Bridge Preservation for Local Agencies

TSP2 Bridge Preservation Partnership




TSP2 AASHTO

WESTERN MIDWEST NORTHEAST SOUTHEAST

Overview

- The TSP-2 Bridge Preservation Partnerships
- Asset Management and How Preservation Fits In
- Identifying Preservation Candidates
- Developing and Funding a Bridge Preservation Project
- Developing a Bridge Preservation Program
- Bridge Preservation Activity Review

AASHTO TSP-2 Bridge Preservation Program

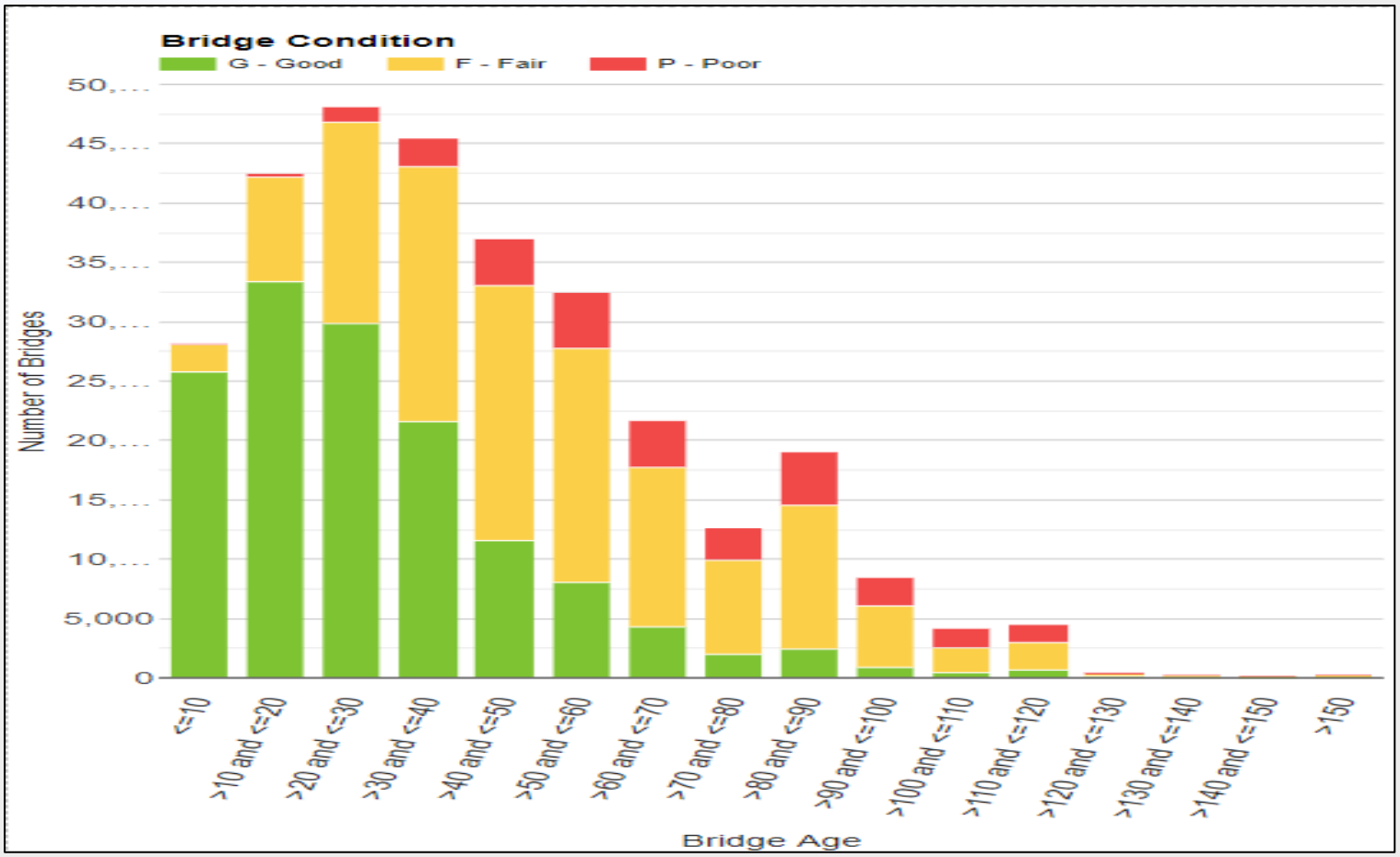
- Information on how to extend the useful life of our bridges
- A Partnership of Owners, Industry, and Academia
- Annual meetings, monthly calls and working groups to collaborate and disseminate information on preserving bridges

TSP2 AASHTO

Local Agency Outreach Working Group

- Increase preservation of Local Infrastructure Assets.
- Provide education opportunities to Local Agencies.
- 40+ members composed of DOTs, County and City Engineers, FHWA, LTAPs, Academia and Industry.

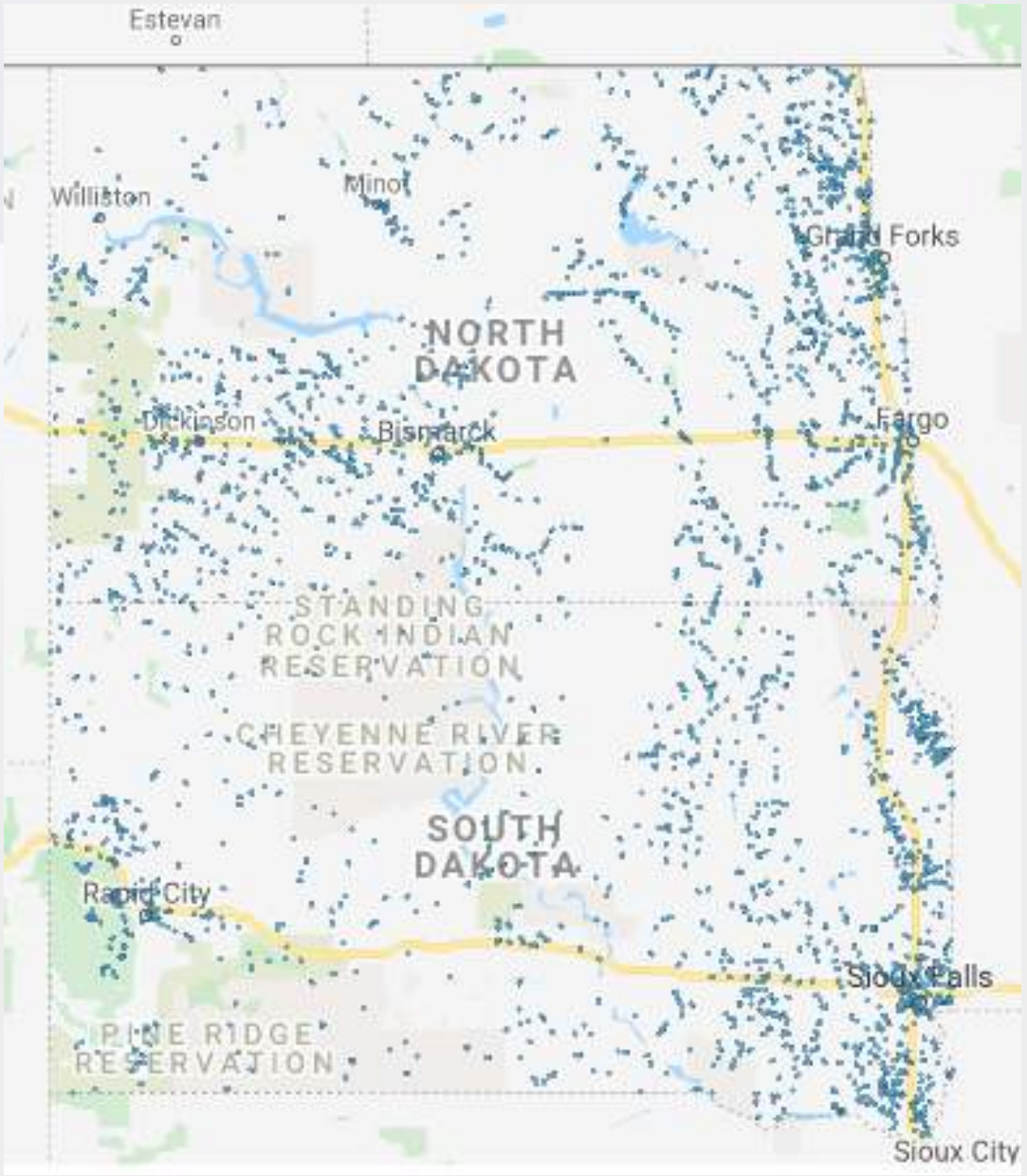
Local Agency's Maintain ~1/2 of all Bridges



N/S Dakota Local Good Bridges

3,018 Good Condition

Source:
infobridge.fhwa.dot.gov



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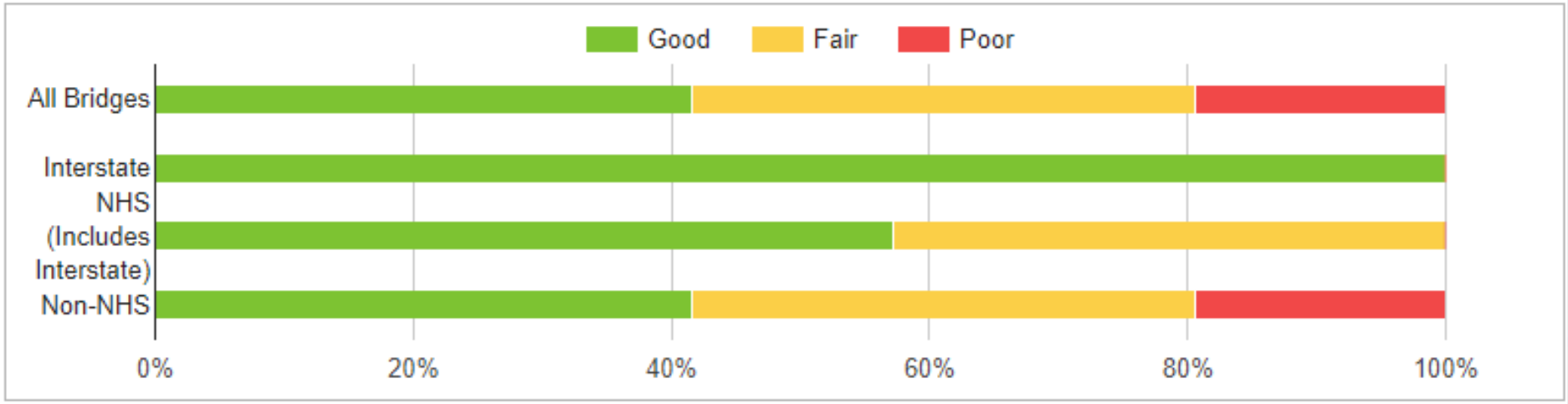


