

**NCHRP 20-68A  
US Domestic Scan Program  
Scan 07-05**

# **Best Practices in Bridge Management Decision-Making**

## **Overview of Scan Results**

Midwest Bridge Preservation Partnership  
October 2010

**Peter Weykamp**

Bridge Maintenance Program Engineer  
New York Department of Transportation

# Purpose

**Discover** and collect information on how DOTs manage maintenance of highway bridges and how maintenance impacts the overall bridge program

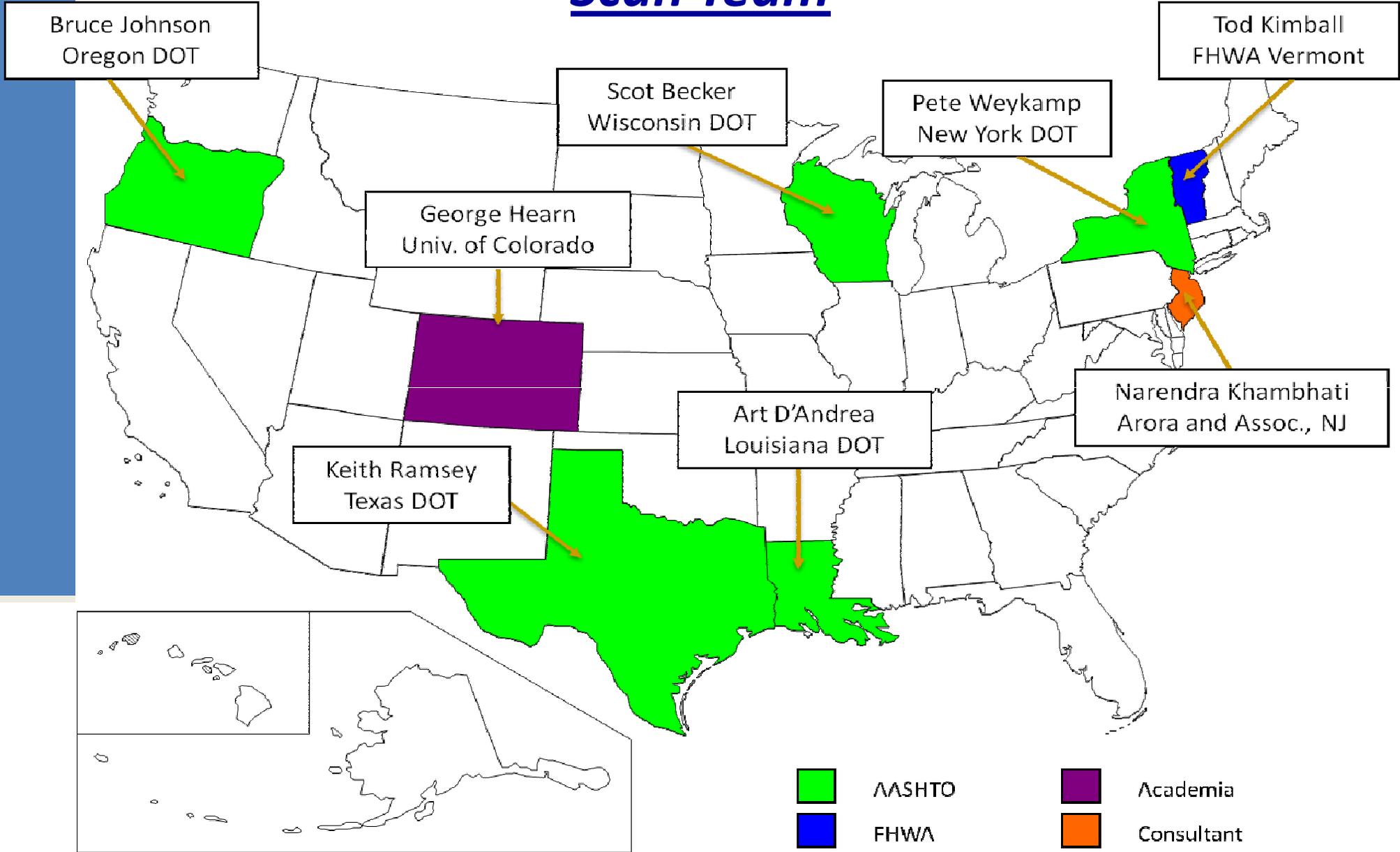
**Focus** on decision processes for maintenance programs;

How Do Decisions Rely On:

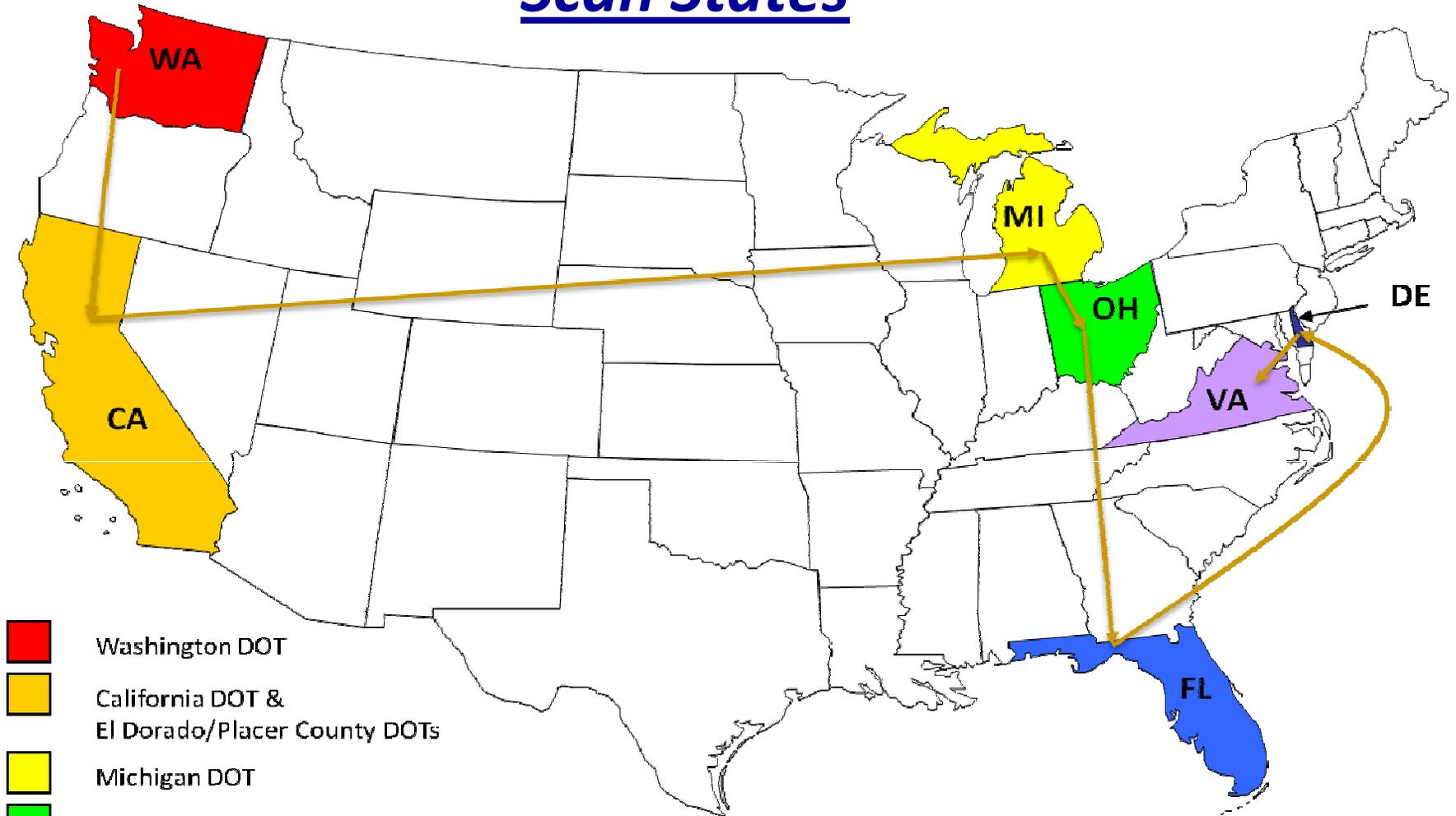
- Bridge Conditions
- Maintenance Needs
- Effectiveness of Maintenance
- Funding Availability



