than ever

Funding crisis

- Revenue significantly under projections
- Inflation increasing cost of maintenance and construction
- Challenge in getting another tax increase



* Includes maintenance, preservation, safety improvements, and other department operations.
** Less Debt Service.

Source: WSDOT

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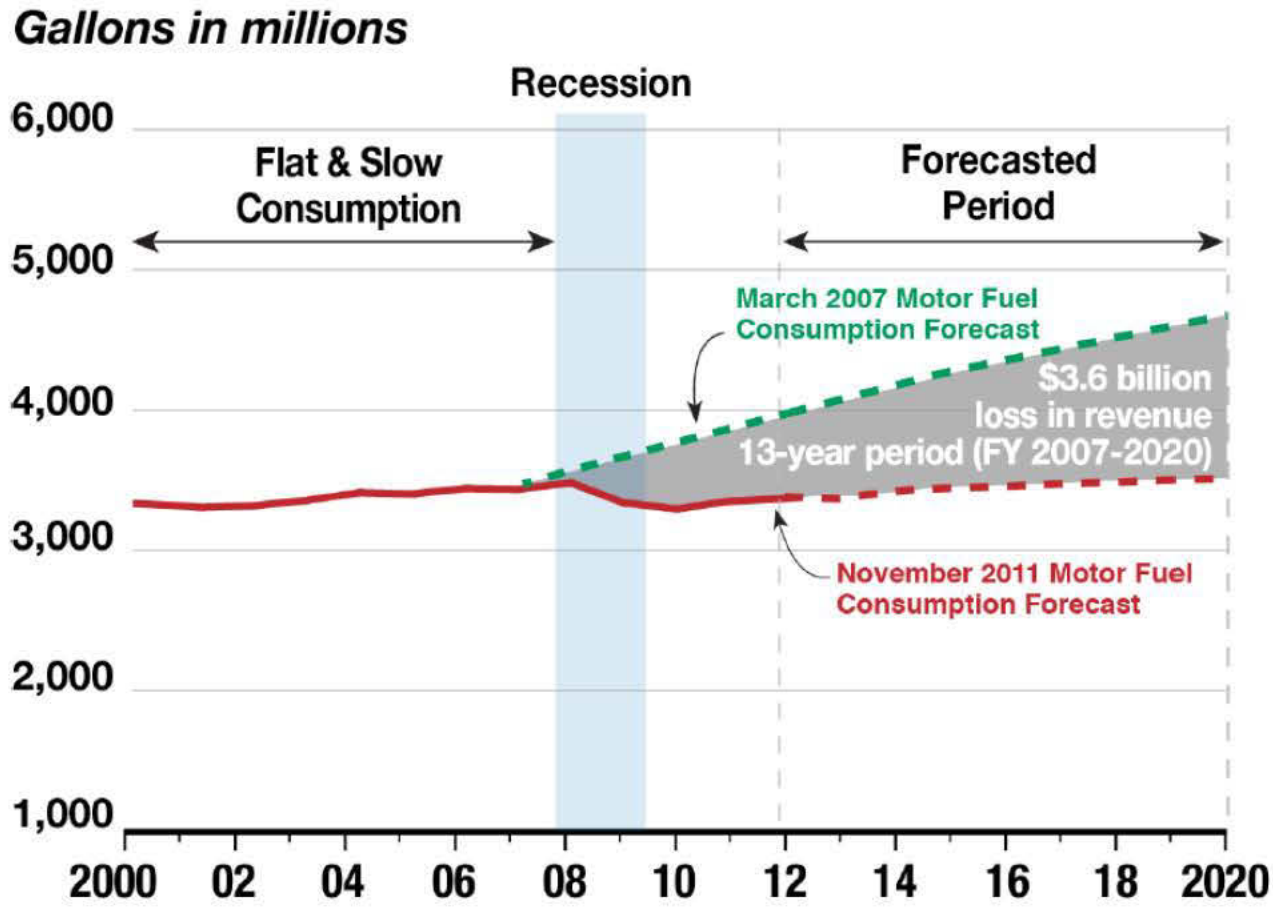
Fuel-efficient vehicles, weak economy impact fuel sales

Fewer gallons sold = reduced gas tax revenue projections

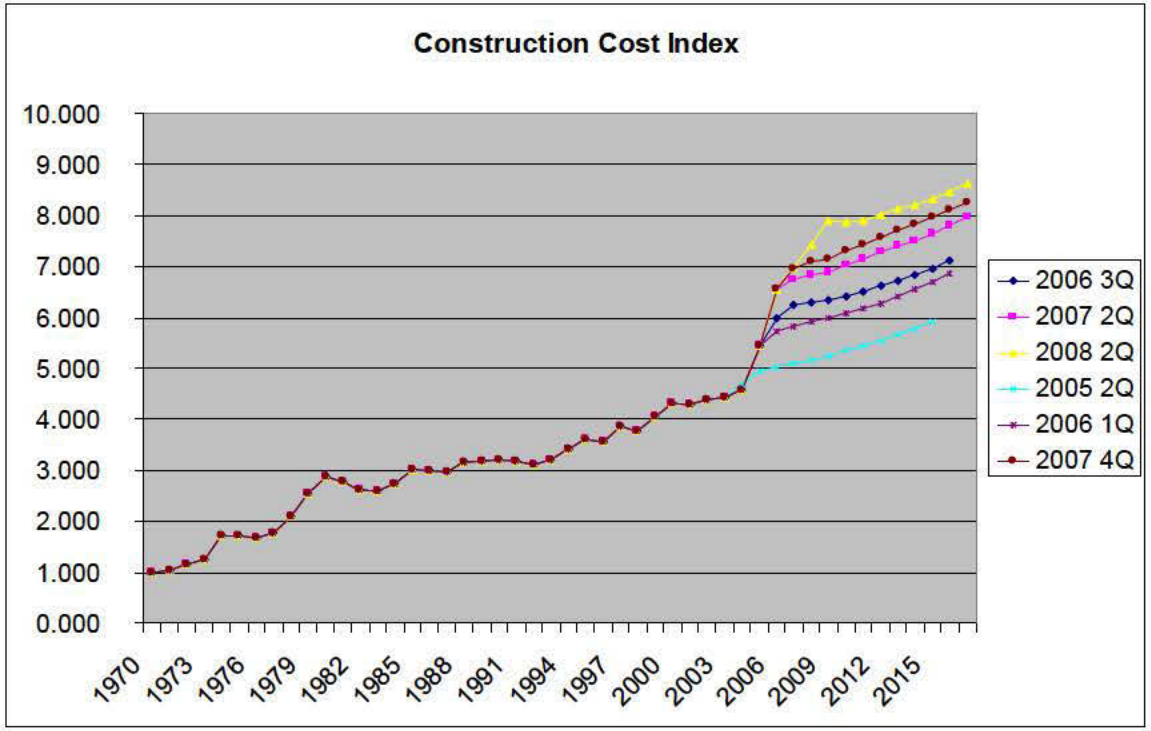
Gross fuel consumption - forecast has gone down



- The state gas tax funds 76% of all transportation investments.
- Since March 2007, projected fuel tax revenues will fall by $3.6 billion over the 13-year period.

