

Bridge Preservation Programs

Most bridge budgets are spent on the bridges in the worst condition, and most of the inventory is quietly sliding toward that condition while it waits. A preservation program is the deliberate alternative: spend modest amounts on good and fair bridges, on a schedule or in response to early defects, so that they stay good or fair longer. This course defines preservation the way FHWA does and separates it from routine maintenance, rehabilitation and replacement. It covers cyclical and condition-based work, how preservation is tied to asset management and to the State asset management plan required by 23 CFR Part 515, and the eleven steps FHWA lays out for building a program. It draws mainly on the FHWA Bridge Preservation Guide: Maintaining a Resilient Infrastructure to Preserve Mobility (FHWA-HIF-18-022, 2018) and on the text of 23 CFR 515.9. Numbers in worked examples that do not come from these documents are labeled illustrative.

Learning objectives

- Define preservation vs rehabilitation
- Distinguish cyclical and condition-based work
- Link preservation to asset management
- Build a preservation program

Why preservation, and why now

The FHWA Bridge Preservation Guide begins from a budget problem. State DOTs, local agencies and other owners face aging infrastructure, limited funds and growing competition for those funds among highway assets. Under those pressures, the Guide says, a "worst-first" approach, focusing only on replacing poor bridges while ignoring the maintenance needs of good and fair bridges, "is inefficient and cost-prohibitive in the long term." A successful program "seeks a balanced approach to preservation and rehabilitation/replacement."

The logic is about timing. A bridge component deteriorates slowly at first and then faster, as cracks admit water, water carries chlorides to the reinforcement, and corrosion spalls the cover and exposes more steel. Treatments applied early, while the component is good or fair, are cheap and slow that curve. Treatments applied late, after the component is poor, are expensive and only reset it. The Guide's Figure 14 shows this as a curve of condition over time with three zones: preservation while good or fair, rehabilitation, and replacement. It notes that "typically, when a bridge component enters into poor condition, bridge preservation ends until that bridge component is rehabilitated back into good or fair condition, or replaced."

Figure 17 compares two lines for the same bridge: without preservation, debris and chemicals attack the elements and service life is shorter; with cyclical and condition-based preservation applied in good and fair condition, the curve flattens and service life is longer. The monetized benefit, the Guide explains, is lower annualized cost: "Longer service life means lower annualized costs of rehabilitation or replacement."

The federal frame

The Guide explains that for decades the Highway Bridge Replacement and Rehabilitation Program, later the Highway Bridge Program, was the main federal bridge fund, and that it gave States discretion to use funds for a broad array of preventive maintenance as well as rehabilitation and replacement. MAP-21 and the FAST Act "recognized preservation as a vital component of achieving and sustaining a desired state of good repair." Section 1103 of MAP-21 amended the definition of

"construction" in 23 U.S.C. 101 to include preservation, so preservation is eligible for federal funding. Routine maintenance is not (23 U.S.C. 116(b)). That distinction is why precise definitions matter, and why this course spends time on them. See the flag on this course about later legislation.

Where this course fits

This is the program-level course. BR-DP02 covers deck preservation treatments in detail. BR-B02 (Deck Joints) and BR-B01 (Bearings) cover two of the components where preservation pays off most. BR-M01 covers bridge management systems and performance measures, which supply the analysis behind a program. BR-I04 and BR-S02 cover the element and condition data that drive condition-based rules.

Definitions: the vocabulary of preservation

The Guide offers definitions "as a means of establishing clear and consistent terminology for bridge owners and preservation practitioners." They are reproduced here closely because consistent use of them is the first step in any program.

Asset management

Quoting 23 U.S.C. 101(a)(2) as added by MAP-21: "a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based on quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the life cycle of the assets at a minimum practicable cost."

Maintenance

Work performed to maintain the condition of the transportation system or respond to specific conditions or events that restore the highway system to a functional state of operations. Maintenance includes both routine and preventive maintenance.

Routine maintenance

Work performed in reaction to an event or season, or activities done for short-term operational need, that do not have preservation value. The Guide's Table 1 lists examples not eligible for federal funds: trash, litter and dead animal removal; snow removal and application of salt or deicing chemicals; graffiti removal; hazardous material removal; asphalt patch with no membrane on a concrete deck; accident damage to the bridge and its appurtenances; and storm damage.

