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42.1 Overview

This chapter provides goals, objectives, measures, and strategies for the preservation of bridges. This chapter contains criteria that is used to identify condition based and cyclical preservation, maintenance, and improvement work actions for bridges. Bridge preservation is defined as actions or strategies that prevent, delay, or reduce deterioration of bridges or bridge elements; restore the function of existing bridges; keep bridges in good or fair condition; and extend their service life. Preservation actions may be cyclic or condition-driven. (1)

A successful bridge program will seek a balanced approach to preservation, rehabilitation, and replacement. One measure of success is to maximize the life of structures while minimizing the life cycle cost. Preservation of structures is one of the strategies in maximizing the effectiveness of the overall bridge program by retarding the rate of overall deterioration of the bridges.

Bridges are key components of our highway infrastructure. Wisconsin has over 14,000 bridges, of which about 37% are owned by WisDOT. The average age of these bridges in 2019 is 38 years. The aging infrastructure is expected to deteriorate faster in the coming decades with increased operational demand unless concerted efforts are taken to preserve and extend their life. In addition, the state bridge infrastructure is also likely to see an increased funding competition among various highway assets. As a result, WisDOT must emphasize a concerted effort to preserve and extend the life of bridge infrastructure while minimizing long-term maintenance costs.

This chapter provides WisDOT personnel and partners with a framework for developing preservation programs and projects using a systematic and consistent process that reflects the environment and conditions of bridges and reflects the priorities and strategies of the Department.

A well-defined bridge preservation program will also help WisDOT use federal funding (2) for Preventative Maintenance (PM) activities by using a systematic process of identifying bridge preservation needs and its qualifying parameters as identified in FHWA's Bridge Preservation Guide (1). This chapter will promote timely preservation actions to extend and optimize the life of bridges in the state.

42.2 WisDOT Goals and Strategies for Bridge Preservation

The main goal of a bridge preservation program is to maximize the useful life of bridges in a cost-effective way. To meet this goal, many of the strategies are aimed at applying the appropriate bridge preservation treatments and activities at the proper time resulting in longer service life at an optimal life cycle cost. Federal transportation legislation (MAP-21) promotes the goal of maintaining or preserving infrastructure assets "in a state of good repair". Preservation of assets is one of the tools that will be used to achieve an overall transportation investment strategy.

42.2.1 Goals for WisDOT Bridge Preservation Program

The bridge preservation goals address the priorities of the department and our stakeholders and include:

- Maintain bridges in a "state of good repair" using low-cost effective strategies.
- Implement timely preservation treatments on structurally sound bridges to promote optimal life cycle cost and extend service life. This will reduce the need for major rehabilitation and replacement – "right treatment at the right time".
- Promote and support budgeting of preventive maintenance activities.
- Establish performance goals and monitor progress related to preservation of bridges.
- Optimize the benefits and effectiveness of long-term maintenance investment in achieving bridges in good condition.

42.2.2 Strategies to Achieve WisDOT Bridge Preservation Goals

To achieve the goals of the bridge preservation program, WisDOT will use data-driven strategies. This approach is aimed at applying the appropriate bridge preservation treatments and activities at the proper time. These strategies are also aimed at maximizing efficiency and effectiveness of the program. The strategies of the WisDOT Bridge Preservation Program include:

- Regular analysis of the bridge inventory data to establish conditions and trends related to performance.
- Develop and maintain criteria for eligible preservation activities.
- Define preservation program and project needs (using HSIS and WISAMS).
- Develop estimates of needed financial resources at the project/program level.
- Prioritize, plan, and perform preservation treatments.

- As appropriate, group preservation maintenance projects to promote economy of scale.
- Identify preservation needs that complement maintenance, repair, and rehabilitation actions and timelines.
- Securing approval and support from key stakeholders in the use of Federal and State funding for systematic preventive maintenance and preservation activities.
- Utilize multiple programs to implement preservation work activities Improvement (Let) program, DMA, PBM & RMA maintenance programs.
- Develop and maintain records of preservation applications to analyze for cost and effectiveness of treatments.
- Consider preservation at the bridge design stage.

42.3 Bridge Preservation Actions

This chapter focuses on bridge preservation actions that relate to preventive maintenance and element rehabilitation. Cyclical and condition-based activities are subsets of preventative maintenance as shown below in Figure 42.3-1. Descriptions of these preservation actions can be found in 42.7.