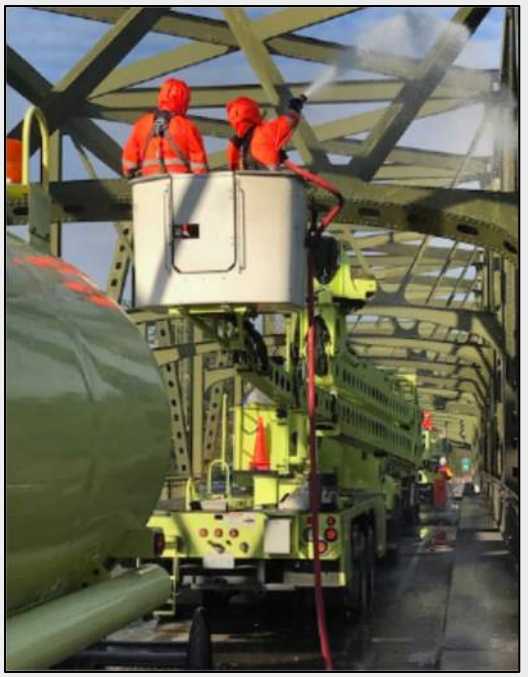
	Good	Fair	Poor
All Bridges	3,018 (41.66%)	2,823 (38.96%)	1,404 (19.38%)
	Total: 7,245		

Asset Management Plan

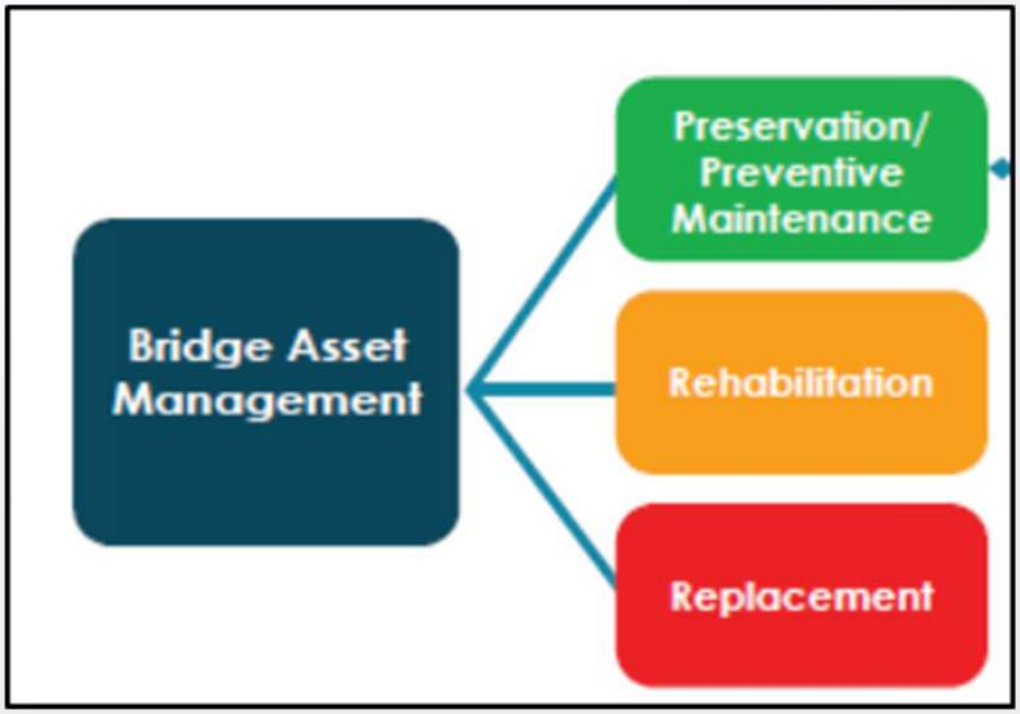
"Hold on, where's the forest again?"

FHWA : Asset Management Plan

- A **strategic** and **systematic** process of operating, maintaining, and improving physical assets.
- Focus on both engineering and economic analysis based on quality information.
- Identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions.
- The goal is to achieve and sustain a desired state of good repair over the life cycle of the assets at a **minimum practicable cost.**



3 Categories of Bridge Actions



Bridge Replacement

- Most expensive of bridge actions
- Funding is limited to the worst bridges in the inventory
  - This leads to the “worst-first” approach
  - Cost to replace or perform major repairs = $164 Billion[1]
- Disruptive to the traveling public
- Long timeline: funding process, design and construction

Bridge Rehabilitation

- Large scale projects required to restore the structural integrity of a bridge
- Typically reserved for bridges that have one component with significant deterioration, but the rest of the structure is worth saving
- High cost of rehabilitation can lead to full replacement

Bridge Preservation

- Actions or strategies that prevent, delay, or reduce deterioration of bridges
- Keep bridges in good or fair condition to avoid or delay the need of costly rehabilitation or replacements
- The cheapest bridge actions
- Performed under short term traffic control

Rehabilitation vs. Preservation

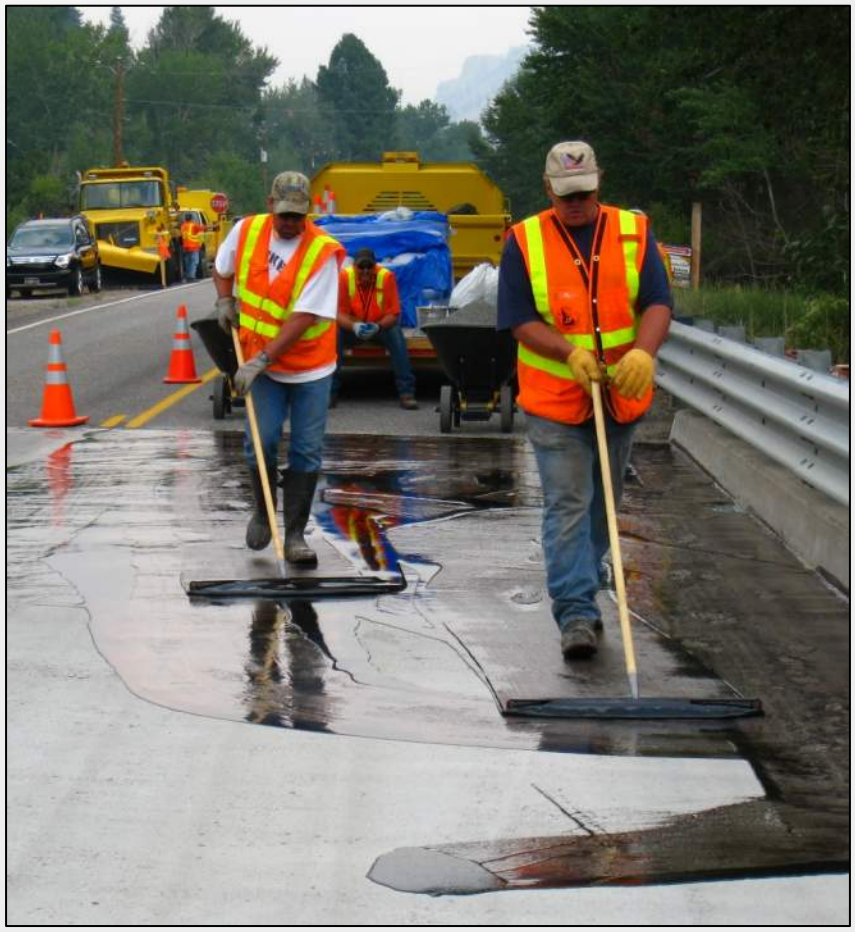
- The deck is typically the highest value component of a bridge
- It is also the component subject to the most rigorous conditions
  - Traffic Impact and Wear cause cracking and rutting
  - Exposure to rain, snow and ice result in corrosion of reinforcement and spalling.
  - Deicing applications leads to rapid early failure as reinforcement corrosion is accelerated

Bridge Deck Rehabilitation

- Deck Replacement or Rehabilitation
  - Requires long term traffic disruption (Staging = 50-60% of project costs)
  - High cost can lead to complete bridge replacement
  - Drain on maintenance until project can be planned

Bridge Deck Preservation

- Deck sealers and thin overlay systems
  - Only requires short term traffic control
  - Inexpensive and cost effective
  - Deck doesn't currently require maintenance resources as the deck condition is still relatively good



Bridge Preservation

- Benefit - easy to understand but difficult to quantify
- Key challenge- activities don't typically improve the condition of the bridge
- Intent- delay how long it takes the bridge to deteriorate
- Effectiveness depends on many factors (climate, structure type, current condition, preservation treatment, etc.)

Car Analogy

Preservation
- Oil Changes
- Washing
- Tire Rotation
- Transmission Service

Rehabilitation
- Engine Rebuild
- Body work and Painting
- Tire Replacement
- Transmission Replacement