# Scan Team

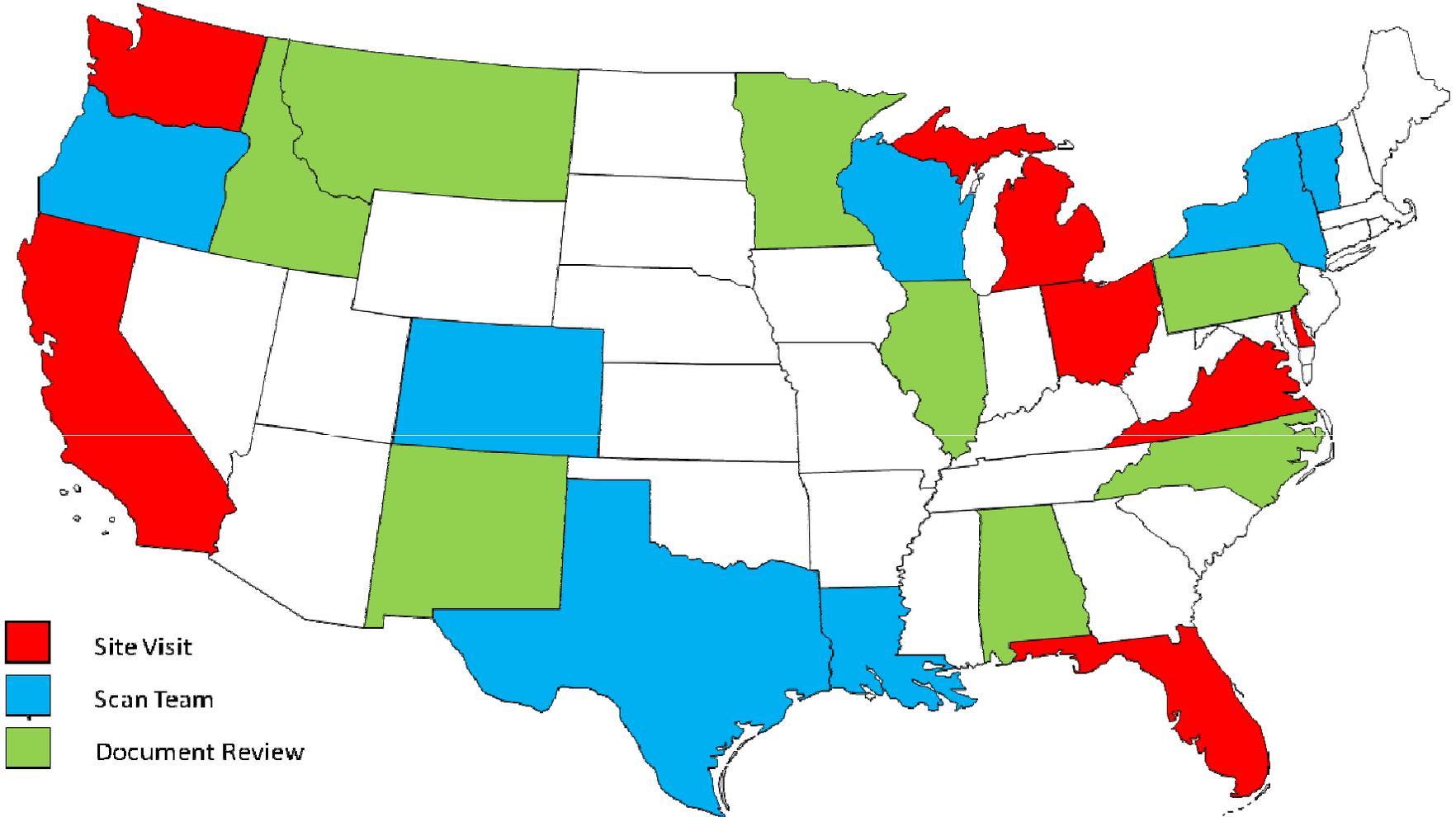


# Scan States



-  Washington DOT
-  California DOT & El Dorado/Placer County DOTs
-  Michigan DOT
-  Ohio DOT
-  Florida DOT & Turnpike
-  Delaware DOT
-  Virginia DOT

# Inputs



- Site Visit
- Scan Team
- Document Review

# **KEY FINDINGS**

**Bridge Management Process**

**Preventive Maintenance**

**Agency Support**



# **Bridge Management**

- ***Maintenance Needs***
- ***Prioritization***
- ***Performance Measures***
- ***Verification***



# *Maintenance Needs*

*Identified at the element level*

*Uniform, specific, and repeatable*

*Stated as standard work actions*

*Accessible throughout the agency*



# *Element Level*

## TYPES

- Modified NBI
- Commonly Recognized (CoRe) Bridge Elements
- Own system

## SUPPORTS

- Detailed reports
- Maintenance decisions
- Treatment options
- Early intervention
- Minimize repair costs

# ***NBI CONDITION ASSESSMENT***

	<b>***** CONDITION *****</b>	<b>***** CODE</b>
(58)	DECK	4
(59)	SUPERSTRUCTURE	5
(60)	SUBSTRUCTURE	6
(61)	CHANNEL & CHANNEL PROTECTION	8
(62)	CULVERTS	N

# *Uniform, Specific, & Repeatable*

## METHODS

- Inspectors recommend action
- Drop-down menu
- Actions prioritized
- Costs per action
- Stored in database
- Draft work order

Num.	MAP Activity
4B1	Movable & Floating Bridge Operations
9B2	Disaster Operations
6B1	Traffic Signal System Operations
5B1	Snow & Ice Control Operations
4B2	Keller Ferry Operations
4B3	Urban Tunnel Systems Operations
4A2	Structural Bridge Repair
6A4	Regulatory/Warning Sign Maintenance
2A5	Slope Repairs
6B3	Intelligent Transportation Systems(ITS)
2A3	Maintain Catch Basins & Inlets
1A1	Pavement Patching & Repair
4A1	Bridge Deck Repair
6A7	Guardrail Maintenance*
6A1	Pavement Striping Maintenance
6A2	Raised/Depressed Pavement Markers
3A4	Control of Vegetation Obstructions
7B1	Rest Area Operations
1A4	Sweeping and Cleaning
2A1	Maintain Ditches
6B2	Highway Lighting Systems
6A6	Guidepost Maintenance
1B1	Safety Patrol
2A2	Maintain Culverts
6B4	Permits/Franchises
6A3	Pavement Marking maintenance
3A2	Noxious Weed Control
1A3	Shoulder Maintenance
6A5	Guide Sign Maintenance
2A4	Maintain Detention/Retention Basins
4A3	Bridge Cleaning & painting
3A3	Nuisance Vegetation Control
3A5	Landscape Maintenance
3A1	Litter Pickup

# Corporate Database

OREGON

Type of Work: Element

Candidate ID:

Structure Unit:

Element:

Action:

Priority:

Date Recommended:

Target Year:

Assigned: No

Work Assignment:

Status:

Estimated Quantity:

m.

Estimated Cost:

Applicable Condition States

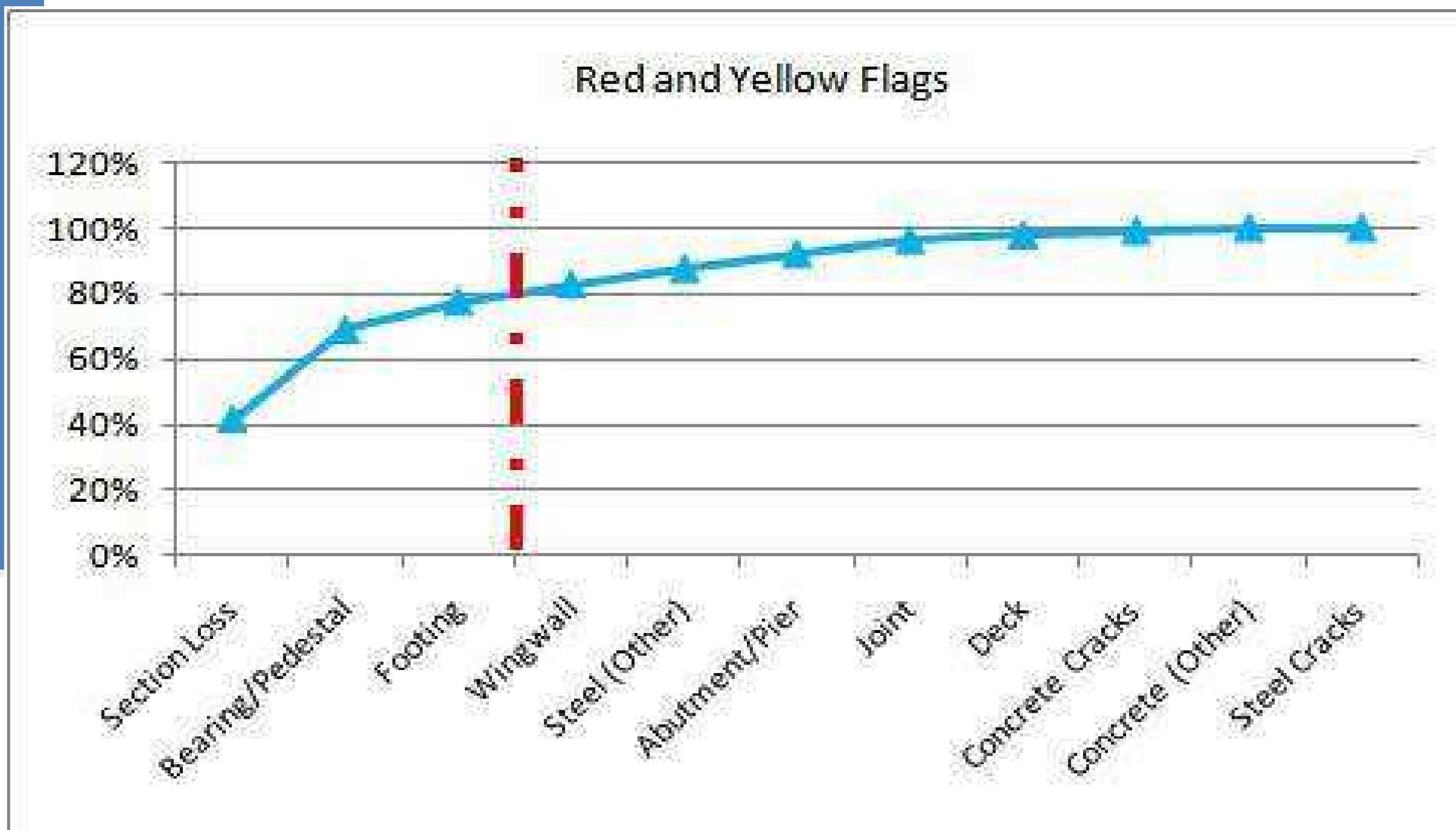
1 2 3 4



BENT12, GIRDER 14: REPLACED DECAYED GIRDER

# Needs Database

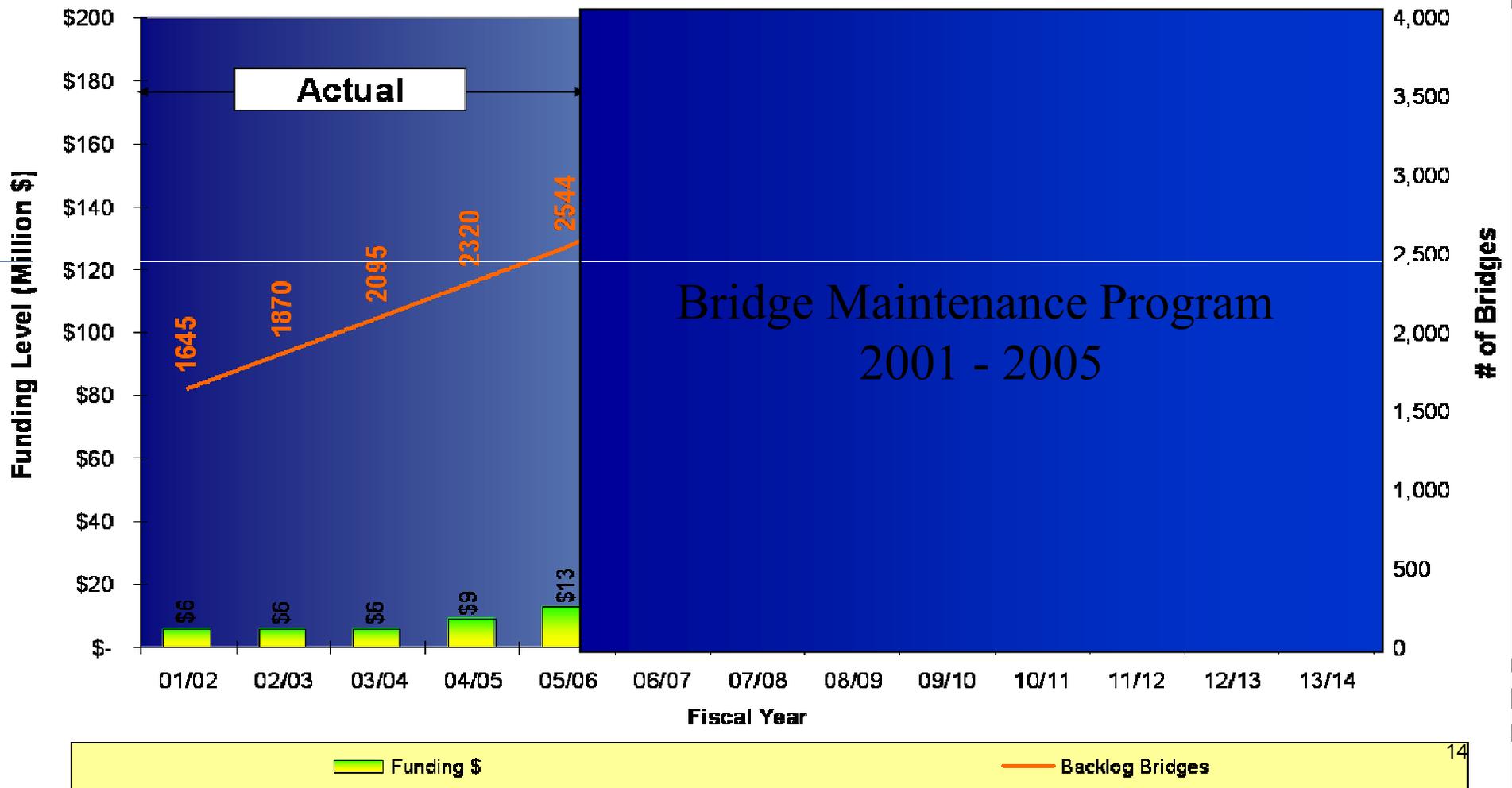
NEW YORK



# Tracking Backlogs

CALTRANS

## Bridge Maintenance Contract Funding and Backlog



## **Prioritization**

***Integrate objectives for deficiencies, preventive maintenance, network performance, and risk***

***Engage both central and regional DOT***

***Advance from network-level rankings to selection of specific projects***



# Prioritization Formulas

## ■ Sufficiency Rating (NBI)

Structural Adequacy and Safety (55% maximum);

Serviceability and Functional Obsolescence (30% maximum);

Essentiality for Public Use (15% maximum); Special Reductions

## ■ Health Index (Pontis)

Health Index (HI) =  $(\sum \text{CEV} \div \sum \text{TEV}) \times 100$

TEV = Total element quantity  $\times$  Failure cost of element (FC)

CEV =  $(\sum [\text{Quantity in condition state } i \times \text{WF}(i)]) \times \text{FC}$