Bridge preservation

"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." The commentary adds that effective preservation is intended to delay costly rehabilitation or replacement "while bridges are still in good or fair condition and before the onset of serious deterioration."

Preventive maintenance

"A cost-effective means of extending the service life of highway bridges," applying cost-effective treatments to elements to retard deterioration. Preventive maintenance includes cyclical and condition-based activities.

Rehabilitation

Major work required to restore the structural integrity of a bridge, and work necessary to correct major safety defects (23 CFR 650.403(c)). Rehabilitation provides complete or nearly complete restoration of elements or components; examples are partial or complete deck replacement, superstructure replacement, and substructure or culvert strengthening or replacement. It requires significant engineering, a lengthy schedule and considerable cost.

Replacement

Total replacement of an existing bridge with a new facility in the same general traffic corridor, meeting current geometric, construction and structural standards, with a nominal amount of approach work.

Design life and service life

Design life is the period a component is expected to function when designed, built and maintained per standards. Service life is the period it actually provides the desired function with appropriate preservation. The Guide's point is that "a steadfast bridge preservation program and quality workmanship practiced during the service life of an asset is necessary for the asset to reach its design life."

The action categories

The Guide's Figure 2 places these terms in one hierarchy under bridge asset management: preservation/preventive maintenance (split into cyclical and condition-based maintenance), rehabilitation and replacement. Its Table 4 summarizes eligibility: routine maintenance, no; cyclical maintenance, yes; condition-based maintenance, yes; rehabilitation, yes; replacement, yes.

Preservation versus rehabilitation: drawing the line

The difference between preservation and rehabilitation is not the size of the check. It is the purpose and the condition of the component when the work is done.

- **Preservation** acts on components in good or fair condition, before serious deterioration, to slow deterioration and extend service life. It protects what is still sound.
- **Rehabilitation** restores structural integrity or corrects major safety defects on components that have deteriorated, usually to poor. It rebuilds what has been lost.

The Guide's appendices tie the actions to condition. Appendix A maps NBI general condition ratings: 9, 8 and 7 to preservation/cyclic maintenance; 6 and 5 to preservation/condition-based maintenance; 4 and below to rehabilitation or replacement. Appendix B maps element condition states: CS1 to cyclic maintenance, or condition-based maintenance when cost-effective; CS2 and CS3 to condition-based maintenance, or rehabilitation when the quantity in poor exceeds a limit at which condition-based maintenance is not cost-effective, or replacement when rehabilitation is not cost-effective; and CS4 to rehabilitation or replacement. A footnote adds that the appropriate action "will also be dependent on the element quantity in each condition state."

Gray zones

Some activities appear on both sides depending on scale. A joint seal replacement on a fair bridge is condition-based preservation (it is in the Guide's Table 3). A full deck replacement is rehabilitation. Concrete patching in conjunction with an

overlay is condition-based preservation; partial deck replacement is rehabilitation. When in doubt, the test is whether the work protects sound material and extends service life (preservation), or restores lost capacity or corrects a safety defect (rehabilitation).

Routine maintenance is not preservation

The Guide insists on separating routine maintenance from preservation because of funding: routine maintenance is not eligible for federal funds. Snow removal is routine; cleaning and washing decks, joints and drains to remove salt and debris is cyclical preservation. An asphalt patch on a bare concrete deck with no membrane is routine (it has no preservation value and traps chlorides); an asphalt overlay with a waterproof membrane is condition-based preservation. Agencies should write these distinctions into their work codes so that the costs land in the right program.

Why the line matters for decision-making

The two kinds of work compete for the same dollars but answer different questions. Rehabilitation answers "how do we fix this bridge?" Preservation answers "how do we keep the rest from needing to be fixed?" An agency that funds only the first question will see its fair bridges slide into poor faster than it can rehabilitate them. FHWA's Figure 18 expresses the goal: keep the counts (or deck area) of bridges needing condition-based maintenance and rehabilitation from growing, so that the cyclic population stays large.