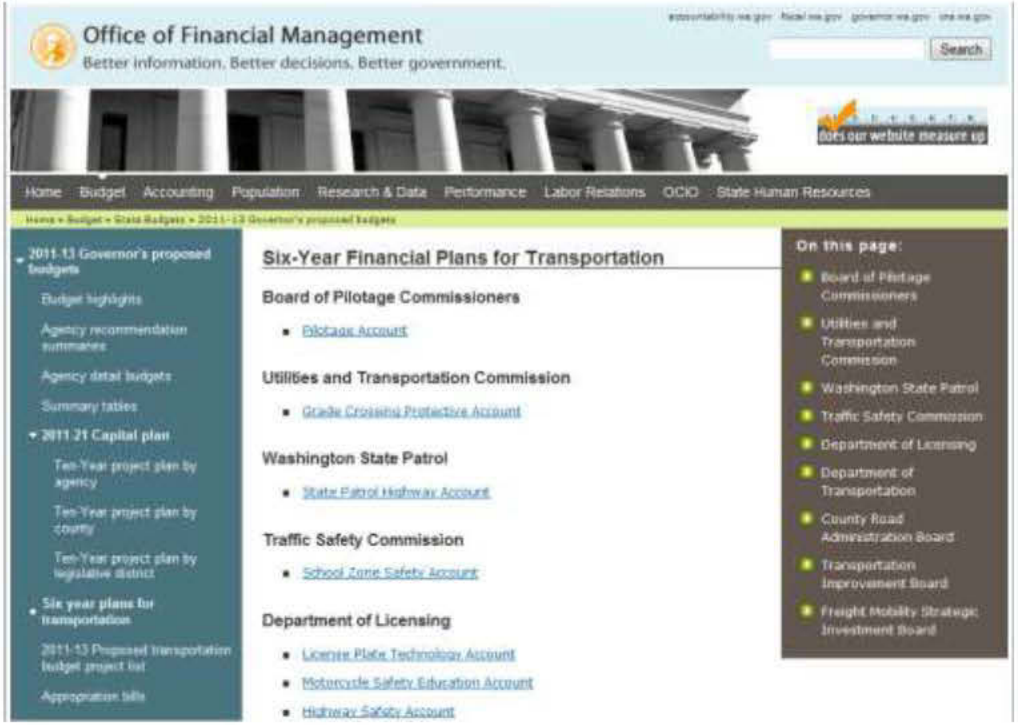
Cost of Construction

- Averaged 4% between 1970 and 2006
- 1974 – OPEC Oil Embargo
- 1980 – 2nd OPEC Oil Crisis
- 2006 – 2009 Material Cost increase



Legislative Vision for Transportation Budgeting

The State Legislature finds that solutions to state highway deficiencies have become increasingly complex and diverse and that anticipated transportation revenues will fall substantially short of the amount required to satisfy all transportation needs. Difficult investment trade-offs will be required.



The Governor's Office of Financial Management shall propose a comprehensive ten-year investment program for the preservation and improvement programs defined in this section, consistent with the policy goals described under RCW 47.04.280.

PURPOSE OF TRANSPORTATION ATTAINMENT REPORTS

Washington's Transportation Attainment Reports provide a high-level assessment of the state's progress in achieving its transportation goals using key performance measures and data.

Statewide Transportation Goals

In 2007, the Washington State Legislature amended RCW 47.04.280 to establish five statewide transportation policy goals to guide the planning, operation, performance of, and investment in the state's transportation system. They are not prioritized.

- *Safety*: To provide for and improve the safety and security of transportation customers and the transportation system.
- *Preservation:* To maintain, preserve and extend the life and utility of prior investments in transportation systems and services.
- *Mobility (addressing congestion):* To improve the predictable movement of goods and people throughout Washington state.
- *Environment:* To enhance Washington's quality of life through transportation investments that promote energy conservation, enhance healthy communities and protect the environment.
- *Stewardship:* To continuously improve the quality, effectiveness and efficiency of the transportation system.

In 2010, the Legislature added a sixth goal:

- *Economic vitality:* To promote and develop transportation systems that stimulate, support and enhance the movement of people and goods to ensure a prosperous economy.

2012 Biennial Transportation Attainment Report

Washington's Transportation System: Goals, Objectives and Performance Measures

Goal 2. Preservation

To maintain, preserve and extend the life and utility of prior investments in transportation systems and services.

Measures	*Objective*	*Status*	*Progress*	*Five-Year Trend*
Measure 2.1 Highway Pavement Percent of state highway pavement in fair or better condition	Extend the useful life of pavement	92.7% of state highway pavement in fair or better condition in 2011	◆	
Measure 2.2 Bridges Percent of state bridges rated structurally deficient (SD)	Keep bridges safe and open to traffic	5% of bridges were rated SD in 2011, a 0.3% improvement from 2008	*	
Measure 2.3 Ferry Terminals Percent of state ferry terminal systems in fair or better condition	Extend the useful life ferry terminals and vessels	86 % rated fair or better in 2011, a 2% increase from 2008	*	

Types of Investment Tradeoffs

- Project level
- Corridor level
- Between projects/corridors

Integrating Enterprise Risk Management Into Decision Making

- Set a goal at the planning phase, what performance is necessary to achieve that goal?
- Do I have existing assets in place to achieve that performance?
- If I don't, what additional assets or approaches do I need and **when**?

