WSDOT Pavement Preservation Performance

Jianhua Li, PhD PE

2014 NWPMA Conference

FHWA Pavement Preservation Definition

- **Pavement Preservation** is “a program employing a network level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety and meet motorist expectations.”
- **An effective pavement preservation** is to address pavements while they are still in good condition and before the onset of serious damage.
- The **goal** is to postpone costly rehabilitation and reconstruction, without significant enhancement on structural strength or traffic load capacity.

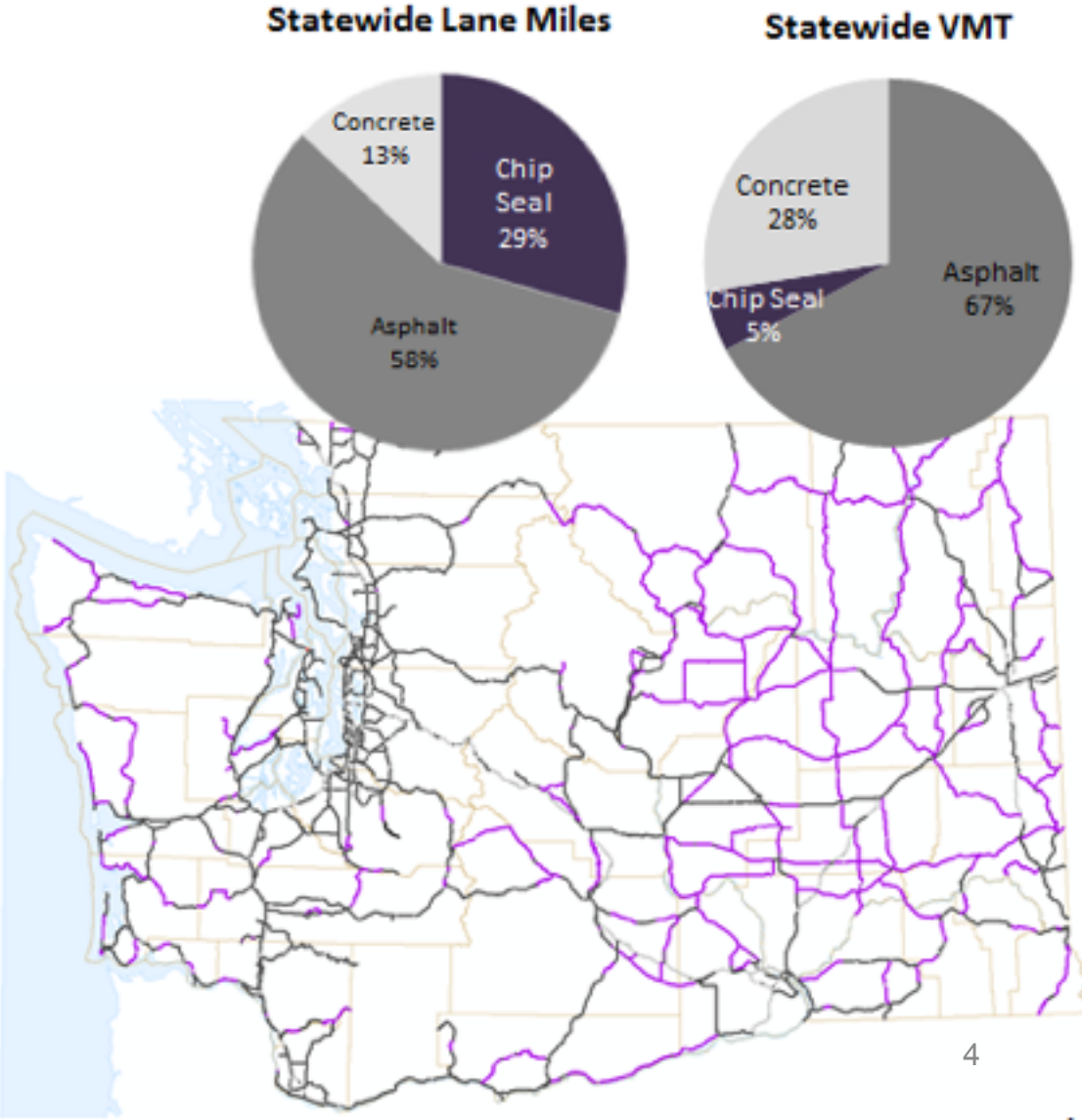
Source: http://www.fhwa.dot.gov/pavement/preservation