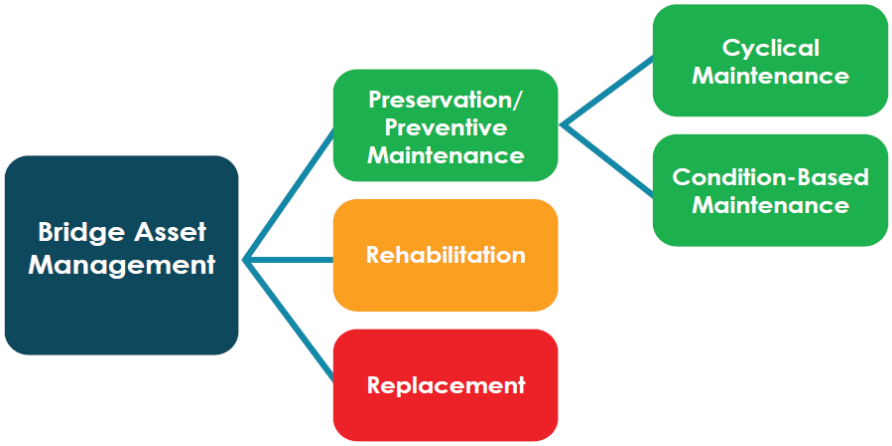

Figure 42.3-1
Asset Management and Preservation Actions

Major rehabilitation, bridge replacement, improvement, and new bridge construction projects are addressed by other WisDOT Bridge Programs.

42.4 Bridge Preservation Goals, Strategies and Performance Measures

This chapter outlines preservation goals, strategies and performance measures to track progress. Maintaining safe and dependable operations is a high priority for the department. **The Department has the goal to maintain 95% of the state-owned bridges in fair or better condition** (NBI ratings 5 or higher). To achieve this goal, the department employs strategies that include condition and cyclical treatments.

42.4.1 Condition Based Strategies

Condition based preventive maintenance activities are performed on bridge elements as needed and identified through the bridge inspection process. To achieve the goal of maintaining 95% of the state system bridge inventory in fair or better condition, maintaining key bridge elements or components that will promote this goal. These include:

- Bridge decks in good or fair condition (per NBI condition rating).
- Strip seal joints effective in stopping leakage. (effective joint)).
- Coated steel surfaces for superstructures in condition state 2 or better.
- Bearing elements in condition state 2 or better.

42.4.2 Cyclical Based Strategies

Cyclical based activities are performed on a pre-determined interval and aimed to preserve existing bridge element or component conditions. These types of activities may not improve the condition of the bridge element or component directly, but will delay their deterioration. Examples of cyclical activities include:

- Deck sweeping
- Deck and Superstructure washing
- Deck sealing.

42.4.3 Performance Measures and Objectives

Performance measures in this chapter are consistent with the objectives of the program and reflect the experience and input of the WisDOT Regional Bridge Maintenance Staff as well as consideration of other DOT's insight and experience.

Table 42.4-1 lists the measures and objectives for preservation program performance:

Objective	Target/Goals	Performance Measure
Maintain bridges in good or fair condition	95% of bridges	Percentage of bridge in good or fair condition (NBI rating 5 or higher)
Maintain bridge decks in good or fair condition	95% of bridge decks	Percentage of bridge decks in good or fair condition (NBI Rating 5 or higher)
Maintain effective expansion joints that do not leak	85% of bridges with strip seal joints that are effective in stopping leakage	Percent of a bridges with 90% of their strip seal expansion joints in condition state 2 or better (effective joint)
Maintain coated steel surfaces in condition state 2 or better	90% of coated steel surfaces	Percentage of coated steel surfaces in condition state 2 or better (effective)
Maintain bearings in condition state 2 or better	95 % of bearings in condition state 2 or better	Percentage of bearings in condition state 2 or better
Seal eligible concrete decks (NBI rating 6 or higher) with sealant every 4 years	Seal 25% eligible concrete decks	Number of decks sealed (sq. ft of deck area) each year during a 4-year period