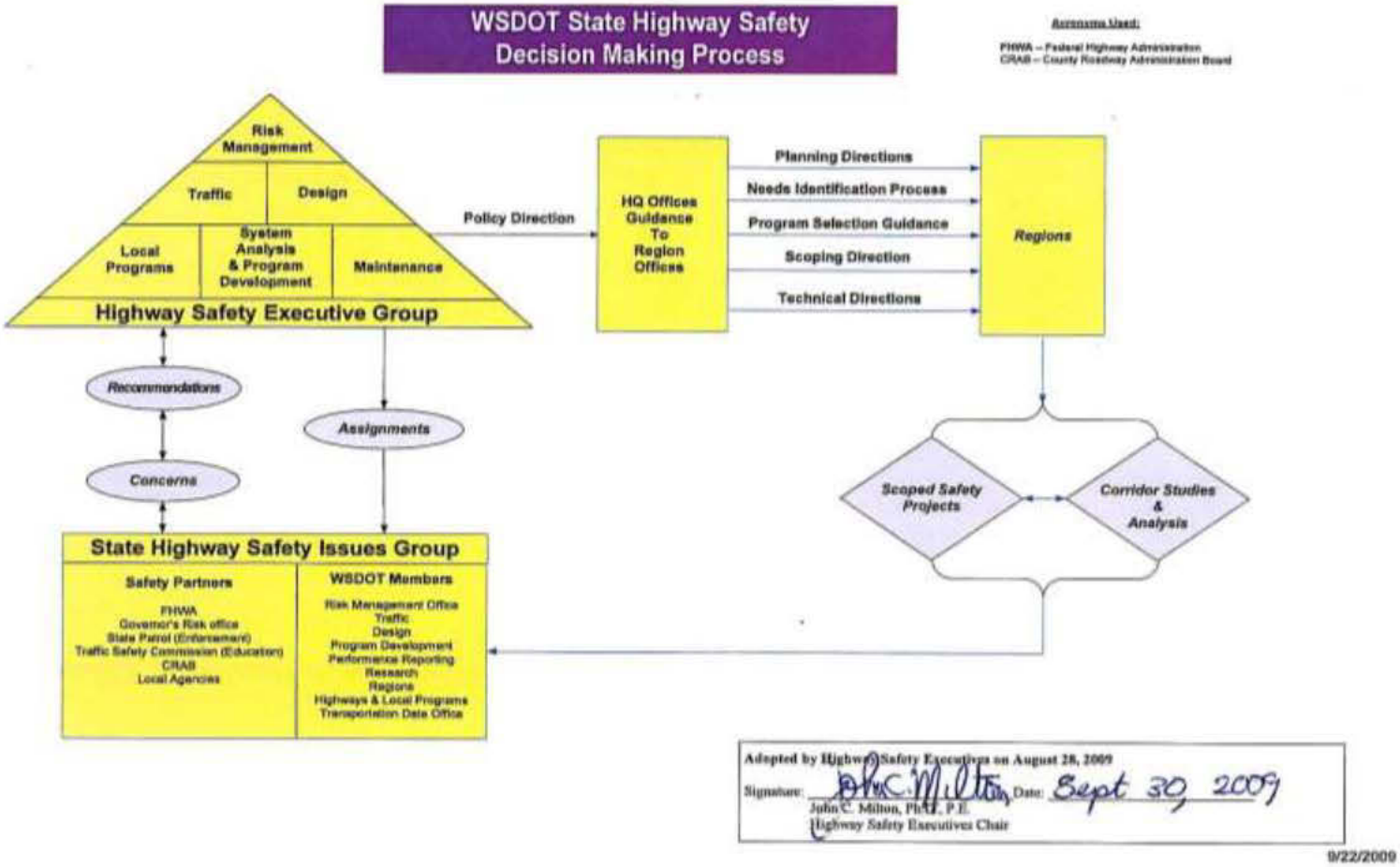
- What risks and costs am I willing to accept to achieve that performance at the location?
- What risks and costs am I willing to accept at that location versus across the network and competing legislative objectives?

Source: Milton and Van Schalkwyk (2012)

Do I need to modify my business processes to achieve my performance goals at acceptable risk levels?

Executive Decision Making

WSDOT executives establish decision making policy for business processes in the safety and other capital programs.



What is Safety?

The goal of safety planning is to save lives and reduce injuries!

Washington State Strategic Highway Safety Plan goal: zero fatalities and serious injuries in 2030

Safety is often **defined** subjectively and is often derived from one's perspective!

If we fail to define safety from a common perspective then planning for safety is not optimized!

Evaluation is an Essential Step in the Planning Process

- In order to be effective at selecting countermeasure options, we need to understand information about the nature of the collisions on highways;
  - What are the contributing factors
  - What are the types of crashes
  - And do so in a quantifiable manner
  - By quantifying these impacts, we could measure the magnitude and contributing circumstances in order to identify **where** the greatest potential for collision reduction in fatal and serious collisions were located.

2010 New Priority Rankings

Priority One Areas for 2010	Percent of Total Deaths, 2006-2008
Impaired Driving	47.7%
Speeding	40.2%
Run off the Road Collisions*	41.8%

*Moved up from Priority Level Two in last edition of Target Zero

2010 New Priority Rankings

Priority Two Areas for 2010	Percent of Total Fatalities 2006-2008
Young Drivers (ages 16-25)*	18.4% (ages 16-20) 20.7% (ages 21-25) Total: 37.9%**
Unrestrained Occupants	29.0%
Distracted Drivers*	29.0%
Intersection Related	20.6%
Traffic Data Systems	n/a