Health 80-89



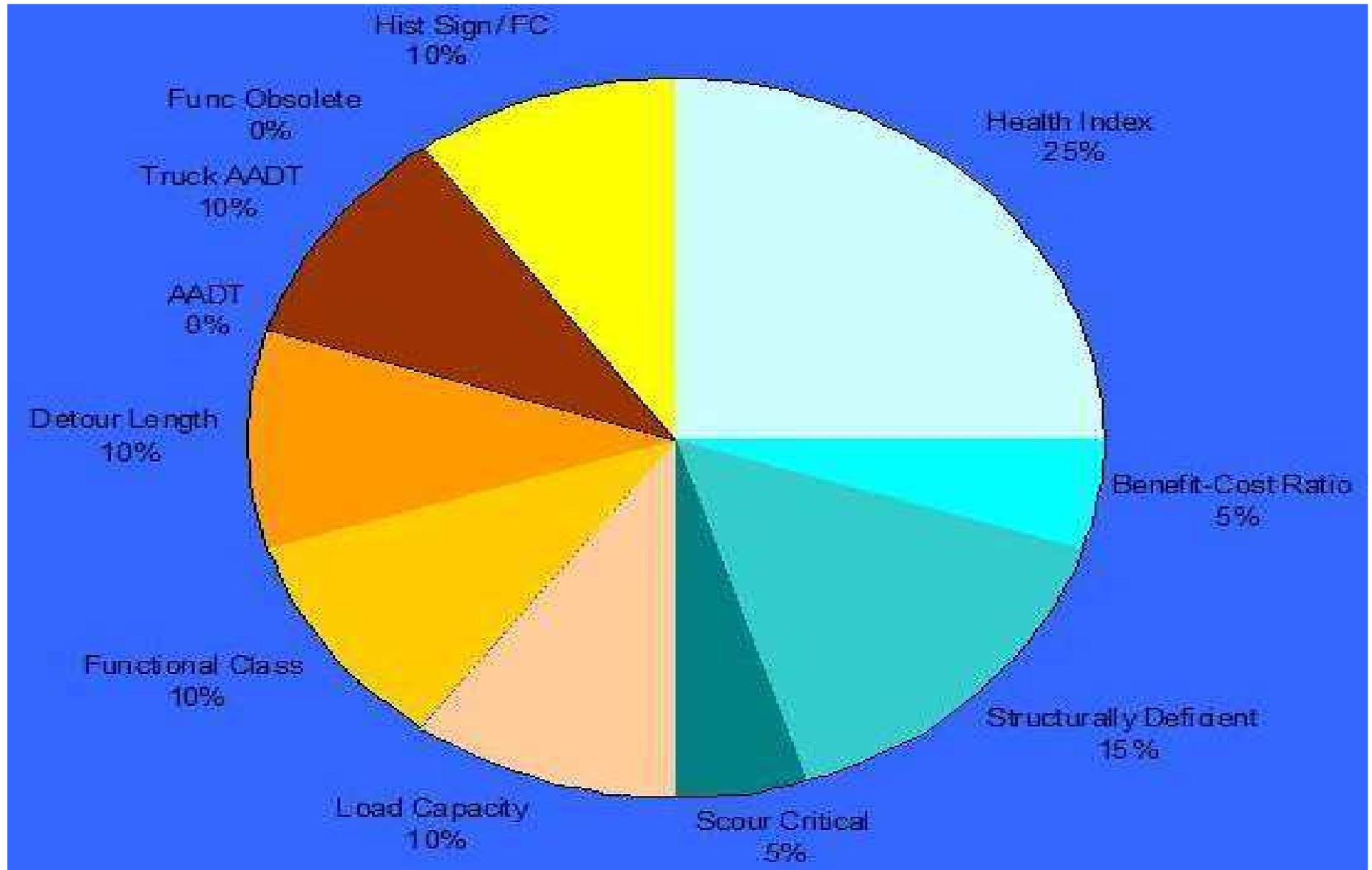
Health 70-79



Health below 70

# Deficiency Formula

DELAWARE



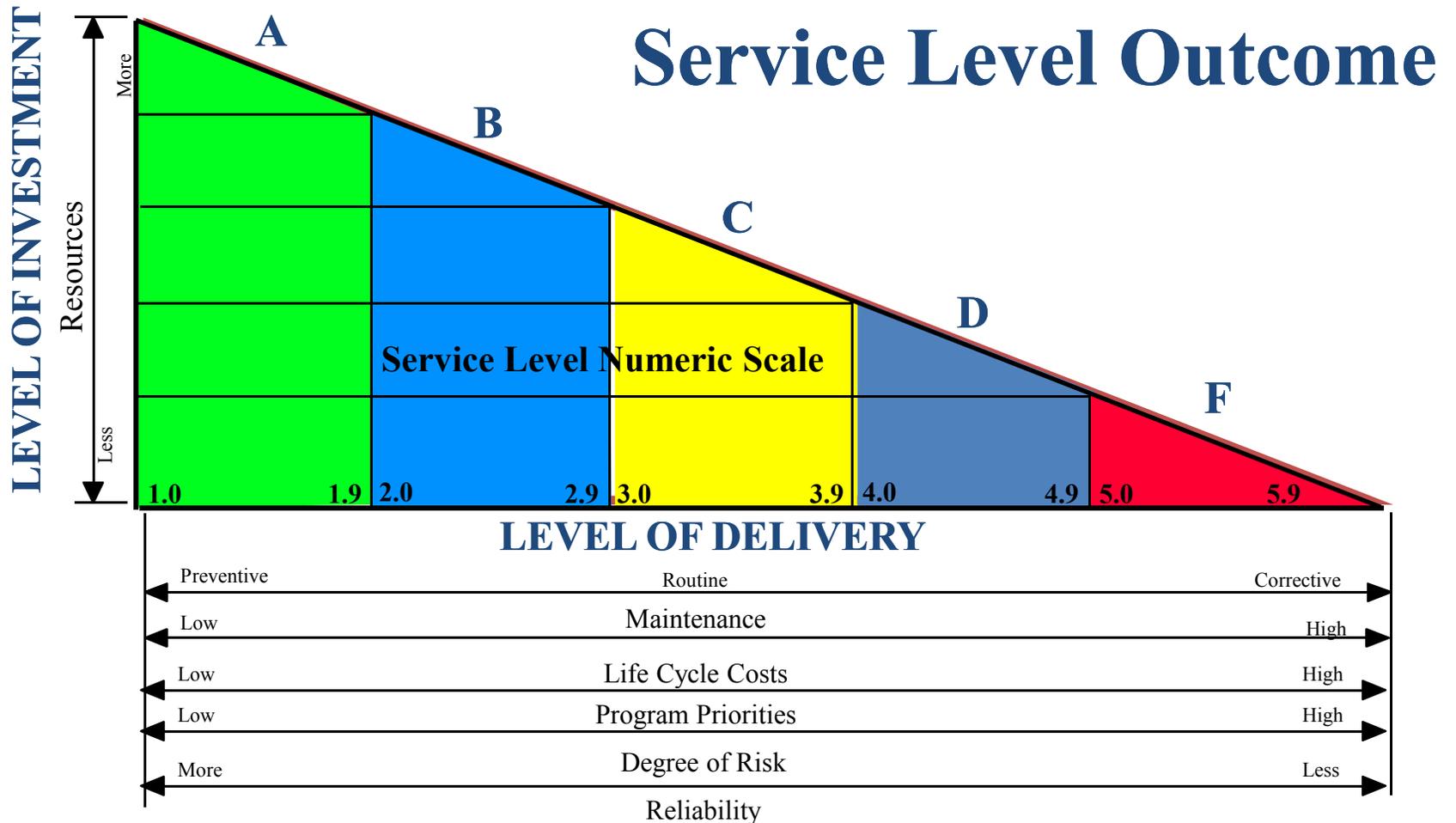
### MAP = Maintenance Accountability Program Priorities listed by Activity

Num.	MAP Activity
4B1	Movable & Floating Bridge Operations
9B2	Disaster Operations
6B1	Traffic Signal System Operations
5B1	Snow & Ice Control Operations
4B2	Keller Ferry Operations
4B3	Urban Tunnel Systems Operations
4A2	Structural Bridge Repair
6A4	Regulatory/Warning Sign Maintenance
2A5	Slope Repairs
6B3	Intelligent Transportation Systems(ITS)
2A3	Maintain Catch Basins & Inlets
1A1	Pavement Patching & Repair
4A1	Bridge Deck Repair
6A7	Guardrail Maintenance*
6A1	Pavement Striping Maintenance
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1B1	Safety Patrol
2A2	Maintain Culverts
6B4	Permits/Franchises
6A3	Pavement Marking maintenance
3A2	Noxious Weed Control
1A3	Shoulder Maintenance
6A5	Guide Sign Maintenance
2A4	Maintain Detention/Retention Basins
4A3	Bridge Cleaning & painting
3A3	Nuisance Vegetation Control
3A5	Landscape Maintenance
3A1	Litter Pickup

# How Does Maintenance Measure Performance?

WASHINGTON



# 4A2 Structural Bridge Repair

Bridge inspections result in the “to-do list” of smaller-scale structural repairs for the Maintenance Program to complete. Examples of these repairs include:

**Bridge Cap Repair**  
**Bridge Column**  
**Repair**  
**Debris Removal**  
**Scour Repair**  
**Expansion Joint**  
**Repair**

2007-09 M Program Budget: \$9.2 million

# 4A2 Structural Bridge Repair Performance Measurement

The performance measurement for this activity focuses on Priority 1 repairs. A list of all repairs for maintenance to complete is compiled each year. The list is identified by either:

the formal bridge inspection process, or  
maintenance personnel during daily work activities.