OUTLINE

- Background
- Long-term Monitoring of WSDOT Pavement Performance
- WSDOT Pavement Maintenance – *Lowering costs by extending pavement life*
- Maintenance Research Project
- Conclusions

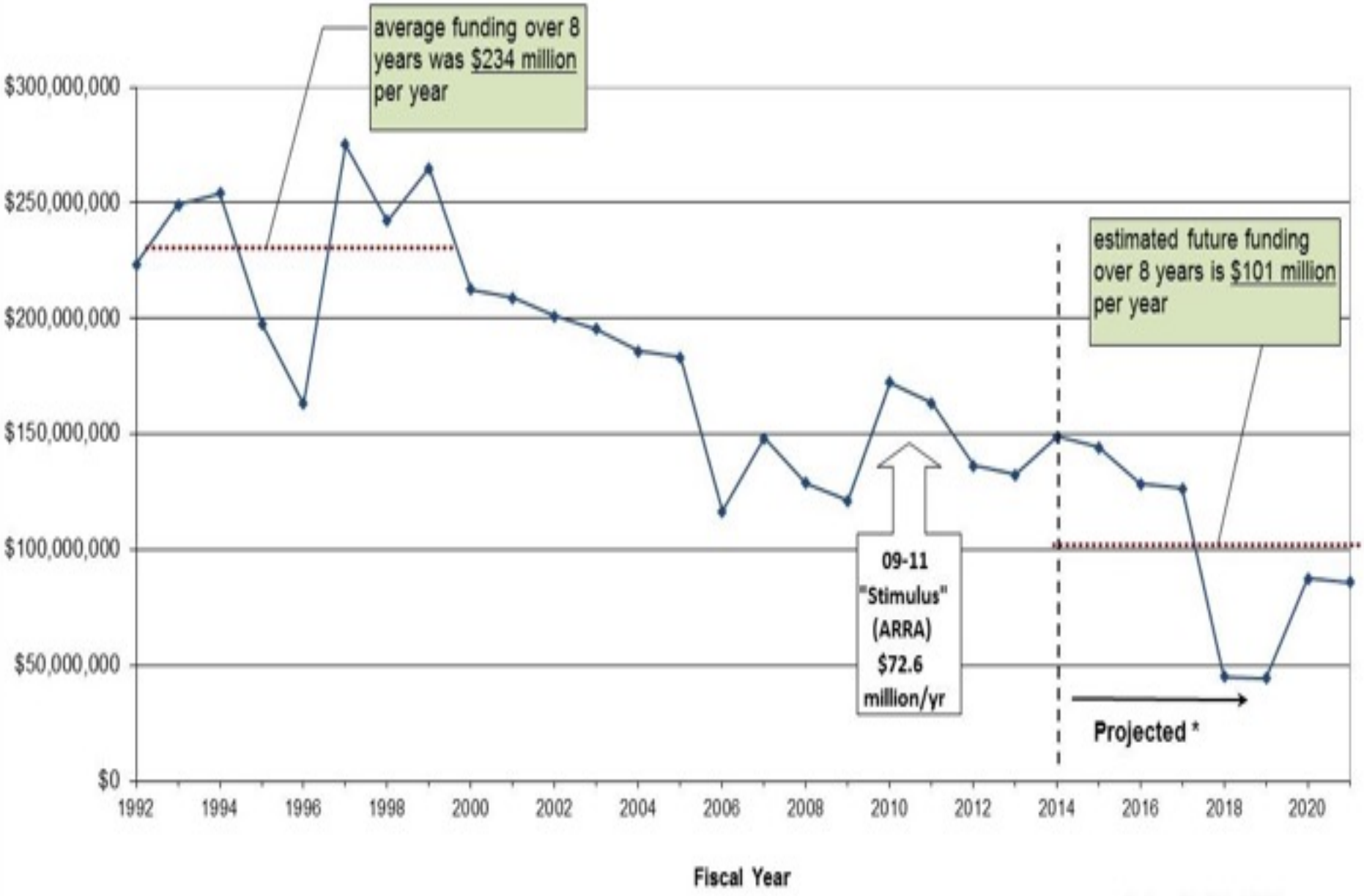
The Pavement Management Perspective

- 18,500 lane-miles
- Wide variety of conditi
- Preservation options
- Inadequate funding