*Moved up from Priority Level Three in last edition of Target Zero

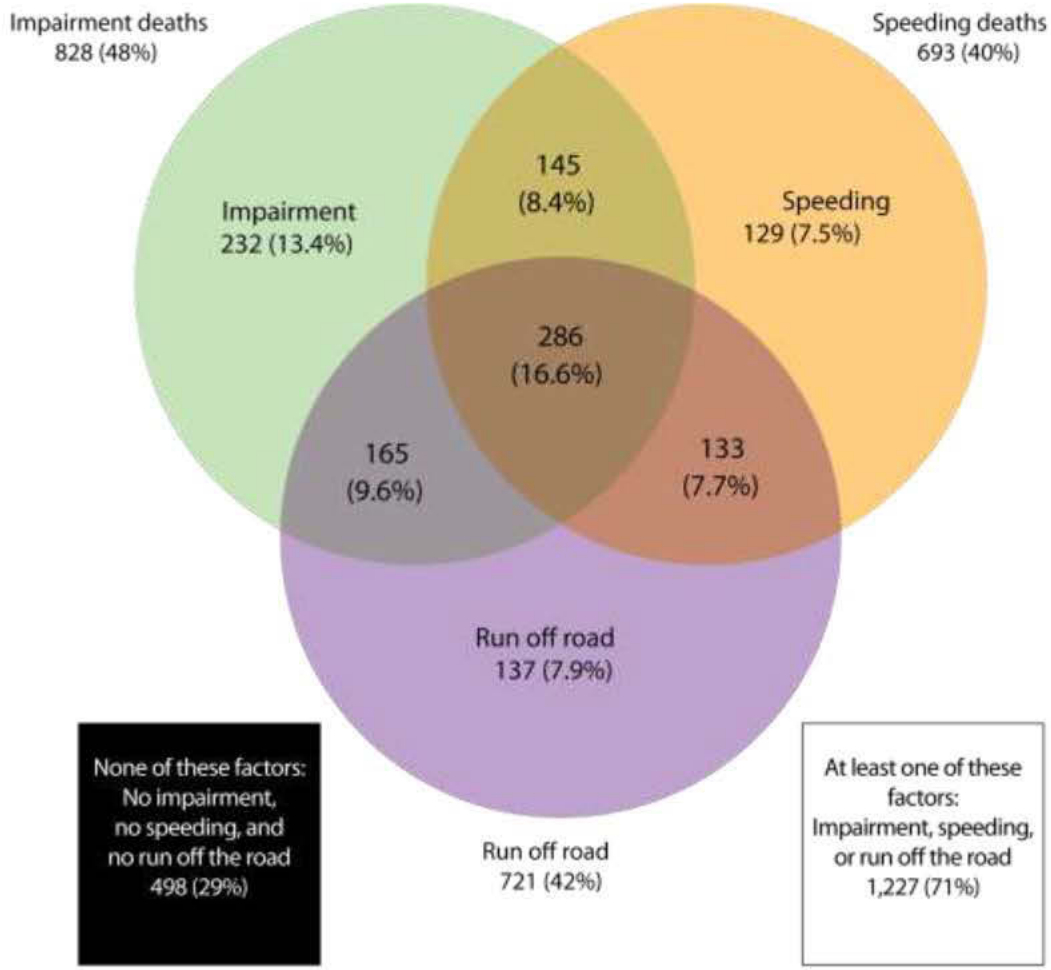
** Percentages do not add up perfectly because some collisions involved drivers from both age groups.

2010 New Priority Rankings

Priority Three Areas for 2010	Percent of Total Deaths 2006-2008
Unlicensed Drivers	20.4%
Opposite Direction Multi-vehicle	18.7%
Motorcyclists	13.0%
Pedestrians	11.5%
Heavy Trucks	11.5%
Emergency Medical Services	n/a

Target Zero Priorities

The role of impairment, speed, and run off the road in 1,725 traffic fatailites in Washington 2006-2008



Data source: FARS and WSDOT.

Note: Percentages in the diagram represent the percentage of all 1,725 fatalities for 2006-2008

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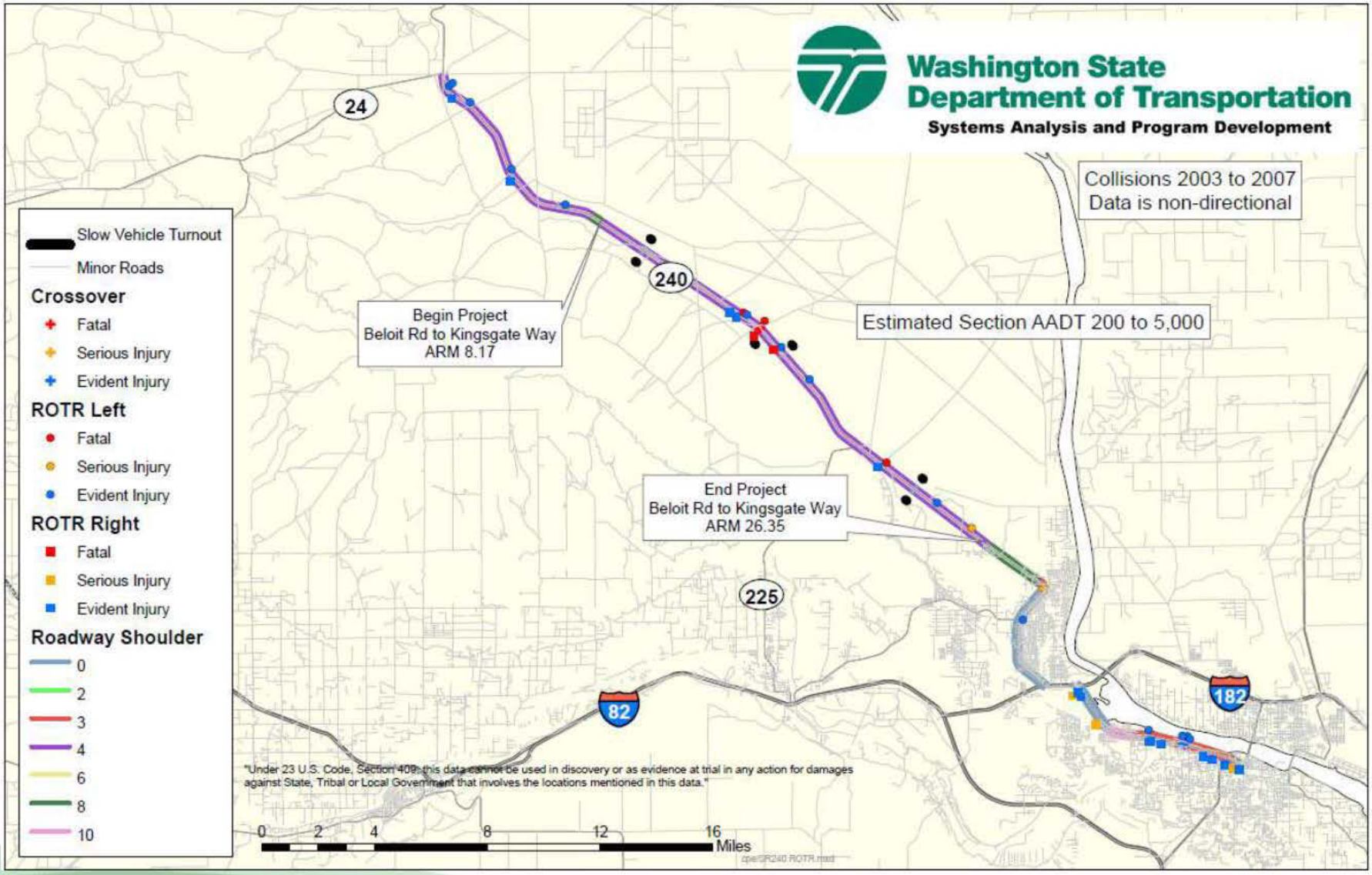
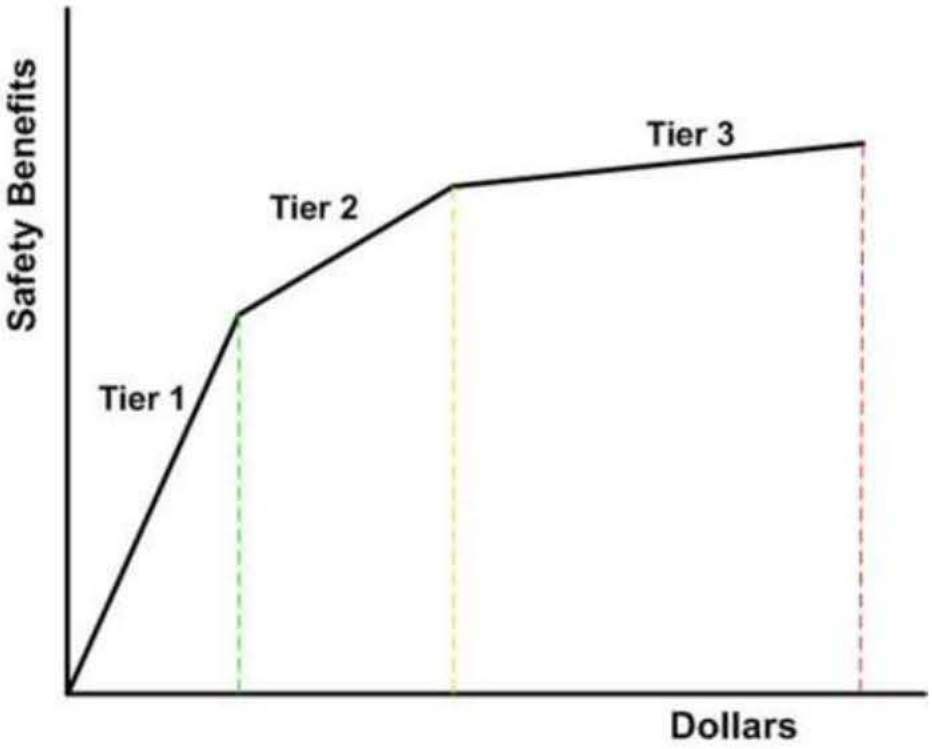
Corridor Analysis for Investment Decision Making