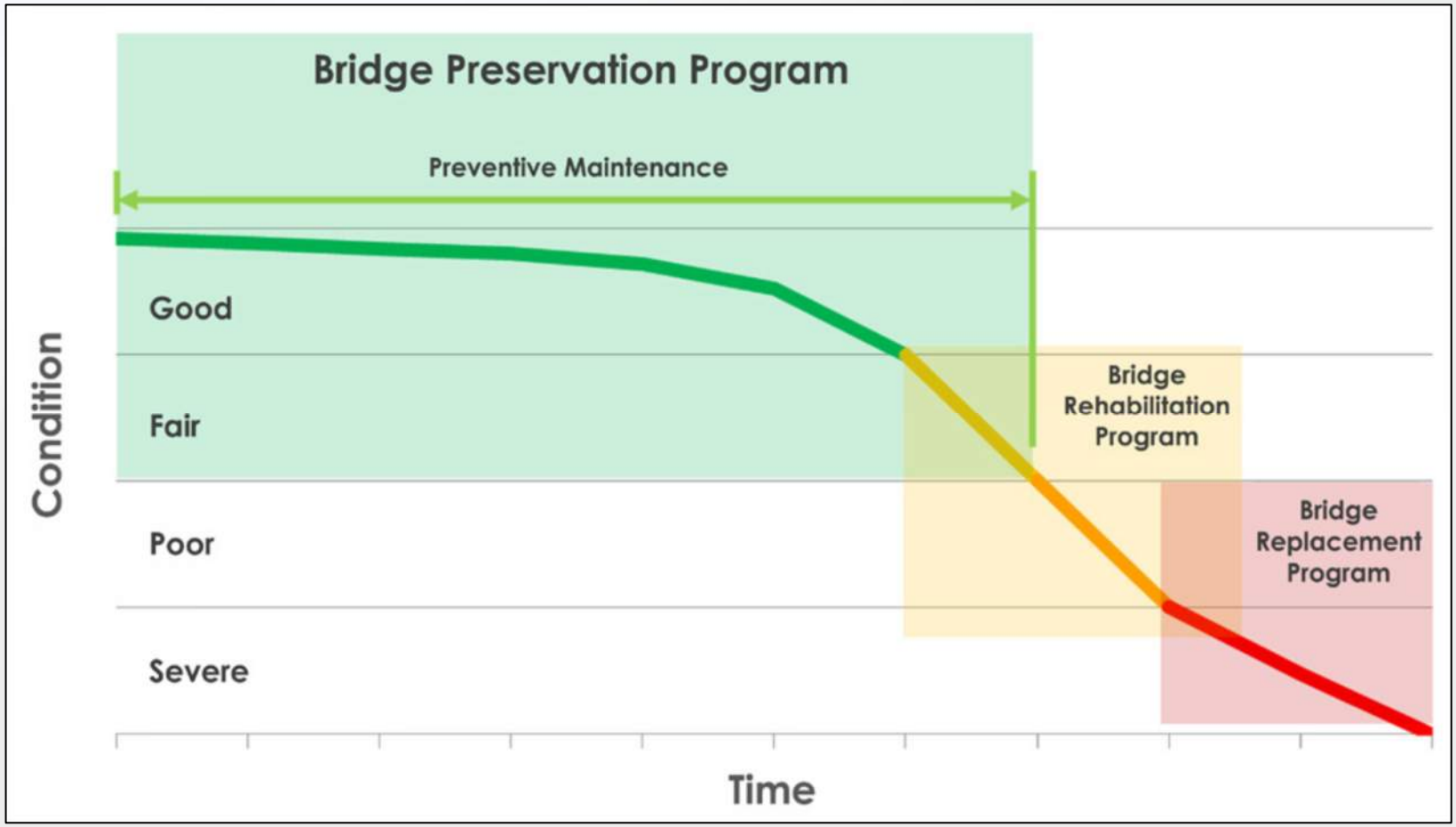
Typical Preservation Actions

- Deck Treatments (Sealers and overlays)
- Bridge Washing
- Bridge Joint Maintenance
- Painting Steel Structures
- Concrete Patching
- Asphalt/ Membranes

Candidates for Preservation

High Value Bridges

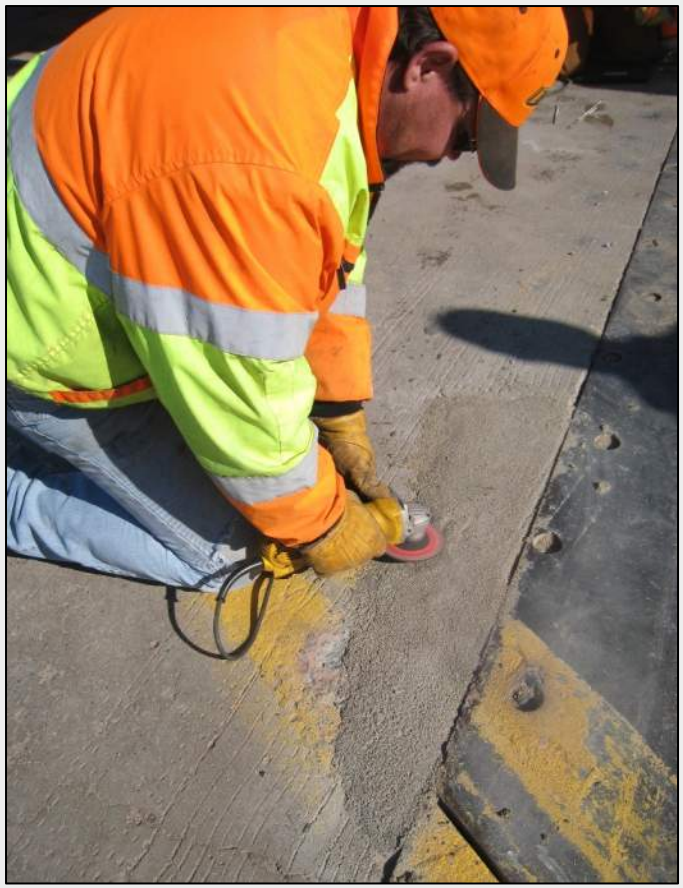
Candidates for Preservation



Source: GPI, Ref 3

How to Search for Good Candidates

- National Bridge Inspection (NBI) Data
  - Search available NBI data
  - Element level data provides far more information than the Deck, Superstructure and Substructure general condition rating
  - Element level inspections provide great information for planning work
  - Defects are assigned to elements and can be a useful for planning preservation work



Developing a Bridge Preservation Project

- Determine whether the work will be completed in-house, or with contracted forces
- For contracted work, bundle several bridges with similar work to attract competitive bids

Funding Bridge Preservation

The Moving Ahead for Progress in the 21st Century Act (MAP-21) and the Fixing America's Surface Transportation (FAST) Act recognized the benefits of preservation and identify preservation actions as eligible for Federal Funding

Activities Eligible for Federal Funding

Cyclical Maintenance Activity	Bridge Component
Clean/Wash Bridge	Deck and/or Super/Substructure
Clean and Flush Drains	Deck
Clean Joints	Deck
Deck/Parapet/Rail Sealing and Crack Sealing	Deck
Seal Concrete	Super/Substructure

Reference 5




Activities Eligible for Federal Funding

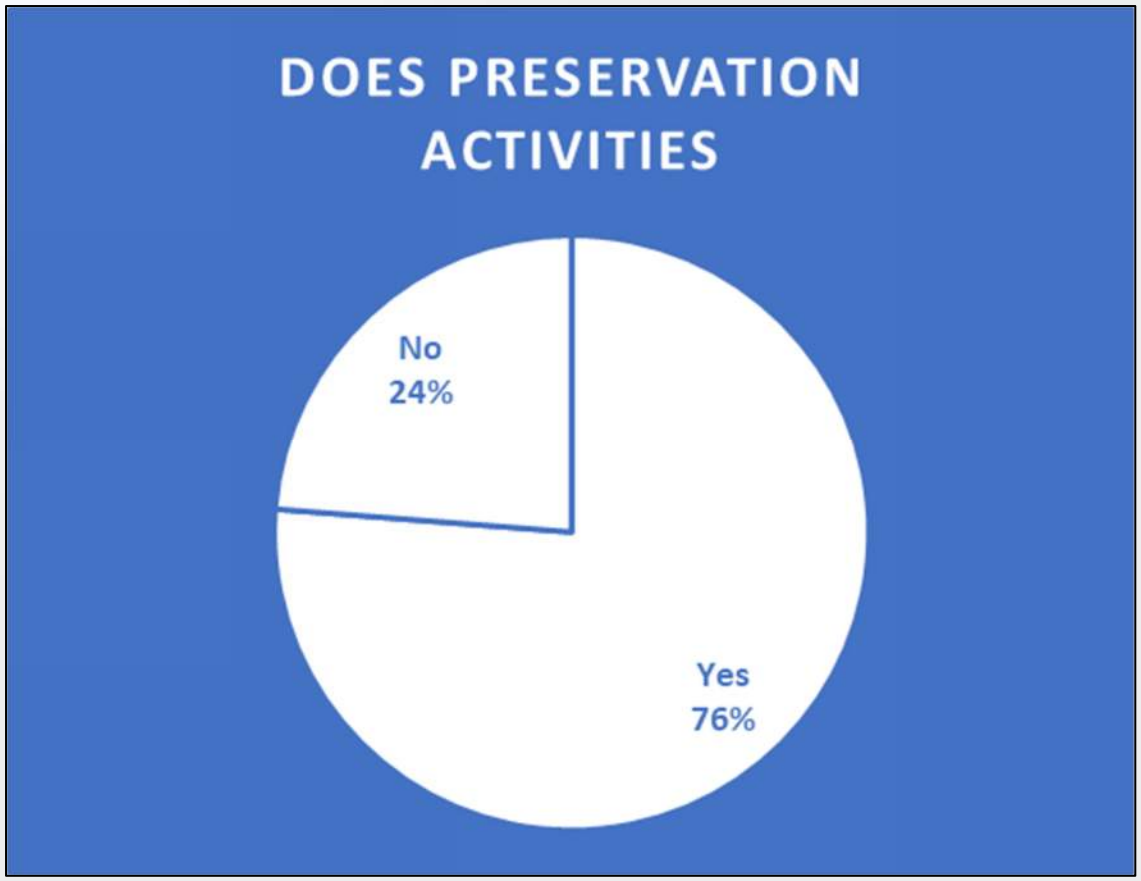
Examples of Condition-Based Maintenance Activity	Bridge Component
Drains, Repair/Replace	Deck
Joint Seal Replacement	Deck
Joint Repair/Replace/Elimination	Deck
Electrochemical Extraction (ECE)/Cathodic Protection (CP)	Deck
Concrete Deck Repair (see halo effect below) in Conjunction with Overlays, CP Systems or ECE Treatment	Deck
Deck Overlays (thin polymer epoxy, asphalt with waterproof membrane, rigid overlays)	Deck
Repair/Replace Approach Slabs	Approach
Seal/Patch/Repair Superstructure Concrete	Superstructure
Protective Coat Concrete/Steel Elements	Superstructure
Spot/Zone/Full Painting Steel Elements	Superstructure
Steel Member Repair	Superstructure
Fatigue Crack Mitigation (pin-and-hanger replacement, retrofit fracture critical members)	Superstructure
Bearing Restoration (cleaning, lubrication, resetting, replacement)	Superstructure
Movable Bridge Machinery Cleaning/Lubrication/Repair	Superstructure