Washington State Department of Transportation

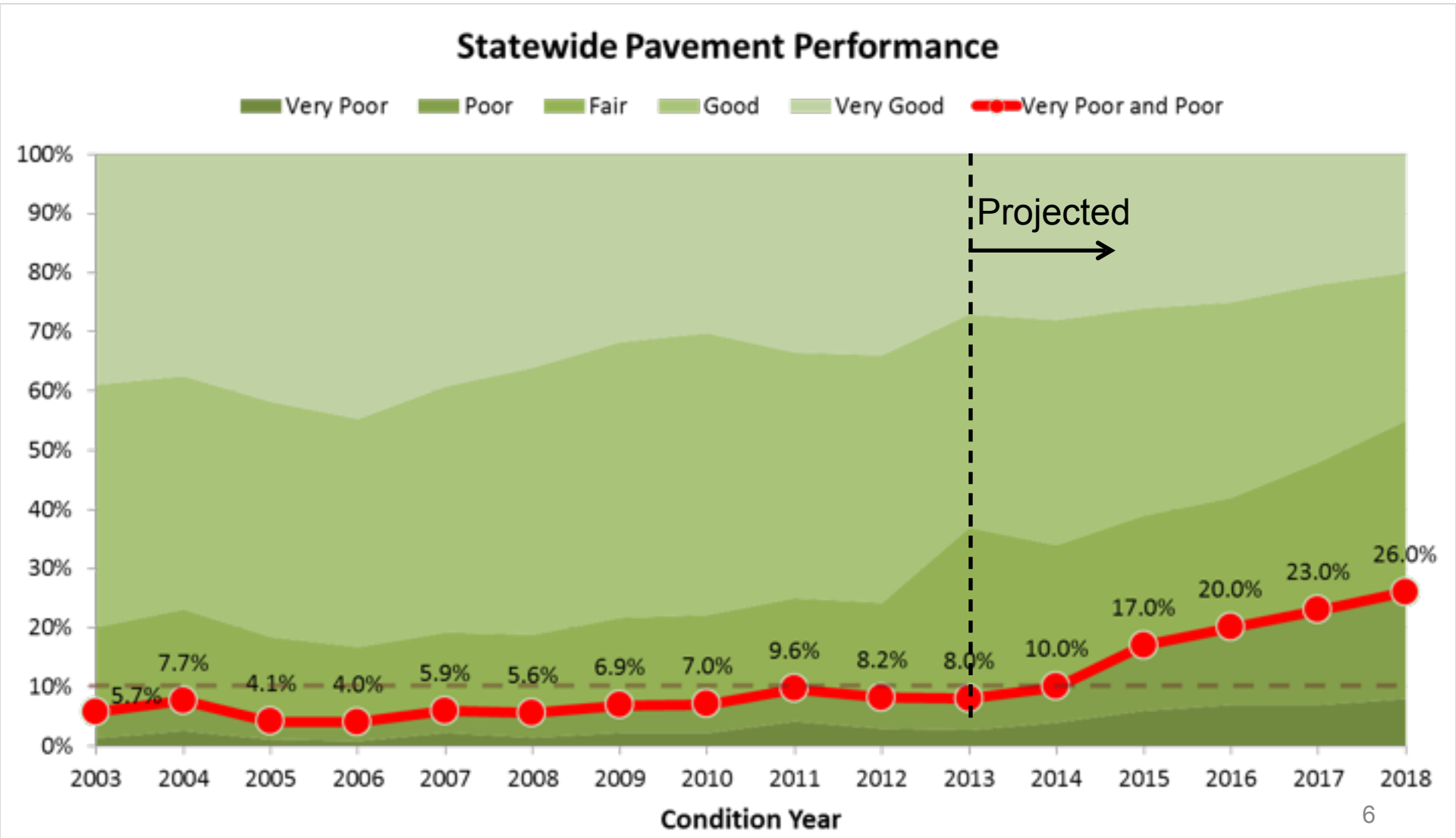
30-year Annual Pavement Funding



* As of Feb. 2014

Pavement Condition

When developed in 2001, WSDOT's goal was 0% in Poor condition.