Alternative Evaluation



- Consider options or countermeasures, an expensive, moderate and low cost solution (asset modification) to achieve reduction in fatal and serious crashes

- Complete a root cause analysis (evaluation)
- Solutions need not be infrastructure related (eg the 4 Es) we add one more E (evaluation)
- Tier 3 assumes that the solution will generate benefits over time (20 years typical)
- Due to random nature of crashes, they may or may not occur
- Some locations have a higher likelihood such as interstate/high volume roadways
- Tier 3 solutions generally come at a high cost

Performance Opportunities & Risks

- Planning - $17 m Interchange
  - Some crash history
  - Strong community, business & elected support
- WSDOT scopes 2 additional alternatives
  - Signal/channelization - $2 m
  - Roundabout - $3 m (highest benefit/cost ratio)
  - Moderate community, business & elected support
- What is the best alternative?
  - From a safety perspective the alternative that returns the greatest reduction in crashes.

Performance Opportunities & Risks

- In the past we generally had sufficient funds to address our highest priorities
- Budgets don’t allow for that approach anymore
- Planning to optimize performance allows for:
- WSDOT uses the savings to other locations on its’ network
  - $14M of guardrail infill, pedestrian, ADA enhancements, added intersection improvements and education
- Big gains in performance for small risk

Steps to Optimize Network Performance

- Identify locations below acceptable performance threshold during next 6-10 years
- Evaluate alternatives and assess how quickly they can obtain an increase in performance
  - Achieve performance sooner in lieu over a longer period of time
- Identify the potential risks and costs
- Optimize benefits to the potential risks and cost
- Select an preferred alternative