Cyclical preservation

The Guide defines cyclical maintenance activities as those "performed on pre-determined intervals that aim to preserve and delay deterioration of bridge elements or component conditions." The commentary adds that frequency can change with environment or condition, using the example of a superstructure cleaning interval of three years that may need to shorten if pigeons begin nesting on the superstructure.

Examples from the Guide (Table 2)

Cyclical activity	Component
Clean/wash bridge	Deck and/or superstructure/substructure
Clean and flush drains	Deck
Clean joints	Deck
Deck, parapet and rail sealing, and crack sealing	Deck
Seal concrete	Superstructure/substructure

The Guide explains why each matters. Cleaning decks, joints, drains, superstructure and substructure "slows the deterioration of concrete and steel elements that would otherwise be accelerated by debris, bird droppings, and contaminants." Deck sealers protect reinforcement "by stopping or minimizing the intrusion of water and chloride through the concrete."

An example cyclical rule

The Guide's Table 5 gives an example cyclical rule for decks with NBI Item 58 of 7 or higher:

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

These are examples, not national standards. An agency should set its own intervals from its climate, deicing practice, traffic and product experience, and adjust them as inspection data show how long treatments actually last.

Why cyclical work is easy to start and easy to drop

The Guide suggests an agency can start a preservation program by cyclically cleaning and washing bridges in good or fair condition, using brooms and shovels to remove debris and grit and hoses or pressure washers to dilute deicing chemicals. Cyclical work needs little engineering and can be done by maintenance forces. Its weakness is that its benefits are invisible in any single year, so it is the first thing cut when budgets tighten. The Guide's program summary recommends promoting "as a policy the scheduled replacement of wearing surfaces, coatings, surface sealers, and joint seals in place of policies that wait for defects before planning repairs."

Condition-based preservation

Condition-based maintenance activities "are performed on bridge components or elements in response to known defects." They improve the condition of that portion of the element and "may or may not result in an increase in the component condition rating." They are identified through inspection.

The Guide gives an example of a substructure element rated fair because of spalled concrete and exposed reinforcement. After maintenance removed loose concrete, cleaned the reinforcement and formed and placed new concrete, the substructure rating was changed to good.

Examples from the Guide (Table 3)

Component	Condition-based activities
Deck	Drain repair/replace; joint seal replacement; joint repair/replace/elimination; electrochemical extraction (ECE) or cathodic protection (CP); concrete deck repair in conjunction with overlays, CP or ECE; deck overlays (thin polymer epoxy, asphalt with waterproof membrane, rigid overlays)
Approach	Repair/replace approach slabs
Superstructure	Seal/patch/repair concrete; protective coat concrete and steel; spot, zone or full painting; steel member repair; fatigue crack mitigation (pin-and-hanger replacement, retrofit of fracture critical members); bearing restoration (cleaning, lubrication, resetting, replacement); movable bridge machinery cleaning, lubrication and repair
Substructure/culvert	Patch/repair concrete; protective coat; ECE/CP; spot, zone or full painting; pile preservation (jackets, wraps, CP)
Channel	Channel cleaning and debris removal; scour countermeasure installation or repair

The halo effect

The Guide flags one trap in condition-based deck work: the halo effect. When a delaminated area caused by chloride-induced corrosion is removed and replaced with chloride-free repair material, "if a high concentration of chlorides remains in the area surrounding the replaced concrete, the corrosion potential will lead to rapid corrosion in the area surrounding the repair." That

is why the Guide pairs deck repair with overlays, CP or ECE rather than listing patching alone. The same mechanism explains the joint lesson in BR-B02 that a new blockout must be bonded to sound, uncontaminated concrete.

An example condition-based rule

The Guide's Table 6 shows an example rule. If a deck's top surface rating (an agency item it labels BSIR #58a) is 5 or better with no more than 5% defect area, and its bottom surface rating (#58b) is better than 5 with no more than 2% defect area, an epoxy overlay is a candidate; after the work, the top rating becomes 8 or 9 and the bottom does not change, with an expected service life of 10 to 15 years. A second row shows deck patching where top defect area is no more than 10% and bottom no more than 25%, raising the top rating by one with a service life of 3 to 10 years. The specific items and thresholds are one agency's; what matters is the form: a trigger condition, an action, an expected effect on condition, and an expected life.