Table 42.4-1
Objectives and Performance Measures

42.4.4 Preservation Program Benefits

Each objective and measure proposed in Table 42.4-1 is aimed at extending the life of the main bridge components by performing timely cyclical or condition-based (corrective) preservation actions. The cost of performing preservation actions is minor when compared to premature replacement or rehabilitation of bridge components. The benefits of each objective are discussed below:

- Maintaining 95% of bridge decks in good or fair condition is an asset management approach that should extend the service life of bridges and promote the MAP21 objectives. Experience has shown that bridges designed for a 100-year life expectancy should have decks that last 55 with progressive preservation activities though the life of the bridge deck. Appropriate corrective actions taken as part of deck preservation extends the bridge deck life significantly. The costs of such corrective actions are substantially less than the costs of prematurely replacing the decks.

- The objective of maintaining 85% of strip seals in good or fair condition will focus on a program that will help in minimizing the damage on bridge superstructure and substructure components. Leaking joints cause significant deterioration and damage to bridge components that include girders, bearings, and substructures. There is significant cost each year in repairing structural elements that have deteriorated prematurely as a result of leaking joints. Maintaining effective (non-leaking) strip seals can delay superstructure and substructure deterioration.

- Maintaining protective paint systems is important. The structural components of the steel bridges will corrode and lose load carrying capacity if left unprotected or partially-protected. Protective paint coatings systems should have a service life of 25-40 years for the protection of structural steel. The objective of maintaining 90% of coated steel surfaces in good or fair condition will aim at creating a paint program for extending the life of steel components up to 100 years.

- Bridge bearings are a key component. Bearings support bridge super structures and allow for expansion of the superstructure. Experience has shown that loss of lubrication, tipping, or corrosion of bearings can cause harm to the deck and superstructure. The proposed measure of keeping 95% of bearings in good or fair condition will help WisDOT maintain bridges in a state of good repair.

- Objective of sealing 25% of all eligible concrete decks at 4 year intervals will help delay deck deterioration and prolong deck life. Sealing decks every 4 years at a minor cost can delay deck deterioration by 10-12 years that will promote increased deck life.

42.5 Bridge Preservation Activities, Eligibility and Need Assessment Criteria

The bridge preservation activities shown below relate to deck, superstructure and substructure elements. Table 42.5-1 shows the most common bridge preservation activities that are considered cost effective when applied to the appropriate bridge at the appropriate time, as well as considered eligible for bridge preservation funding. Additionally, these activities together with the eligibility and prioritization criteria discussed in this section will form a basis to generate an eligibility list of bridges that are candidates for cyclical and condition based PM actions.

Bridge Component	Bridge Preservation Type	Activity Description	Preventive Maintenance Type	Action Frequency (years)
All	Preventive Maintenance	Sweeping, power washing, cleaning	Cyclical	1-2
Deck	Preventive Maintenance	Deck washing	Cyclical	1
		Deck sweeping		1
		Deck sealing/crack sealing		4-5
		Thin polymer (epoxy) overlays		7-15
		Drainage cleaning/repair	Condition Based	As needed
		Joint cleaning		
		Deck patching		1- 2
		Chloride extraction		1 -2
		Asphalt overlay with membrane		5-15
		Polymer modified asphalt overlay		10-15
		Joint seal replacement		10
		Drainage cleaning/repair		1
	Repair or Rehab Element	Rigid concrete overlays	Condition Based	As needed
		Structural reinforced concrete overlay		
		Deck joint replacement		
		Eliminate joints		
Super	Preventive Maintenance	Bridge approach restoration	Cyclical	2
		Seat and beam ends washing		2
	Repair or Rehab Element	Bridge rail restoration	Condition Based	As needed
		Retrofit rail		
		Painting		
		Bearing restoration (replacement, cleaning, resetting)		
		Superstructure restoration		
		Pin and hanger replacement		
		Retrofit fracture critical members		
Sub	Preventive Maintenance	Substructure restoration	Condition Based	As needed
		Scour counter measure		
		Channel restoration		

Table 42.5-1
Bridge Preservation Activities

42.5.1 Eligibility Criteria

This chapter includes two distinct matrices outlining eligibility criteria for preservation activities shown in Table 42.5-2 and Table 42.5-3. The first matrix relates to concrete deck/slab activities and the second matrix covers other bridge component activities. Bridge inspection information and data that is managed in HSIS and the WISAMS (Chapter 41.2.1) will be used to develop reports that quantify needs at the program and project level. This method will also serve to develop reports to monitor progress related to performance goals.