Pavement Performance

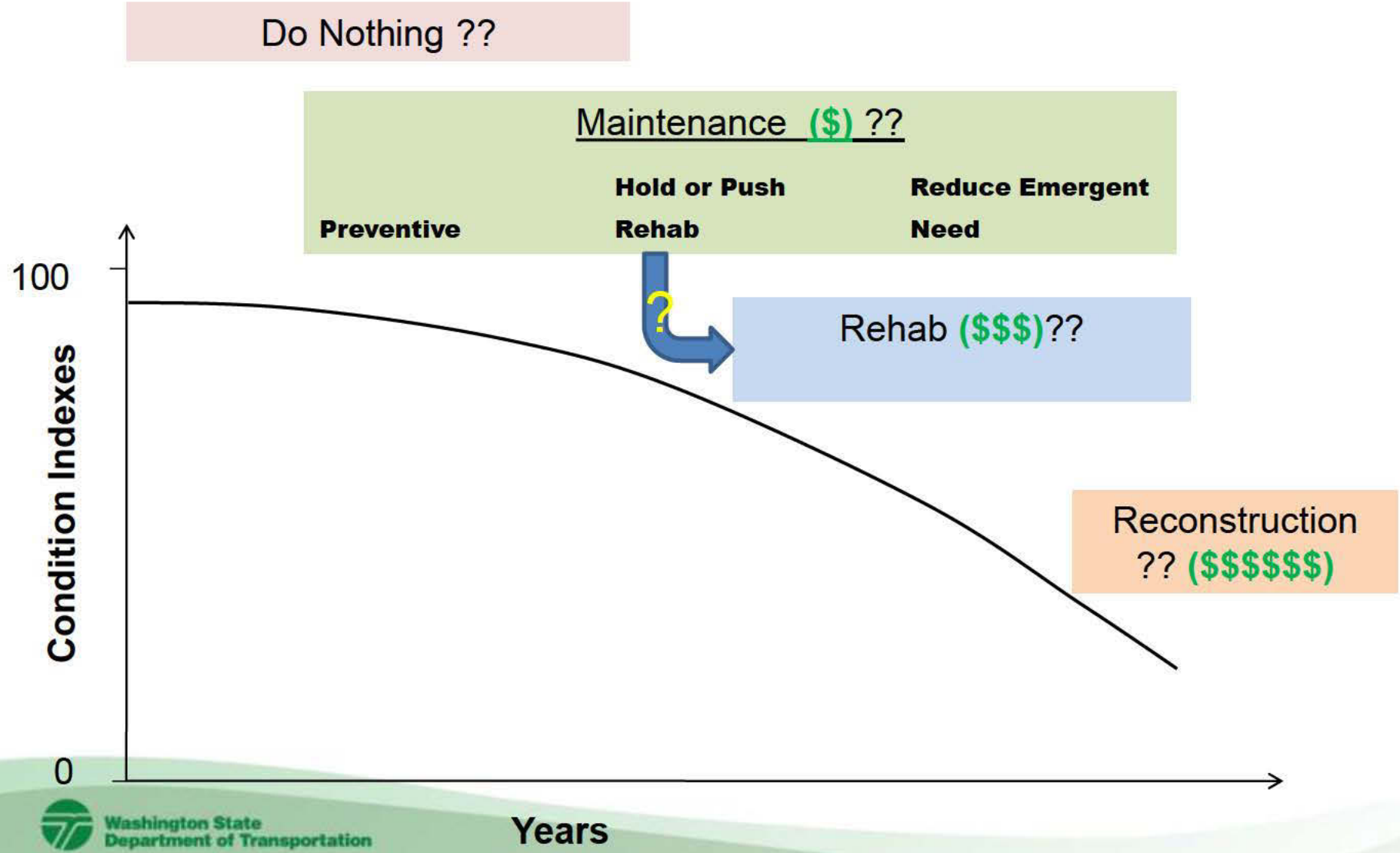
Flexible Pavements

- Minimum Performance Standard
  - Rutting – ½ inch
  - Cracking Index – score of 45 out of 100
  - Ride – 220 inches per mile (lagging indicator)
- Alternative Analysis based on Lowest Life-cycle cost
  - Preventative Maintenance (strategic Crack Sealing)
  - Chip Seals on lower volume and lower truck loadings
- Prioritization
  - 70% of the analysis units within a paving job should be below the minimum performance standard to be included in program proposal

Rigid Pavements

- Minimum Performance Standard
  - Rutting – ½ inch
  - Faulting
  - Cracking
  - Ride – 220 inches per mile
- Alternative Analysis based on Lowest Life-cycle cost
  - Preventative Maintenance to replace isolated panels with significant cracking
  - Grind rutted panels with minimal faulting and rutting
  - Dowel-bar rehab faulted panels & grind
  - Replace concrete roadway that is beyond rehabilitation

Asphalt Pavement Preservation Decisions



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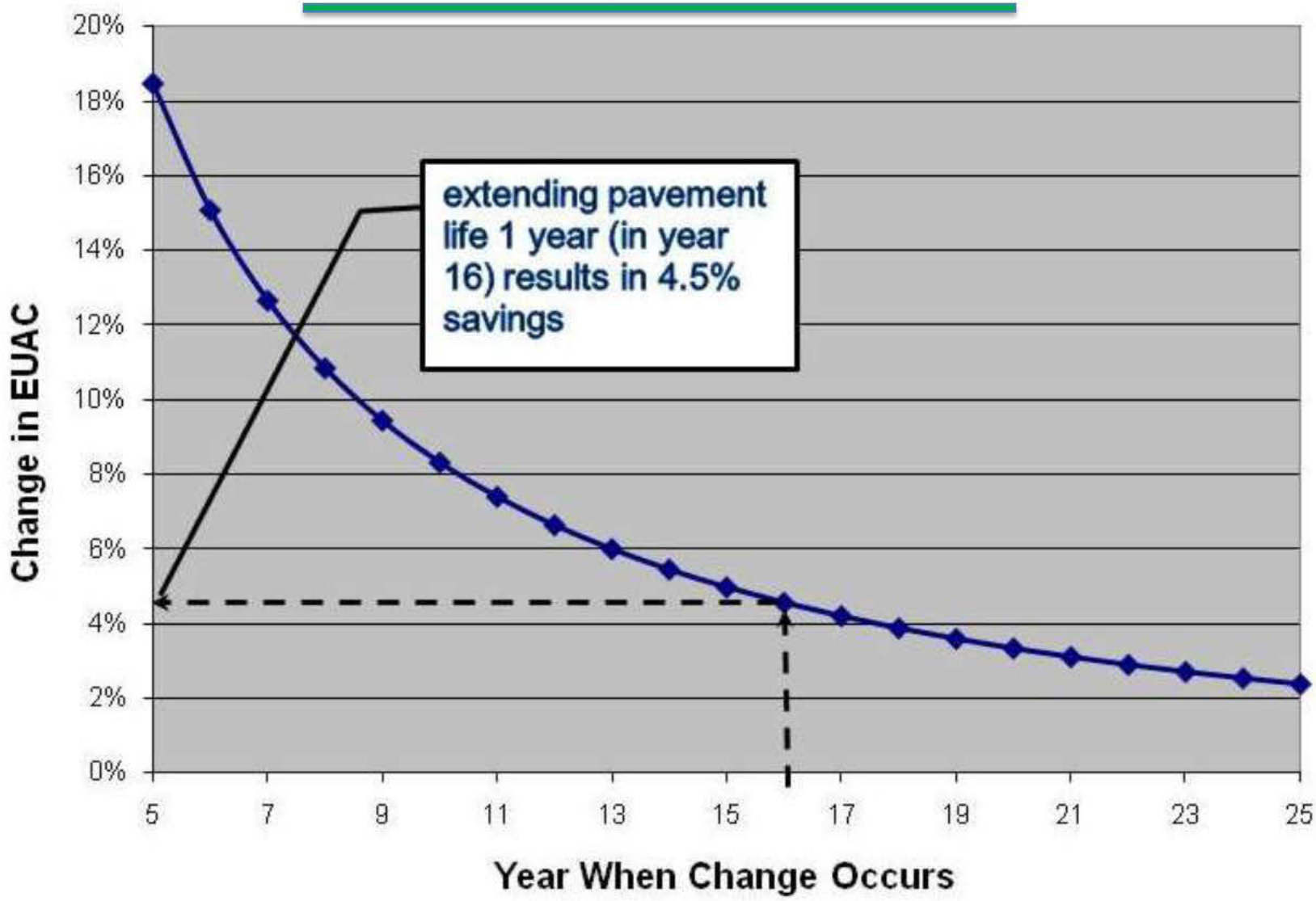
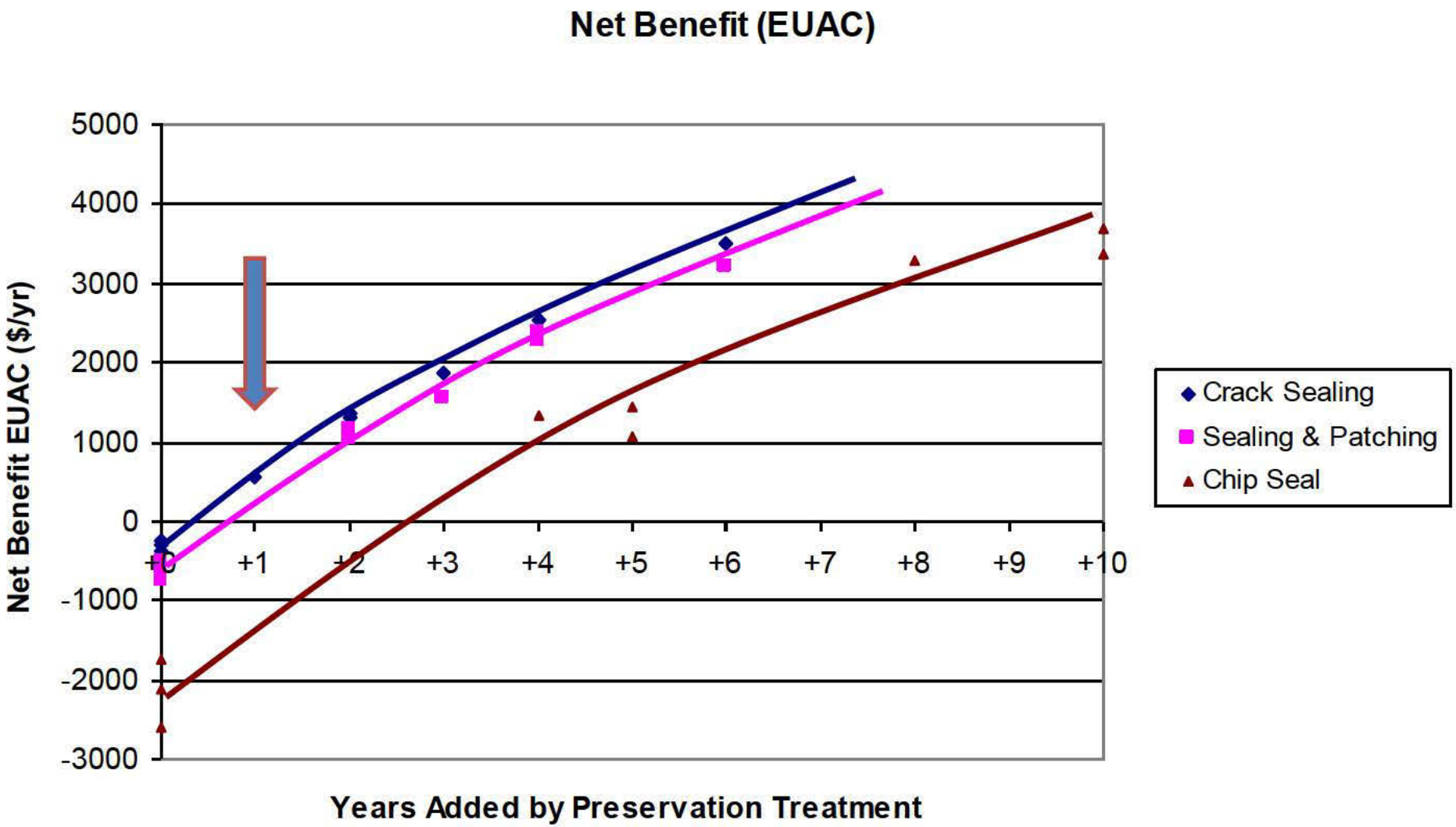
Change in EUAC per Year Change in Pavement Life