Activities Eligible for Federal Funding

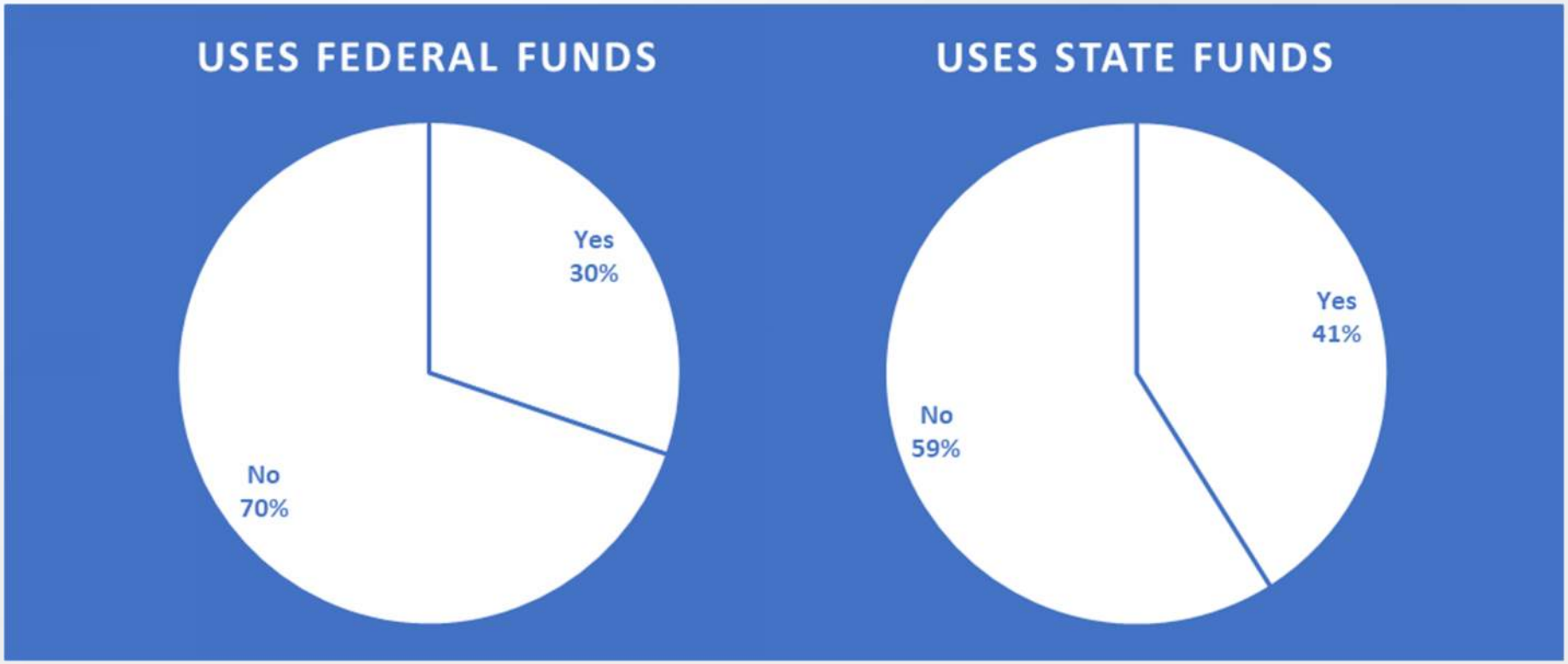
Examples of Condition-Based Maintenance Activity	Bridge Component
Patch/Repair Substructure Concrete	Substructure/Culvert
Protective Coat/Concrete/Steel Substructure	Substructure/Culvert
ECE/CP	Substructure/Culvert
Spot/Zone/Full Painting Steel Substructure	Substructure
Pile Preservation (jackets/wraps/CP)	Substructure
Channel Cleaning / Debris Removal	Channel
Scour Countermeasure (installation/repair)	Channel

Local Preservation and Funding Survey

Over 500 responses



Local Preservation and Funding Survey



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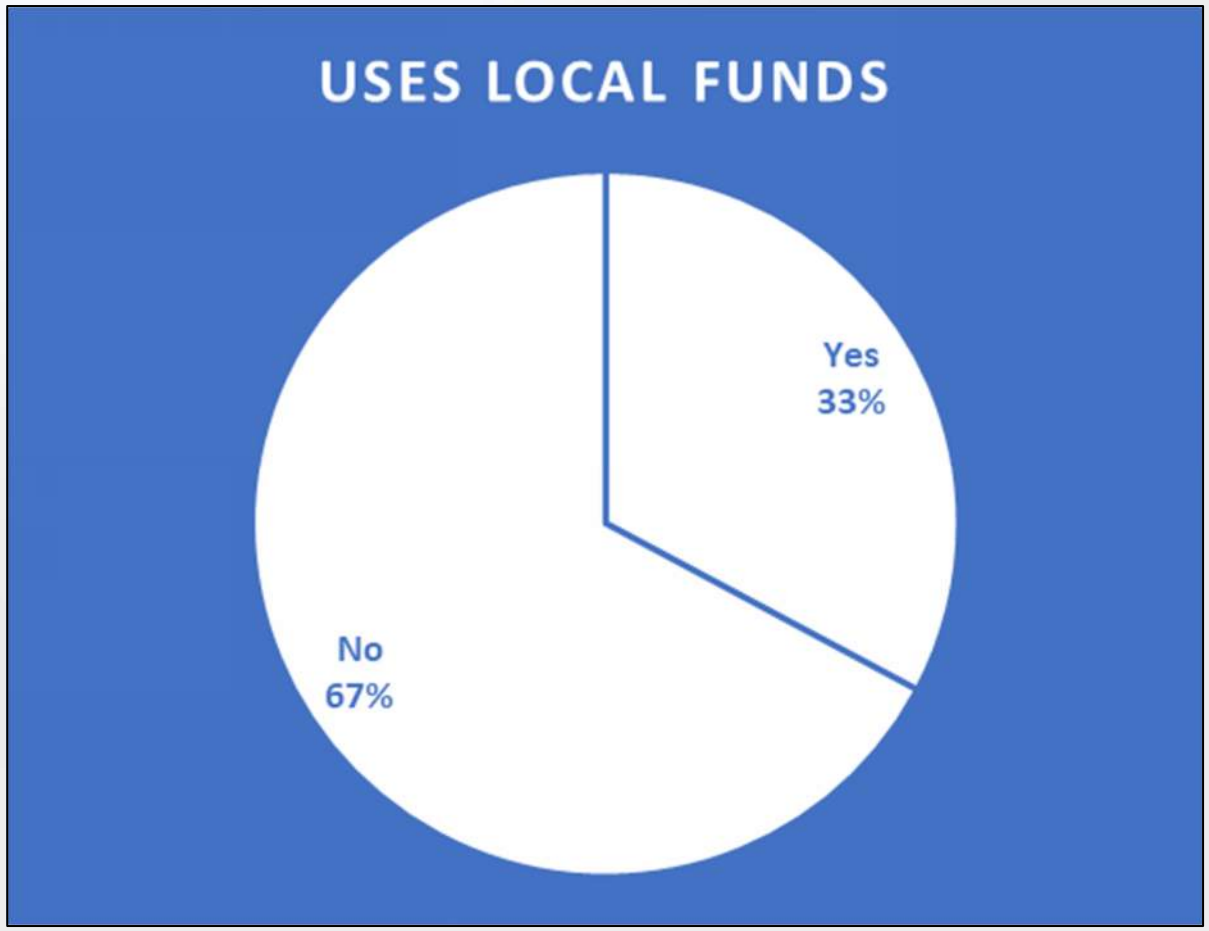

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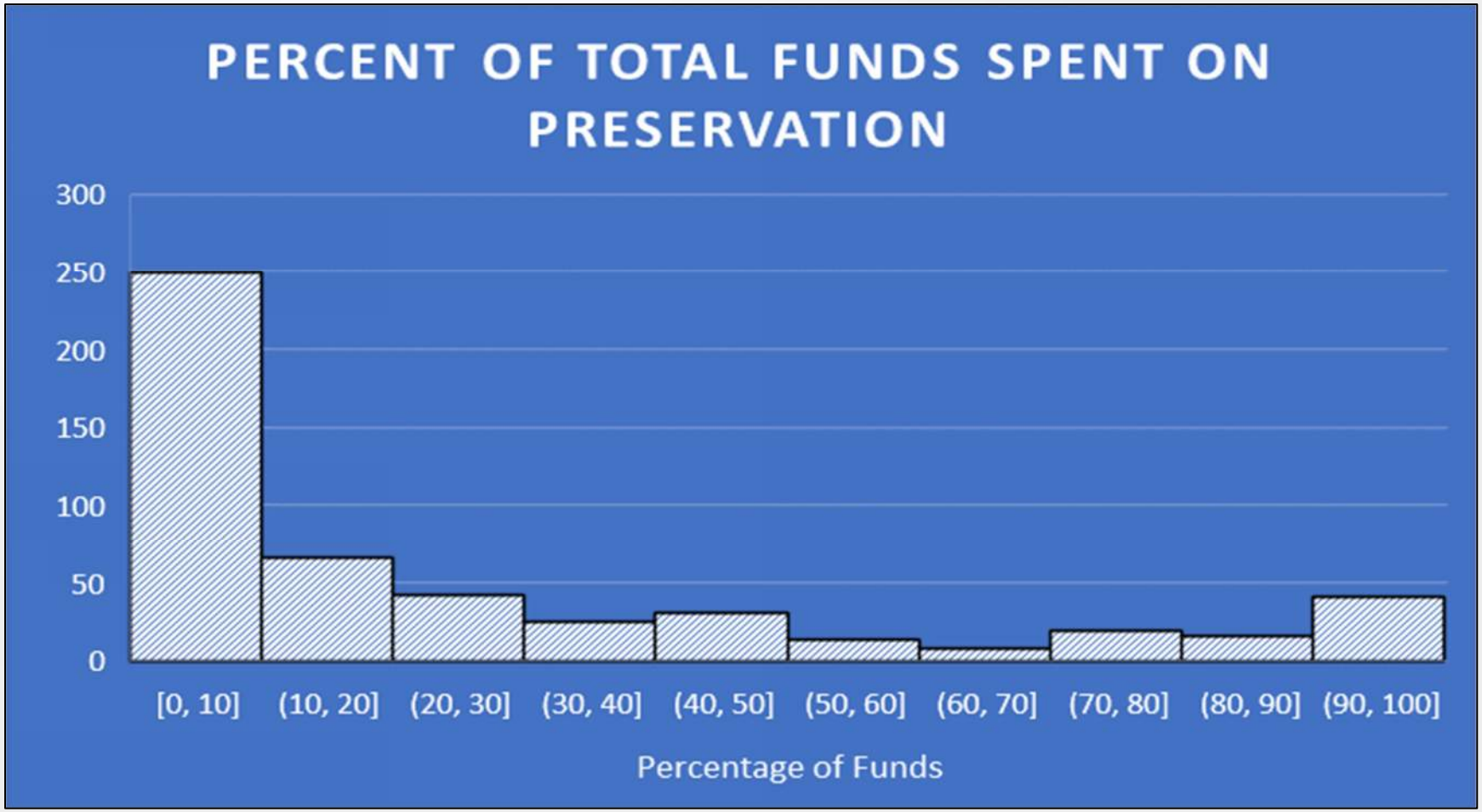


