Integrating Pavement Preservation into StreetSaver®

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StreetSaver®
Keeping good roads good!

Outline

- Introduction to Pavement Preservation
- Preventive Maintenance
- Benefits
- Implementation of Pavement Preservation in StreetSaver®
- Appropriate treatments
- Use of Life Cycle Cost Analysis

Pavement Preservation Definition

- AASHTO/FHWA

- "A program employing a network level, long-term strategy that enhances functional pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety, and meet motorist expectations."

Pavement Preservation Concepts

- Apply:
  - the right treatment
  - to the right pavement
  - at the right time
- Focuses on preventive maintenance
  - Dedicate funds to preventive maintenance
- Can include minor rehabilitation
- Retard development of structural deterioration

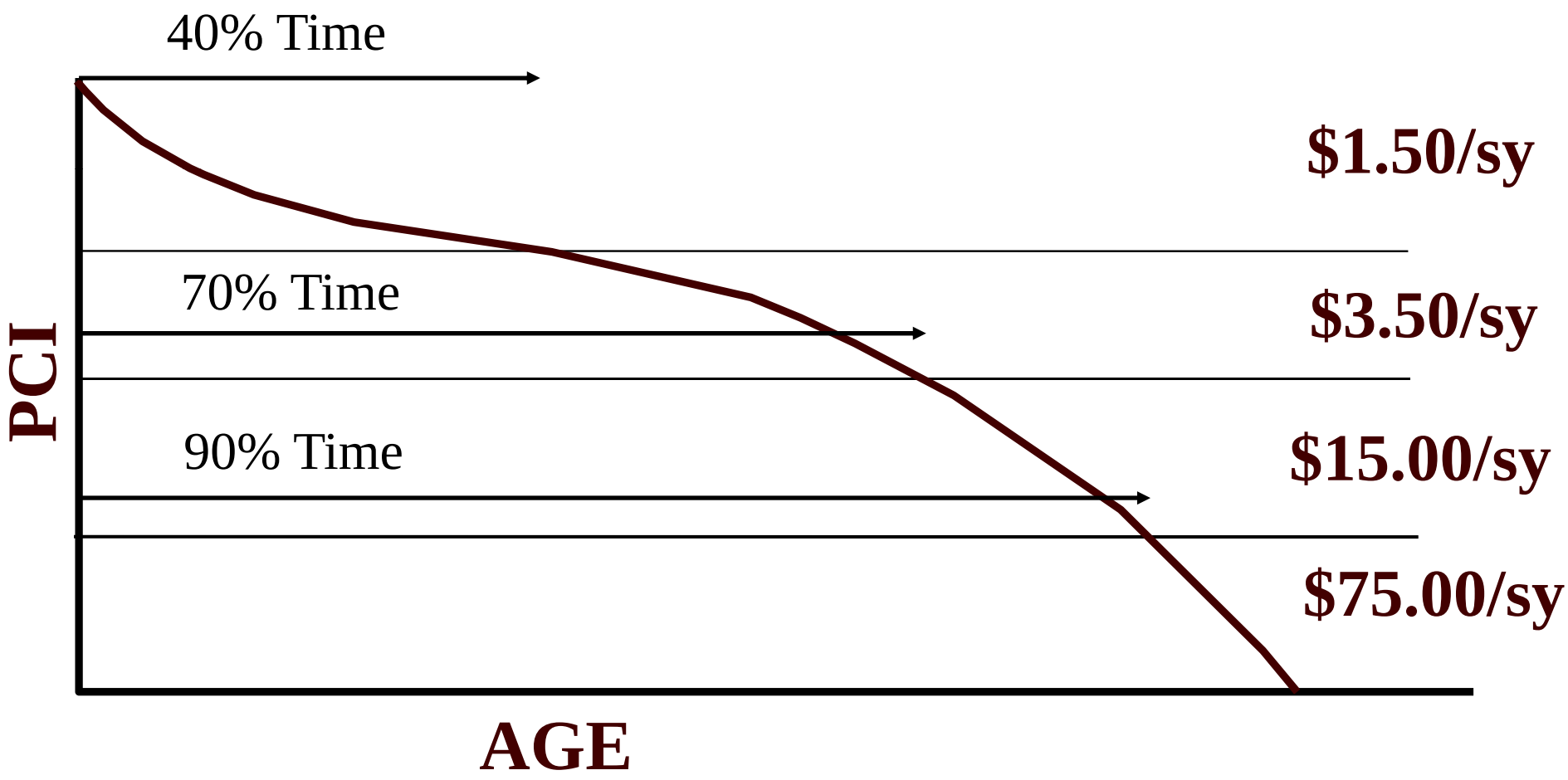
Preventive Maintenance

- Treatments applied to:
  - Preserve the existing structure
  - Retard deterioration
- Primarily prevent environmental caused deterioration
- PM Treatments
  - Applied before major structural damage
  - Relatively inexpensive
  - Results are long term

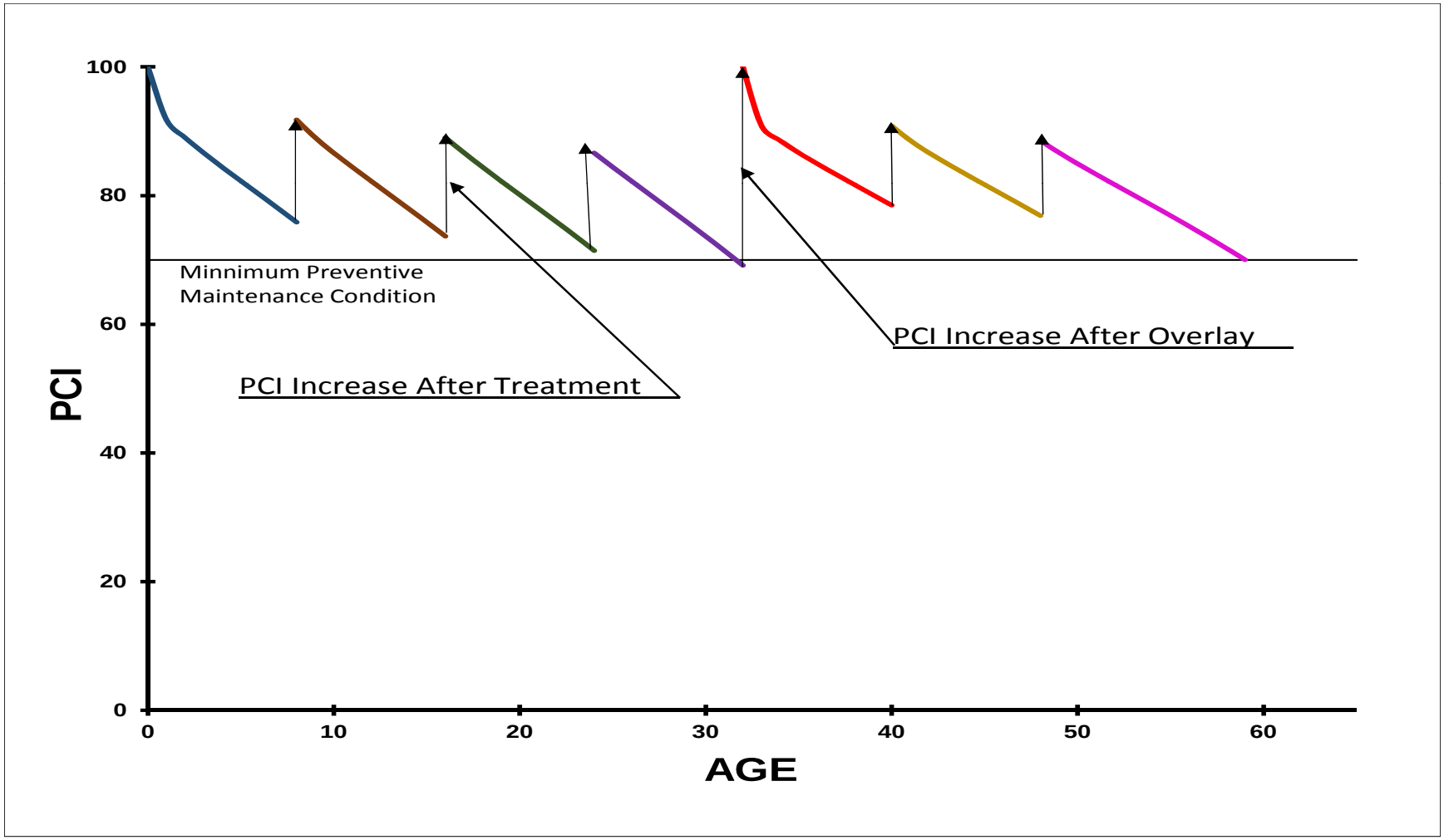
Common PM Treatments

- Crack/joint seals
- Chip seals
- Slurry seals
- Micro-surfacing
- Thin HMAC overlays
- Diamond grinding
- Dowel-bar retrofit

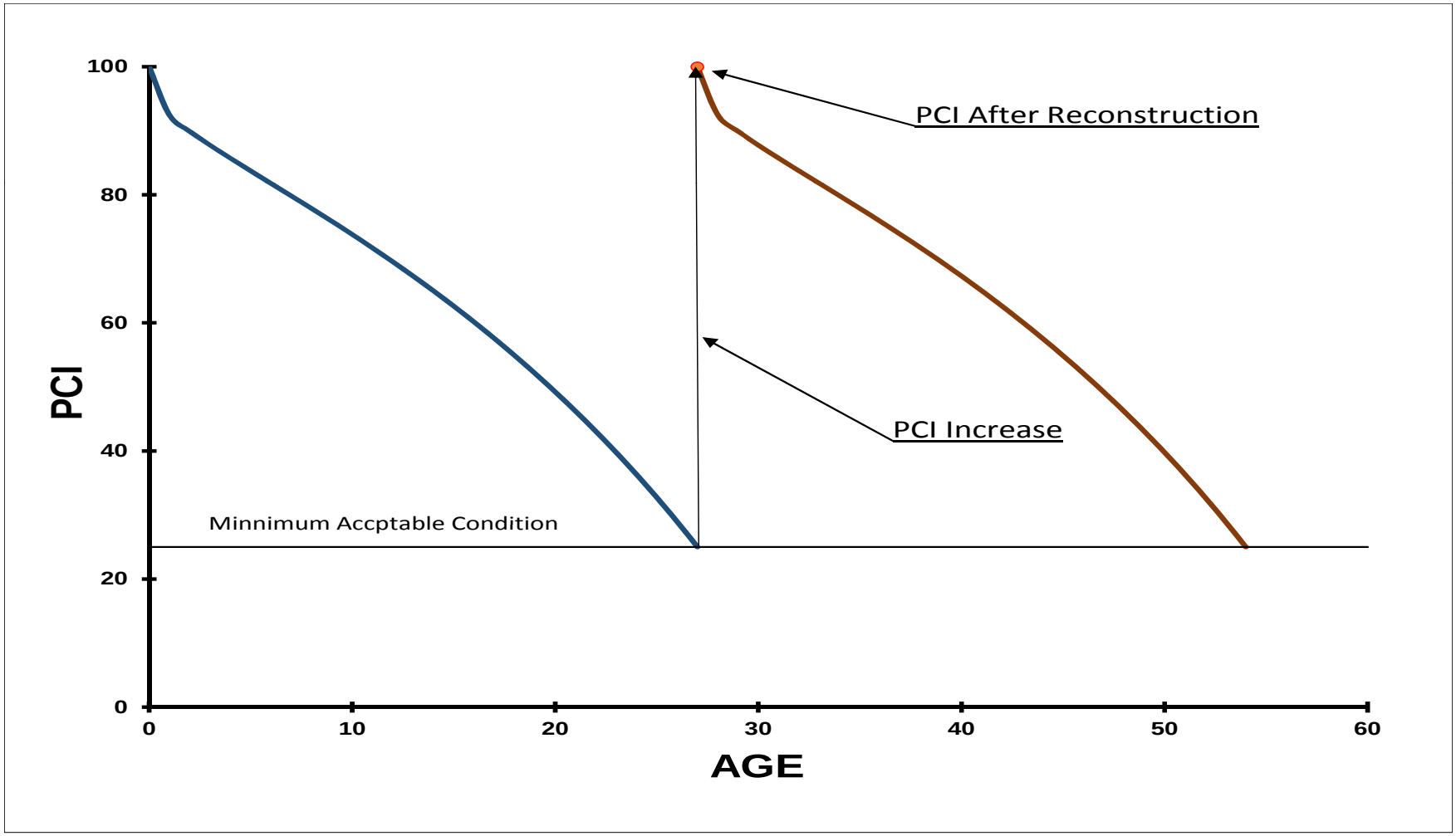
Pay Me Now or Pay Me Later



Preservation Approach



Build It, Let It Fail, Reconstruct It



Pay Me Now

- 3 Seal Coats at $ 4.50 /sy - ~32 yrs
- 1 Overlay Plus Mill at $ 6.50 /sy - ~8 yrs
- 2 Seal Coats at $ 3.00 /sy - ~19 yrs

- Total $14.00 /sy for ~59 yrs

Pay Me Later

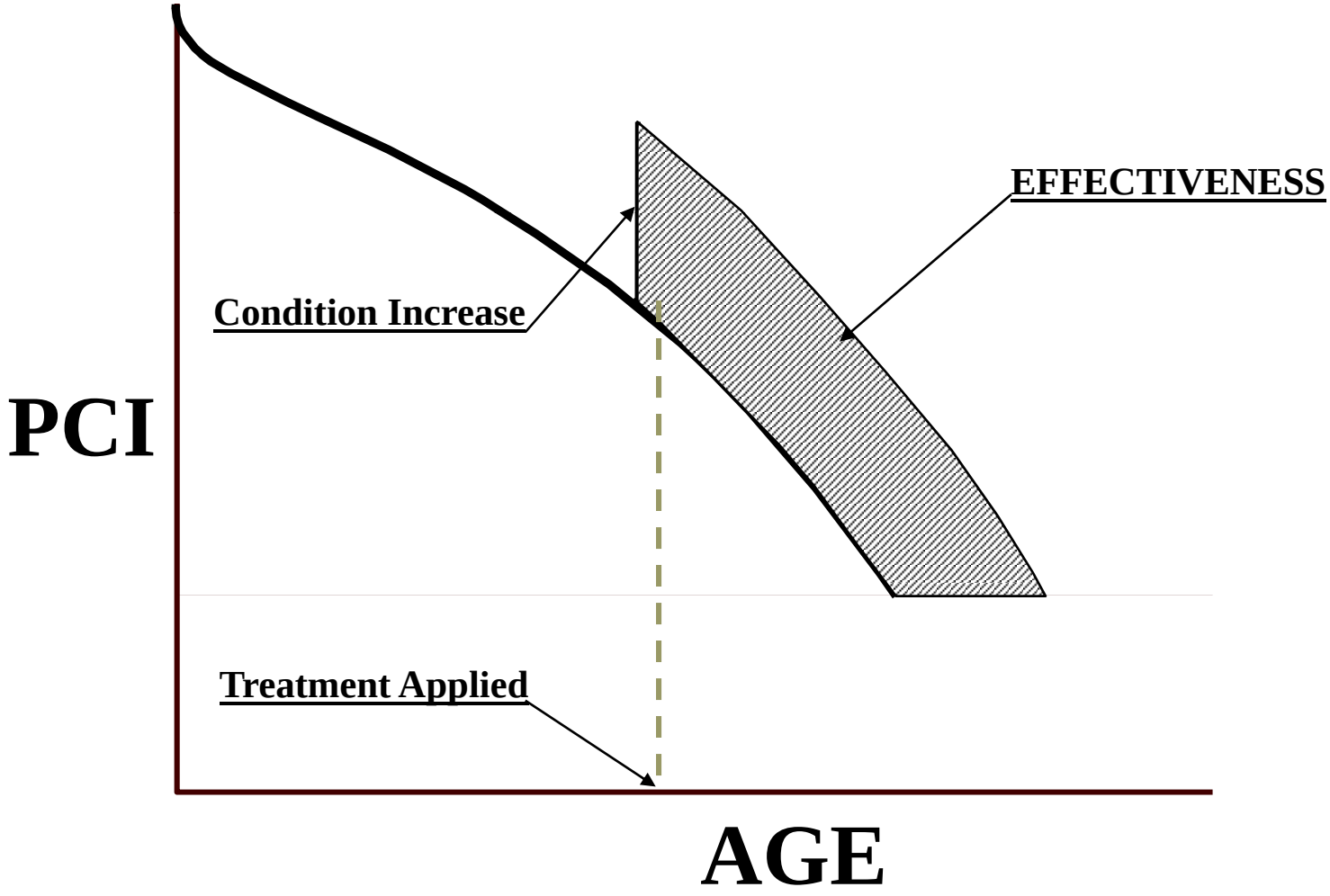
- 1 Remove & Replace at $ 75.00 /sy
  - at ~28 yrs
- Total $75.00 /sy for ~56 yrs

Compare

- Pay Me Now
  - Total $14.00 /sy for 59 yrs
  - ~$0.24 /sy/yr
- Pay Me Later
  - Total $75.00 /sy for 56 yrs
  - At ~$1.34 /sy/yr

- Can keep ~5 pavement sections in good condition compared to fixing one in failed condition over ~56 year period
- 50 Surface Treatments for 1 Reconstruct in any given year
- Which gave best service?