The Level of Service is based on the percentage of Priority 1 repairs completed.

- A: 90 -100% completed
- B: 80 - 89% completed
- C: 65 - 79% completed
- D: 50 – 64% completed
- F: Less than 50% completed

This activity is currently funded at \$9.2 million for the 2007-09 biennium.

Level of Service target is a C

2008 Level of Service delivered is a D

The 2009-11 proposed budget includes an additional \$1.5 million to catch up with this maintenance backlog and achieve the target.

# What is LOS?

A simple scale that rates the outcomes of maintenance activities.

## Pavement Patching & Repair

### Service Level A



### Service Level B



### Service Level C



### Service Level D



### Service Level F



# Performance Measures

***Match objectives in bridge maintenance***

***Identify work to advance maintenance objectives***

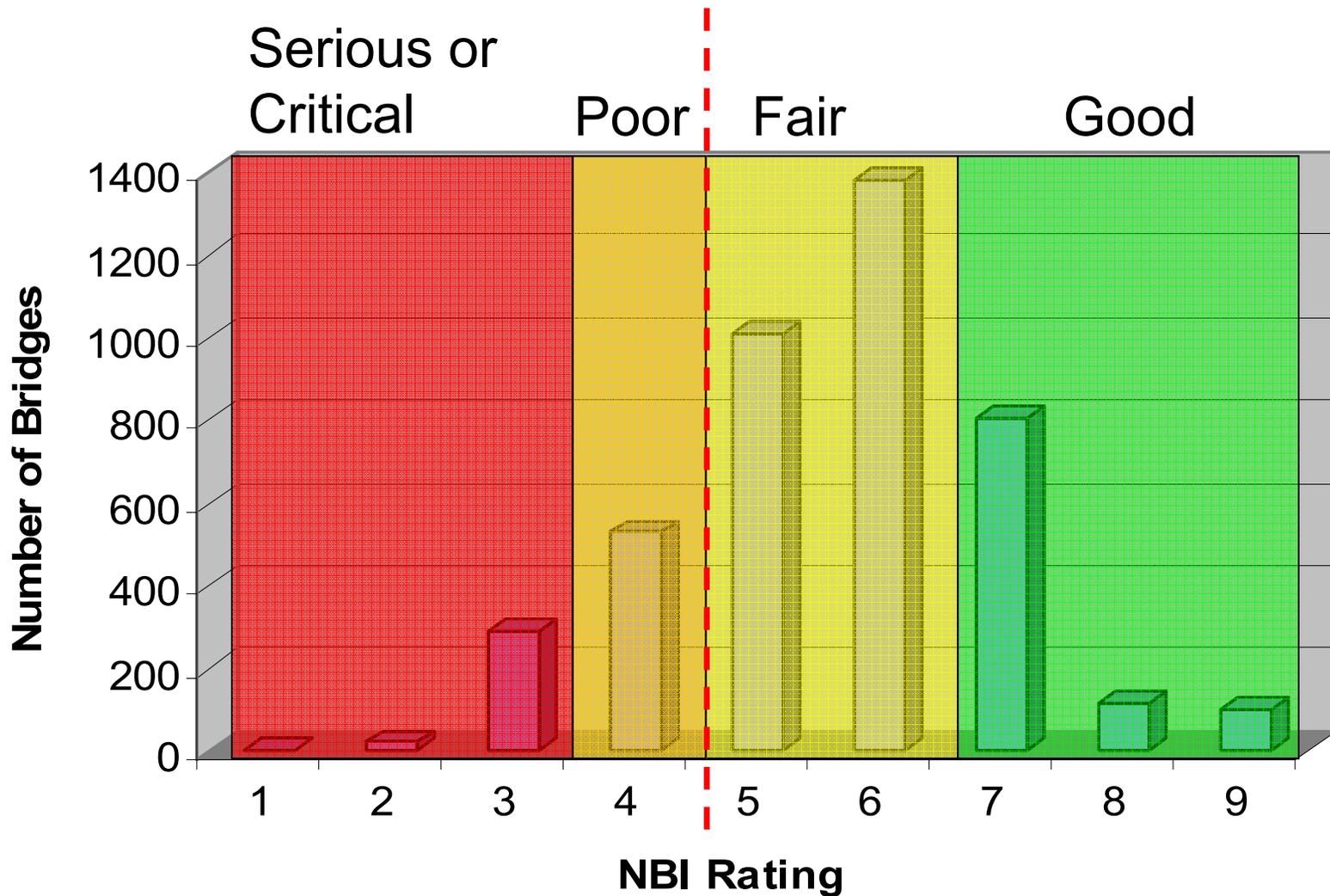
***Provide simple indications of status of bridge networks***



Virginia

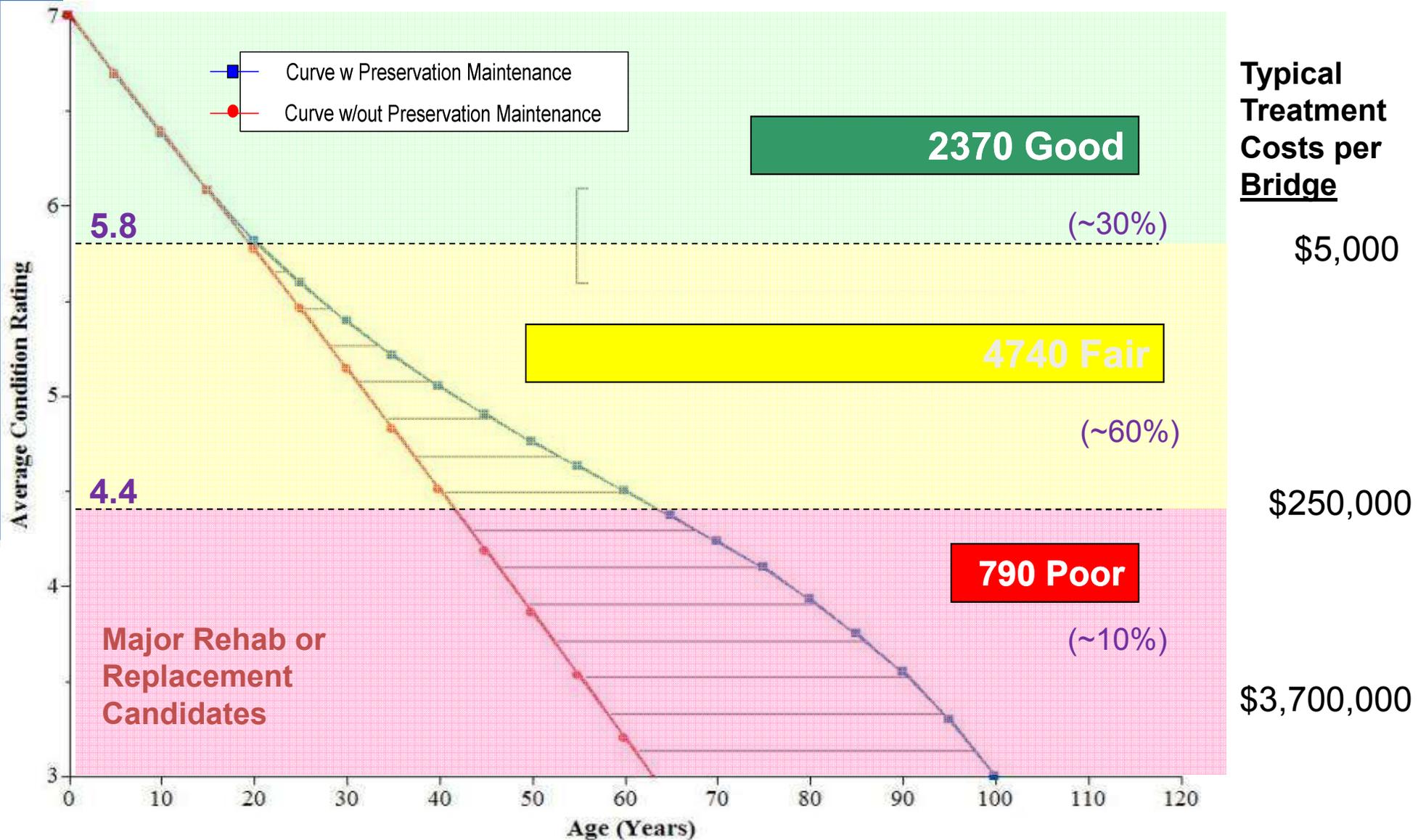
# Bridge Condition Ratings

MICHIGAN



# Service Life Extension

NEW YORK



## Feasible Action Review Committee

Goal: 100% of Priority 1 and 2 WOs completed on time  
90% of all work orders completed on time