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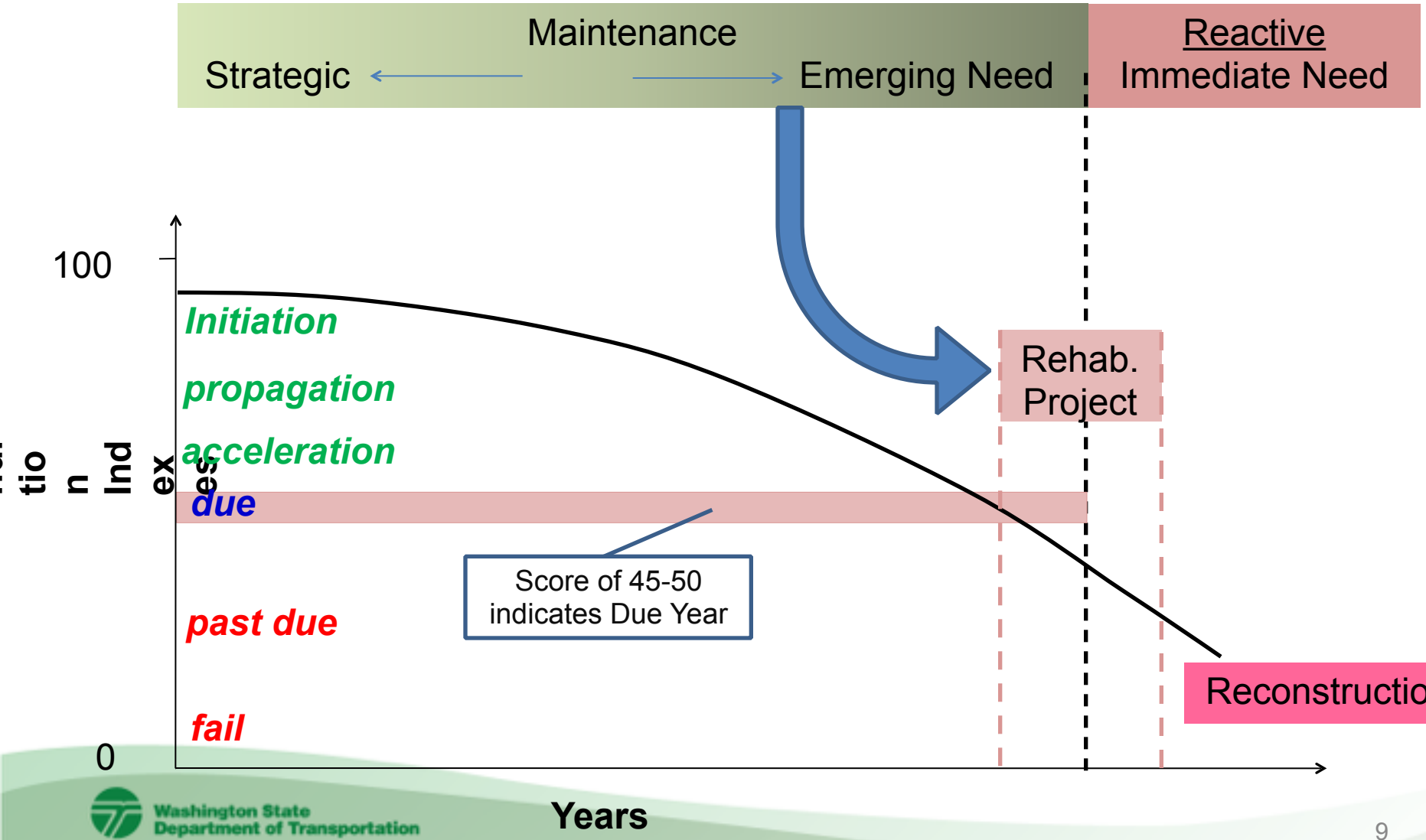
Monitoring Pavement Performance

- Washington State Pavement Management System (WSPMS)
- WSDOT Pavement Condition Index
  - Pavement Structural Condition (PSC)
  - Pavement Profile Condition (PPC)
  - Pavement Rutting Condition (PRC)
- Piecewise Approximation
  - Initiation, propagation, acceleration, due, past due, and fail

Integrated Pavement Preservation Plan



Definitions

Lower the lifecycle cost of the entire program and use the monies generated to extend the agencies reach within the program

1. **Maintenance** (planned, to delay Capital Projects)
   - **Strategic** performed early in pavement life

     Done early in the pavement life cycle up to 2 years prior to a capital project
   - **Emergent** reduce need to perform reactive repair

     Focuses on pavement that are predicted to fail in the next several months to a year if work is not done

2. **Reactive** – (unplanned, for immediate needs)

   Restores the roadway to a serviceable condition

Strategic Repair – early crack seal

Strategic Repair – Fog Seal

Emerging Repair– crack seal, patching

Emerging Repair – chip seal rut fill

Completed product

Used available aggregate, closer to **5/8”** than normal 3/8"

Reactive – full depth failure

Reactive Repair – 6” grind and rebuild in wheel path

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WSDOT Maintenance Treatments