The Guide adds that "when a rule is satisfied, further evaluation is warranted to determine whether to conduct the action." Rules do not account for the relative priority and benefit of different actions or bridges, which must be weighed under budget constraints, along with net benefit, length of service-life extension, availability of specialty contractors, coordination along routes or bundled contracts, and traffic operations.

Measuring condition: NBI ratings and element states

A preservation program needs a "needs identification method that is uniform, specific, and repeatable," which the Guide says can be based on NBI component ratings, detailed inspections and scopes, or element-level condition data.

NBI general condition ratings and Good/Fair/Poor

The Guide explains that general condition ratings (GCRs) on the 0 to 9 scale describe deck (Item 58), superstructure (Item 59), substructure (Item 60) and culvert (Item 62) condition compared with as-built. Under 23 CFR 490.409, a bridge is Good when the minimum of Items 58, 59 and 60 is 7, 8 or 9; Fair when the minimum is 5 or 6; and Poor when any of the three is 4 or below. A culvert is classified by Item 62 alone. (The SNBI replaces the Coding Guide item numbers with new ones; see BR-S01 and BR-S02. The Good/Fair/Poor logic carries forward.)

GCRs help categorize preservation, rehabilitation and replacement needs broadly, but the Guide warns that "they are too broad for determining specific activity on a bridge. If only GCRs are available, detailed scopes are necessary." A deck rated 6 could need crack sealing, a joint replacement, or patching and an overlay; the rating alone does not say which.

Element condition states

The AASHTO Manual for Bridge Element Inspection assigns each element a unit of measure and four condition states, good, fair, poor and severe, with the total quantity distributed among them. Element data are far better suited to preservation because they show how much of an element is in each state, which is what condition-based rules need. Element inspection is covered in BR-I04.

NBEs, BMEs and ADEs

The Guide explains three element categories:

- **National Bridge Elements (NBEs):** the primary structural components needed to determine overall condition and safety, including decks and slabs, railings, superstructures, substructures, bearings and culverts.

- **Bridge Management Elements (BMEs):** components that "support the preservation of the NBEs," including joints, approach slabs, wearing surfaces and protective systems.
- **Agency Developed Elements (ADEs):** custom elements, either sub-elements of NBEs or BMEs or stand-alone. The Guide's examples are a steel beam end ADE under an expansion joint, and a deck drain ADE to monitor scuppers and downspouts. It also notes that diaphragms in straight steel bridges are not NBEs but can be added as ADEs.

The BME category is the heart of preservation. The Guide's Figure 16, credited to George Hearn, shows that preserving one BME can protect several NBEs: a steel coating protects one NBE, the steel beam; a joint protects three, the beam, the bearing and the substructure. That is the quantitative argument for spending preservation dollars on joints and coatings first.

Linking preservation to asset management and the TAMP

Under 23 U.S.C. 119 and 23 CFR Part 515, each State DOT must develop and implement a risk-based asset management plan (often called a TAMP) for the National Highway System. Preservation is one of the action types the plan must manage. The requirements below are from the text of 23 CFR 515.9.

What 23 CFR 515.9 requires

- A plan "to improve or preserve the condition of the assets and improve the performance of the NHS" (515.9(a)).
- At minimum, a summary listing of NHS pavement and bridge assets, regardless of ownership (515.9(b)). Other assets and other roads may be included (515.9(c)).
- Minimum content (515.9(d)): asset management objectives; measures and targets for asset condition, including those under 23 U.S.C. 150 for NHS pavements and bridges; a summary of NHS pavement and bridge condition; performance gap identification; life-cycle planning; risk management analysis, including evaluations under Part 667 of facilities repeatedly damaged by emergency events; a financial plan; and investment strategies.
- A minimum 10-year period (515.9(e)).
- A discussion of how investment strategies make or support progress toward a state of good repair over the life cycle at minimum practicable cost, improving or preserving condition, achieving targets, and achieving national goals (515.9(f)).
- Integration with the planning processes leading to the STIP (515.9(h)), public availability (515.9(i)), and approval by the head of the State DOT (515.9(k)).