Over the last year 7476 of 7492 (99.8%) work orders were completed on time with no delinquent priority 1s and 2s

Priority 1 Emergency 60 days to complete, paperwork may follow corrective action

Priority 2 Urgent 180 days to complete

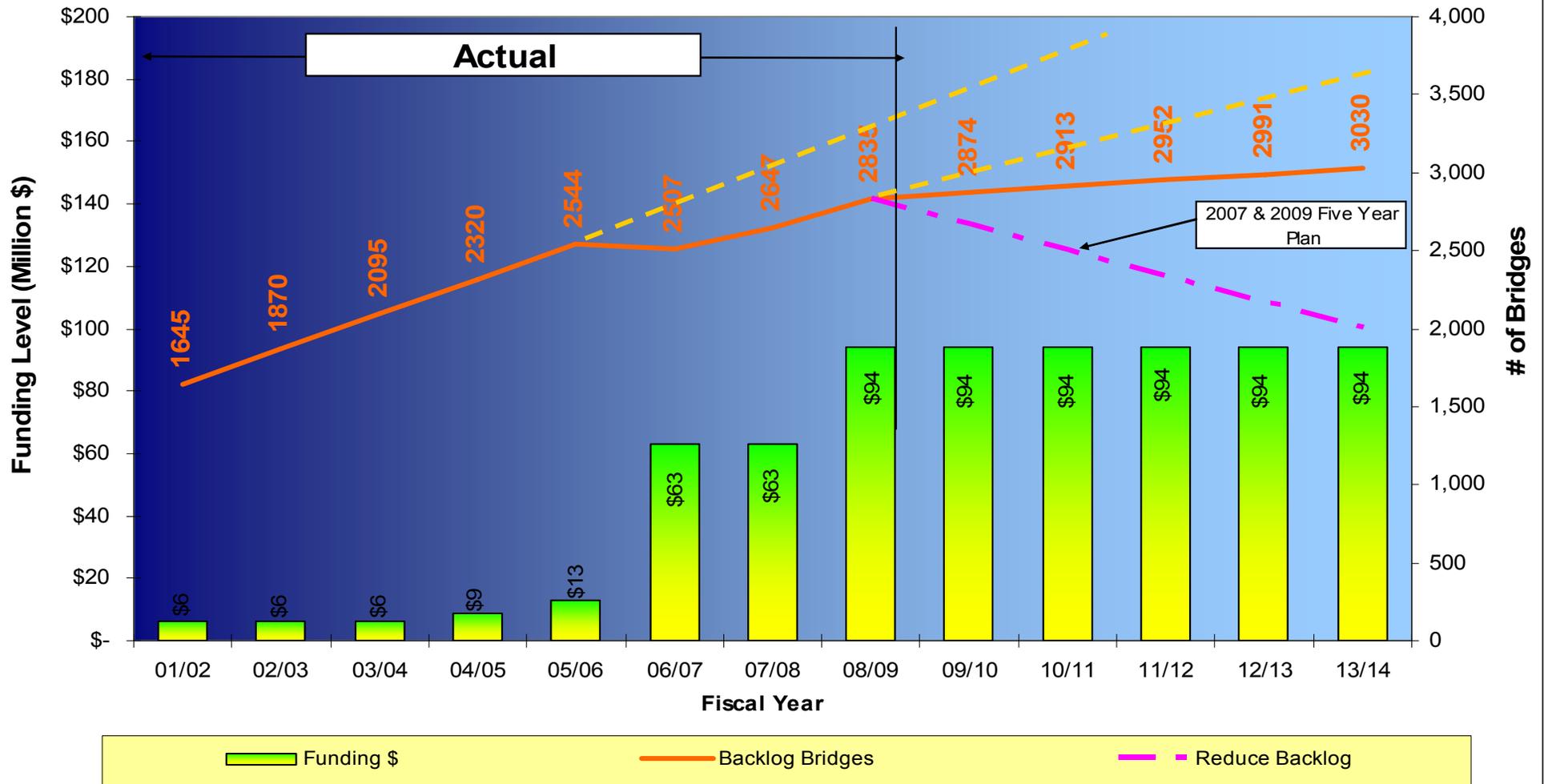
Priority 3 Routine 365 days to complete

Priority 4 Informational no deadline

# Tracking Backlogs

CALTRANS

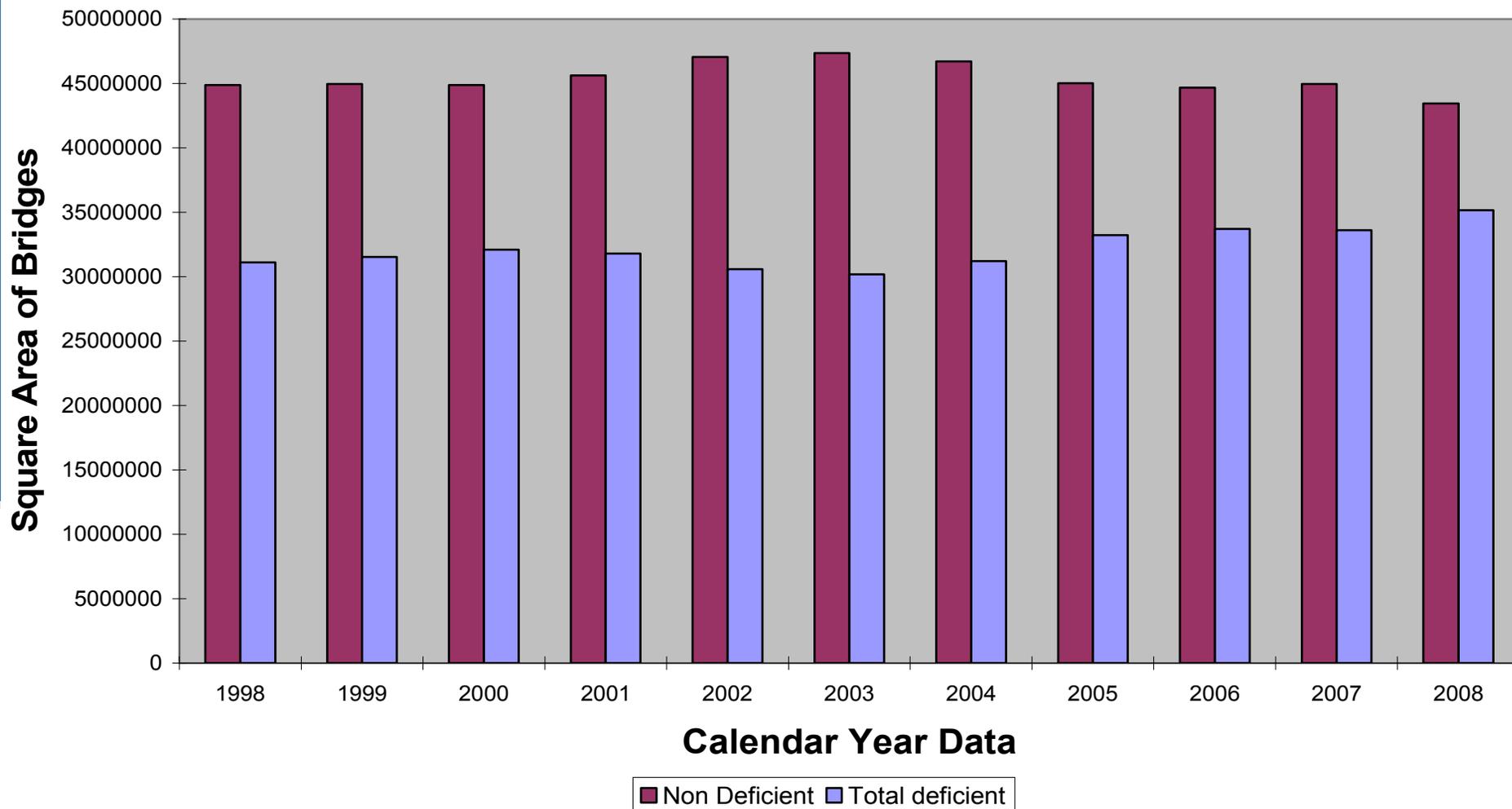
## Bridge Maintenance Contract Funding and Backlog