Pavement Type	Maintenance Treatment	Unit Cost ($/ length)	Life Extension (years)
ACP	Crack sealing	$0.9 to1.2 / foot	1 to 3
	Patching	$5 to 10 / square yard	1 to 5
PCCP, un-doweled JPCP	Crack sealing	$1 to 2 / foot	1 to 4
	Joint sealing	$1.25 to 2.5 / foot	4 to 7
	Grinding	$125,000 / lane-mile	10 to 20
	Slab replacement	$10,000 to 20,000 / slab	5 to 20
	Dowel bar retrofit	$700,000 / lane-mile	10 to 20
Chip seal	Crack sealing	$0.9 to 1.2 / foot	1 to 2
	Patching	$3.5 to 4 / square yard	1 to 3

WSDOT Maintenance Timing - ACP

Condition Zones	Pavement Condition Index	Maintenance Treatment	Risk of Structure Failure	Life Extension (yrs)
Initiation	95~100	-	None	-
Propagation	80~95	Crack sealing with or without patching, partial chip seal overlay	None	1~3
Acceleration	50~80	Crack sealing with more patching, partial chip seal overlay, partial HMA overlay	Low	3~5
Due	45 to 55	Aggressive sealing and patching, partial HMA overlay	Moderate	0~2
Past Due	20~45	Partial HMA overlay, patching	High	0~1
Fail	0~20	Not recommended	Extreme	-

Equivalent Uniform Annual Cost (EUAC)

$$\mathrm{EUAC} = \frac{\mathrm{NPV} * i}{1 - 1/(1+i)^{\mathrm{n}}}$$

Where,

NPV Net present value

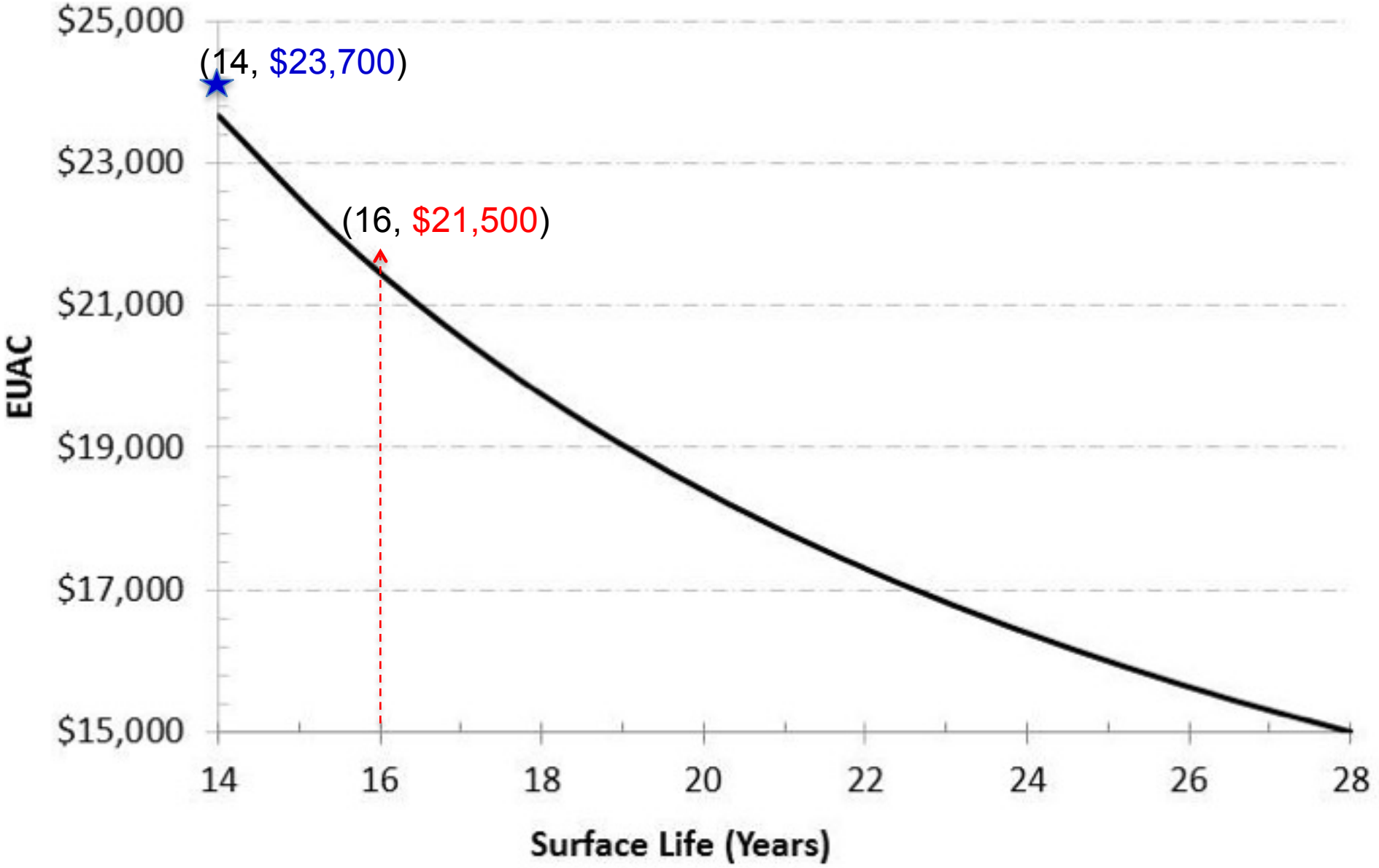
$$\mathrm{NPV} = \mathrm{Rehab.\,Cost} + \frac{\mathrm{Maint.\,Cost}}{(1+i)^{k}}$$