Net Benefit (EUAC)
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
Net Benefit EUAC ($/yr)
+0
+1
+2
+3
+4
+5
+6
+7
+8
+9
+10
Years Added by Preservation Treatment
Crack Sealing
Sealing & Patching
Chip Seal

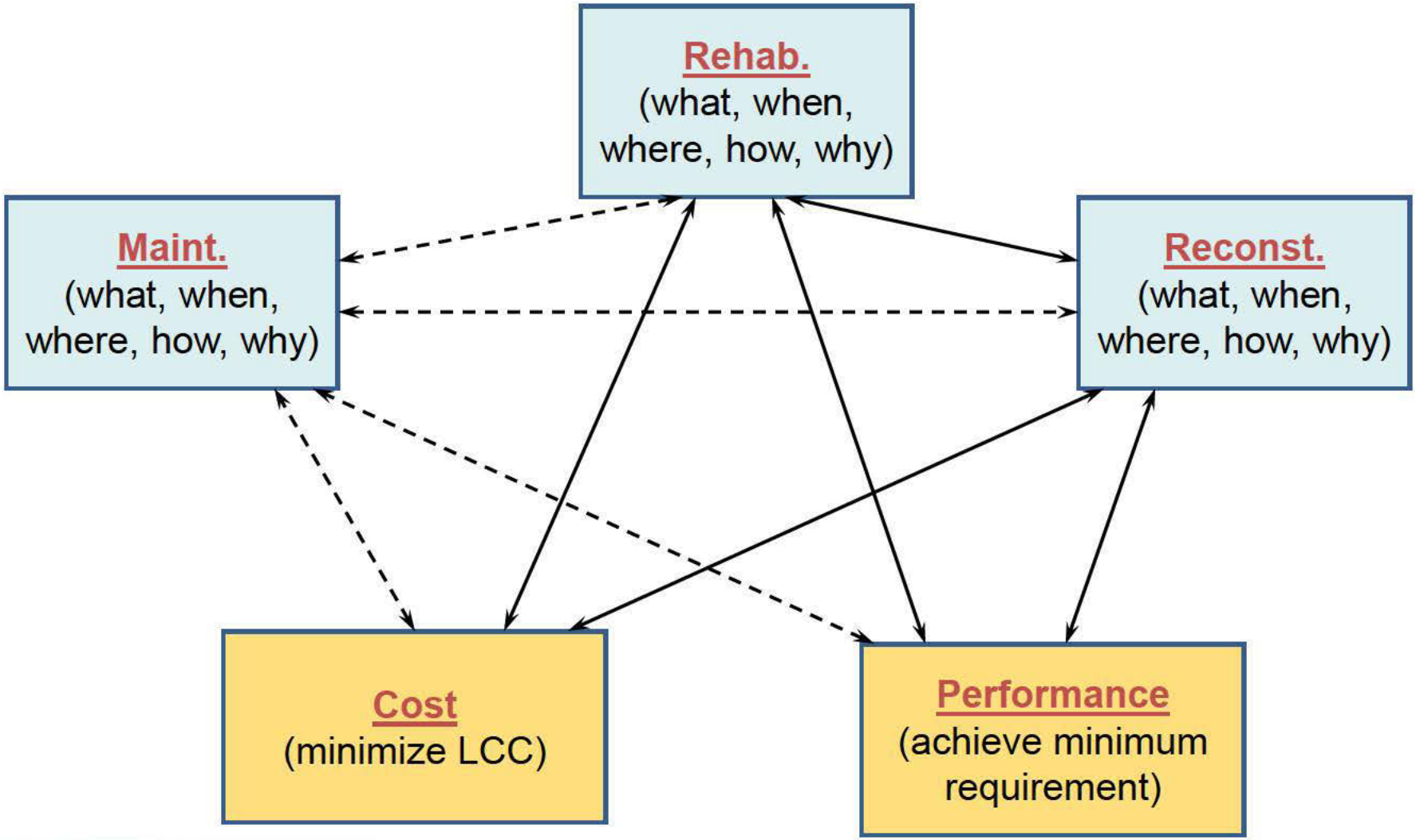
Uses for Economic Performance Methodologies