# Deficient - Deck Area

NEW YORK

## Statewide -- State Owned



# Verification

***Strategy is effective***

*Investment pays off*

***Needs are met***

*Level of Service indicators*

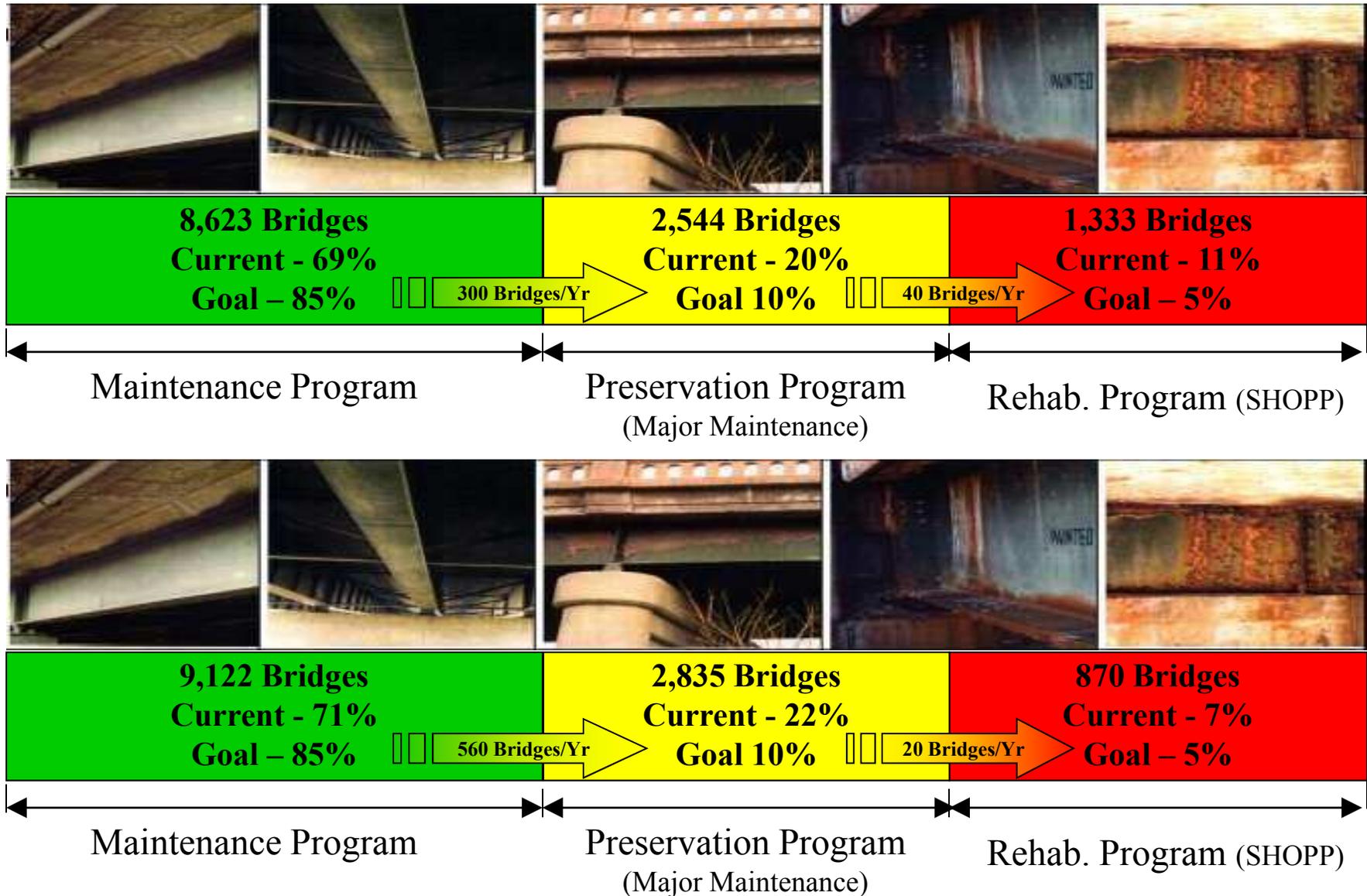
*Needs – Accomplishment = Gap*

***Work completed***

*Report into BMS, MMS, Capital Program, ...*



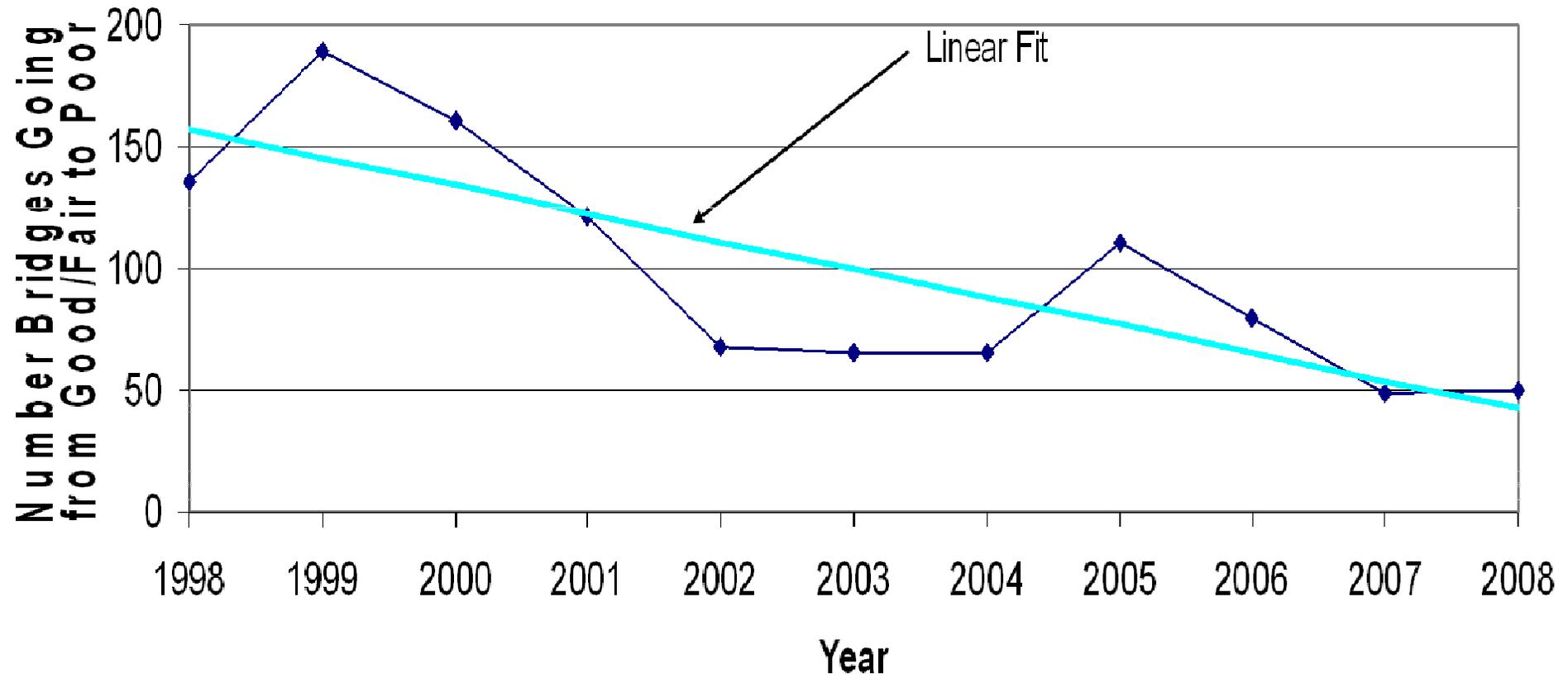
# CALTRANS '05 –'09 Bridge Preservation



# Tracking Trends

MICHIGAN

## Deterioration Rate Statewide Trunkline Bridges



# **Preventive Maintenance**

***Significant part of program***

***Applied before bridges become deficient***

***Implements clear plans of action***

***Flexible allocation of resources***



*Washington*

# Bridge Deck Preservation Matrix

MICHIGAN

CONDITION STATE				REPAIR OPTIONS (c)	POTENTIAL RESULT TO NBI		NEXT ANTICIPATED EVALUATION
Deck Surface NBI #58a	Deck Surface Deficiencies % (a)	Deck NBI #58	Deck Underside Deficiencies % (b)		Item # 58a Deck Surface Rating	Item # 58 Deck Rating	
N/A	N/A	N/A	N/A	CSM Activities	No Change (d)	No Change (d)	1 to 8 years
NBI = 5, 6, 7	2% to 5%	NBI > 5	N/A	Deck Patch / Seal Cracks	Up by 1 pt	No Change (d)	3 to 10 years
				Epoxy Overlay	NBI now 8, 9	No Change	10 to 15 years
		NBI ≤ 5	N/A	Deck Patch	Up by 1 pt	No Change	3 to 10 years
				Hold	No Change	No Change	1 to 8 years
NBI = 5	5% to 15%	N/A		Hold	No Change	No Change	1 to 8 years
				Deck Patch	Up by 1 pt	No Change	3 to 10 years
NBI = 4 or 5	15% to 30%	NBI = 5, 6	<10%	Deep Concrete Overlay	NBI now 8, 9	Up by 1 or 2 pts	25 to 30 years
		NBI = 3 or 4	10% to 30%	Shallow Concrete Overlay	NBI now 8, 9	Up by 1 pt	10 to 15 years
		NBI = 2 or 3	>30%	HMA Overlay with waterproofing membrane(e)	NBI now 8, 9	No Change	8 to 10 years
NBI = ≤ 4	>30%	NBI = > 5	<5 %	Deep Concrete Overlay	NBI now 8, 9	Up by 1 or 2 pts	20 to 25 years
				Shallow Concrete Overlay	NBI now 8, 9	Up by 1 pt	10 years
		NBI = 3, 4, or 5	5% to 30%	HMA Overlay with waterproofing membrane(e)	NBI now 8, 9	No Change	5 to 7 years
				Replace Deck	NBI now 9	NBI now 9	40+ years
				HMA Cap (f)	NBI now 8, 9	No Change	1 to 3 years

# Cyclical Maintenance

VIRGINIA

Bridge Deck Washing (Concrete) – 1 Year  
Bridge Deck Sweeping – 1 Year  
Seats & Beam Ends Washing – 2 Years  
Cutting & Removing Vegetation - 2 Years  
Routine Maintenance of Timber Structures - 2 Years  
Replacement of Compression Seal Joints – 10 years  
Scheduled Replacement of Pourable Joints – 6 years  
Cleaning and Lubricating Bearing Devices – 4 years  
Scheduled Beam Ends Painting – 10 Years  
Installation of Thin Epoxy Concrete Overlay – 15 Years  
Removing Debris from Culverts – 5 Years