Better Condition Over Longer Time Gives Better Return on Funds Invested



Pavement Management

- A decision making process

- Used to
  - Find cost-effective treatments
  - At designated times
  - To provide desired level of service

StreetSaver® PMP

- Network-level with some project selection components
- Help agencies planning & programming pavement work - M&R
- Show the impact of different funding
  - Levels
  - Approaches (PavPres vs Worst First)
- PM has always been a focus of StreetSaver

Network-Level Elements

- Inventory
- Condition Assessment
- Determination of Needed Work & Funds
- Identification of Candidate Projects
- Determination of Impacts of Funding Alternatives
- Feedback

To Incorporate PPP into PMP

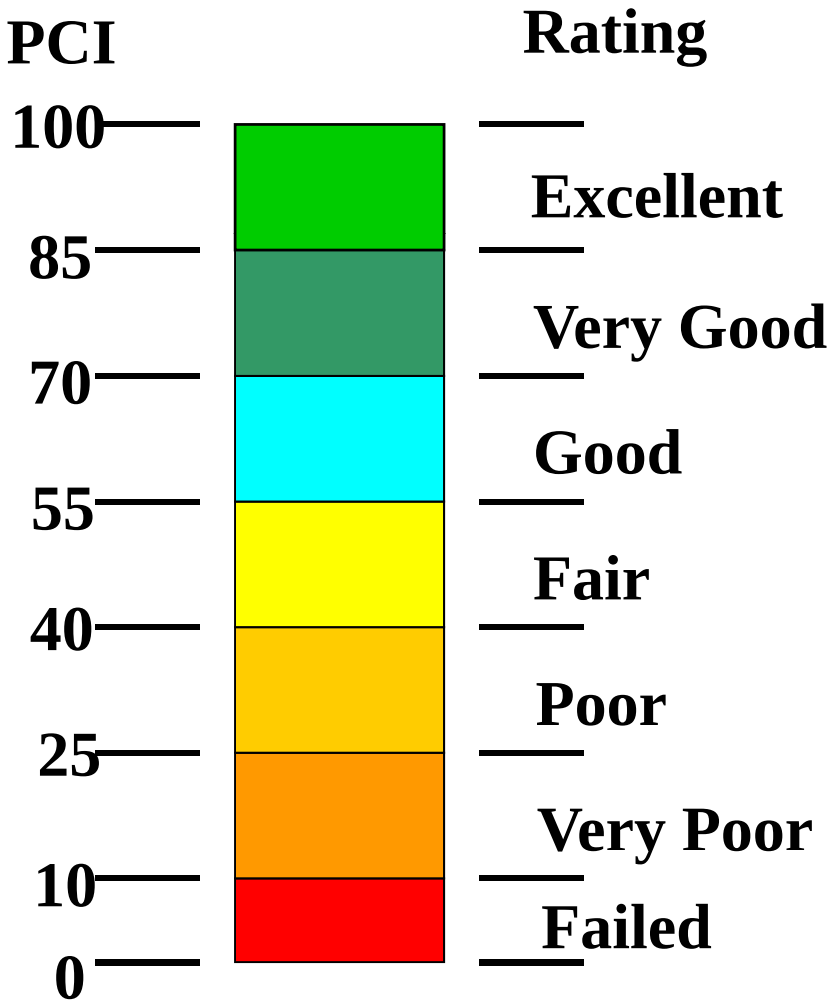
- Each of the elements were designed to address preventive maintenance (PM) & pavement preservation (PP)
- This presentation will focus on selecting appropriate strategies
- Part II will discuss actual decision tree setup

Short Introduction to PCI

- StreetSaver® uses PCI as the basic condition indicator
  - Used with other information to identify appropriate treatments

Condition Assessment

- Health of Individual Segments
  - Engineering
  - Functional
  - Safety
- Collectively Define Health of Network



Needs Analysis

- Identify Sections Needing Work
- Estimate Funds Needed
- Rehabilitation - Condition Driven
- Preventive Maintenance
  - Minimum Condition &
  - Time Interval

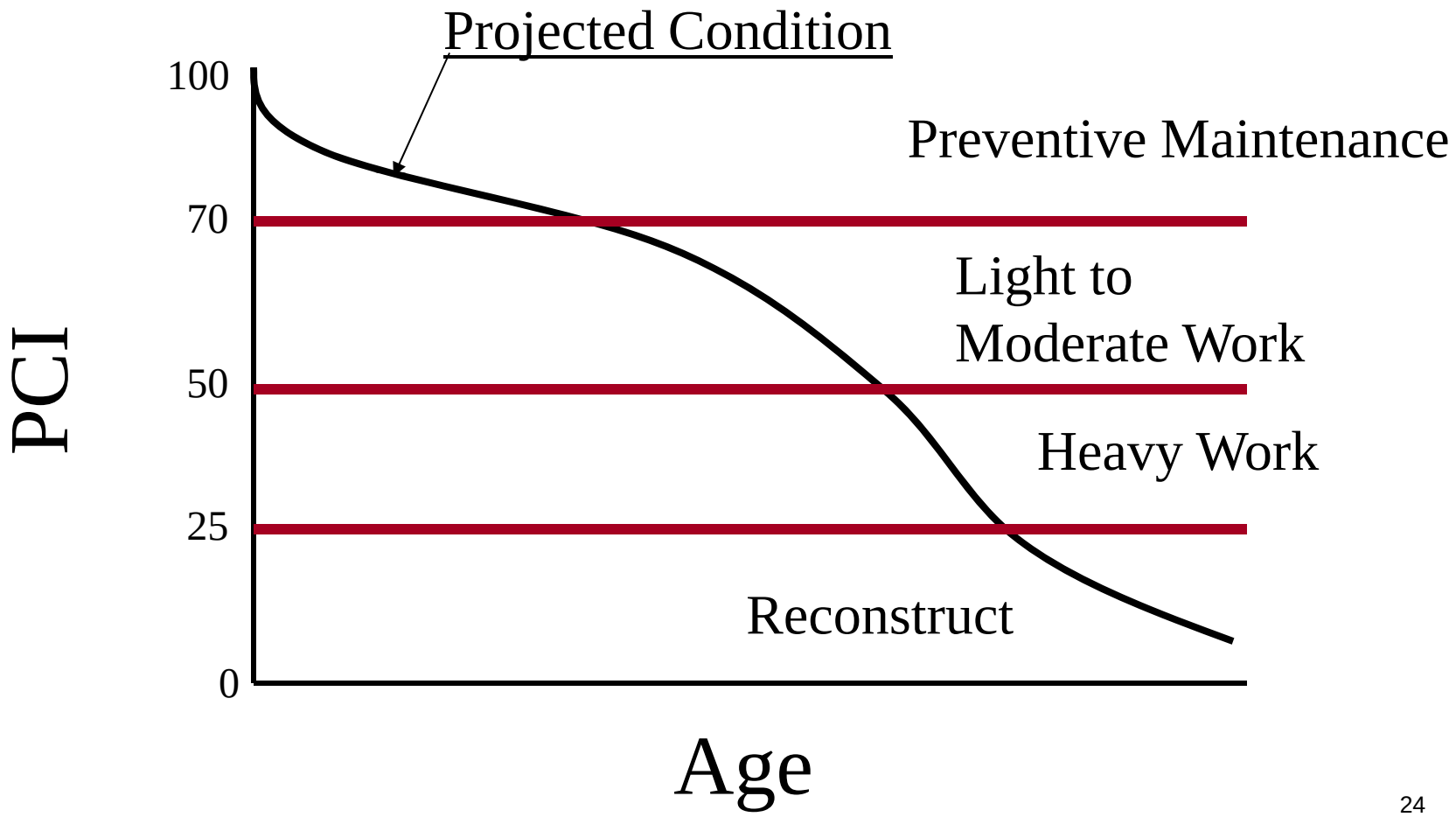
Needs Analysis Process

- Projects PCI to 1st analysis year
- Identifies treatments based on ***decision trees***
- Makes adjustments if treatment identified
- Projects PCI to 2nd analysis year
- Repeats until analysis years completed
- No constraints on funds

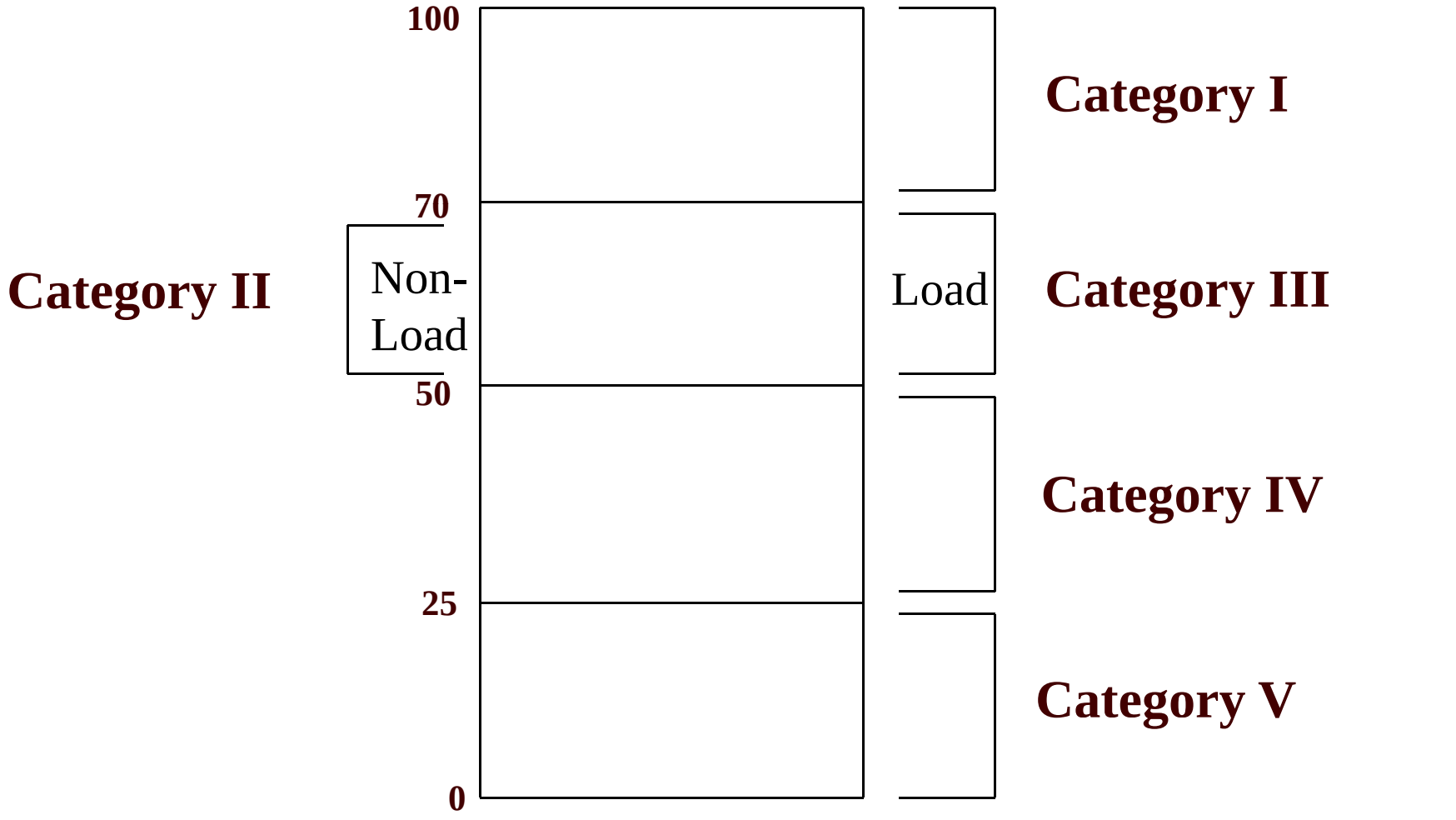
Scenarios Analysis

- Projects PCI to 1st analysis year
- Identifies segments for treatments based on ***decision trees*** & constraints (funding & targets)
- Makes adjustments if treatment identified
- Projects PCI to 2nd analysis year
- Repeats until analysis years complete