- Evaluation of Pavement Management
  - How efficiently are pavements performing?
  - Are the most cost-effective decisions being implemented?
- Evaluation of Pavement Design
  - Is pavement structure over designed or under designed?
- Evaluation of Freight Corridors
  - Are freight corridors designed with the most efficient pavements?

Economic Performance Measures

- Historical Cost of Pavement Service
  - EUAC ($ / lane-mile year spent)
    - Equivalent Uniform Annualized Cost
- Expected Cost of Future Pavement Rehab
  - LCCA ($ / lane-mile year gained)
    - Life Cycle Cost Analysis
- ESAL Efficiency
  - Divide EUAC by average ESALs per lane per year
  - $ / ESAL
    - Equivalent Single Axle Loadings

Decisions and Outcomes



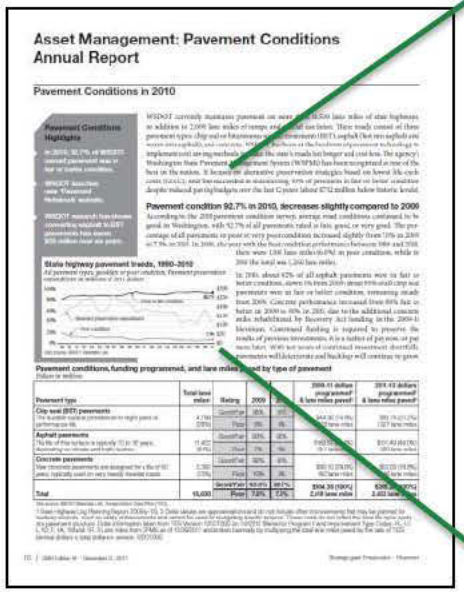
1990-2010: Changes in Pavement Asset Management

Then (1990)	Now (2010)
Worst first	Lowest life cycle cost
Allocation funding	Need based funding
WSPMS as sideline	WSPMS as key decision making tool
Hveem mix design protocol	Superpave mix design
Volumetrics in the lab	Volumetrics in the field
Concrete Total Replacement	Dowel bar retrofit
Dowel bar retrofit	Triage protocol
Thick overlays (>2"+)	P-1 protocol (2" overlays for all HMA)
No westside BST	All west side regions doing BST
BST only if ADT <2000 ADT	BST on all routes under 5,000 ADT and consideration for rtes between 5,000-10,000
No RAP	Consuming all the RAP produced in the state
No RAS	Test project with RAS
No clear pavement selection	Pavement Type Selection Protocol
No dowel bar selection	Dowel Bar Selection Protocol

Telling the story

Pavement:

Innovations to lower costs, preserve life


Asset Management: Pavement Conditions Annual Report

Pavement Conditions in 2010

Pavement Conditions Highlights

Pavement condition 92.7% in 2010, decreases slightly compared to 2009

State highway pavement trends, 1990–2010

Pavement conditions, funding programmed, and lane miles paved by type of pavement

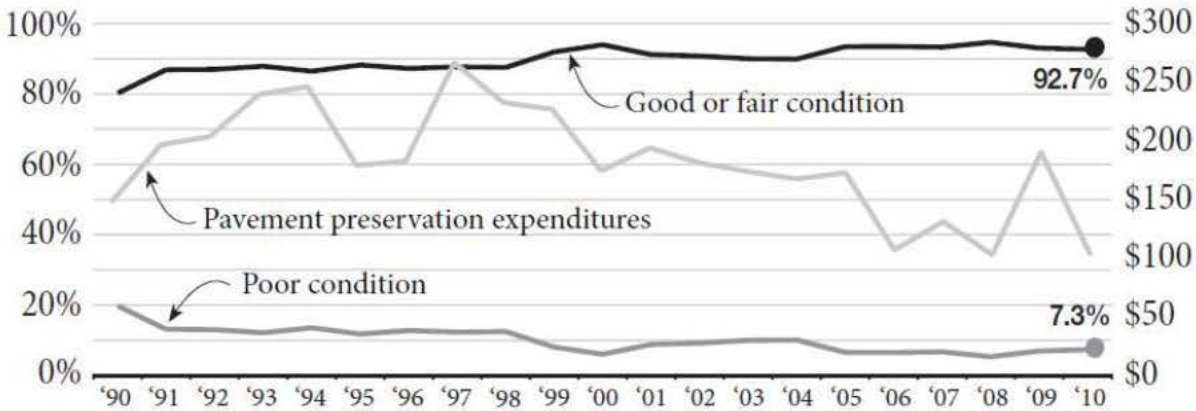
WSDOT's pavement technology innovations help offset declining investments

WSDOT uses pavement technology to make the state's roads last longer and cost less. Efficiencies include:

- Dowel bar retrofits on concrete pavements
- Selective panel replacement and diamond grinding on concrete pavements
- Converting higher cost asphalt pavements to lower cost chip seal pavements ($151 million saved as of December 2011)

State highway pavement trends, 1990–2010

All pavement types; good/fair or poor condition; Pavement preservation expenditures in millions of 2011 dollars



Data source: WSDOT Materials Lab.

Washington State Department of Transportation

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Questions?

For additional information on Flexible Design at WSDOT, please contact:

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