i Discount rate, assuming *4%*;

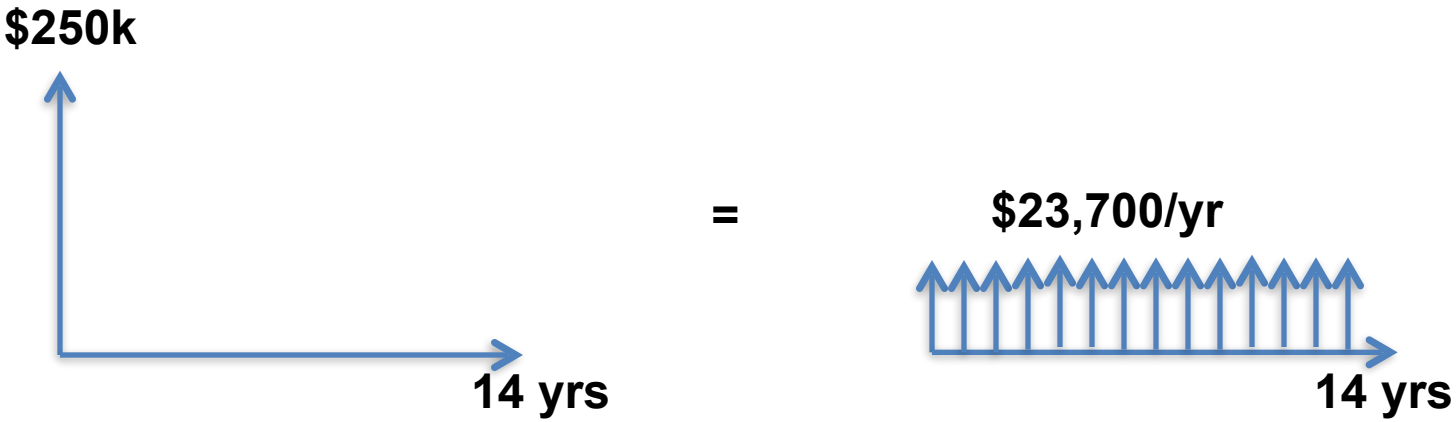
n Service life of the rehabilitation and maintenance, in years;

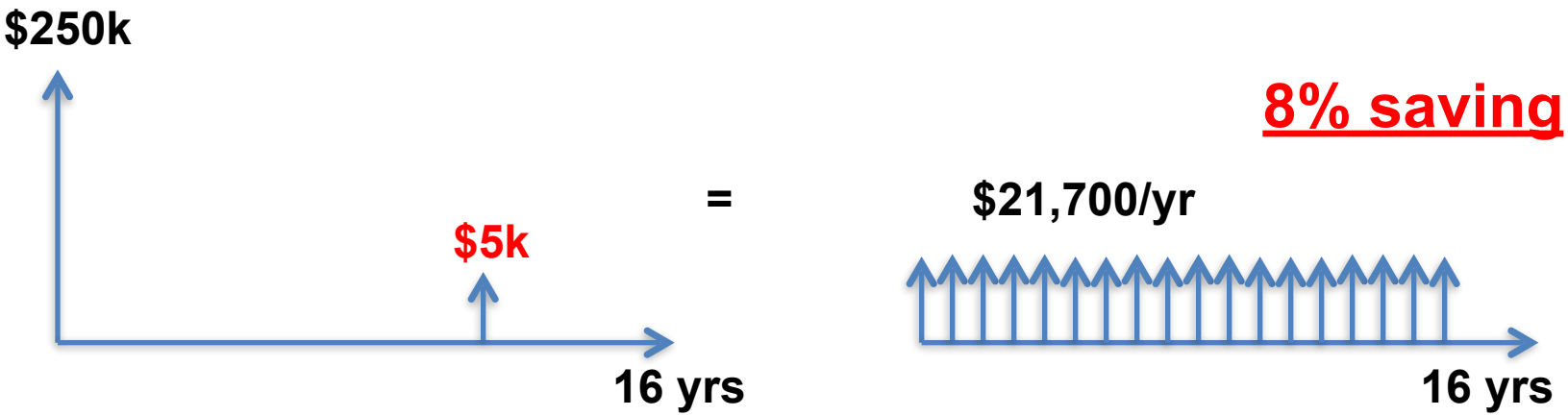
k Year that maintenance will be performed.