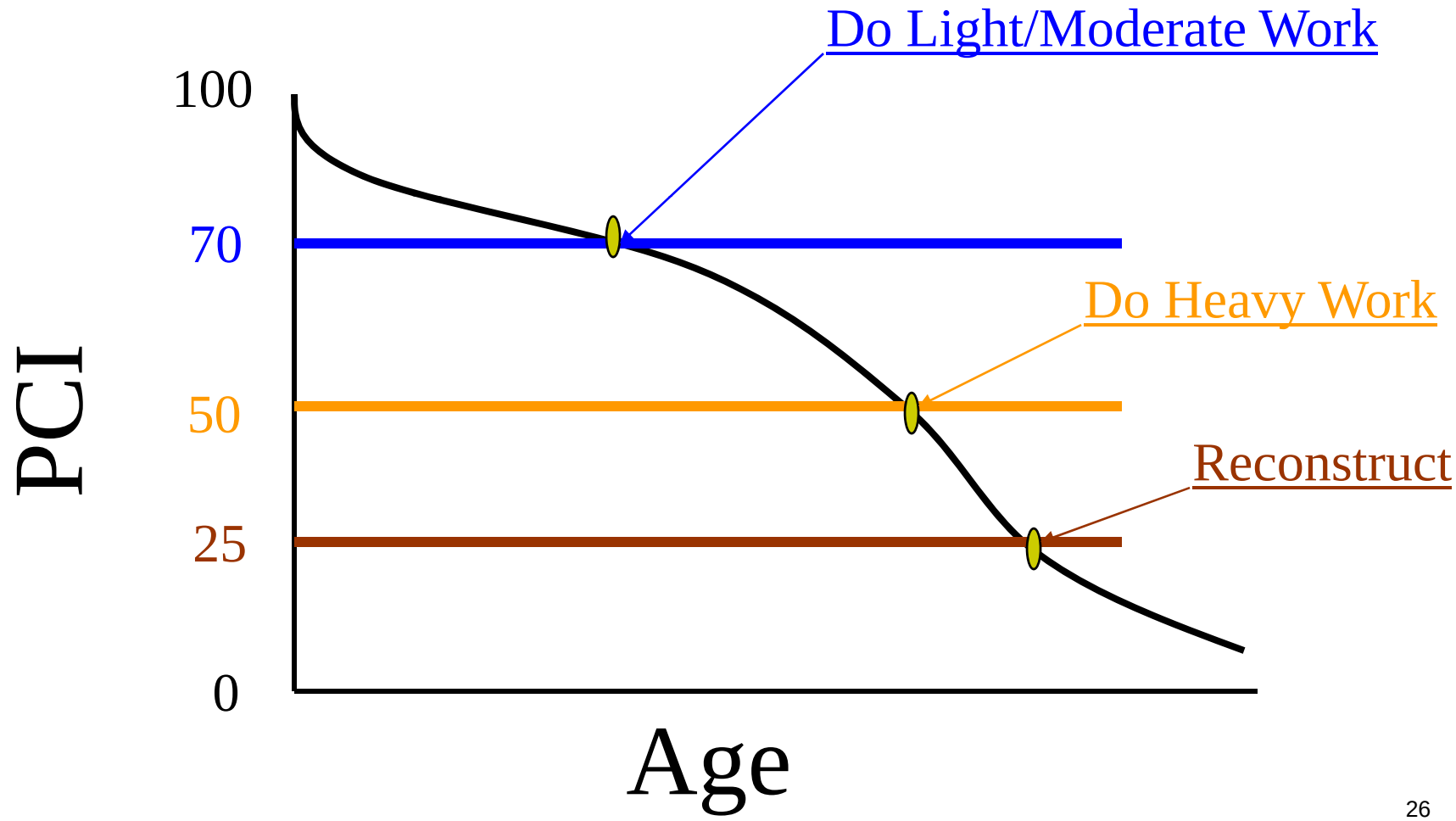
StreetSaver® Treatment Levels



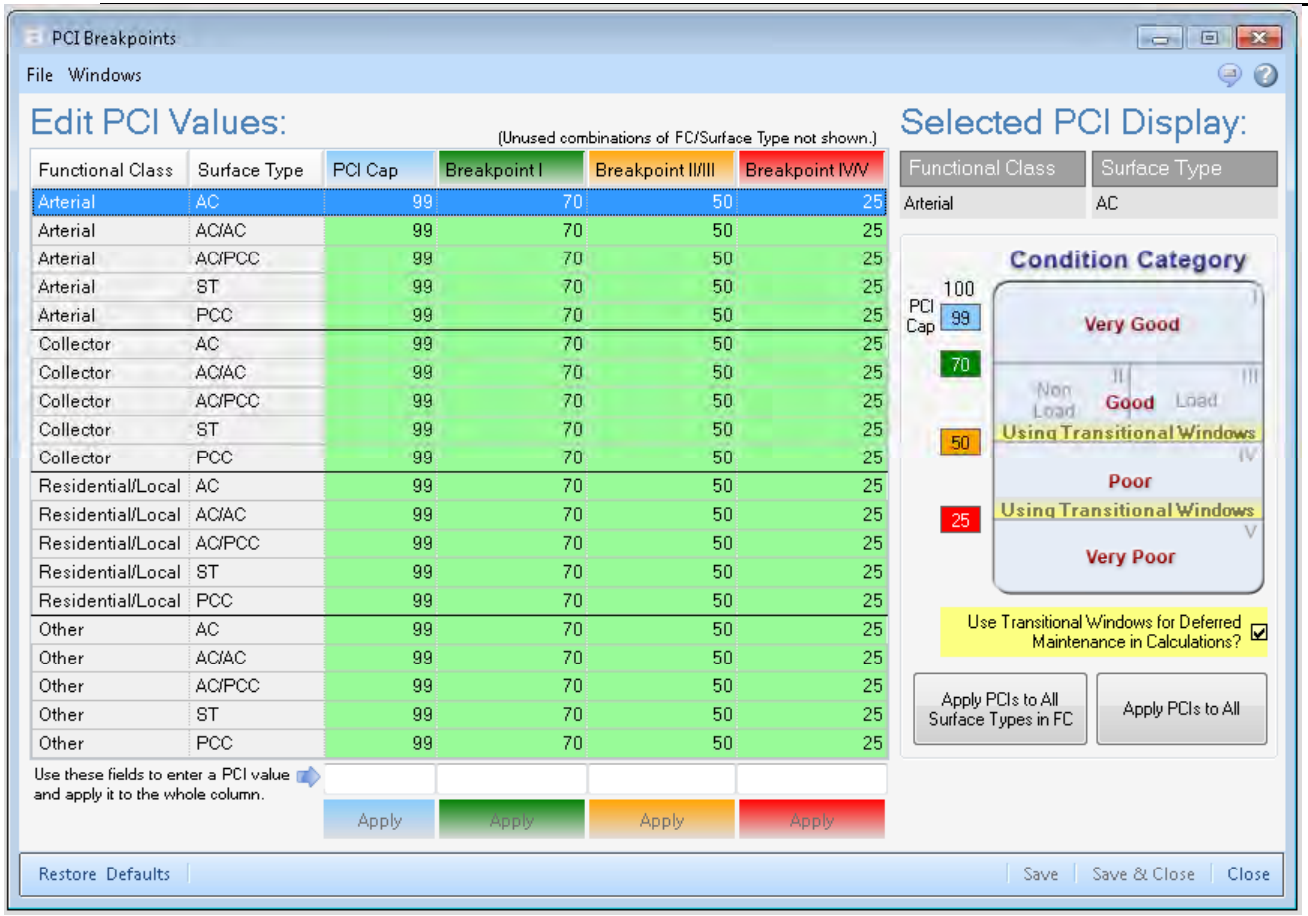
StreetSaver® Condition Categories



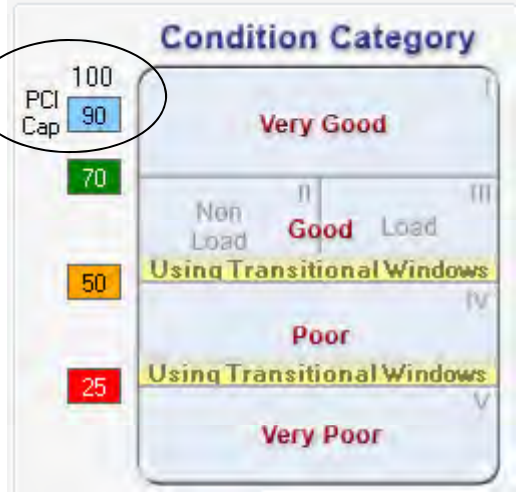
Default Trigger Values



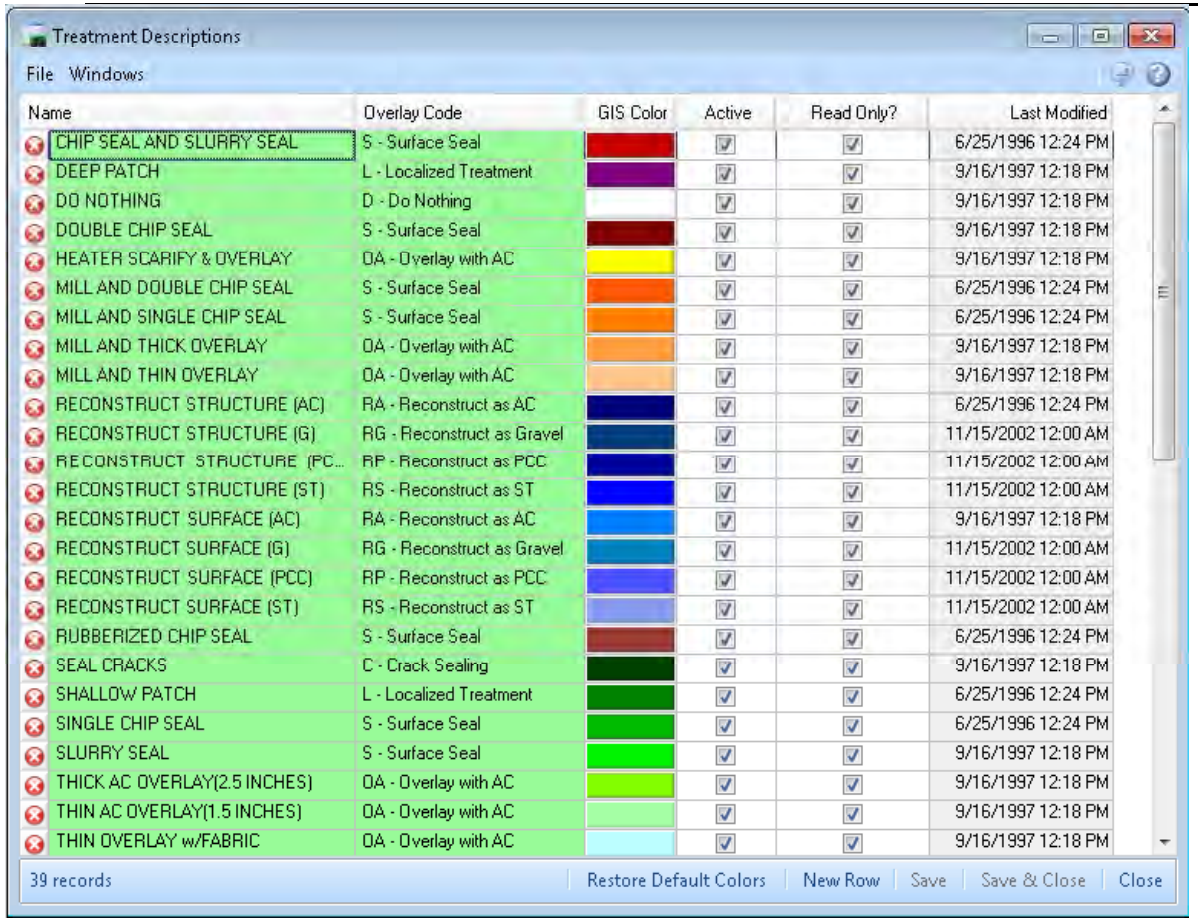
Set/Changed in Table Maintenance

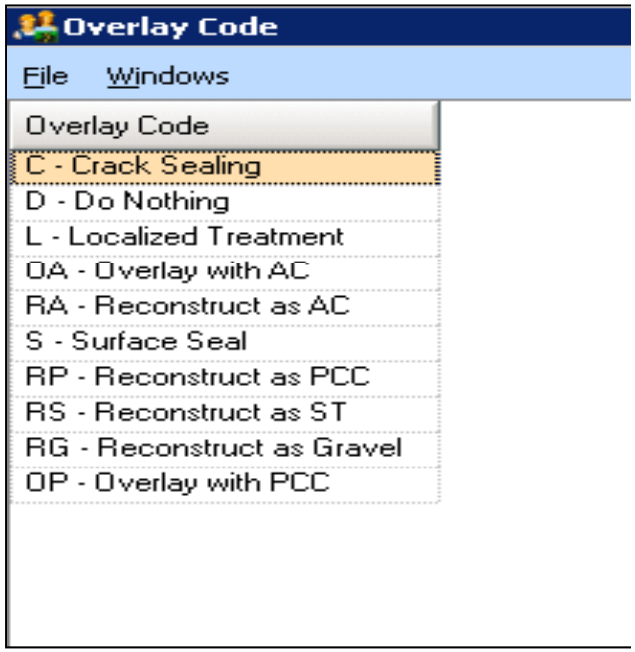


No treatment will be applied if PCI is greater than PCI Cap

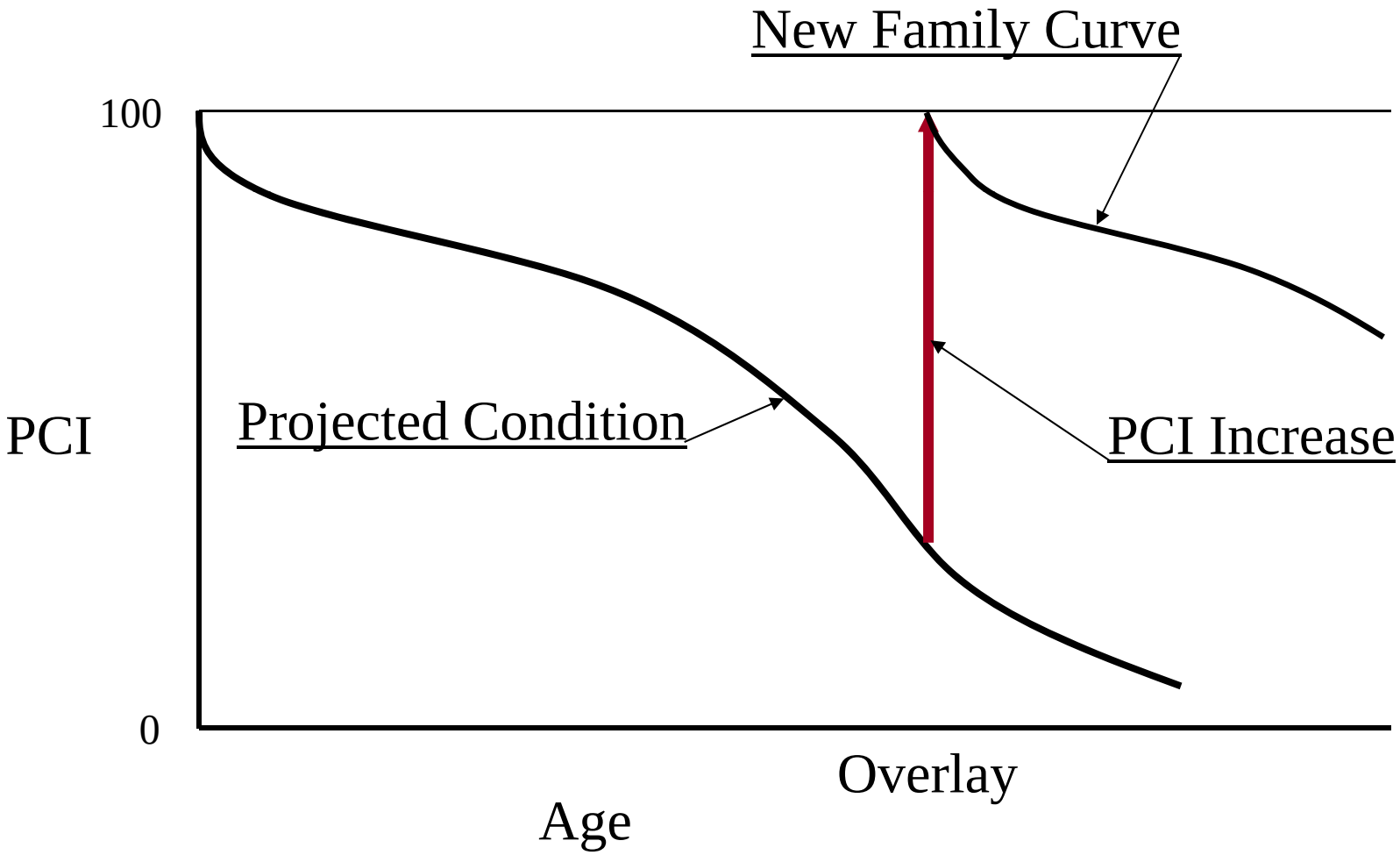


Can Only Select Established Treatments

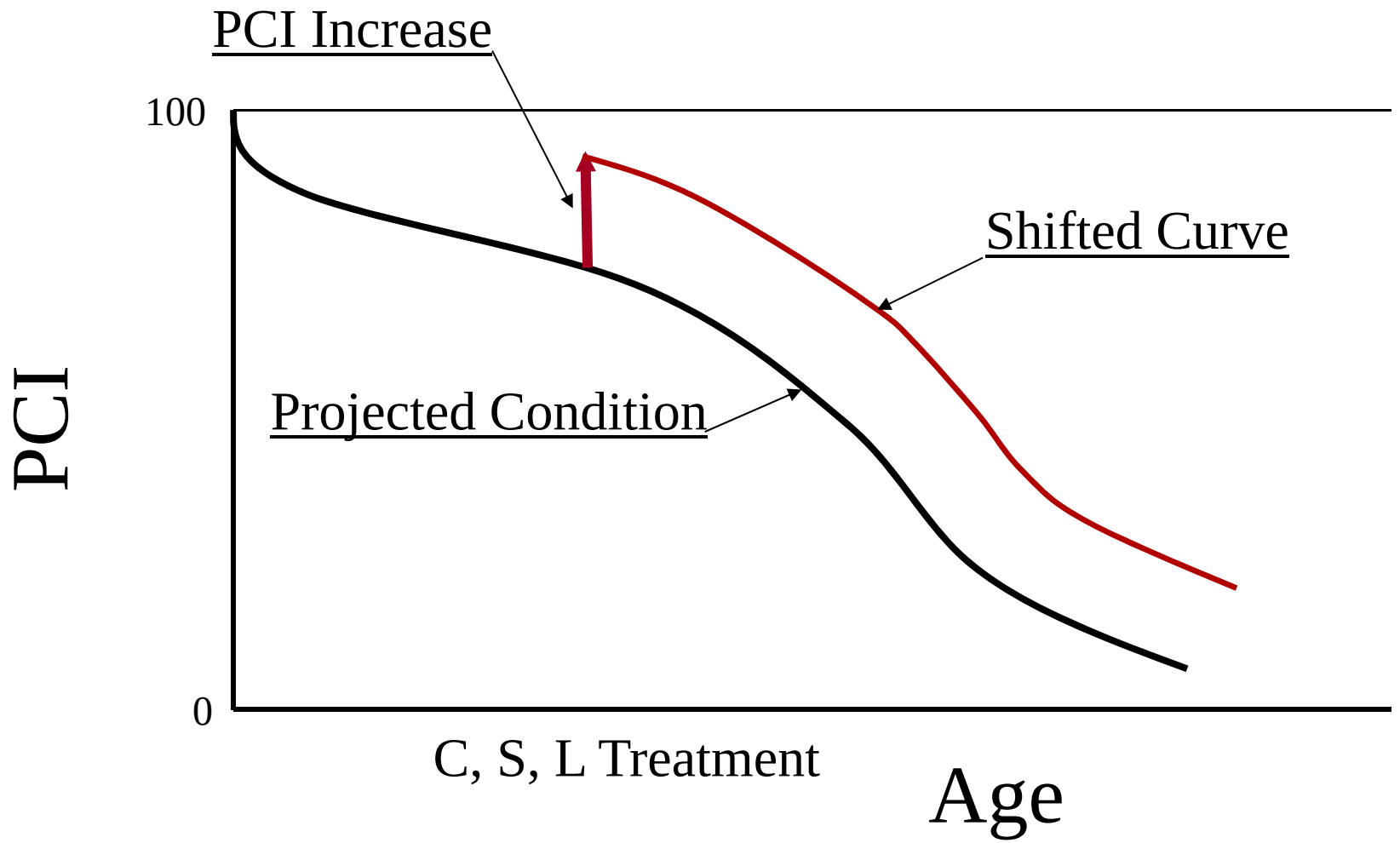




Overlay & Reconstruction (O & R)



Surface Seal, Crack Seal, Localized (S, C, & L)