The deck/slab matrix shown in Table 42.5-2 is based on the NBI Item 58 - Condition Rating for decks and total deck/slab distress area. The distress area on a deck is quantified using inspection defects including delaminations, spalls, cracking, and scaling. Other deck inspection methods such as chain drag sounding, ground penetrating radar (GPR) surveys, infrared (IR) surveys, and chloride potentials may also be used in quantifying deck defects.

The matrix shown in Table 42.5-3 is based on listed NBI condition ratings and specific inspection element condition states. As with decks, information and data from HSIS will be used with this matrix as well.

Table 42.5-3 also makes reference to “defects”. For a better understanding of this concept, the reader is referred to Appendix D of the *AASHTO Manual for Bridge Element Inspection*. This appendix describes the element materials defined for this guide and the defects that may be observed for each condition state. Included are individual materials, such as reinforced and prestressed concrete, steel, timber, masonry, and other materials.

These matrices guide the user to select a preservation activity and also show the potential enhancement to the NBI values and anticipated service life increase as a result of that activity. Note that even though some preservation activities list no change to the potential result to the condition rating of NBI items, there is an inherent benefit both in the short and long term of these preservation activities to extend the current condition and ultimately extend the life of the bridge.

Sound engineering judgment is needed to decide if the recommended action is best suited for extending the life of the bridge.

	NBI Item 58	Top Deck Element Distress Area (%)	Bottom Deck Element Distress Area (%)	Preservation Activity	Benefit to Deck from Action	Application Frequency (in years)
Concrete Deck/Slab	≥7	-	-	Deck Sweeping/Washing	Extend Service Life	1 to 2
		5% < 3220 < 25%	-	Crack Sealing	Extend Service Life	3 to 5
		3220 CS3 + CS4 > 0%	-	Deck Sealing	Service life extended	3 to 5
		-	1080 < 5%	Full Depth Deck Patching	Service life maintained	As needed
		3210 CS3 + CS4 < 5%	1080 < 5%	Wearing Surface Patching	Service life maintained	As needed
		>20% (3220 OR 8911 CS3 + CS4) OR >15% 3210 (applied to bare deck)	(1140 OR 1150) < 20% for timber deck	Polymer Modified Asphalt Overlay	Service life extended	10 to 15
		>20% (3210 OR 8911 CS3 + CS4) OR >50% 3220 (reapplication)	1080 < 5% for concrete deck			
		>20% (3220 OR 8911 CS3 + CS4) OR >15% 3210 (applied to bare deck)	(1140 OR 1150) < 20% for timber deck	HMA w/ membrane	Service life extended	5 to 15
		>20% (3210 OR 8911 CS3 + CS4) OR >50% 3220 (reapplication)	1080 < 5% for concrete deck			
		3210 < 5%	1080 < 1%	Polyester Polymer Concrete	Service life extended	20 to 30
		3210 < 2% (applied to bare deck)	1080 < 1%	Thin Polymer Overlay	Service life extended	7 to 15
		8513 CS3 + CS4 > 15% (reapplication)				
	6	-	-	Deck Sweeping/Washing	Extend Service Life	1 to 2
		5% < 3220 < 25%	-	Crack Sealing	Extend Service Life	3 to 5
		3220 CS3 + CS4 > 0%	-	Deck Sealing	Service life extended	3 to 5
		-	1080 < 5%	Full Depth Deck Patching	Service life maintained	As needed
		3210 CS3 + CS4 < 5%	1080 < 5%	Wearing Surface Patching	Service life maintained	As needed
		>20% (3220 OR 8911 CS3 + CS4) OR >15% 3210 (applied to bare deck)	(1140 OR 1150) < 20% for timber deck	Polymer Modified Asphalt Overlay	Improve NBI (58) ≥ 7	10 to 15
		>20% (3210 OR 8911 CS3 + CS4) OR >50% 3220 (reapplication)	1080 < 5% for concrete deck			
		>20% (3220 OR 8911 CS3 + CS4) OR >15% 3210 (applied to bare deck)	(1140 OR 1150) < 20% for timber deck	HMA w/ membrane	Improve NBI (58) ≥ 7	5 to 15
		>20% (3210 OR 8911 CS3 + CS4) OR >50% 3220 (reapplication)	1080 < 5% for concrete deck			
		8513 CS3 + CS4 > 15% (reapplication)	1080 < 1%	Thin Polymer Overlay	Service life extended	7 to 15
		>20% (3220 OR 8911 CS3 + CS4) OR >15% 3210 (applied to bare deck)	1080 < 5% OR 1130 CS3 + CS4 < 25%	Concrete Overlay	Improve NBI (58) ≥ 7	12 to 20
		>20% (3210 OR 8911 CS3 + CS4) OR >50% 3220 (reapplication)				
	5	5% < 3220 < 25%	-	Crack Sealing	Extend Service Life	3 to 5
		3220 CS3 + CS4 > 0%	-	Deck Sealing	Service life extended	3 to 5
		-	1080 < 5%	Full Depth Deck Patching	Service life maintained	As needed
		3210 CS3 + CS4 < 5%	1080 < 5%	Wearing Surface Patching	Service life maintained	As needed
		>20% (3220 OR 8911 CS3 + CS4) OR >15% 3210 (applied to bare deck)	1080 < 5% OR 1130 CS3 + CS4 < 25%	Concrete Overlay	Improve NBI (58) ≥ 7	12 to 20
		>20% (3210 OR 8911 CS3 + CS4) OR >50% 3220 (reapplication)				
	4	>20% (3220 OR 8911 CS3 + CS4) OR >15% 3210 (applied to bare deck)	1080 < 5% OR 1130 CS3 + CS4 < 25%	Concrete Overlay	Improve NBI (58) ≥ 7	12 to 20
		>20% (3210 OR 8911 CS3 + CS4) OR >50% 3220 (reapplication)				
	≤ 4	-	1080 > 15% OR 1130 CS3 + CS4 > 50%	Deck Replacement	Improve NBI (58) = 9	25 to 45