Funding Availability

- Although Federal Funding is available for preservation, the project selection process tends to favor rehab or replacement.
- Even state funds tend to go towards rehabilitation/replacement for.
- **Replacement or Rehabilitation projects tend to be prioritized over Preservation.**

Bridge Preservation Program

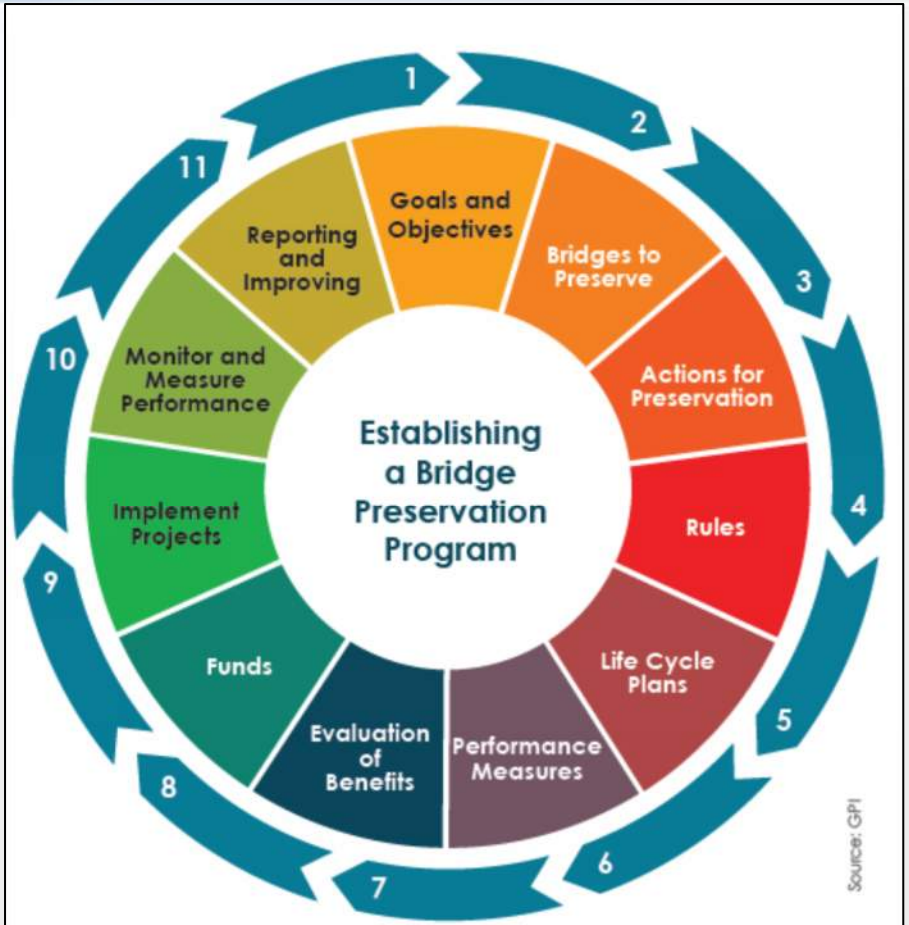


Figure 15. Steps for establishing a bridge preservation program.

Establish Agency Rules to Achieve Goals

- Cyclical Maintenance Example for Bridge Decks in Good condition (NBI > 6)

Preservation Activity	Interval Years
Deck Sweeping/Washing	1 to 2
Crack Sealing	3 to 5
Deck Sealing	3 to 5
Polymer Overlay	8 to 12
Polymer-Modified Asphalt Overlay	12 to 15

Measure the Benefit of Actions

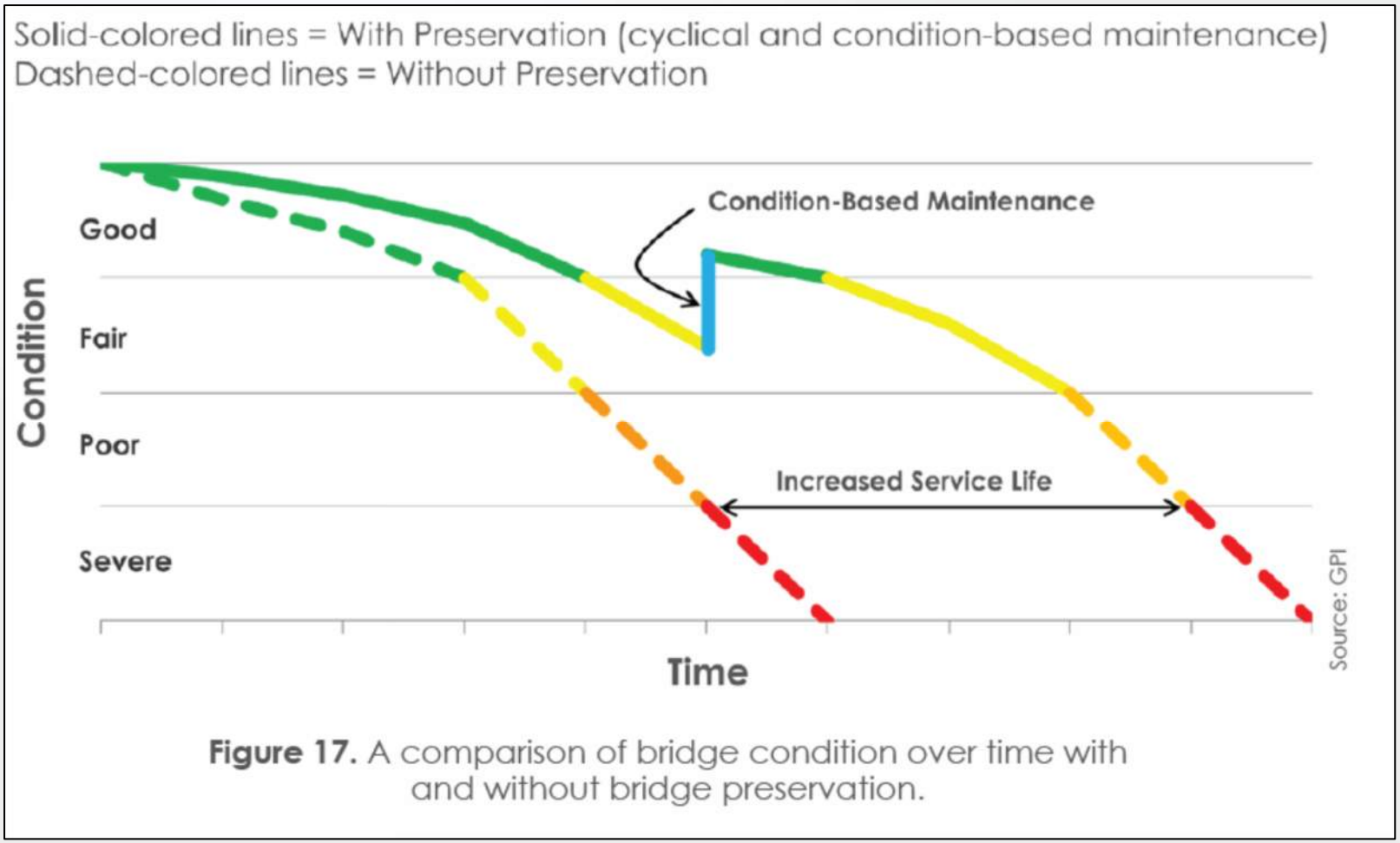
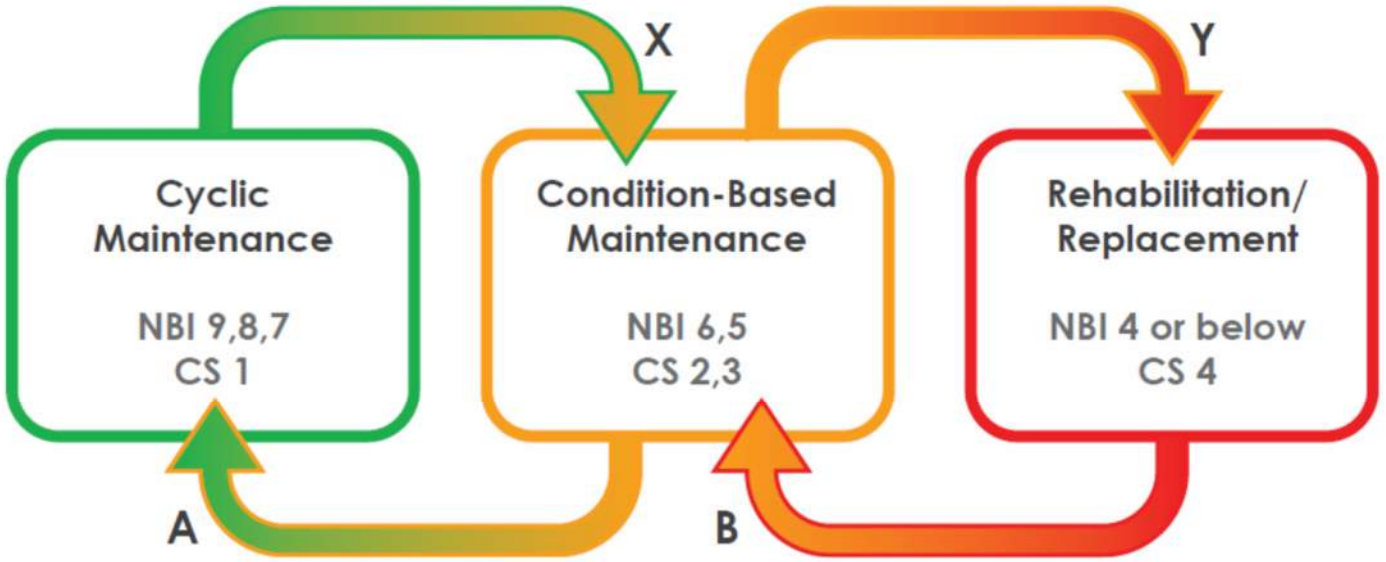


Figure 17. A comparison of bridge condition over time with and without bridge preservation.