PM in StreetSaver®

- Applied if PCI above Cat II/III trigger value
- Projected to remain above for next three years
- Applied based on
  - Time of last treatment

    and
  - Designated sequence time

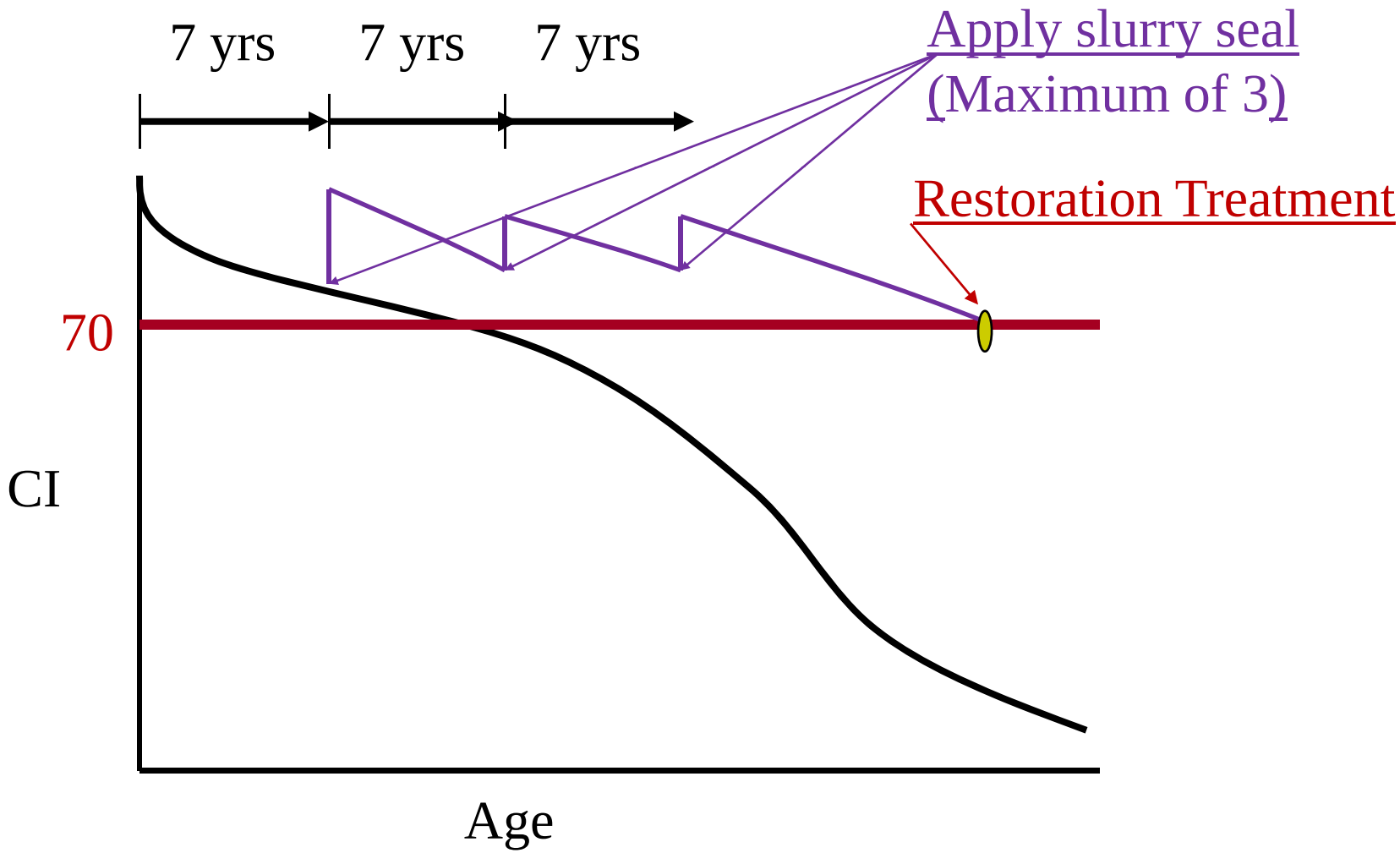
PM in StreetSaver®

- Seal Coat (Chip Seal, Slurry, etc.)
  - Enter Treatment
  - Enter Years between Application
  - Enter maximum number of seals
  - Enter Costs
- Application Interval Begins
  - At Construction
  - At Overlay
  - At Prior Seal Coat

Restoration Treatment

- When maximum number of seals reached
  - No further seals
  - Programmed for restoration treatment when PCI reaches Cat II/III trigger value
- Based on issues of instability created by several sequential seals
- Normally includes a mill & overlay

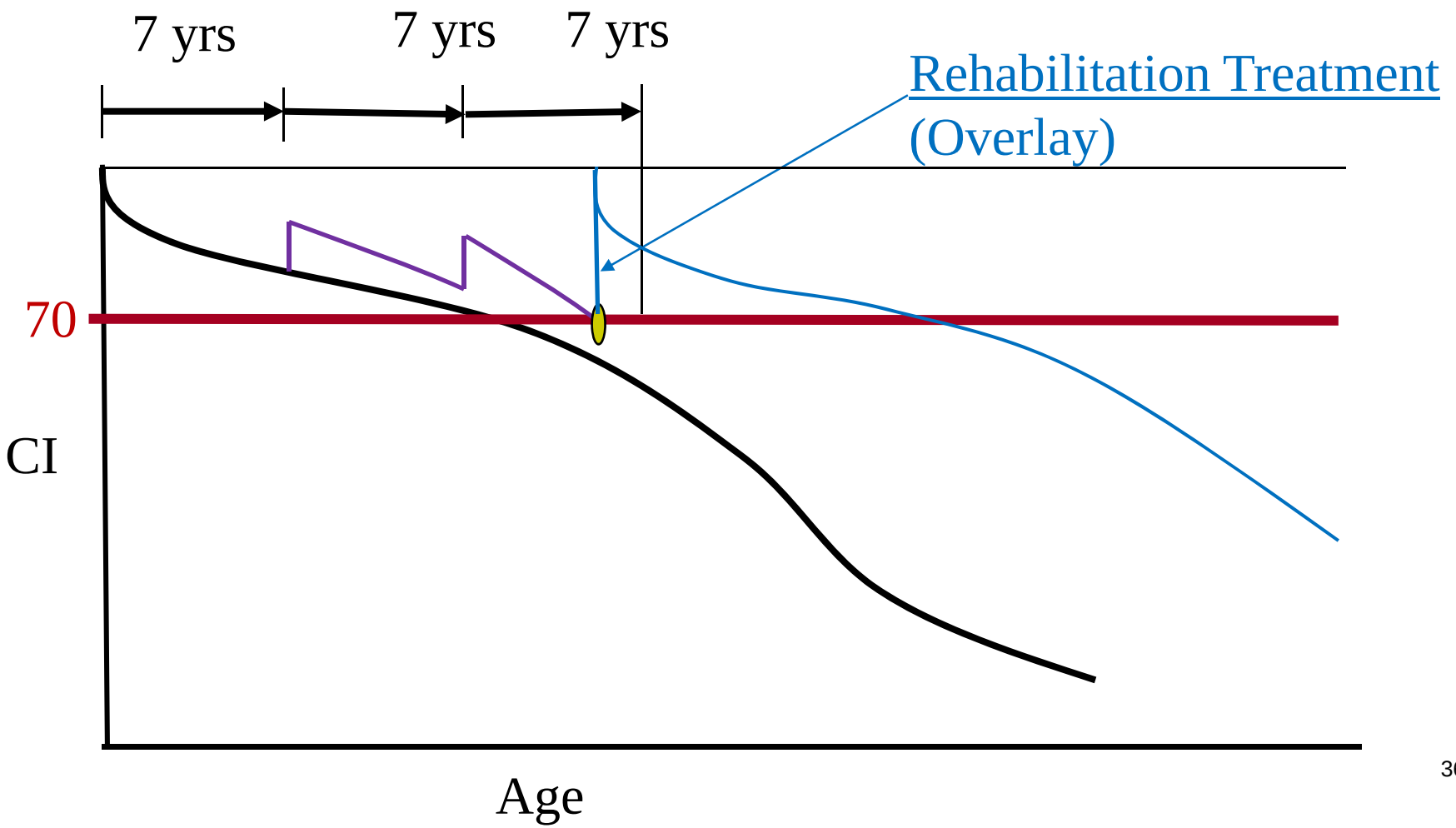
Preventive Maintenance - Time Driven



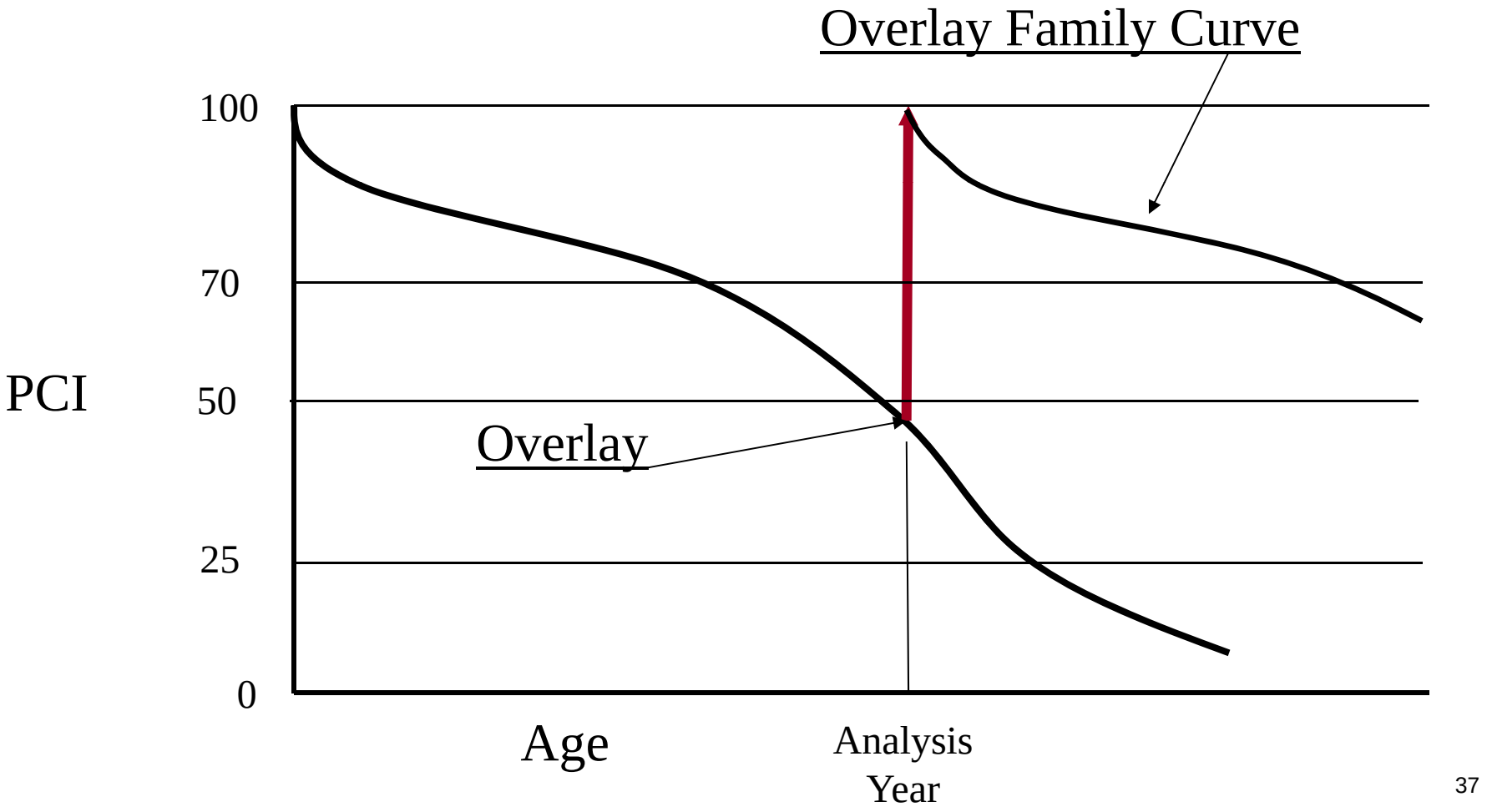
Rehabilitation Treatment

- Identified for application when PCI projected to reach one of the Cat II through III trigger values
- Can still be a seal – normally with significant surface repair prior to treatment
- Localized & Do-Nothing can be used

Rehabilitation Following PM



Rehabilitation with No Prior PM



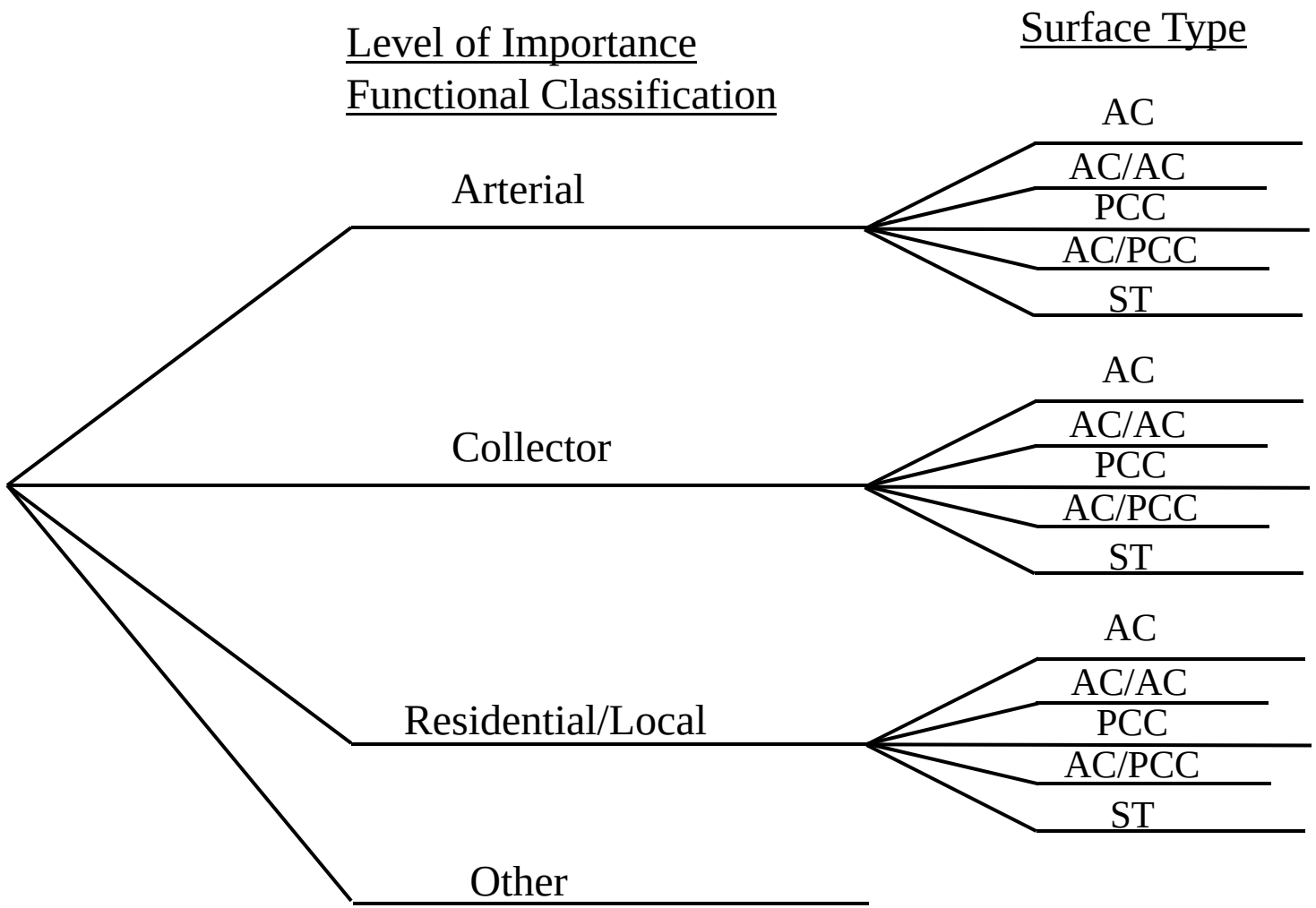
Decision Tree Approach

- Connects selected information to a treatment
- Network-level planning treatment
  - Assigned each section needing work
  - During analysis period (5 to 30 yrs)
  - Costs connected to treatments

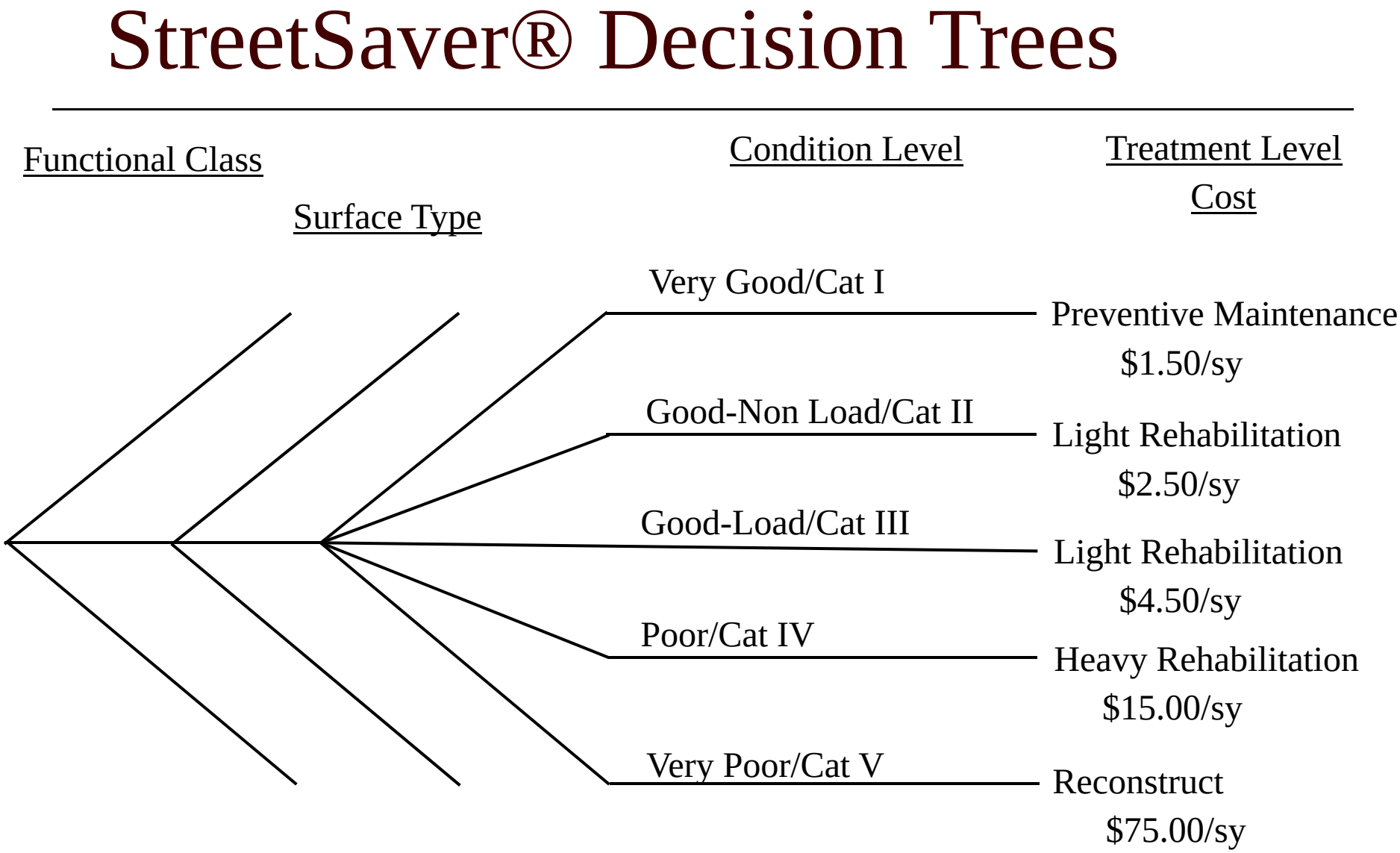
Factors Considered in StreetSaver®

- Condition
  - Projected PCI
  - Cause of damage
- Functional classification
  - Usage
  - Construction
- Surface type
  - Construction