EUAC vs. Surface Life



EUAC Benefit

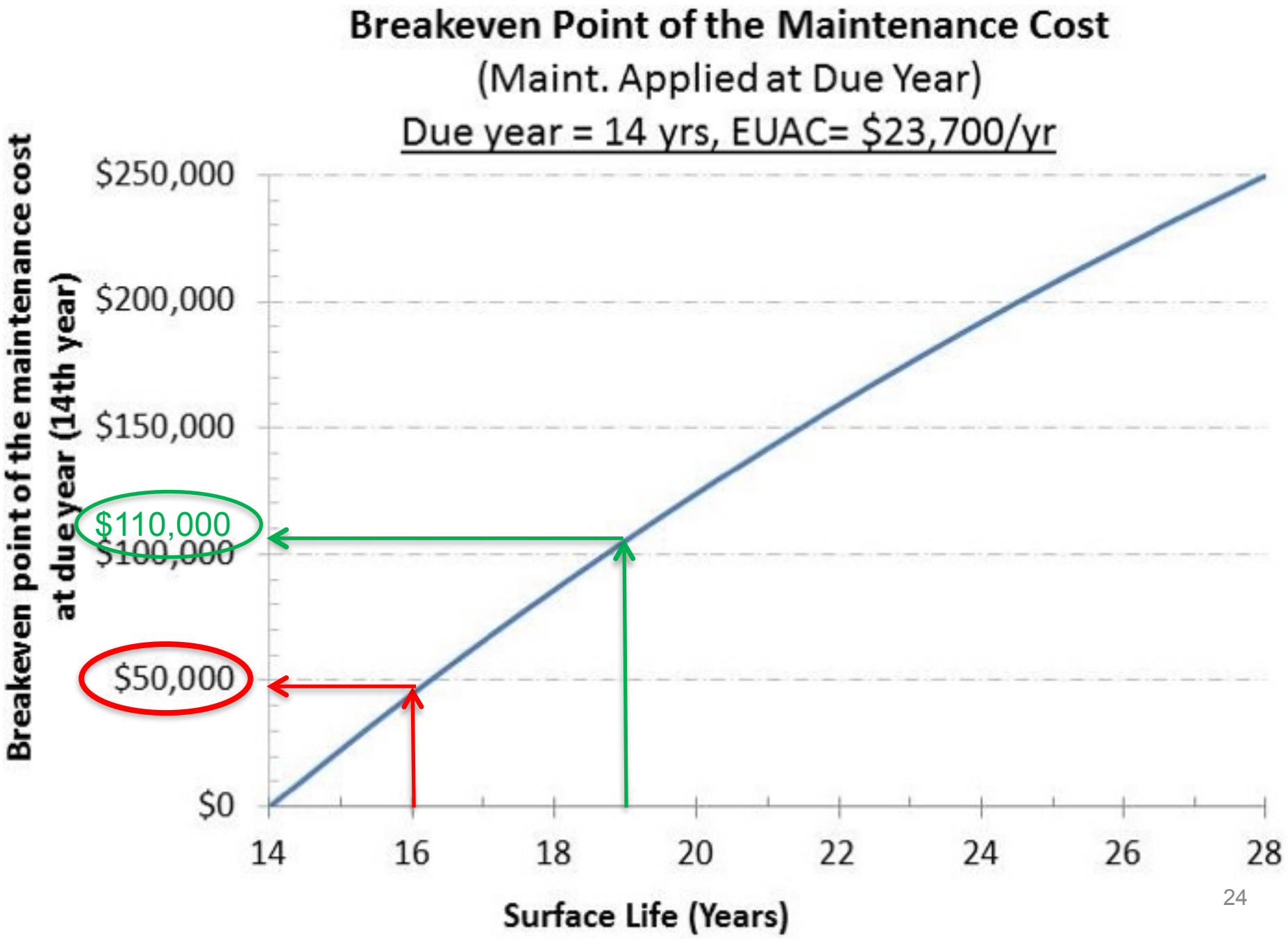




8% saving

EUAC of WSDOT Treatments

Treatment	Added Life *(Years)*	Typical Construction Cost	EUAC *($/lm/yr)*
Asphalt Maintenance	2	$5,000	$2,650
Asphalt Rehab	14	$250,000	$24,000
Chip Seal Rehab	7	$45,000	$7,500
Concrete Grind	10	$125,000	$15,000
Concrete Dowel Bar Retrofit	15	$700,000	$63,000
Concrete Reconstruction	50	$2,500,000	$116,000


Breakeven Point of the Maintenance Cost
(Maint. Applied at Due Year)
Due year = 14 yrs, EUAC= $23,700/yr
Breakeven point of the maintenance cost at due year (14th year)
$250,000
$200,000
$150,000
$110,000
$100,000
$50,000
$0
14
16
18
20
22
24
26
28
Surface Life (Years)

WSDOT Planned Maintenance Cost – ACP, Chip Seal

FY	Lane-miles	Total Cost ($)	Avg. Unit Cost ($/lane-mile)	Regions' Estimated Avg. Life Extension (Years)
2009-11	*599*	*2,103,000*	*3,500*	*3.1*
2011-13	1,068	3,819,000	3,600	2.6

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Study Objective

Investigate the effects of different pavement maintenance treatments on various levels of pavement condition to determine the longevity and cost effectiveness of the treatments.

(What's the best bang for the buck.)

Maintenance Research Project

It is very difficult to definitively quantify effect of maintenance treatments:

- Variability in condition survey data
- Natural variability in pavement structures
- Difficult to control maintenance experiments
- Many confounding factors that affect performance (and complicate experiments)
- Typically maintenance and rehabilitation data are not integrated or collected systematically

Simplified Research Approach

- Limited number of treatment types
- Modify treatments in segments (about ¼ mile) on same test section
- Repeat at different geographic areas
- Document and monitor
  - previous condition
  - treatment methods and materials
  - cost
  - Performance – extension of pavement life

Test Site Make-Up

Treatments	Strategic	Emerging	Reactive
Crack seal only	*4*	*0*	*1*
Chip seal only	*3*	*0*	*1*
Patching only	*8*	*3*	*0*
Wheel path chip seal	*3*	*0*	*0*
Crack seal & chip seal	*0*	*0*	*1*