Monitor and Report Program



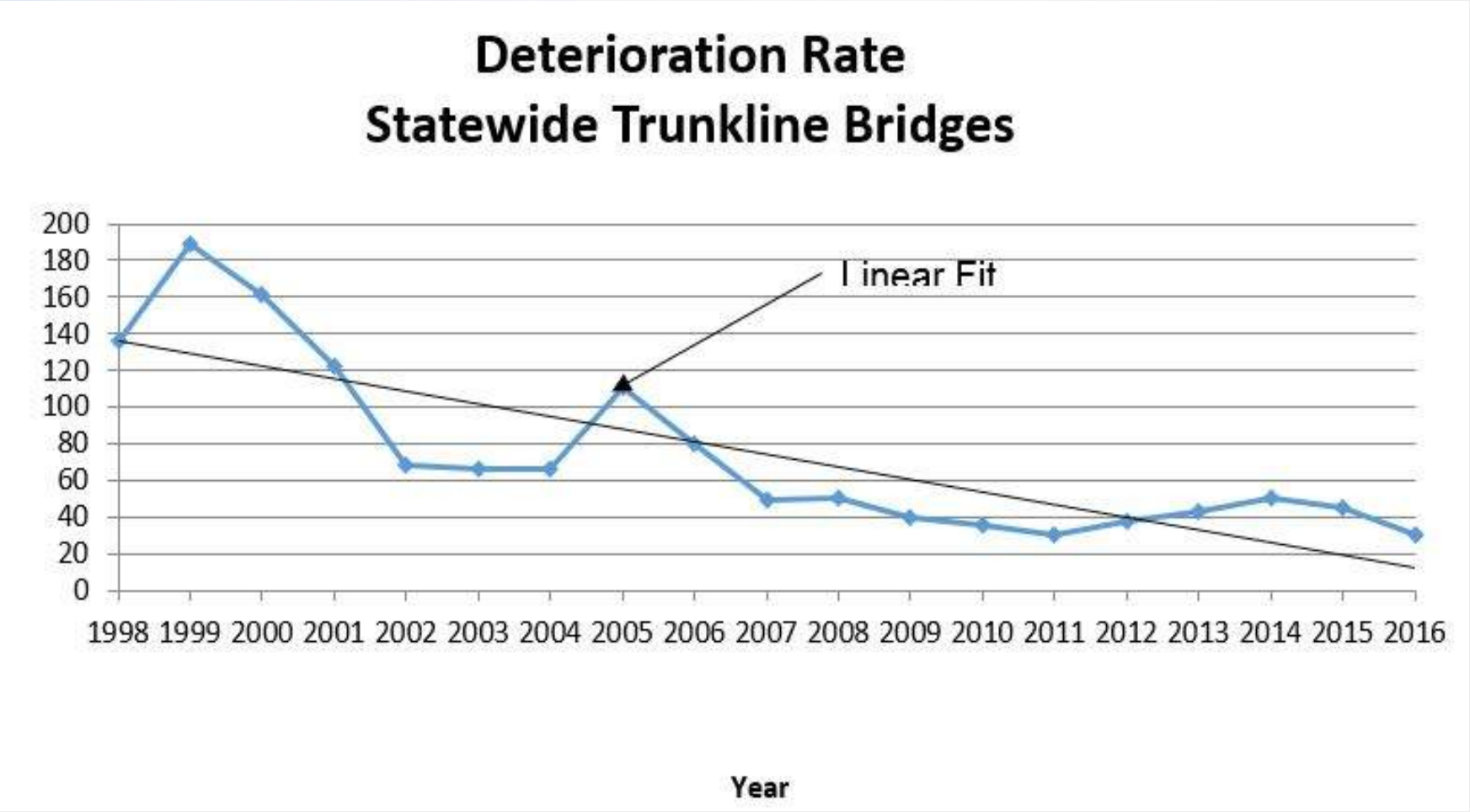
Preservation is effective when X and Y are minimized

Desired goal is A > X; B > Y; (A+B) ≥ (X+Y)

X, Y, A, and B are Bridge Counts or Deck Area, Component Rating, or Element Rating.

Figure 18. Measuring preservation performance.

Michigan Case Study of Preservation



OVERVIEW OF PRESERVATION TREATMENTS

Bridge Cleaning & Washing

Benefits:

- Flushing and washing reduces the potential of chloride intrusion in deck.
- Essential for proper joint and bearing movement.
- Extend the life of steel coating systems.

Bridge Cleaning & Washing

Elements to Wash:

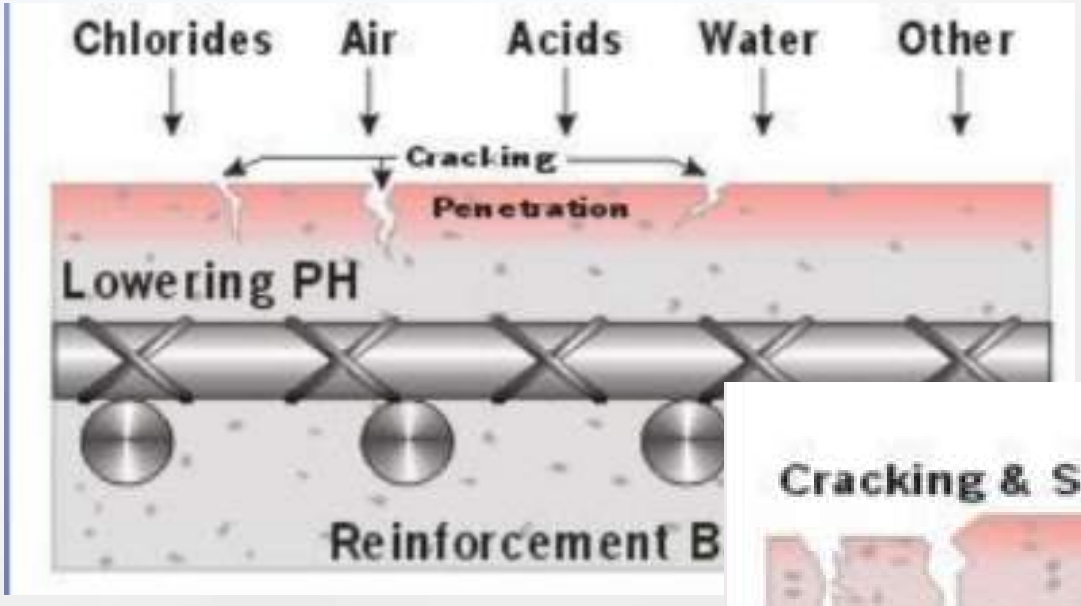
- Decks, joints, curbs and rails
- Abutments, beam seats and bearings
- Beam ends, trusses and end diaphragms

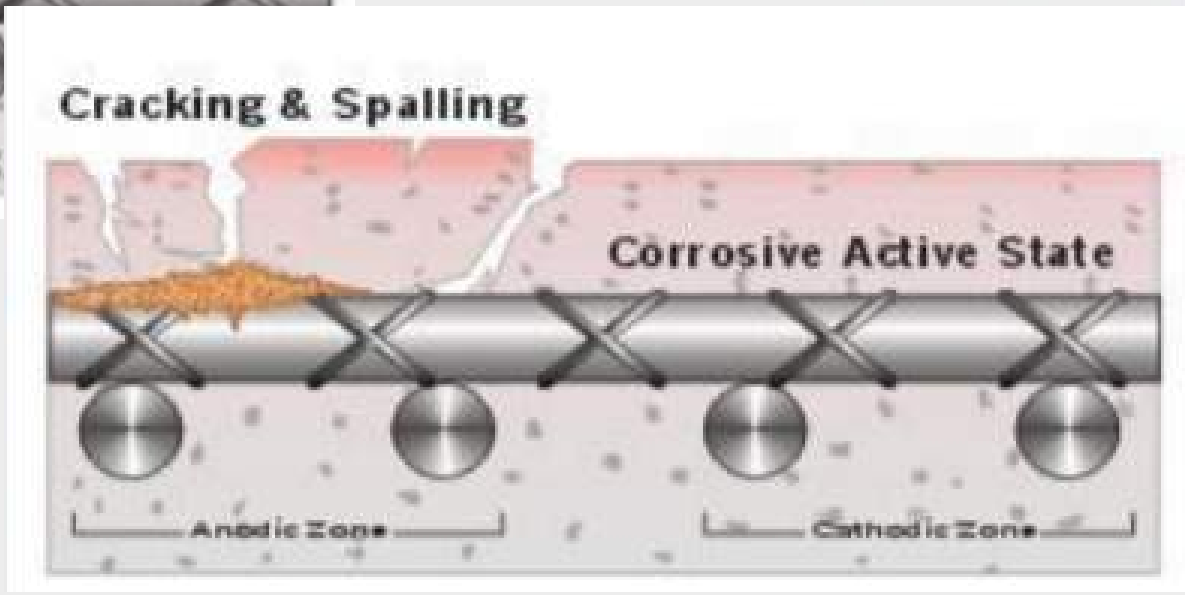
Bridge Cleaning & Washing

Things to Consider:

- Follow state and federal regulations. (Some debris may be hazardous)
- Sweep and collect large debris for disposal.
- Flush during high water flow to minimize environmental impact.
- Clean on regular cycle of avoid large build-up with hand removal

Concrete Sealing





Penetrating Sealers (Silanes, Siloxanes and Siliconates)

- Penetrating water repellents protect from moisture and chloride penetration into the concrete
- Achieves a depth of penetration into the concrete that seals and protects without impacting slip/skid resistance
- Does not fill visible cracks in concrete
- Reapplied on a 5 to 10 year cycle.