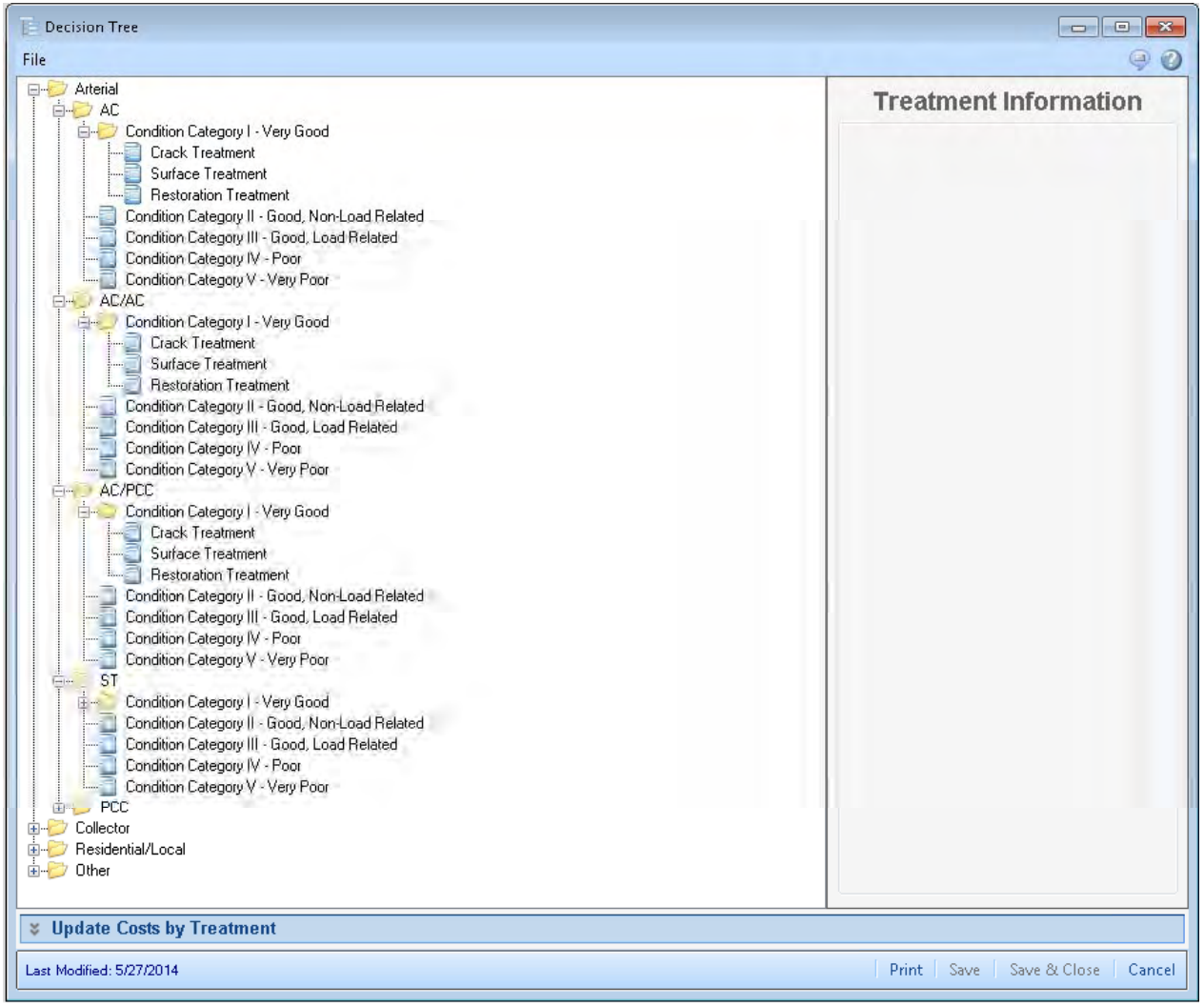
StreetSaver® Decision Trees



StreetSaver® Decision Trees



All StreetSaver® Databases Have Default Decision Trees



Selecting Appropriate Treatments

- Treatment applied
- Treatment cost
- Treatment timing for seals
  - Surface seals
  - Crack seals

Some Preservation Treatments

- Crack sealing
- Fog/Rejuvenating Seals
- Chip seals
- Slurry seals
- Scrub seals
- Microsurfacing

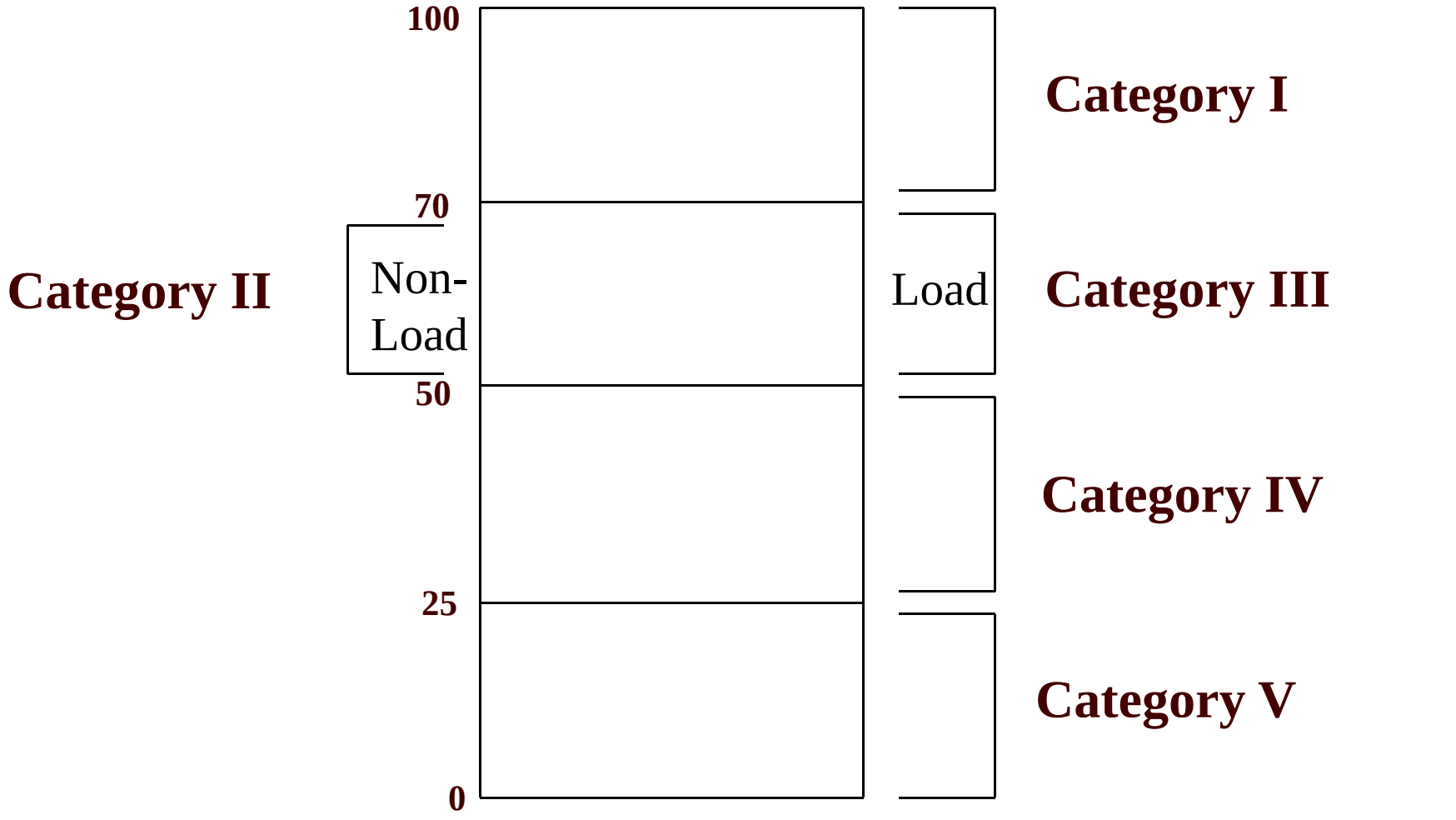
Non-Structural Activities

- Open graded friction course
- RHMA-O, RHMA-HB
- PBA-G
- BWC
- BWC-Rubber
- Thin Overlays

Only PM as Preservation?

- PM treatments will be preservation treatment
- Some rehabilitation treatments can be preservation treatments
  - Primarily Cat II & Cat III

StreetSaver® Condition Categories



GENERAL GUIDELINES FOR EFFECTIVE MAINTENANCE TREATMENT SELECTION

Parameters																																
				Rutting		Climate				Traffic Volumes									Treatment Costs						Treatment Life Based On Traffic Volumes & Pavement Condition								
																				Cost: $/SQ YD (Treatment Only)					adt < 5000			adt>5000<30,000			adt >30,000		
Preventive Treatments	Raveling	Oxidation	Bleeding	<1/2"	>1/2"	Desert	Valley	Coastal	Mountains	adt < 5000	adt>5000<30,000	adt >30,000	Night	Cold	Stop Points	urban	Rural	High Snow Plow	Cost per lane-mile (Total Project Cost includes traffic control)	Large Projects	Medium Projects	Small Projects	Addtl Premium for night work $/SQ YD	Addtl Premium for Short Work Periods or Work Zones $/SQ YD	Pavement Condition								
																									Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
Crack/Joint Seal																																	
Emulsion	N	N	N	N	N	G	G	G	G	G	G	G	N	N	G	G	G	G	8,000	0.50-0.65	0.60-0.75	0.70-0.8	0.15-0.2	+0.60-1.00	2 to 8	2 to 6	1 to 4	2 to 7	2 to 5	1 to 4	2 to 6	2 to 4	1 to 4
Modified (Rubber)	N	N	N	N	N	G	G	G	G	G	G	G	G	G	G	G	G	G	8,000	0.55-0.70	0.65-0.80	0.75-0.9	0.15-0.2	+0.60-1.00	5 to 9	3 to 7	N	5 to 8	3 to 6	N	3 to 7	2 to 5	N
Seal Coats																																	
Fog Seal (See note 1)	F	G	N	N	N	G	G	G	G	F	F	N	N	P	F	G	G	F	13,000	0.15-0.30	0.15-0.30	0.15-0.3	+0.05	+0.10	1 to 3	N	N	1 to 2	N	N	1 to 2	N	N
Rejuvenator (See note 1)	G	G	N	N	N	G	G	G	G	G	F	N	N	N	N	G	G	F	15,000	0.20-0.50	0.20-0.50	0.20-0.5	+0.10	+0.20	3 to 6	3 to 4	2 to 3	2 to 4	2 to 3	2 to 3	2 to 4	2 to 3	1 to 3
Scrub Seal (See Note 4)	G	G	N	N	N	G	G	G	G	G	F	N	N	G	N	F	G	P	17,000	2.15	2.15	2.15	N/A	N/A	4 to 7	3 to 6	3 to 4	3 to 6	2 to 4	2 to 3	2 to 3	2 to 3	2 to 3
Slurry Seals																																	
Type II (See note 1)	F	G	N	N	N	G	G	G	F	G	G	G	N	N	G	G	G	P	23,000	1.60-2.20	1.75-2.40	1.90-2.6	N/A	+0.30	3 to 10	4 to 6	2 to 4	7 to 10	4 to 6	1 to 4	7 to 10	3 to 5	1 to 3
Type III	G	G	N	F	N	G	G	G	F	G	G	G	N	N	G	G	G	P	24,000	1.60-2.20	1.75-2.40	1.90-2.6	N/A	+0.30	3 to 10	4 to 6	2 to 4	7 to 10	4 to 6	1 to 4	7 to 10	3 to 5	1 to 3
REAS	G	G	N	F	N	G	G	G	F	G	G	G	N	N	G	G	G	P		1.20-1.80	1.20-1.80	1.20-1.8	N/A	+0.30	3 to 10	5 to7	N	7 to 10	5 to 7	N	7 to 9	5 to 7	N
Microsurfacing																																	
Type II	G	G	N	G	F	G	G	G	G	G	G	G	G	N	G	G	G	P	31,000	2.00-2.80	2.10-2.90	2.25-3.0	0.10-0.2	N/A	3 to 12	5 to 8	2 to 4	7 to 12	5 to 7	2 to 4	7 to 10	3 to 6	1 to 4
Type III	G	G	N	G	G	G	G	G	G	G	G	G	G	N	G	G	G	P	31,000	2.00-2.80	2.10-2.90	2.25-3.0	0.10-0.2	N/A	3 to 12	5 to 8	2 to 4	7 to 12	5 to 7	2 to 4	7 to 10	3 to 6	1 to 4
Chip Seals																																	
PME - Med. Fine (See Note 4)	G	G	N	F	N	G	G	F	F	G	G	N	N	N	P	P	G	P	27,000	1.80-2.00	2.25-2.75	3.00-3.5	N/A	+0.50-1.00	3 to 12	5 to 8	2 to 4	7 to 12	5 to 7	2 to 4	7 to 10	3 to 6	1 to 4
PME - Medium (See Note 4)	G	G	N	F	N	G	G	F	F	G	N	N	N	N	P	P	G	F	27,000	1.80-2.00	2.25-2.75	3.00-3.5	N/A	+0.50-1.00	3 to 12	5 to 8	2 to 4	7 to 12	5 to 7	2 to 4	7 to 10	3 to 6	1 to 4
PMA - Medium (See Note 3.)	G	G	N	F	N	G	G	G	G	G	G	N	N	G	P	P	G	F	24,000				N/A		3 to 12	6 to 9	4 to 6	7 to 12	5 to 7	4 to 6	7 to 10	4 to 6	3 to 5
PMA - Coarse (See Note 3.)	G	G	N	F	N	G	G	G	G	G	N	N	N	G	P	P	G	G	24,000				N/A		3 to 12	6 to 9	4 to 6	7 to 12	5 to 7	4 to 6	7 to 10	4 to 6	3 to 5
AR - Medium	G	G	N	F	N	G	G	G	G	G	G	N	G	G	P	P	G	F	65,000	3.75-4.55	4.00-4.75	4.25-5.0	N/A	+0.50-1.00	3 to 12	6 to 9	4 to 6	7 to 12	5 to 7	4 to 6	7 to 10	4 to 6	3 to 5
AR - Coarse	G	G	N	F	N	G	G	G	G	G	N	N	G	G	P	P	G	G	65,000	3.75-4.55	4.00-4.75	4.25-5.0	N/A	+0.50-1.00	3 to 12	6 to 9	4 to 6	7 to 12	5 to 7	4 to 6	7 to 10	4 to 6	3 to 5
Cape Seals																																	
Slurry	G	G	N	F	N	G	G	G	G	G	G	G	N	N	G	G	G	P							9 to 14	7 to 10	5 to 7	8 to 12	6 to 8	5 to 7	8 to 10	5 to 7	4 to 6
Micro	G	G	N	G	F	G	G	G	G	G	G	G	N	N	G	G	G	P							10 to 14	8 to 10	5 to 8	8 to 12	6 to 8	5 to 8	8 to 10	5 to 7	4 to 6
PM Alternative to a Seal Coat > 30,000 ADT																																	
PBA-O	G	G	P	F	N	G	G	G	G	G	G	G	F	F	G	G	G	P	65,000	8-12	8-14	10-16		+1.20-4.00	3 to 14	6 to 12	4 to 7	8 to 12	6 to 10	4 to 5	8 to 10	5 to 7	3 to 5
RAC-O	G	G	P	F	N	G	G	G	G	G	G	G	F	P	G	G	G	P	60,000	10-14	10-14			+1.50-3.50	3 to 14	5 to 12	4 to 7	8 to 12	5 to 10	4 to 5	8 to 10	5 to 9	3 to 5
RAC-O High Binder (HB)	G	G	P	F	N	G	G	G	G	G	G	G	F	P	G	G	G	P	65,000	10-14	10-14			+1.50-3.50	3 to 15	6 to 12	4 to 8	10 to 12	6 to 12	4 to 6	8 to 12	5 to 10	4 to 5
RAC-G	G	G	P	G	F	G	G	G	G	G	G	G	F	F	G	G	G	G	65,000	10-14	10-14			+1.50-3.50	3 to 14	6 to 10	4 to 6	8 to 12	5 to 9	4 to 5	8 to 10	5 to 7	3 to 5
PBA-G	G	G	P	P	N	G	G	G	G	G	G	G	F	F	G	G	G	G	60,000	8-12	8-14	10-16		+1.20-4.00	3 to 14	6 to 12	4 to 7	8 to 12	6 to 10	4 to 5	8 to 10	5 to 7	3 to 5
Thin Bonded Wearing Course (BWC)	G	G	P	F	N	G	G	G	G	G	G	G	F	F	G	G	G	G	85,000	10-14	10-14			+1.50-3.50	3 to 12	5 to 10	4 to 6	8 to 10	5 to 9	4 to 5	8 to 10	5 to 9	3 to 4
Thin Bonded Wearing Course Rubber (BWC-RAC O/C	G	G	P	F	N	G	G	G	G	G	G	G	F	F	G	G	G	G	85,000	10-14	10-14			+1.50-3.50	3 to 12	5 to 10	4 to 6	8 to 10	5 to 9	4 to 5	8 to 10	5 to 9	3 to 4
Maintenance Treatments																																	
Thin Lifts Overlays																																	
Conventional	G	G	P	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	45,000	8-12	8-14	10-16		+1.20-4.00	3 to 12	5 to 10	4 to 6	8 to 10	6 to 9	3 to 6	6 to 8	4 to 6	1 to 3
PBA	G	G	P	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	60,000	8-12	8-14	10-16		+1.20-4.00	3 to 14	6 to 12	4 to 7	8 to 12	6 to 10	4 to 5	8 to 10	5 to 7	3 to 5
RAC	G	G	P	G	F	G	G	G	G	G	G	G	F	F	G	G	G	G	65,000	10-14	10-14			+1.50-3.50	3 to 14	5 to 12	4 to 7	8 to 12	5 to 10	4 to 5	8 to 10	5 to 9	3 to 5
Digouts	P	P	G	N	G	G	G	G	G	G	G	G	G	G	G	G	G	G	125,000														