Table 42.5-2
Concrete Deck/Slab Eligibility Matrix

NBI Item	Element	NBI Criteria	Defect	Element Defect Condition State Criteria	Repair Action	Potential Benefits to NBI or CS	Anticipated Service Life Years
Deck	Joints	Item 58 ≥ 5	2350	CS2, CS3, or CS4	Joint Cleaning	CS1or CS2	
			2310	CS3 + CS4 ≥ 10%	Joint Seal Replacement/Restoration	CS1	5 to 8
			2360	CS3 + CS4 ≥ 25%	Joint Replacement ④ ⑦	CS1	10 to 20
				All Condition State	Joint Elimination ④	Elimination	15 to 25
	Railing	Item 58 ≥ 5		CS3 or CS4	Railing Restoration	CS1 or CS2	3 to 10
				CS3 or CS4	Railing Replacement/Retrofit ⑧	CS1	10 to 20
Super	Steel Elements	Item 59 ≥ 5		N/A	Superstructure Washing/Cleaning	NA	1 to 2
			3440	CS2 + CS3 Area> 5% ⑥	Painting - Spot	CS1	1 to 5
				CS3 Area ≤ 25% ⑥	Painting - Zone	CS1 ①	5 to 7
				CS3 Area ≥ 25% ⑥	Painting - Complete	CS1 ②	15 to 20
		Item 59 ≥ 4		CS2, CS3, or CS4	Superstructure Restoration ③	NBI ≥ 7	5 to 20
	Bearings	Item 59 ≥ 5		CS3 or CS4	Bearing Reset/Repair	CS1 or CS2	1 to 5
				CS2 or CS3	Bearing Cleaning/Painting	CS1 or CS2	5 to 7
				CS3 + CS4 ≥ 25% or CS4 > 5%	Bearing Replacement	CS1	10 to 15
Sub	Miscellaneous	Item 60 ≥ 5		N/A	Substructure Washing/Cleaning	NA	1 to 2
			3440	CS2+CS3+CS4 Area > 5% ⑥	Painting - Spot	CS1	1 to 5
			3440	CS3 Area > 25% ⑥	Painting - Complete	CS1 ②	10 to 20
				CS2 or CS3 or CS4	Substructure Restoration ⑤	NBI ≥ 7	5 to 20
			9290	CS1 or CS2	Pier Protection ⑨	NBI ≥ 7	5 to 20
				CS3 or CS4	Scour Counter Measure ⑩	NBI ≥ 7	5 to 20

Table 42.5-3
Other Bridge Elements Eligibility Matrix

① Increase NBI only if combine with structural steel repairs.