Life-cycle planning

The Guide defines life cycle planning (LCP), referring to 23 CFR 515 and FHWA LCP guidance, as "a process that estimates the cost of managing an asset class, or asset sub-group, over its service life with consideration for minimizing cost while preserving or improving its condition." LCP evaluates preservation actions and timing, proportions of spending among preservation, rehabilitation and replacement, and funding levels, leading to a long-term strategy that minimizes life-cycle cost while maintaining condition. LCP is where preservation earns its place: a strategy that leaves preservation out generally shows higher life-cycle cost for the same condition.

Performance gaps and targets

The national bridge measures under 23 CFR 490 are the percentages of NHS bridge deck area in Good and in Poor condition. A preservation program supports both: it slows the flow of Good bridges into Fair and of Fair bridges into Poor. A TAMP that relies only on replacement to meet a Poor target will generally need far more money than one that also uses preservation to reduce the inflow.

Practical linkages

- Define preservation actions, triggers and expected effects in the bridge management system (BR-M01) so they appear in life-cycle scenarios.
- Report preservation spending and accomplishments in the TAMP investment strategy.
- Use preservation outcomes (for example, the share of joints in CS2 or better) as supplemental measures alongside the federal ones.
- Treat preservation as a risk mitigation strategy: protecting BMEs reduces the likelihood of sudden NBE deterioration.

Building a program: the FHWA steps

The Guide says that "establishing a bridge preservation program can be simple." An agency can begin with cyclical cleaning and washing of good and fair bridges and add actions as the program develops. Its Figure 15 lays out eleven steps in a cycle.

1. Identify agency goals and objectives

The agency outlines goals and objectives to preserve its bridges and identifies dedicated funds for preservation.

2. Identify bridges to preserve

Bridges are preserved "when preservation is feasible and beneficial, targeting bridges and components that are in good or fair condition, have adequate load capacity, and continue to meet the mobility (traffic) demands." Preserving a bridge that is functionally obsolete or scheduled for replacement soon is not a good investment.

3. Develop a list of actions

Use the cyclical and condition-based actions (Tables 2 and 3), considering the relationships among elements, especially how BMEs protect NBEs.

4. Establish agency rules

A rule identifies when an action may be appropriate. Cyclical rules pair an action with an interval; condition-based rules pair an action with an element or component condition.

5. Develop life cycle plans

Use the actions and rules in LCP scenarios to find the strategy that minimizes life-cycle cost for the desired condition.

6. Develop performance measures

The Guide says measures of accomplishment are comparative: actions completed against actions planned, and average condition of elements in the preservation population. Examples include GCR of components in Good, Fair or Poor; percent of deck joints in CS2 or better; and percent of steel protective coating elements in CS2 or better.

7. Develop methods to evaluate benefits

Benefits are the lower annualized costs from longer service life. Programs "are adopted and adjusted based on net benefits."

8. Determine availability of dedicated funds

Completed work links costs to benefits. An unconstrained funding scenario in a BMS can supplement this. Together, they support advocating for current or increased funding.

9. Implement and evaluate projects

Prepare work orders and contracts and evaluate completed work for quality and completeness.

10. Monitor and measure performance

Monitor component or element condition trends, numbers of bridges, and needs. Because results are not recorded until the next inspection, "it may take multiple inspection cycles to effectively measure the program's performance."

11. Report and improve

Report to executives and the public, from simple reports to dashboards (the Guide shows the Michigan Transportation Asset Management Council dashboard), and improve by comparing assumed and actual results.

Measuring whether preservation is working

The Guide's Figure 18, credited to Raj Ailaney of FHWA, gives a compact way to judge a program. It divides the inventory into three bands: cyclic maintenance (NBI 9, 8, 7 or element CS1), condition-based maintenance (NBI 6, 5 or CS2 and CS3), and rehabilitation/replacement (NBI 4 or below or CS4). It labels flows between bands: X is the count (or deck area, or element quantity) moving from cyclic to condition-based in a period, Y the count moving from condition-based to rehabilitation/replacement. A is the count moving back up from condition-based to cyclic as a result of condition-based work, and B the count moving up from rehabilitation/replacement to the higher bands as a result of rehabilitation or replacement.