Dr. Hicks, Cal PPC

Estimated Life of Treatments

Treatment	Good Condition (PCI=80)	Fair Condition (PCI=60)	Poor Condition (PCI=40)
Fog Seal	3 - 5	1 - 3	1 - 2
Chip Seal	7 - 10	3 - 5	1 - 3
Slurry Seal	7 - 10	3 - 5	1 - 3
Micro-surfacing	8 - 12	5 - 7	2 - 4
Thin HMA	10 - 12	5 - 7	2 - 4

Maintenance Treatment Guidance

- WSDOT Pavement Preservation Guide for Local Agencies
  - http://www.wsdot.wa.gov/research/reports/fullreports/800.1.pdf
- National Center for Pavement Preservation
  - http://www.pavementpreservation.org/fhwa/
  - Pavement Preservation Checklist Series
- California Pavement Preservation Center
  - http://www.csuchico.edu/cp2c/Strategy%20Selection.shtml

Crack Sealing Applicability

- Applicable to medium severity cracks (maybe low severity) in pavements with low & moderate amounts of cracking and little or no faulting of cracks
- Often applied prior to slurry seals & micro-surfacing as pre-treatment
- Effectiveness a function of selecting right pavement, crack preparation, crack sealing material, environment, and pavement materials

Seal Coats Address

- Weathering & Raveling
- Minor cracking
- Minor surface irregularities
- Skid problems (except fog seals)
- Reduce surface permeability

Fog Seal Applicability

- Asphalt surfaced pavements in good condition before significant cracking, or weathering and raveling
- Add additional binder to dry chip seal
- Generally lower volume roads
- Some concern about impact on skid resistance
- Effectiveness a function of selecting the right pavement, environment, and pavement materials

Rejuvenator Seal Applicability

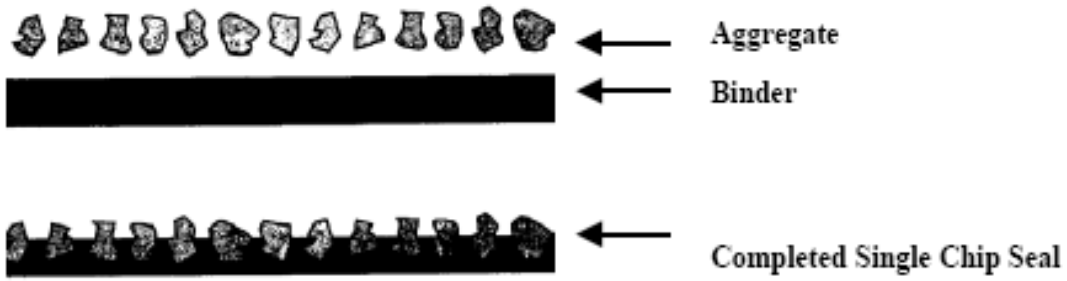
- Asphalt surfaced pavements in good condition before significant cracking, with minor weathering and raveling
- Generally lower volume roads
- Some concern about impact on skid resistance
- Effectiveness a function of selecting the right pavement, environment, and pavement materials

Slurry Seal Applicability

- Asphalt surfaced pavements in good condition before significant cracking but with low severity weathering & raveling
- Generally lower volume roads
- Effectiveness a function of selecting right pavement, mix & application of material, traffic levels, and weather at time of application

Micro-Surfacing Applicability

- Asphalt surfaced pavements in good condition before significant cracking but with low to medium severity weathering & raveling and moderate to severe rutting
- Generally higher volume roads
- Opened to traffic loadings quickly
- Effectiveness a function of selecting right pavement, mix & application of material, and weather at time of application

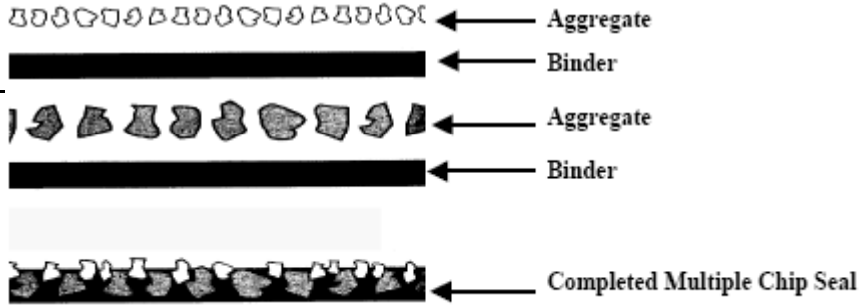


Chip Seal Applicability

- Asphalt surfaced pavements in good condition before significant cracking but with low to medium severity weathering & raveling and rutting
- Can improve skid resistance
- Generally lower volume roads
- Aggregate loss and surface texture are issues
- Effectiveness a function of selecting right pavement, properties & application of material, and traffic at time of application

Other Chip Seals

- Multiple Chip Seal



- Stress Absorbing Membrane (SAM) Seal
  - Normally high application rate of asphalt rubber binder
- Stress Absorbing Membrane Inter-layer (SAMI)
  - Normally like SAM but applied prior to overlay

Other Chip Seal Binders

- Asphalt Emulsion: Polymer-modified emulsions (PME)
- Performance-Based Asphalt (PBA) Cements: Hot applied modified binders
- Asphalt Rubber Binder: Binders modified with high levels of crumbed tire rubber and a high natural rubber content material – applied hot and require hot chips pre-coated with asphalt
- Rejuvenating Emulsion: Emulsions modified with rejuvenating oils (and sometimes polymers) used to penetrate and soften existing asphalt pavements

CALTRANS Maintenance Technical Advisory Guide (MTAG) – Chap 5

Table 2: Binder/Chip Seal Combinations for Addressing Specific Distress Mechanisms

Binder/ Chip Seal Combination	Raveling	Aged Pavements	Bleeding/Flushing	Load Associated Cracks	Water Proofing	Climate Associated Cracks	Heavy Traffic Volumes	Stone Retention	Improve Skid Resistance
PME/Single	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes
PME/Double	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes
PME/Sand	Yes	Yes	No	No	Yes	No	No (light)	Yes	No
PBA/Single	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes
PBA/Double	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PBA/Sand	Yes	Yes	No	No	Yes	No	No	Yes	No
AR/SAM	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Rejuvenating Emulsion	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes

Cape Seal Applicability

- Asphalt surfaced pavements in good to poor condition with some cracking and low to medium severity weathering & raveling
- Where chip seal texture or chip loss are unacceptable but chip seal is right treatment
- Effectiveness a function of selecting right pavement, properties & application of material, and traffic at time of application

Cape Seal Options

- Chip seals with PBA or RA binders
  - Provides more crack sealing capability
  - Can work as flexible surfacing on low volume pavements with considerable cracking if pavement is still stable
- Micro-surfacing instead of slurry
  - When surface needs to be opened quickly
  - Rut filling
  - Skid resistance
  - Longer life

Thin Overlay Applicability

- Asphalt surfaced pavements in good to fair condition with some cracking and low to medium severity weathering & raveling
- Where seal coats are unacceptable
- Higher volume roads
- Effectiveness a function of selecting right pavement, properties & application of material, and environment

Structurally Inadequate

- Overlay or other strengthening approach required
  - ***Not preservation*** treatments
- Reconstruction - remove & replace
  - Use new design procedure
- Overlay - add additional surface layer
  - Use overlay design procedure
  - Use in-place material property values for layers left in place

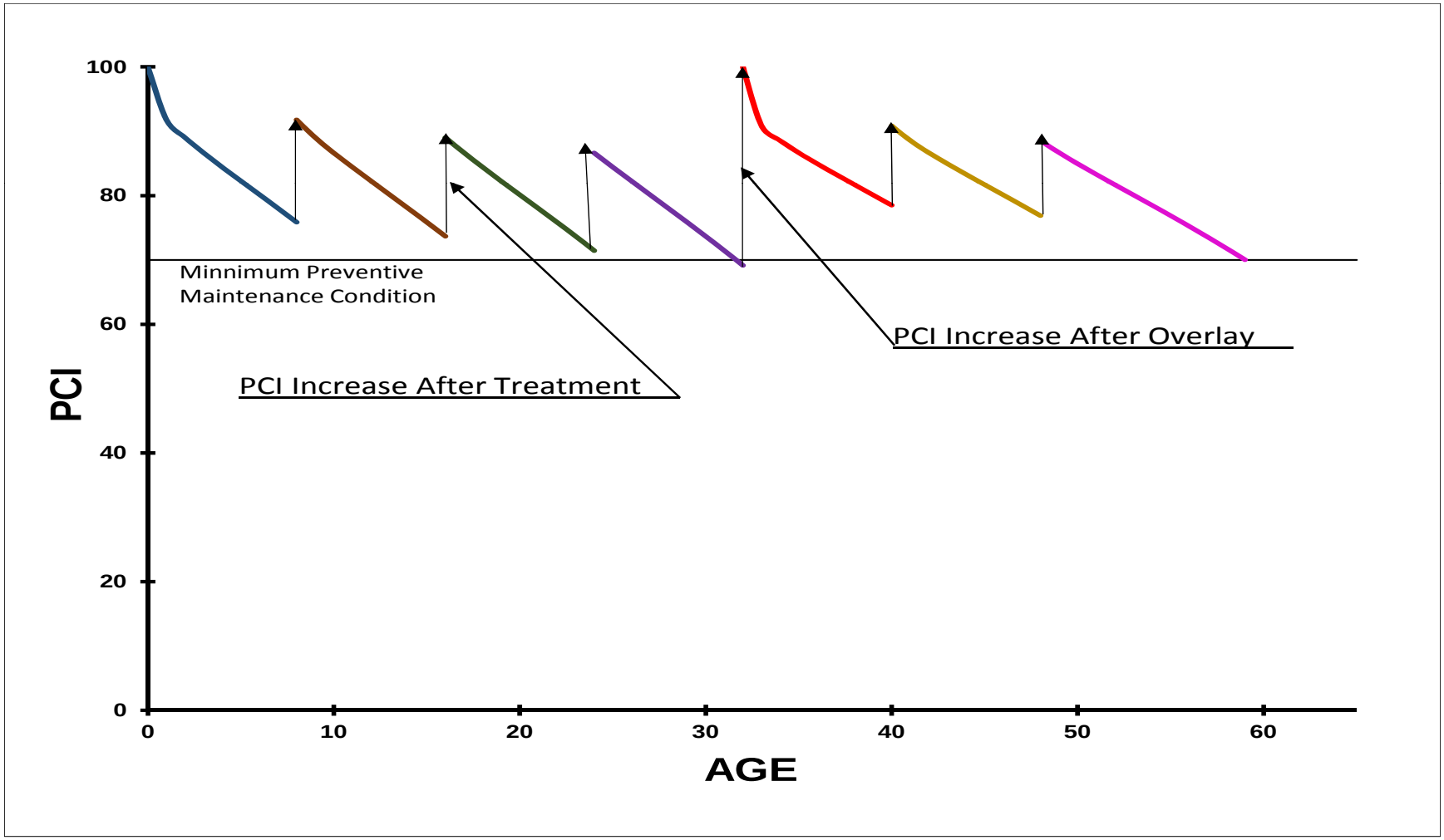
Planning Treatment/Cost Category

- Cost more important than actual treatment
- Actual treatment selected later in Project-Selection Level

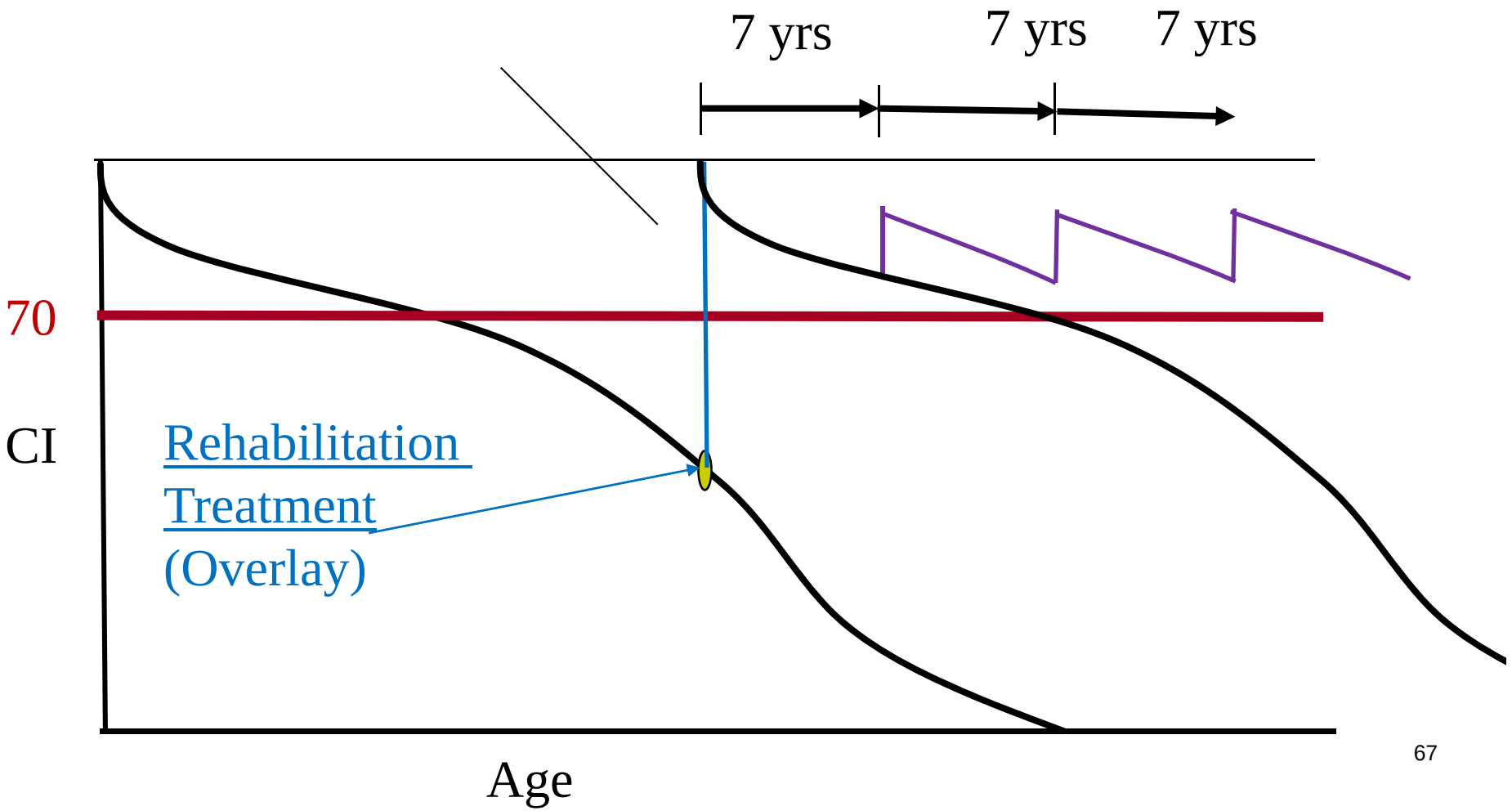
Select Best Treatments

- Which treatment is best?
  - Actually looking at treatments in a strategy
  - One that provides desired performance
  - Often several are appropriate
- Which provides desired performance for least cost?
  - Life cycle cost analysis