② Complete painting only if combined with structural steel repairs to improve the component NBI ≥ 7.

③ Superstructure restoration includes all work related to the superstructure including but not limited to strengthening, pin and hanger replacement, retrofit FC member, etc.

④ Combined with deck overlay or replacement project.

⑤ Substructure restoration includes all work related to the substructure including but not limited to fiber wrapping, strengthening, crack injection, encapsulation, etc.—regardless of material type.

⑥ Element condition state for steel protective coating.

⑦ Includes but is not limited to end block/paving block replacement.

⑧ Must bring railing to current standards or have an approved exception to standards.

⑨ Examples are pier protection dolphins and fender systems.

⑩ Provide scour countermeasures after repairing any other substructure defects.

42.5.2 Identification of Preservation Needs

The identification of preservation needs will start with inventory and inspection information collected as part of the ongoing inspection program. The inspection information is analyzed by BOS asset management engineers with the Wisconsin Structures Asset Management System (WISAMS - 41.2.1). The analysis will include inspection reports, past work actions, and preservation policy logic as shown in Table 42.5-2 and Table 42.5-3. BOS will develop bridge work eligibility reports.

The programming of projects will start with the development of eligibility reports as defined in Chapter 41 – Structures Asset Management. Eligible work could be standalone projects or combined into roadway projects, or combined into a group that may include cyclical preventive maintenance activities. Programming of work will be through the Improvement (Let) program and various Maintenance programs (DMA, RMA, and PBM)

42.6 Funding Resources and Budgeting

The experiences of several states have shown that having commitments for funding preservation programs extends the life of bridges and defers untimely replacement. Having a commitment for funding of bridge preservation will help WisDOT optimize the overall bridge program. We promote the idea of recognizing and prioritizing preservation opportunities as part of the planning and programming functions of the department at the Division and Regional level. Through this organizational approach to implementation, preservation will yield the greatest system wide benefits. We recognize the ability to implement policy-driven bridge preservation work actions through a number of our department bridge improvement and maintenance programs. Some work actions are more appropriate for various programs depending on the scale, complexity, or resourcing of the work.

Implementing bridge improvements, rehabilitation, maintenance, and preservation activities occurs through a number of programs. These programs include:

- **Let Improvement Projects (Let).** The let improvement program is identified and programmed in Regional Planning and developed in Regional PDS. The projects are let to competitive bid on a regular schedule.

- **Discretionary Maintenance Agreement (DMA).** This is a contracting mechanism initiated by the Department with a county highway department for specific projects and locations. DMAs are typically used in response to highway or services maintenance research opportunities, or awarded as part of a targeted maintenance initiative.

- **Performance-based Maintenance (PbM).** Performance-based highway maintenance is based on the authority to contract with counties to perform specific highway maintenance tasks. Unlike Discretionary Maintenance Agreements which are paid based on actual cost reimbursement basis, PbM contracts are paid based on a negotiated contract price

- **Routine Maintenance Agreement (RMA).** Maintenance of state highways is performed by county highway departments under annual calendar year contracts called the Routine Maintenance Agreement (RMA) document. The RMA document provides each county with a state highway maintenance budget and the approval for expenditure within that budget.

Given our ability to use the structure inventory data and preservation policy to identify work actions from minor preservation activities through major reconstruction activities, we direct a range of work activates to various maintenance and improvement programs to promote appropriate actions throughout the complete lifecycle of the structures. This is shown in Figure 42.6-1 as the Overall Structures Program.