The Guide states: "Preservation is effective when X and Y are minimized. Desired goal is A greater than X; B greater than Y; (A+B) greater than or equal to (X+Y)." In words: more bridges should be restored to good through condition-based work than deteriorate into fair, more should be brought out of poor than fall into it, and overall upward movement should at least match downward movement.

Useful measures

- Deck area or bridge counts in Good, Fair and Poor, and the transitions between them each year.
- Element quantities by condition state for key BMEs: joints, wearing surfaces, protective coatings.
- Actions completed versus planned, by type.
- Average age of treatments versus their target interval (for example, years since last deck seal).
- Deterioration rates of preserved versus unpreserved groups, where data allow.

Pitfalls

- **Lag.** Results appear only after the next inspection, so judging a program on one cycle is premature.
- **Insensitivity of GCRs.** Many preservation actions do not change a 0 to 9 rating even when they clearly help. Element data are more sensitive.
- **Selection bias.** Preserved bridges are often in better condition to begin with. Compare deterioration rates rather than conditions.
- **Counting activity as outcome.** Square feet of sealer applied is a measure of effort, not of benefit.

Worked example: a small preservation program (illustrative)

All numbers in this example are illustrative and do not come from the Guide or any agency.

Inventory. A county owns 120 bridges with total deck area of 300,000 sq ft. By deck area, 40% are Good, 50% Fair and 10% Poor. Its bridge budget has gone almost entirely to replacing one or two Poor bridges a year.

Step 1, goals. Keep Poor deck area below 10% over ten years without increasing the total budget, while reducing the flow of Fair bridges to Poor.

Step 2, bridges to preserve. Exclude 8 bridges already programmed for replacement and 5 with load capacity problems slated for study. That leaves 107 candidates in Good or Fair condition.

Steps 3 and 4, actions and rules.

- Cyclical: sweep and wash decks, joints, seats and drains every year on all 107; seal concrete decks with NBI deck rating 7 or above every 4 years; clean joints annually.
- Condition-based: replace joint seals when element 300 to 302 has more than 10% of length in CS3 or CS4 and beam ends beneath are not yet in CS3; install thin polymer overlays on decks rated 6 with less than 5% spall and delamination; spot paint steel beam ends where coating is in CS3.

The joint rule follows the Guide's suggestion to "prioritize new joint seals at bridges with beam ends in good condition": protecting good beam ends saves the most.

Step 5, life-cycle comparison. The county runs two ten-year scenarios with the same total spending. Scenario 1 spends everything on replacement. Scenario 2 shifts 25% to preservation. In this illustration the BMS projects that Scenario 2 ends the decade with Poor deck area of 9% versus 14% for Scenario 1, because fewer Fair bridges fall to Poor. (These projections depend entirely on the deterioration and treatment models in the BMS and are illustrative.)

Step 6, measures. Percent of deck area Good, Fair and Poor; percent of joint length in CS2 or better; washing completed versus planned.

Steps 8 to 11. The county writes the preservation share into its capital program, bundles joint seal replacements into one annual contract to attract bidders, records completed actions in its inventory, and reports a one-page summary to its board each year comparing actual with projected transitions.

What could go wrong. If washing is cut in a tight year, the joint and beam end gains erode. If joint seals are replaced without cleaning the seats or fixing troughs, the beam ends continue to corrode. If the deck sealing interval is never checked against inspection data, sealers may be applied too late or too often. The program summary in the Guide addresses each of these by making scheduled replacement and data tracking policy.

Program summary and first actions

The Guide closes with practical first steps for an agency starting out, suggesting that each can be put forward "as a regular procedure, as options in policy, or as requirements in policy as the benefits of bridge preservation are realized":

- Start a bridge cleaning program with tools most agencies have, brooms and shovels to remove debris and grit, then hoses and pressure washers to dilute deicing chemicals and remove what remains.

- Encourage maintenance crews to check deck joints for leakage and replace seals where needed; have supervisors note the condition of both joints and beam ends, and prioritize new seals at bridges with beam ends in good condition.
- Promote as policy the scheduled replacement of wearing surfaces, coatings, surface sealers and joint seals instead of waiting for defects.
- Use inspection data to track wearing surfaces, coatings, sealers and joint seals and update replacement intervals accordingly.
- Quantify and publicize reductions in annualized costs to gain and hold executive support.