Penetrating Sealers (Silanes)

Bridge Deck Crack Fillers
Flood Coat Application

- Seals cracks in the bridge deck concrete to prevent the intrusion of moisture, de-icing chemicals and other damaging environmental affects
- Most effective when placed early, after initial shrinkage cracking and prior to exposure to de-icing chemicals

Thin Polymer Overlay System

- Ultra low permeability to protect the deck concrete from the intrusion of moisture, de-icing chemicals and degradation
- Provide a protective, durable, skid-resistant wearing course for a concrete bridge deck

Thin Polymer Overlay System

- Most cost effective when installed prior to concrete spalling caused by corrosion of steel reinforcing
- Costs are low compared to other protective deck overlay systems
- Can easily be installed with maintenance crews

Thin **Polymer** Overlay System

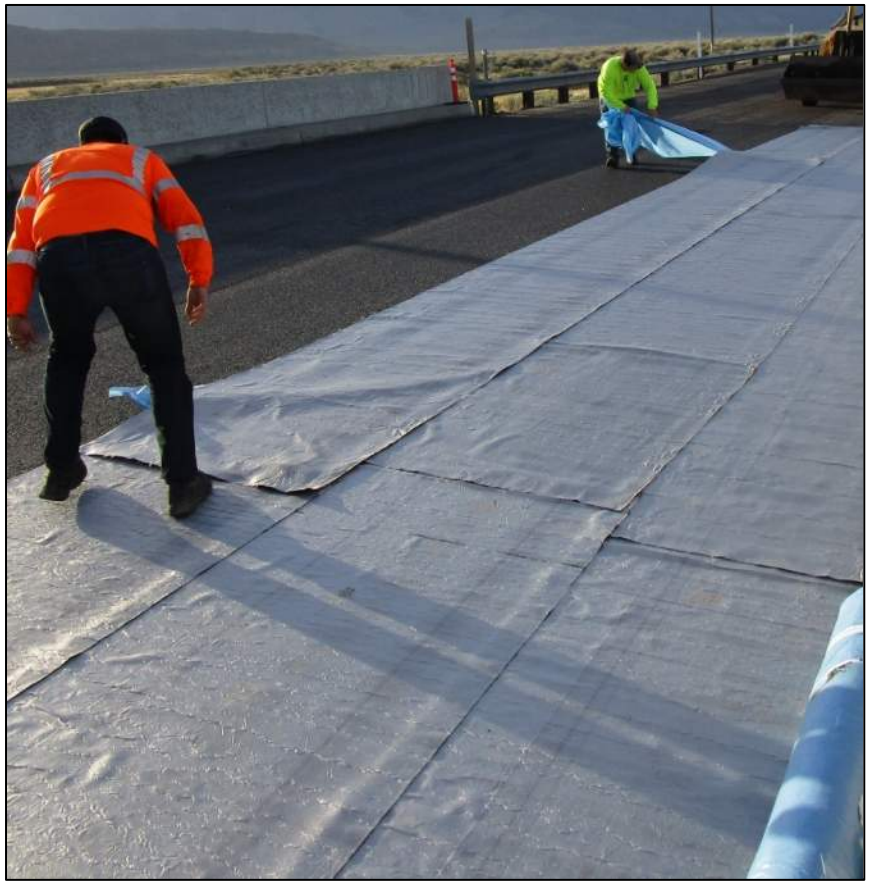
- Install the second lift just as done on the 1st lift.
- 2nd lift will require more resin and aggregate.
- Final overlay thickness is approximately 3/8”.

Asphalt Systems

- Spray Applied Membranes (Polyurea)
- Polymer Membrane (Epoxy)
- Rolled Membrane (Fabric)

Rolled on Membrane Installation

- Overlap and offset seams per manufacturer recommendations.
- Have laps splices going downhill.



Rolled on Membrane: Pave Top Course

Joint Systems – Repair & Replacement

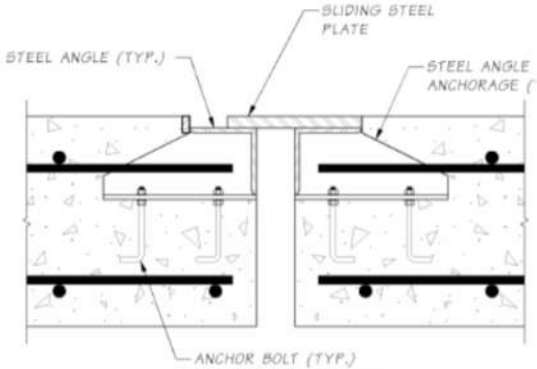
A bridge expansion joint is designed to:

- Provide a gap to accommodate longitudinal and transverse movements of a bridge superstructure. These movements are generally a result of live loads, thermal changes, creep and shrinkage, and the physical properties of the bridge materials

- Protect the superstructure and substructure elements below the bridge deck from water runoff, adverse chemicals, and debris buildup

Joint Systems – Lots of Different Types

- Asphaltic Plug Joints
- Compression and Bonded Seal Joint
- Pourable Joints
- Open/Sliding Plate/Butt Joint
- Strip Seal/Armored Joints



Steel Sliding Plate Joint

Joint Systems – Repair & Replacement

Description

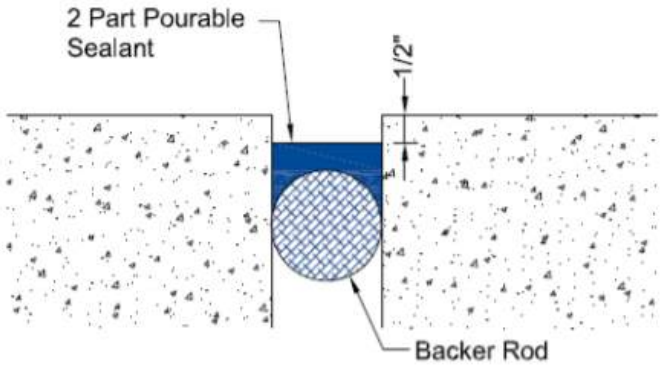
Repair or remove and replace deteriorated or damaged sections of joint systems, including surrounding concrete. Perform this work on all types of joint systems, as required

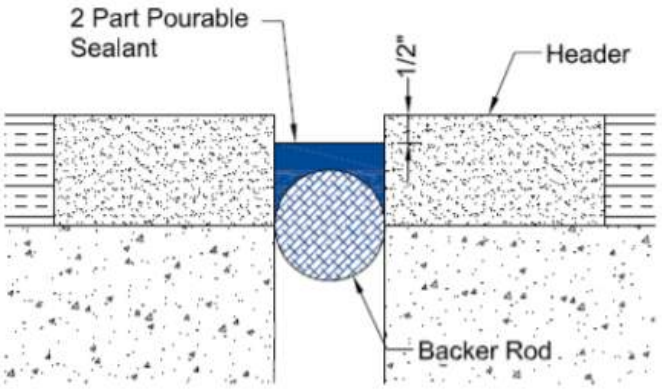
Objectives

Provide proper operation of the joint system and safety for the traveling public

Joint Systems – Repair & Replacement

Joint Systems – Pourable Joint





Reference: NCHRP12-100

Bridge Maintenance Painting

- Painting systems are used to protect the steel.
- Spot painting is an important tool to extend the service life of the existing bridge coating.
- Pay close attention to worker safety and environmental regulations.

Corrosion of Beam End, Cross Frame and Bearing

Source: NCHRP Project 14-30

Candidates for Bridge Maintenance Painting

Coating Failure Exposing Rusted Mill Scale

Inter-Coat Failure

Source: NCHRP Project 14-30

Bridge Maintenance Painting: Surface Prep

Figure 24. Shrouded grinder with back pack vacuum (pneumatic powered)

Figure 25. Feathering of existing coating

Source: NCHRP Project 14-30

Bridge Maintenance Painting

- Performed when the existing coating on a bridge has deteriorated
- Surface preparation and coating application are critical to longevity
- Can be installed with agency maintenance personnel when properly trained
- A good specification and training of inspectors is vital

Source: NCHRP Project 14-30

Figure 30. Coating application on riveted steel using a mitt

Concrete Patching

- Corrosion of Rebar
- Freeze/Thaw Cycling
  - Salt Scaling
- Load Stresses
  - Poor Original Installation
  - Overload
  - Dry Shrinkage Cracking
- Accidents, Fires
- Delamination's and Cold Joints

Concrete Patching Materials:

- Patching materials replace damaged concrete / restore concrete cover
- Considerations
  - Service Conditions
  - Causes of Deterioration
  - Methods of Testing
  - Application Conditions
  - Finish Requirements

Patching Considerations

- Traffic Control
- Time Consideration
  - Mark Area to Repair that can be completed in Lane Closure
- Adequate Tools, Power, and PPE
- Demolition
  - Saw-cut edges (Clean Slurry)
  - Remove unsound concrete
  - Replace damaged rebar
  - Primers/SSD

Concrete Patching

Saw Cut Perimeter

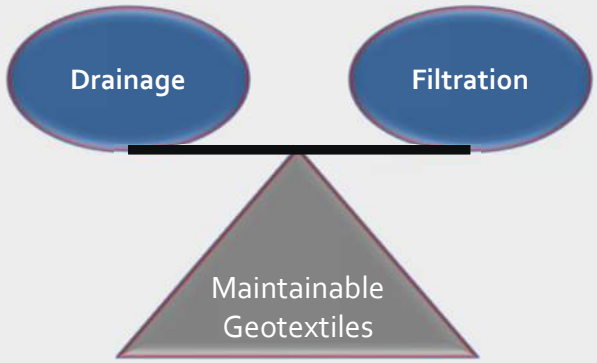
Chip out to sound concrete

Install Anodes "Hockey Pucks" (Optional)

Substructure Drainage & Soil Filtration

Basic Elements Required for Drainage Systems

- Unobstructed drainage path
- Filtration to prevent loss of soil
- Accessibility for maintenance to obtain design life or beyond

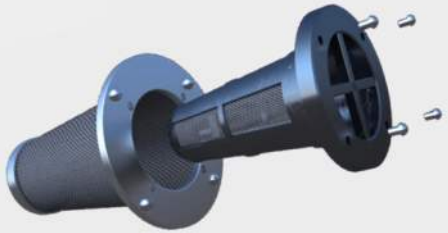


Uses - Maintainable Weep Hole Filters

- Helps prevent clogging
- Mitigates hydrostatic pressure

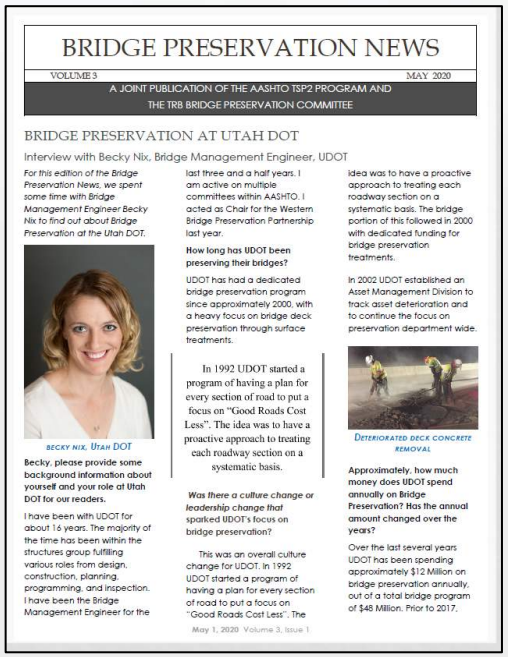
Benefits - Maintainable Weep Hole Filters

- Relieves hydrostatic pressure
- Installs through the front of the wall
- Geotextile fabric to stop erosion
- Accessible & Maintainable
- Simple Installation & Easily Cleaned



ADDITION RESOURCES

Newsletters



BRIDGE PRESERVATION NEWS

VOLUME 3 MAY 2020

A JOINT PUBLICATION OF THE AASHTO TSP2 PROGRAM AND THE TRB BRIDGE PRESERVATION COMMITTEE

BRIDGE PRESERVATION AT UTAH DOT

Interview with Becky Nix, Bridge Management Engineer, UDOT

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BECKY NIX, UTAH DOT

Becky, please provide some background information about yourself and your role at Utah DOT for our readers.