# Agency Support

**LEGISLATURE:** *gas tax, dedicated fund, MPO percentage*

**DOT Executives:** *Maintenance is not a episodic. ODOT – “Fix it First”*

**DOT Central:** *Use quantitative performance measures, Recognize districts’ first-hand knowledge*

**District Engineers:** *Evaluate needs and trends funds and projects*

**Inspectors:** *Identify needs, recommend actions*

**Crews:** *Execute work, take initiative*

# Key Recommendations

1. **Require element-level inspection programs, and establish standard condition states, quantities, and recommended actions** (maintenance, rehabilitation, replacement) to match the operational characteristics of the maintenance program of the agency
2. **Establish national performance measures for all highway bridges** for comparisons among bridge owners and owner-specific performance measures that can be used to allocate funding levels for a full range of actions to optimize bridge conditions

# Key Recommendations

3. **Use owner-specific performance measures** to set overall funding levels for maintenance programs.
4. Determine bridge needs and treatment schedule based on owner-specific objectives, and utilize schedule to **develop needs-based funding mechanisms** (for the full range of recommended actions) that are consistent with network performance measures.

# Key Recommendations

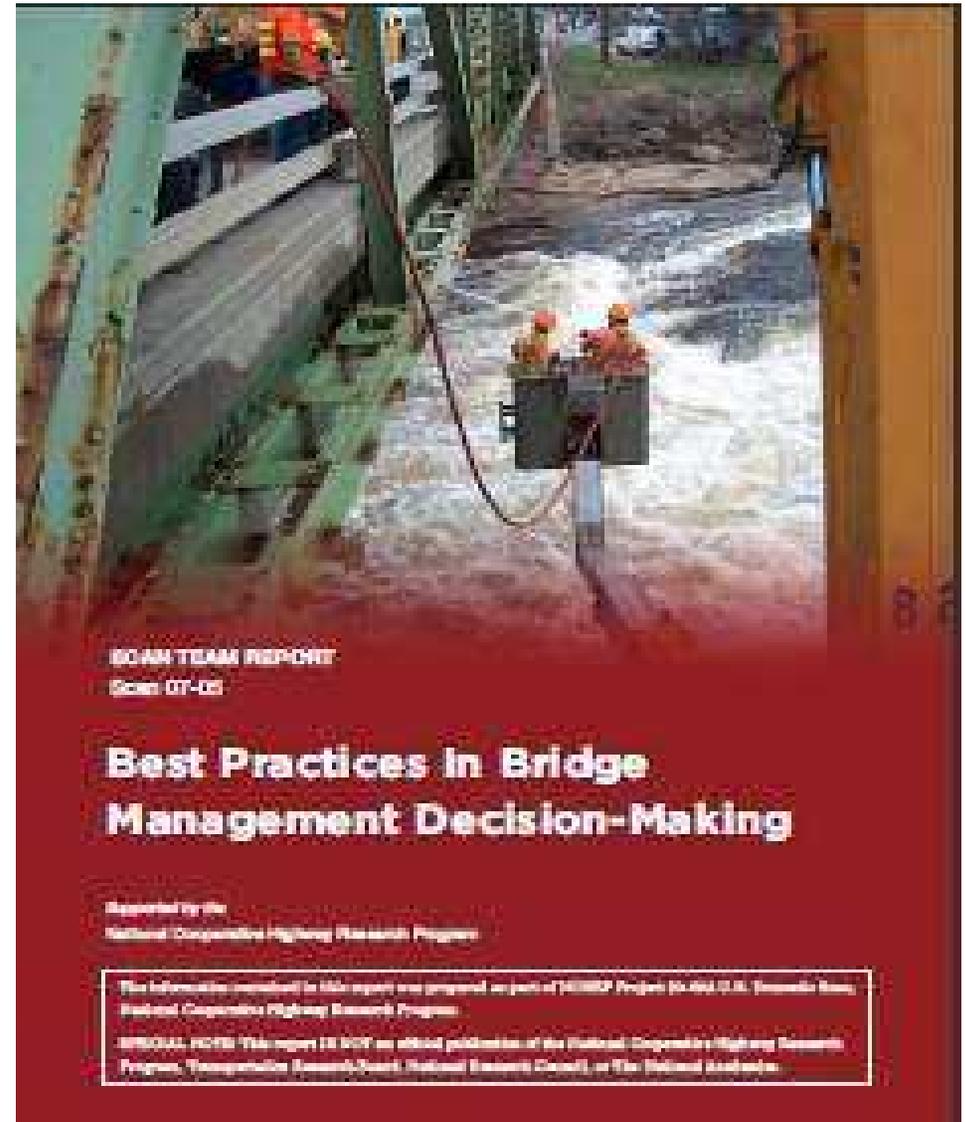
- 5. Establish standards, and require implementation by bridge owners, of preventive maintenance programs** that are funded at levels set by analysis of performance measures. Programs must include the repair needs of 'cusp' bridges to keep them from becoming 'deficient' bridges. Experience in scan states has shown that preventive and minor maintenance must be a significant portion of bridge programs that optimize bridge conditions within limited budgets.

# Key Recommendations

- 6. Develop work programs for maintenance that include the unit or crew level involvement (i.e. at the lowest level of management or supervision) when those positions are staffed by supervisors with extensive field maintenance experience. Avoid “blind” use of work programs from bridge management systems, and work programs dictated by goals to maximize performance measures (although both bridge management systems and performance measures provide useful information to maintenance crews).**

# FINAL REPORT

- Google: **NCHRP Domestic Scan**
- Look for: **07-05 Best Practices in Bridge Management Decision-Making**



**THANK YOU**

# **BRIDGE MAINTENANCE CREDO**

**We, the bridge maintenance engineers of NYSDOT hold these truths to be self-evident: all joints leak, all concrete cracks, and rust never sleeps. We will strive to capitalize our way out of maintenance and maintain our way out of capital. It is our endeavor to educate others that a bridge is as important to a highway as a diamond is to a ring.**