Best practices from the Guide

- A uniform, specific, repeatable needs identification method.
- Management commitment to asset preservation.
- Resource allocation driven by network goals and a BMS directed to preservation actions.
- A categorization and prioritization process that integrates agency objectives.
- Verification and feedback on completed work.

Checklist for program managers

- Written definitions that separate routine maintenance, preservation, rehabilitation and replacement, mapped to work codes.
- A list of preservation candidates (good or fair, adequate capacity, meeting mobility needs, not programmed for replacement).
- Cyclical rules with intervals, and condition-based rules with triggers, expected effects and expected lives.
- Element data for the BMEs that protect the most NBEs: joints, coatings, wearing surfaces.
- Life-cycle scenarios in the BMS comparing strategies.
- Performance measures tracking transitions, not only condition snapshots.
- A dedicated preservation budget line, tied into the TAMP investment strategy.
- An annual report comparing projected with actual outcomes.

Matching actions to the elements that matter most

The Guide's Figure 16 makes the case that a preservation dollar spent on a Bridge Management Element can protect several National Bridge Elements. Applying that idea element by element helps an agency rank its candidate actions before any life-cycle model is run.

Joints

A transverse deck joint sits over the beam ends, bearings and seat. The Guide's figure shows one joint protecting three NBEs: the beam, the bearing and the substructure. Cyclical joint cleaning and condition-based seal replacement appear in its Tables 2 and 3, and its program summary singles out joint seals at bridges whose beam ends are still good. BR-B02 covers joint types, coding with elements 300 to 306 and defects 2310 to 2370, and the practices that make seals last.

Protective coatings

A steel coating protects one NBE, the steel member it covers, but that member is often the most expensive part of the bridge to repair. Spot, zone and full painting are listed in Table 3. Zone painting at beam ends under joints is a common way to concentrate effort where corrosion starts. BR-ST02 covers coating systems and weathering steel.

Wearing surfaces and deck sealers

Wearing surfaces and sealers protect the deck, which is often the element that drives a bridge into Poor because Item 58 (deck) is one of the three ratings in the Good/Fair/Poor classification. The example cyclical rule in Table 5 is entirely deck work. BR-DP02 covers the treatments.

Drains

Drains are not a national element, but the Guide's ADE example shows how an agency can track them. A clogged scupper ponds water on the deck and a broken downspout discharges salt water onto a girder or pier. Cleaning and flushing drains is cyclical; repair and replacement are condition-based.

Bearings

Bearing restoration (cleaning, lubrication, resetting and replacement) is listed as condition-based work. A bearing that is free to move protects the girders and substructure from restraint forces. See BR-B01.

Channels

Channel cleaning, debris removal and scour countermeasure installation or repair are listed as condition-based work. Debris at piers increases scour and lateral load; see BR-H03.

A ranking heuristic

When candidates compete, a simple ordering helps before formal analysis: first, actions that protect several NBEs at low cost (joint cleaning, seal replacement over good beam ends, drain cleaning); second, actions that keep a deck out of Poor (sealing, thin overlays on fair decks); third, actions that protect a single costly NBE (coating repair); and last, actions with uncertain benefit. The heuristic is a starting point for the BMS analysis, not a substitute for it.

Organizing the work: forces, contracts and records

The Guide's steps 8 and 9 call for dedicated funds and for implementing and evaluating projects. How the work is delivered strongly affects whether a program survives its first lean year.

Maintenance forces

Cyclical work such as sweeping, washing, drain flushing and joint cleaning suits agency maintenance crews. It needs little equipment, can be scheduled around seasons, and can be paired with inspection access. The risk is that crews are pulled to emergencies and routine work such as snow removal, which the Guide classifies as routine maintenance. A written annual schedule, with completion tracked against plan (one of the Guide's example measures), protects the cyclical work.

Contracts

Condition-based work such as joint replacement, overlays, coating and concrete repair often needs specialty contractors. The Guide lists "availability of specialty contractors" and "coordination of work along route segments or bridge bundling contracts" among the factors to consider after a rule is triggered. Bundling similar work on several bridges into one contract can attract bidders and lower unit costs for small agencies.