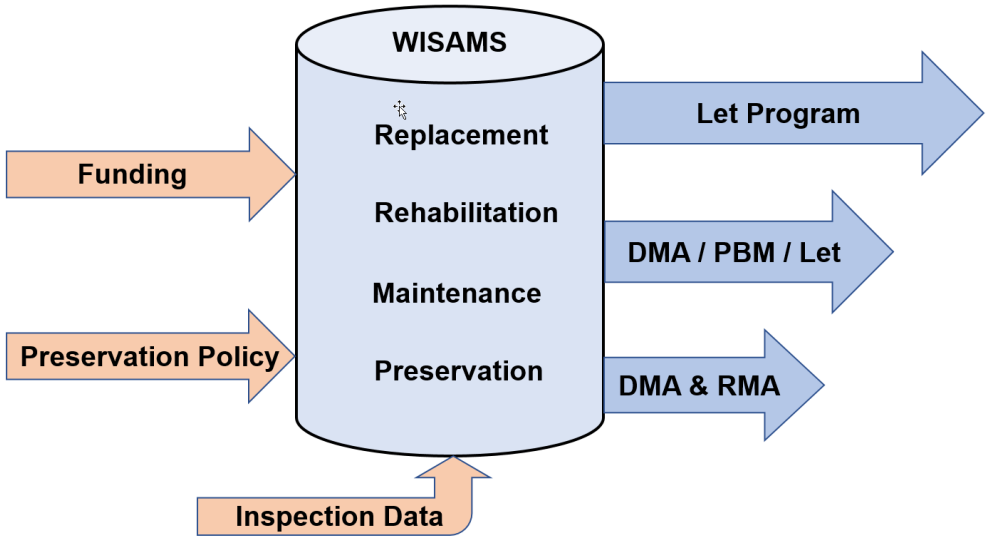

Figure 42.6-1
Overall Structures Program Diagram

Federal Funding and Preventive Maintenance

The May 2016 Agreement for the Use of Federal Funds for Preventive Maintenance of Structures [2], Section 5 (Special Limitations) outlines areas where certain work would not be eligible for federal funding in our improvement program, but could be included in our maintenance program with state funding. The following actions are usually considered ***routine maintenance*** and are not eligible for federal funding in the Let program under the WisDOT/FHWA agreement:

- Vehicle damage repair
- Asphalt deck patching
- Asphalt Overlay *without* Membrane
- Graffiti Removal
- Flood damage & minor channel debris removal

42.7 Definitions

Bridge Program: The WisDOT Bridge Program includes preservation, rehabilitation, improvement or major rehabilitation, replacement and new bridge construction actions.

Bridge Preservation: Bridge Preservation is defined as actions or strategies that prevent, delay, or reduce deterioration of bridges or bridge elements, restore the function of existing bridges, keep bridges in good or fair condition and extend their service life. Preservation actions may be cyclic or condition-driven.

Highway Structures Information System: Highway Structures Information System (HSIS) is the system developed by WisDOT for managing the inventory and inspection data of all highway structures. The inspection data is collected in accordance with the NBIS and *2019 AASHTO Manual for Bridge Element Inspection.*

Wisconsin Structures Asset Management System (WiSAMS): Automated application to determine optimal work candidates for improving the condition of structures. This application serves as a programming and planning tool for structures improvements, rehabilitations, maintenance, and preservation. This application coupled with the Highways Structures Information System (HSIS) serves as a comprehensive Structures (Bridge) Management system.

State of Good Repair (SGR): State of Good Repair (SGR) is a condition in which the existing physical assets, both individually and as a system (a) are functioning as designed within their useful service life, and (b) are sustained through regular maintenance and replacement programs. SGR represents just one element of a comprehensive capital investment program that also addresses system capacity and performance.[(3)]

Systematic Preventive Maintenance Program (SPM): Systematic Preventive Maintenance (SPM) is a planned strategy of cost-effective treatments to highway bridges that are intended to maintain or preserve the structural integrity and functionality of bridge elements and/or components, and retard future deterioration, thus maintaining or extending the useful life of bridges. An SPM program is based on a planned strategy that is equivalent to having a systematic process that defines the strategy, how it is planned, and how activities are determined to be cost effective. An SPM program may be applied to bridges at the network, highway system, or region-wide basis and have acceptable qualifying program parameters. The details on an SPM program and qualifying parameters are found in FHWA's *Bridge Preservation Guide.*

Preventive Maintenance(PM): Preventive maintenance is a cost-effective means to extend the service life of bridges. PM treatments retard future deterioration and avoid large expensive bridge rehabilitation or replacements. PM includes cyclic and condition based treatments.

Cyclical PM Activities: Cyclical PM activities are those activities performed on a pre-determined interval and aimed to preserve existing bridge element or component conditions. Bridge element or component conditions are not always directly improved as a result of these activities, however deterioration is expected to be delayed.