Patching & chip seal	*2*	*0*	*4*
Patching & crack seal	*1*	*1*	*2*
Mill & fill	*1*	*1*	*0*
Ultra-thin overlay	*1*	*0*	*0*
Do nothing (control)	*0*	*1*	*3*
Total	*23*	*6*	*12*


DIGOUTS
CHIP SEAL
DIGOUTS

Crack sealed site after 1 year.

Crack sealed site after 2 years.

Chip seal after 1 year.

Chip seal after 2 years.

Patching after 1 year.

Patching and chip seal after 1 year.

Patching and chip seal after 2 years.

Wheel path chip seal after 1 year.

Observations

- Crack sealing only appears to be effective in preventing further crack growth, however, it is impossible to fill all of the cracks.
- Patching only was very effective because they remove the failed pavement, however, areas beyond the patches continue to deteriorate.
- Chip sealing only was very effective, however, existing wider cracks will reflect through the chip seal.
- Wheel path chip seal was effective on pavements in good condition (preventive), but did not prevent wider cracks from reflecting through the chip seal.

Observations

- Crack sealing plus patching was successful to the extent that all of the cracks between the patches were filled.
- Crack sealing followed by chip seal was successful, but more test sites are needed to drawn any firm conclusions.
- Patching followed by chip seal was not completely effective due to the poor condition of the unpatched areas.

Continued Test Sites

- More test sites of any type.
- More chip seal only sites (wheel path and full lane).
- Chip seal followed by a crack sealing after a year or two.
- No treatment control sections are desired, but not mandatory.

Conclusions

- The continued under-funding of pavement rehabilitation is generating large backlogs of projects.
- Applying maintenance treatments early is far more effective than applying it in poor pavement condition.
- The plan of rehabilitation with well-timed maintenance is more cost effective.
- The EUAC and breakeven point analysis are used to compare different pavement strategies.
- The analysis of WSPMS performance data provides a quantitative understanding of the WSDOT pavement network.

Jianhua Li
WSDOT Materials Lab
Email: lijia@wsdot.wa.gov