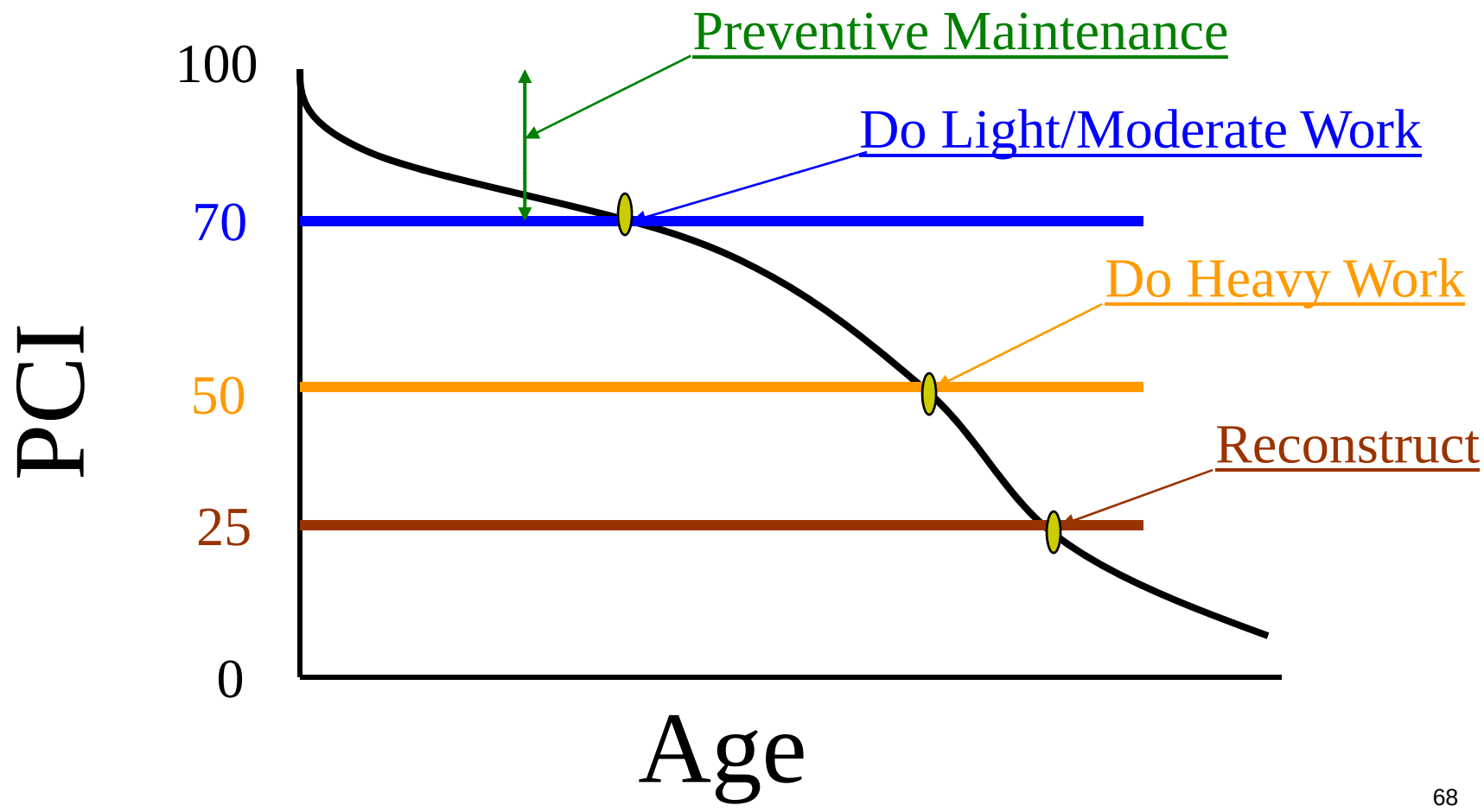
Strategy to Preserve Pavement



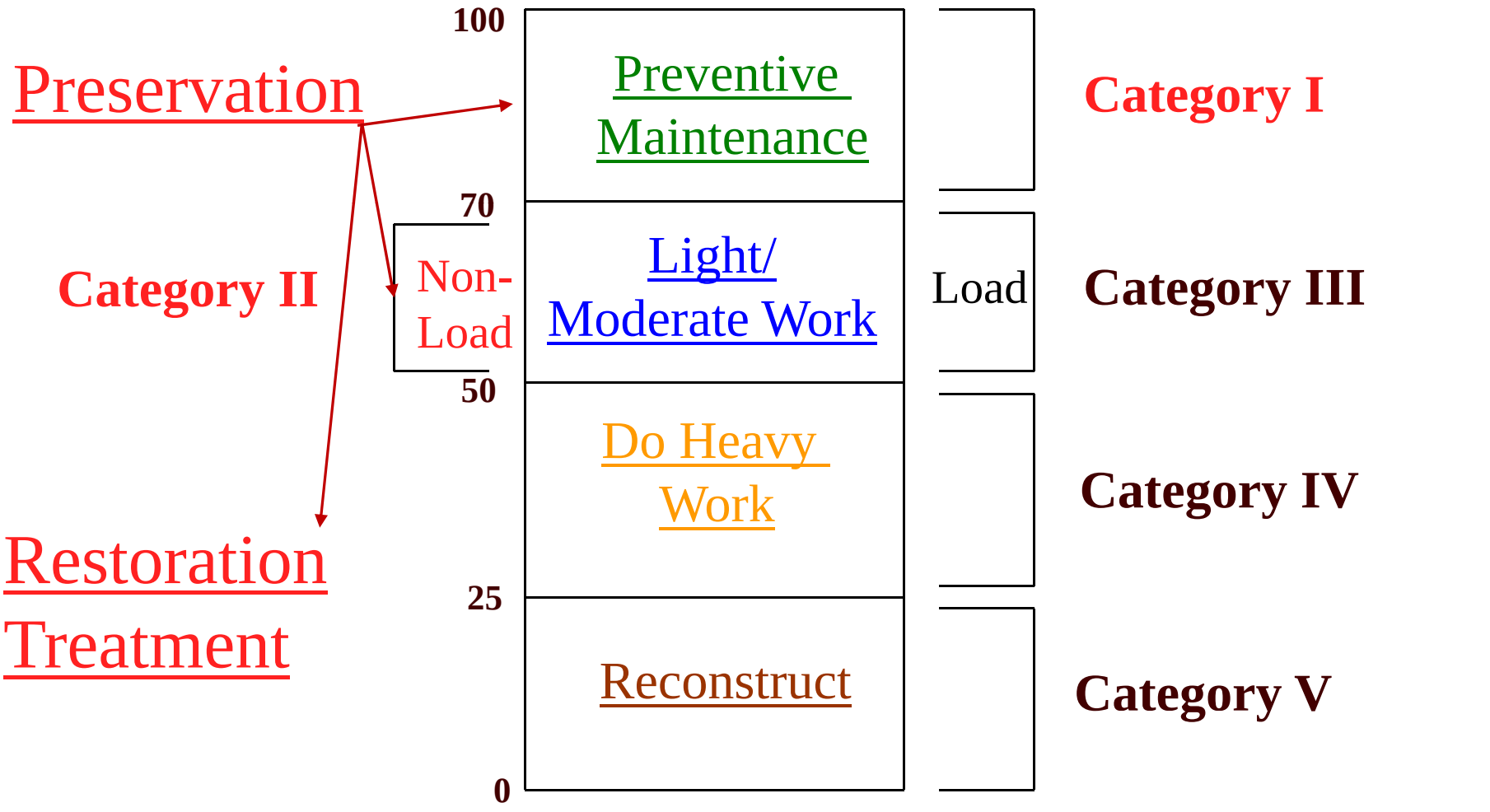
Treatment to Return Pavement to Preservable Condition



Treatments for Each Trigger Value



Preservation Condition Categories



Preferred Method

- Conduct a series of life-cycle cost analyses to identify the most cost effective set of treatments for
  - Each FC/ST combination for
  - Each condition category

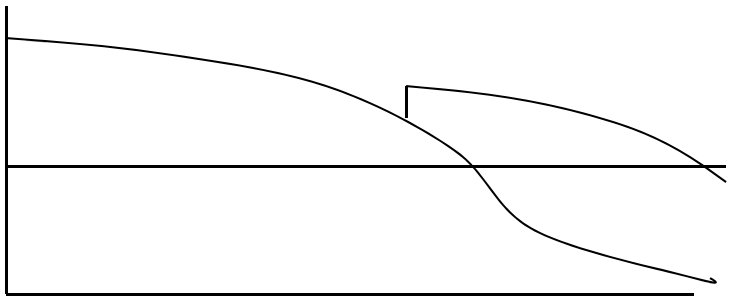
Pavement Life Cycle Cost Analysis

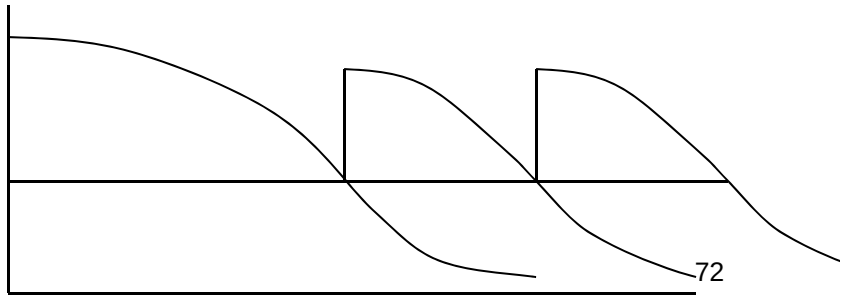
- Pavement LCCA is an economic evaluation technique to determine “total cost” of owning and operating a facility over some period of time (life)
- Purpose of LCCA:
  - Estimate overall costs of pavement alternatives and
  - Select alternative that will provide lowest overall cost over life (analysis period) consistent with required performance and other constraints
- LCCA is a Decision Support Tool

Questions Addressed

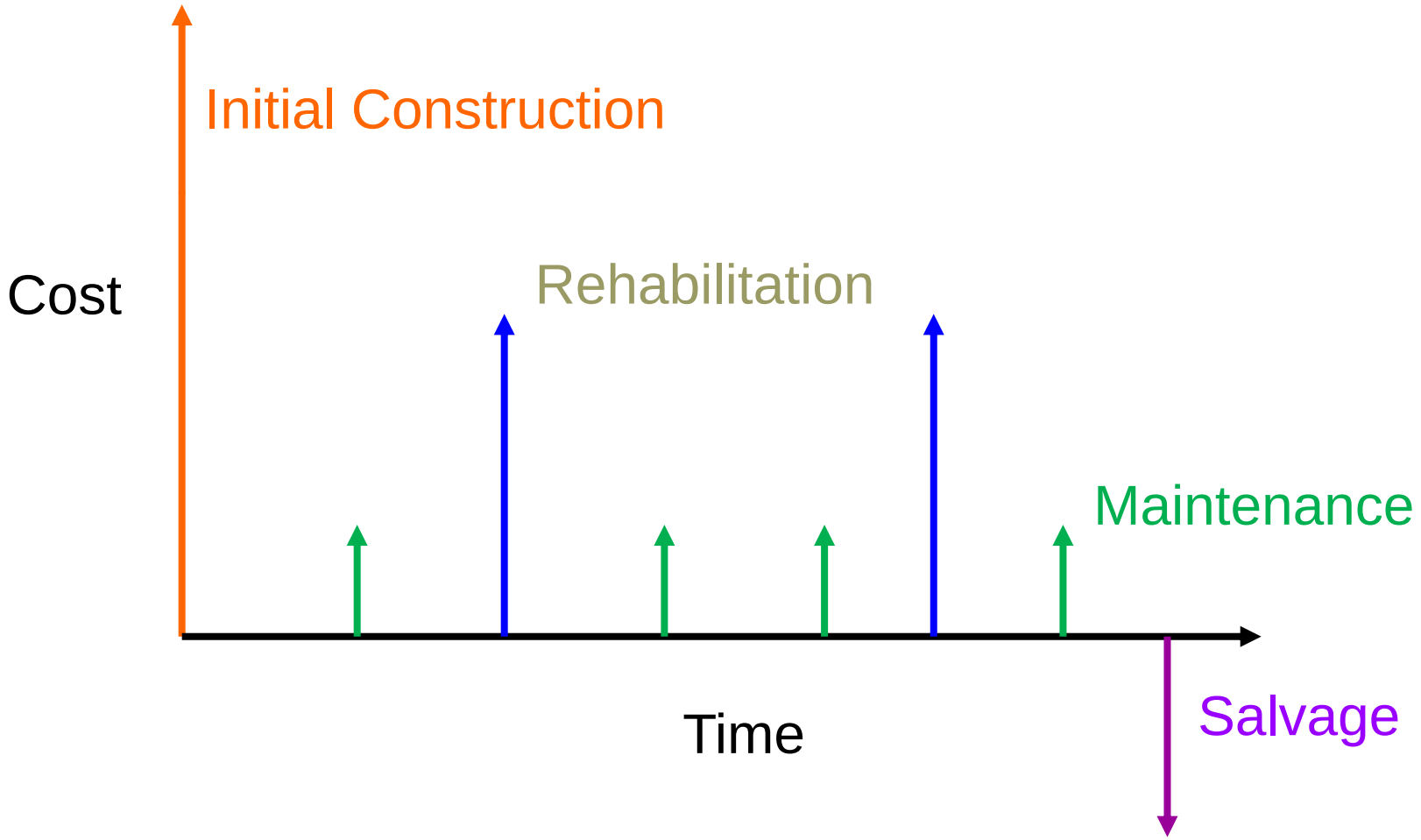
- Select from several alternative approaches

- Build strong and preserve with preventive maintenance or design for short period and rebuild frequently

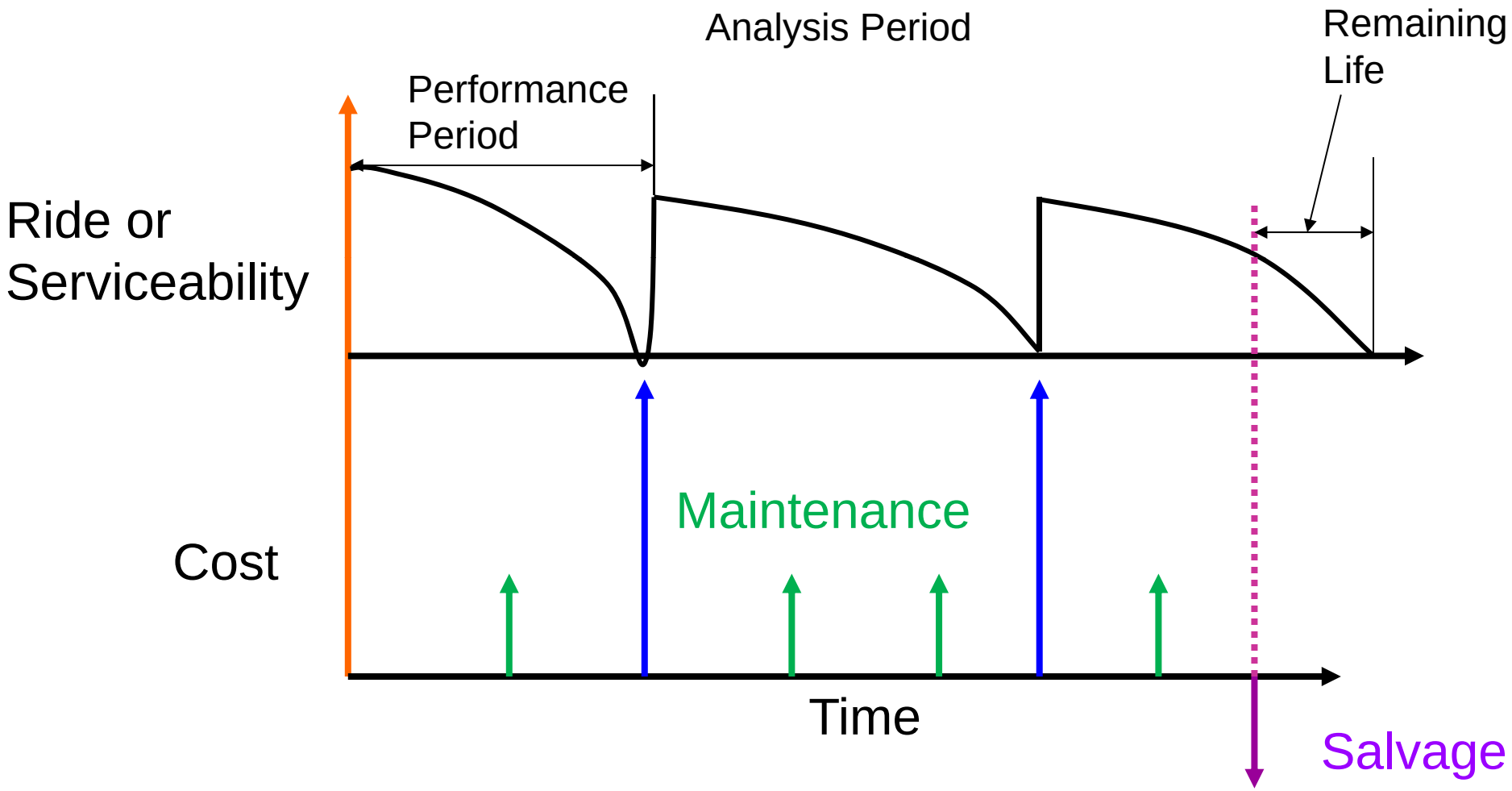




Typical Life Cycle & Agency Costs



Performance & Costs



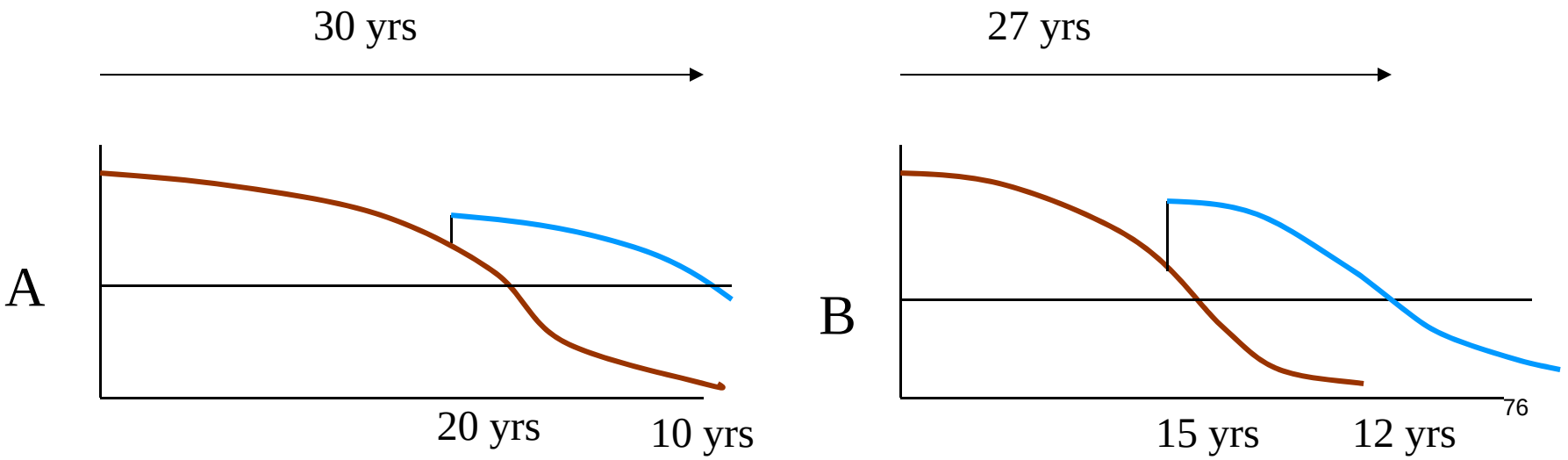
Most of Agency Cost is in:

- Initial Construction
  - 70 to 90%
- Rehabilitation
  - 10 to 25%
- Reactive Maintenance - Almost no effect
- Salvage Value - Very little effect

Life Cycle Cost Analysis

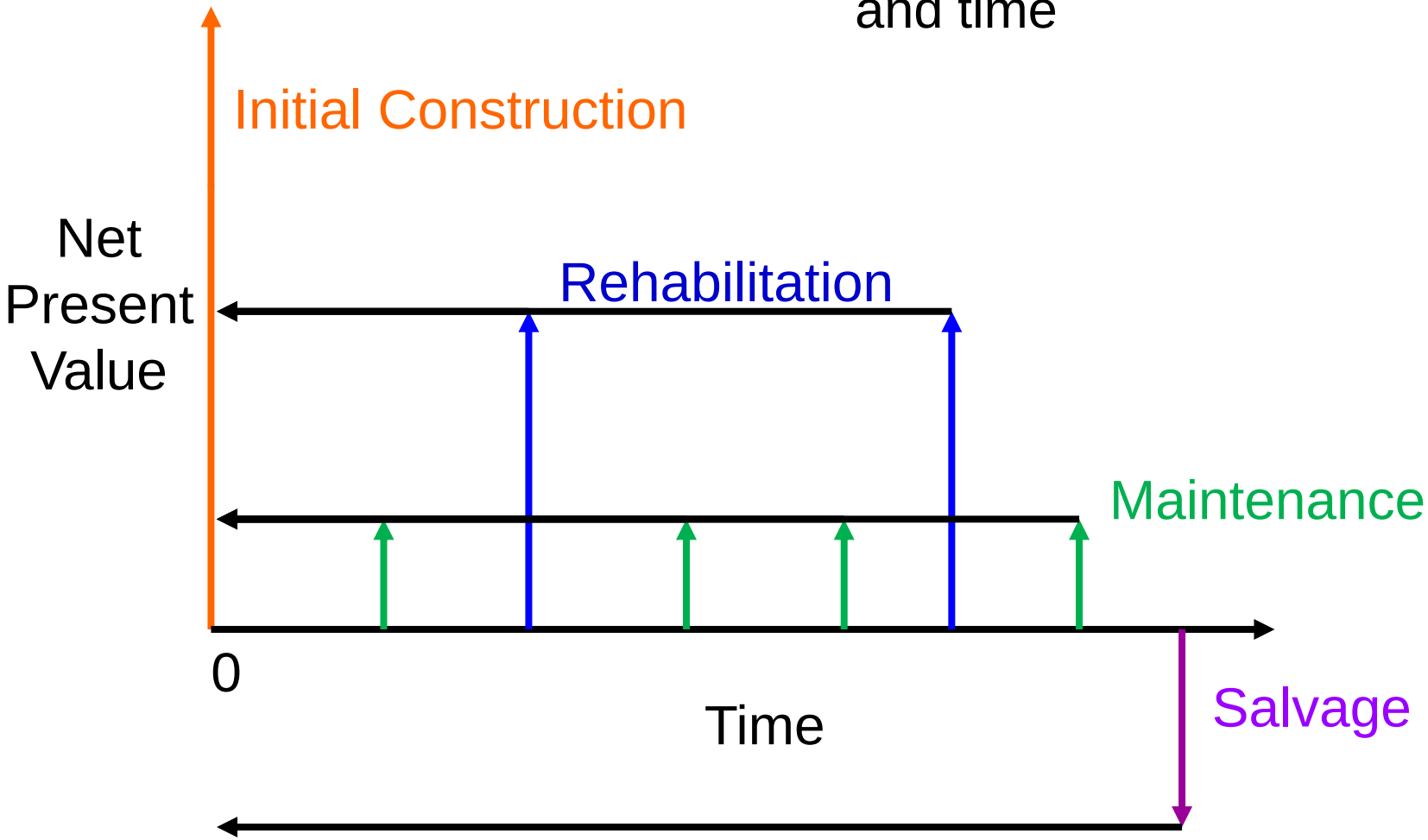
Unequal Total Lifes

- NPV Considering Salvage value
- Equivalent Uniform Annual Cost



Net Present Value

The cost of all activities are computed at time = 0 accounting for discount rate and time

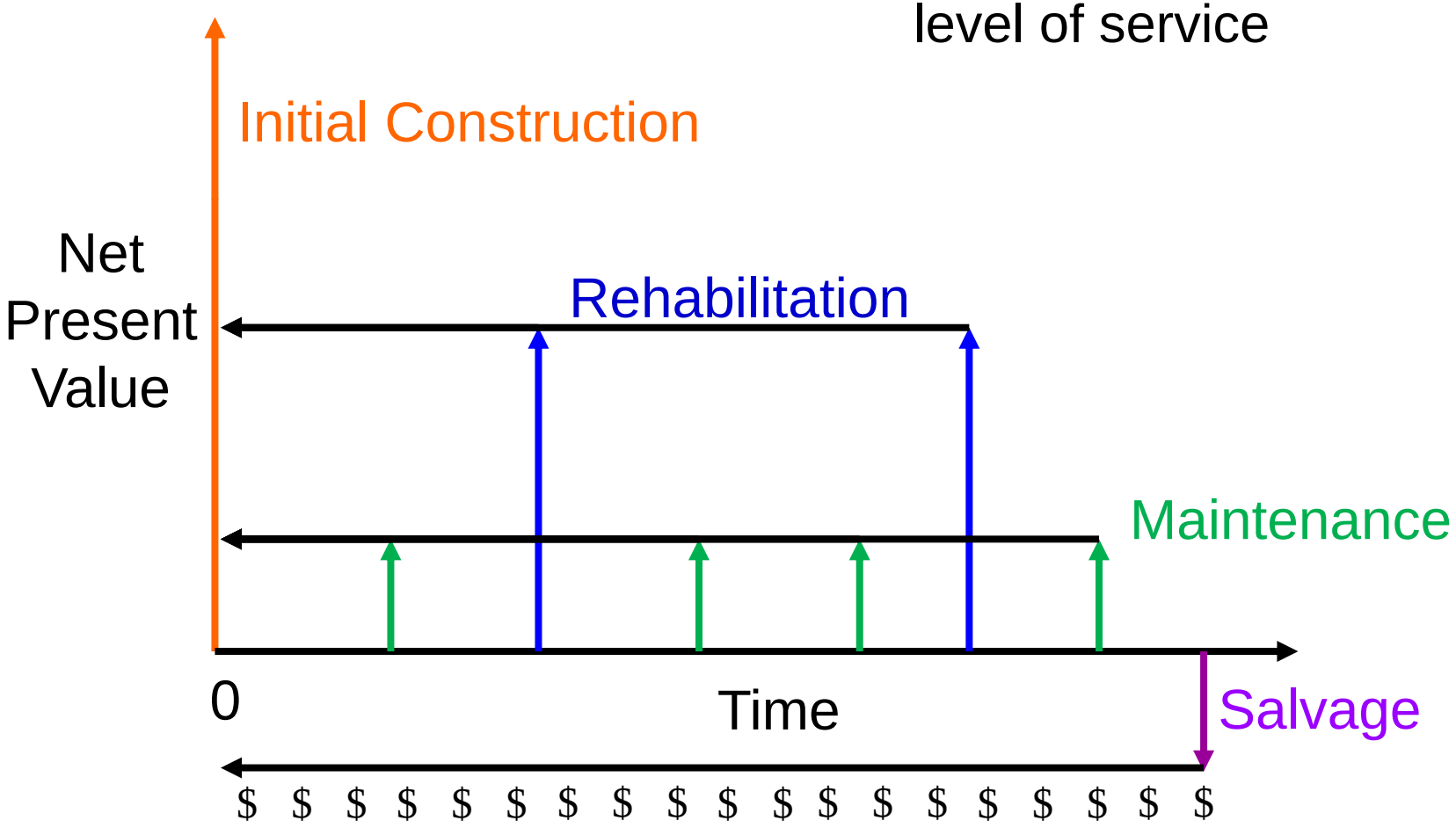


Salvage Value

- Residual Value
  - Value of materials remaining at the end of pavement life – typically not much difference among alternatives
- Service Life
  - Remaining life at end of analysis period
- Used with alternatives that have significant differences in total life

Equivalent Uniform Annual Cost (NPV x CRF)

The annual cost of all activities to provide the pavement at a designated level of service

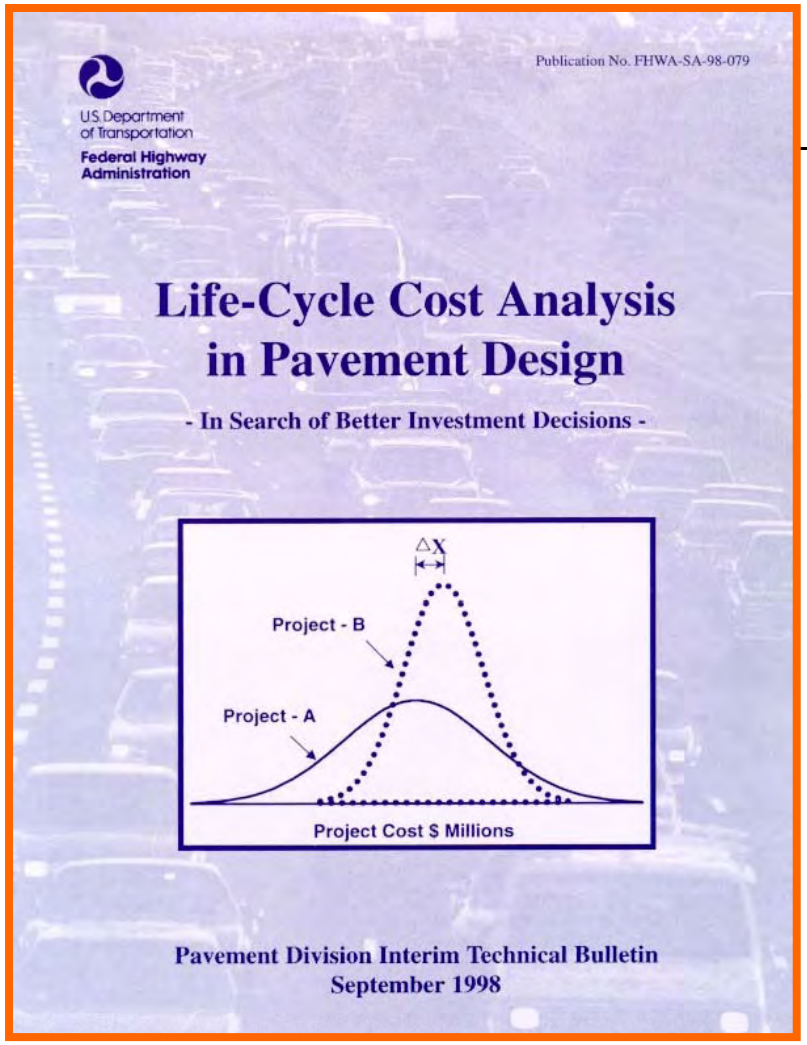


Analysis Period

- New pavement design
  - At least through the life of the first major rehabilitation treatment after initial performance period
- Rehabilitation
  - At least through the life of the subsequent major rehabilitation treatment after initial performance period
- Longer periods are better (avoid salvage value differences)

Discount (Interest) Rate

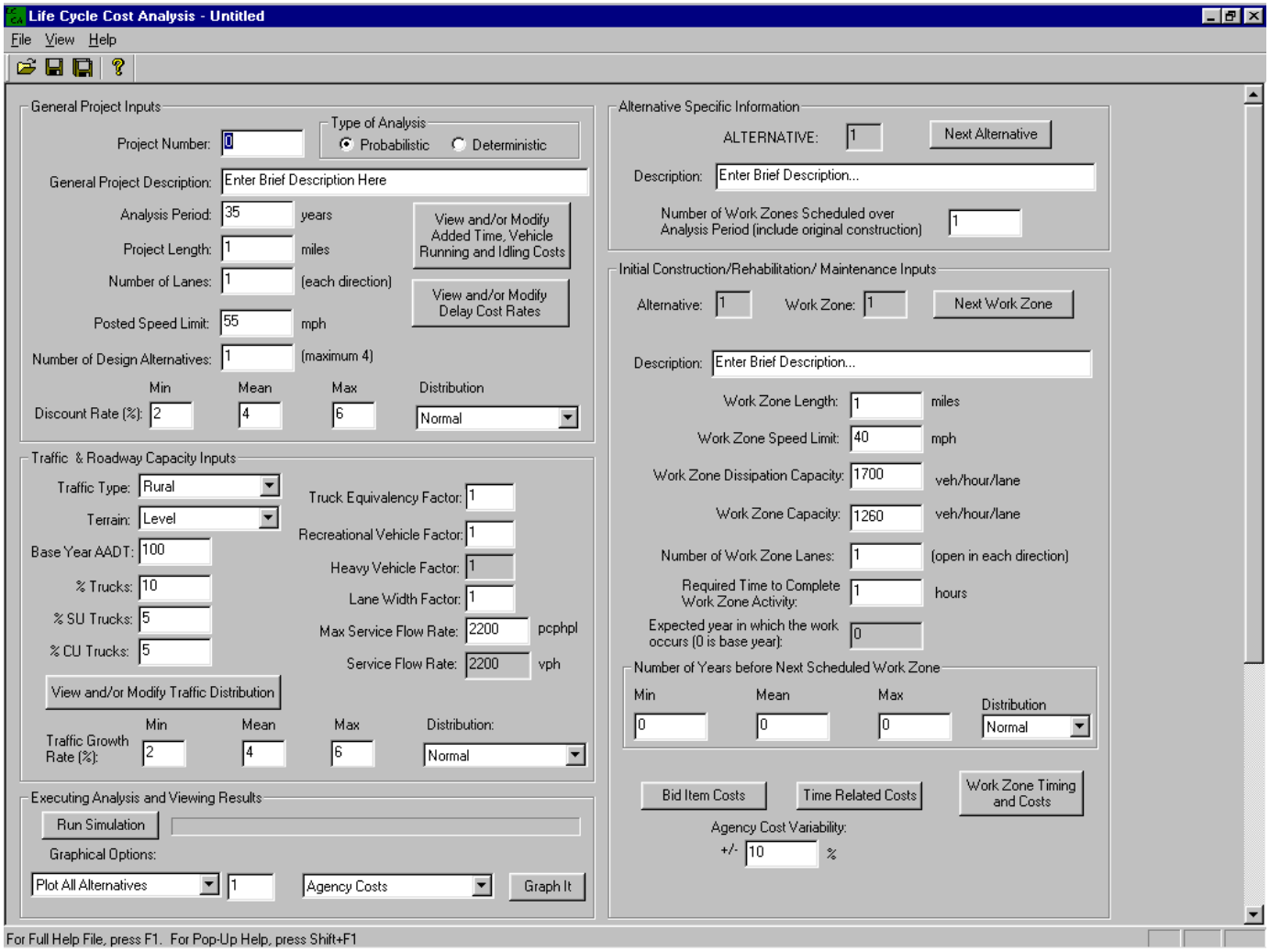
- Time value of money
- Often inflation protected interest rate (10-year Treasury Inflation Protected Security)
- In local agencies
  - Check with financial folks (what do they use?)
  - Typically the agency bond rate



http://restructure.fhwa.dot.gov/dp115/

Good Reference!!

FHWA Has Software Available



ODOT

- ODOT Pavement Design Guide
- Chapter 9: Life Cycle Cost Analysis

WSDOT

FHWA 98 Reoirt

FHWA RealCost LCCA Software

http://www.fhwa.dot.gov/infrastructure/asstmgmt/rc21toc.cfm

Feedback Activity

- At end of construction season
- Review treatments applied
  - Do you need to change decision tree treatment?
  - Was the treatment applied the appropriate treatment or “stop-gap” treatment?
- Review costs for treatments
  - Adjust costs to reflect those from the latest season

Questions