I have been with UDOT for about 16 years. The majority of the time has been within the structures group fulfilling various roles from design, construction, planning, programming, and inspection. I have been the Bridge Management Engineer for the last three and a half years. I am active on multiple committees within AASHTO. I acted as Chair for the Western Bridge Preservation Partnership last year.

How long has UDOT been preserving their bridges?

UDOT has had a dedicated bridge preservation program since approximately 2000, with a heavy focus on bridge deck preservation through surface treatments.

In 1992 UDOT started a program of having a plan for every section of road to put a focus on "Good Roads Cost Less". The idea was to have a proactive approach to treating each roadway section on a systematic basis.

Was there a culture change or leadership change that sparked UDOT's focus on bridge preservation?

This was an overall culture change for UDOT. In 1992 UDOT started a program of having a plan for every section of road to put a focus on "Good Roads Cost Less". The idea was to have a proactive approach to treating each roadway section on a systematic basis. This followed in 2000 with dedicated funding for bridge preservation treatments.

In 2002 UDOT established an Asset Management Division to track asset deterioration and to continue the focus on preservation department wide.

DETERIORATED DECK CONCRETE REMOVAL

Approximately, how much money does UDOT spend annually on Bridge Preservation? Has the annual amount changed over the years?

Over the last several years UDOT has been spending approximately $12 Million on bridge preservation annually, out of a total bridge program of $48 Million. Prior to 2017.

May 1, 2020 Volume 3, Issue 1

Installation Guides

TSP-2 Website

TSP2.ORG

FHWA – NHI Training

- NHI 130106A – Bridge Preservation Fundamentals
- NHI 130106B – Establishing a Bridge Preservation Program
- NHI 130106C – Communication Strategies for Bridge Preservation
- NHI 130107A – Fundamentals of Bridge Maintenance
- NHI 130107B - Bridge Maintenance Painting
- NHI 130107C - Maintenance of Movable Bridges
- NHI 130107D - Maintenance of Masonry Bridge Elements
- NHI 130108 – Bridge Maintenance

Bridge Preservation Newsletter

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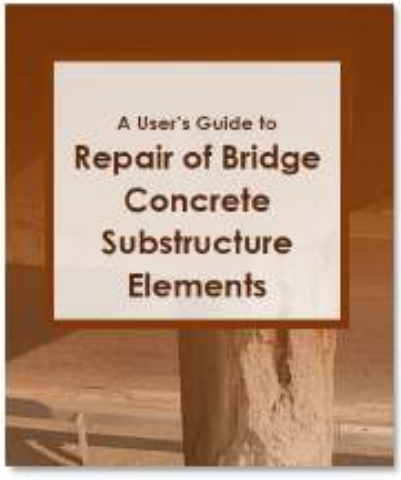
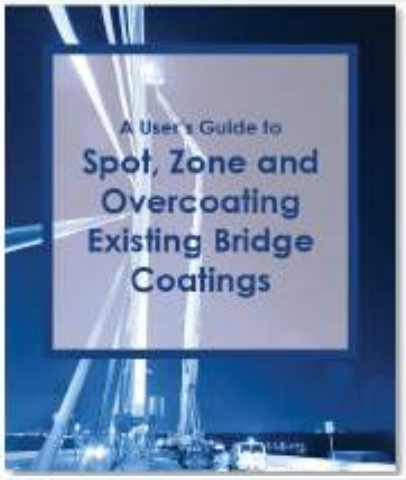
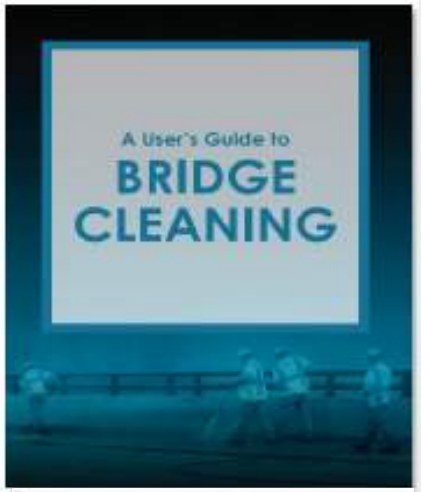
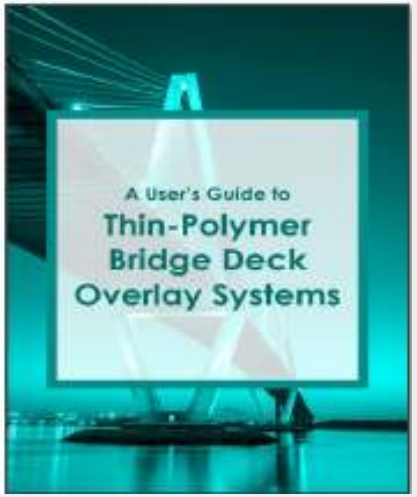
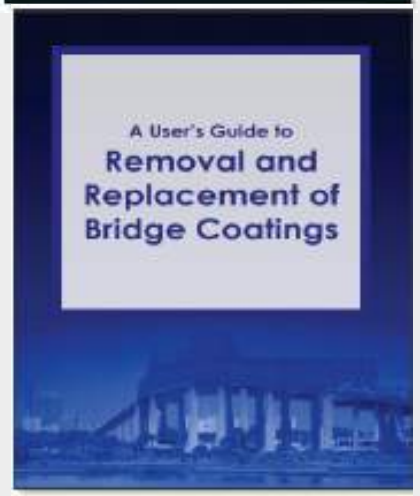
FHWA – Expert Task Group Pocket Guides











FHWA – Pocket Guides

Checklist Format

- Installation guidelines
- Equipment and tools
- Limitations & restrictions
- Avoiding potential failure mechanisms
- Recommended training
- Required technical support
- Recommended QA/QC

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Search
"Bridge Pocket Guide"

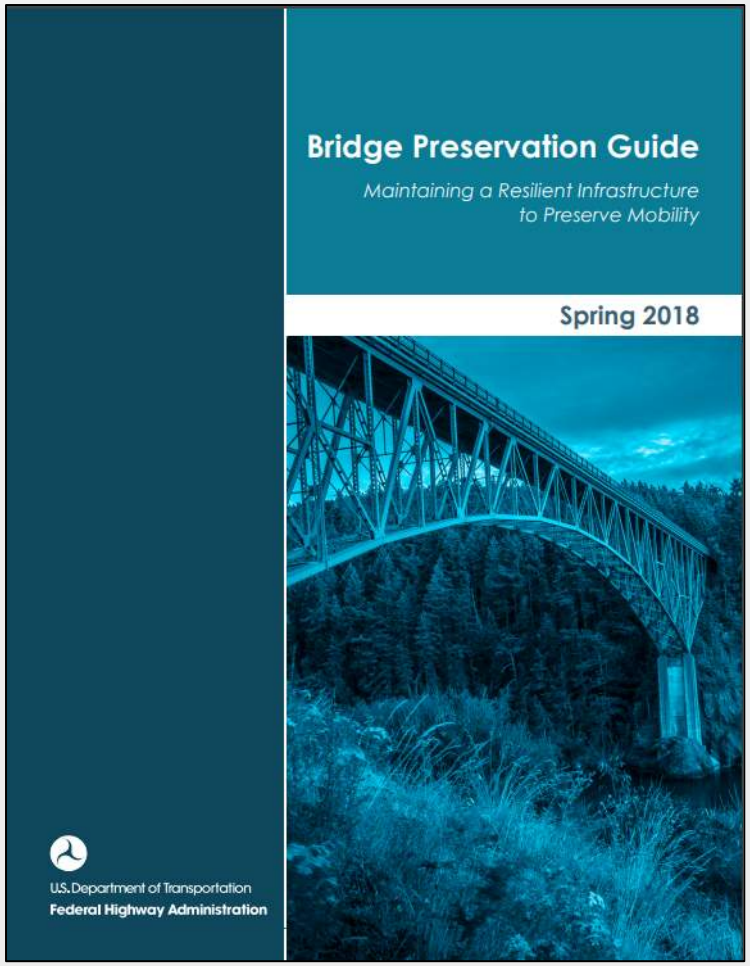
Thin Polymer Overlay System Pocket Guide

https://tsp2bridge.pavementpreservation.org/technical/fhwa/documents/#POCKET GUIDE Thin-Polymer Bridge Deck Overlay System

FHWA – Bridge Preservation Guide

Preservation Guide

- Defines bridge preservation terms and common practices.
- Guidance to State, Locals and other owners on establishing or improving bridge preservation programs.



AASHTO TC3

FHWA Bridge Preservation Guide (2 Modules) – has been published to the AASHTO TC3 training site and available to all
Thin-Polymer Overlays-Complete
Bridge Cleaning – Complete
Bridge Coatings – Complete

TRANSPORTATION CURRICULUM COORDINATION COUNCIL
AASHTO

https://store.transportation.org/

TSP2 - Bridge Preservation Partnerships

- 4 Regional partnerships
- Host monthly conference calls as a forum to collaborate on problems
- Host Annual Meeting

TSP2.ORG

Archived video presentations from annual meetings

NATIONAL CENTER FOR PAVEMENT PRESERVATION

MICHIGAN STATE UNIVERSITY | ENGINEERING RESEARCH & EDUCATION OUTREACH

TSP2 AASHTO Transportation System Preservation Technical Services Program

Bridge Preservation Blog

"A Conversation About Bridge Preservation"

REGIONAL / NATIONAL WORKING GROUPS

TECHNICAL EXCHANGE

RESEARCH ROADMAP DATABASE

TSP2 AASHTO

TRANSPORTATION SYSTEM PRESERVATION
TECHNICAL SERVICES PROGRAM

BRIDGE PRESERVATION

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Questions?

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