Condition Based PM Activities: Condition Based PM Activities are those activities that are performed on bridge elements in response to known defects as identified through the bridge inspection process.

Rehabilitation: Rehabilitation involves major work required to restore the structural integrity of a bridge as well as work necessary to correct major safety defects as defined in the Code of Federal Regulation (CFR) 23 clause 650.403.

Improvement or Major Rehab: Bridge improvement is a set of activities that fixes the deterioration found in a structure and improves the geometrics and load-carrying capacity beyond the original design standards, but may not provide improvement that meets new construction standards.

Replacement: Replacement of an existing bridge with a new facility constructed in the same general traffic corridor is considered total replacement. The replacement structure must meet the current geometric, construction, and structural standards as defined in the Code of Federal Regulation (CFR) 23 clause 650.403.

New Bridge Construction: The construction of a new bridge is defined as bridge construction that does not replace or relocate an existing bridge as described in FHWA's MAP-21 STP.

NBI Condition Rating: The FHWA coding guide describes the condition ratings used in evaluating four main components of a bridge as decks, superstructure, substructure, and culverts. The condition ratings are used to measure the deterioration level of bridges in a consistent and uniform manner to allow for comparison of the condition state of bridges on a national level. The condition ratings are also known as NBI ratings and are measured on a scale of 0 (worst) to 9 (excellent). For WisDOT bridges and culverts, an NBI rating of 4 is classified as poor, an NBI rating of 5 is classified as fair, and an NBI rating of 6 or higher is classified as 'good' (See Table 42.7-1).

Code	Description	Common Actions
9	**EXCELLENT CONDITION**	Preservation/Cyclic Maintenance
8	**VERY GOOD CONDITION**—No problems noted.	
7	**GOOD CONDITION**—Some minor problems.	
6	**SATISFACTORY CONDITION**—Structural elements show some minor deterioration.	Preservation/ Condition-Based Maintenance
5	**FAIR CONDITION**—All primary structural elements are sound but may have some minor section loss, cracking, spalling, or scour.	
4	**POOR CONDITION**—Advanced section loss, deterioration, spalling, or scour.	Rehabilitation or Replacement
3	**SERIOUS CONDITION**—Loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.	
2	**CRITICAL CONDITION**—Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present, or scour may have removed substructure support. Unless closely monitored, the bridge may have to be closed until corrective action is taken.	
1	**IMMINENT FAILURE CONDITION**—Major deterioration or section loss present in critical structural components, or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic, but corrective action may put it back in light service.	
0	**FAILED CONDITION**—Out of service. Bridge is beyond corrective action.	

Table 42.7-1
NBI General Condition Ratings & Common Actions

Element Condition State: A condition state categorizes the nature and extent of damage or deterioration of a bridge element. The 2019 *AASHTO Manual for Bridge Element Inspection* describes a comprehensive set of bridge elements mainly categorized as National Bridge Elements (NBE), Bridge Management Elements (BME) and Agency Develop Elements (ADE) and their corresponding four condition states. The element condition states1 to 4 are described as good (CS1), fair (CS2), poor (CS3), and severe (CS4).

Condition State	Description	Common Actions[10]
1	Varies depending on element—Good	Preservation/Cyclic Maintenance
2	Varies depending on element—Fair	Cyclic Maintenance or Condition-Based Maintenance when cost effective.
3	Varies depending on element—Poor	Condition-Based Maintenance, or Rehabilitation—when quantity of poor exceeds a limit that condition-based maintenance is not cost effective, or Replacement—when rehabilitation is not cost effective.
4	Varies depending on element—Severe	Rehabilitation or Replacement

Table 42.7-2
Element Condition States & Common Actions

42.8 References

1. *Bridge Preservation Guide*, *Maintaining a Resilient Infrastructure to Preserve Mobility* (FHWA) – Spring 2018, (https://www.fhwa.dot.gov/bridge/preservation/guide/guide.pdf)

2. FDM 3-1 Exhibit 5.2 Agreement for the Use of Federal Funds for Preventive Maintenance of Structures. (May 2016). (https://wisconsindot.gov/rdwy/fdm/fd-03-05-e0502.pdf#fd3-5e5.2)

3. Source: U.S. DOT Secretary Mary Peters July 25, 2008 letter to Congress

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