Quality of work

Step 9 stresses evaluation of completed work for quality and completeness. A sealer applied to a wet or dirty deck, or a joint seal set at the wrong temperature, consumes the budget without the benefit. Specifications should include surface preparation, weather limits, manufacturer requirements and acceptance tests (for example, a watertightness test for joints, as described in BR-B02).

Records

Preservation benefits are measured over several inspection cycles, so records must outlive staff turnover. For each action record the bridge, element, quantity, date, product, contractor or crew, and cost. Link the records to the inventory so the next inspector can see what was done and so the BMS can compare treated and untreated groups. Without these records an agency cannot calibrate its rules, update intervals, or demonstrate the benefit that the Guide's step 7 requires.

Eligibility documentation

Because routine maintenance is not eligible for federal funds and preservation is (under the Guide's 2018 framework; see this course's flag), projects that use federal funds should document why each activity is preservation: the element, its condition, the expected effect on service life, and the rule that triggered it.

Common objections and how to answer them

Preservation programs are often harder to sell than replacement projects. These objections come up repeatedly. The answers draw on the Guide's reasoning.

"We cannot afford preservation while we have Poor bridges."

The Guide's answer is that worst-first is "inefficient and cost-prohibitive in the long term." Every Fair bridge that slides into Poor adds to the replacement backlog. Life-cycle planning, required in State TAMPs by 23 CFR 515.9(d)(5), is the tool to show whether a mix that includes preservation keeps Poor lower for the same money.

"Preservation does not change the ratings."

The Guide acknowledges condition-based work "may or may not result in an increase in the component condition rating." The benefit is in slower future deterioration, which shows up in transitions over several cycles (Figure 18) and in element quantities, not necessarily in a single rating.

"We tried sealers and saw no difference."

Ask whether records show when and how the sealer was applied, whether surface preparation was adequate, and how long the agency waited to judge. The Guide warns it may take multiple inspection cycles to measure performance. Adjust intervals and products from data rather than abandoning the action.

"Cleaning is maintenance, not engineering."

Cleaning decks, joints and drains is listed in the Guide as cyclical preservation because it "slows the deterioration of concrete and steel elements." It is also one of the cheapest actions an agency can take, and the Guide suggests it as the starting point for a new program.

"Our BMS is not ready."

The Guide says establishing a program "can be simple." An agency can begin with cleaning and a short list of rules, record what it does, and grow into formal life-cycle analysis as data accumulate.

Self-check: classifying work

Use the Guide's definitions and tables to classify each activity below before reading the answer. The answers follow the Guide's Tables 1 to 4.

1. **Removing a dead deer from the shoulder of a bridge.** Routine maintenance (Table 1); not eligible for federal funds.
2. **Annual pressure washing of a deck, joints and seats after winter.** Cyclical preservation (Table 2).
3. **Replacing a torn strip seal gland on a bridge with good beam ends.** Condition-based preservation (Table 3, joint seal replacement), and a high-value one under the Guide's program summary.
4. **Placing an asphalt patch with no membrane over a spall on a bare concrete deck.** Routine maintenance (Table 1); it has no preservation value.
5. **Repairing deck delaminations and placing a thin polymer overlay on a deck rated 6.** Condition-based preservation (Table 3, concrete deck repair in conjunction with overlays).
6. **Replacing a deck rated 4.** Rehabilitation (partial or complete deck replacement).
7. **Cleaning, lubricating and resetting a tilted rocker bearing.** Condition-based preservation (Table 3, bearing restoration).
8. **Repairing guardrail struck by a truck.** Routine maintenance (Table 1, accident damage).
9. **Installing riprap at a pier after an inspection noted scour.** Condition-based preservation (Table 3, scour countermeasure installation), though a scour critical finding would also trigger the actions in BR-H02.
10. **Building a new bridge alongside an old one in the same corridor.** Replacement.

Notice how often the same component appears in more than one category. A deck can receive routine work (an unmembraned patch), cyclical preservation (washing, sealing), condition-based preservation (repair with an overlay) and rehabilitation (replacement). The category depends on the purpose of the work and the condition of the element when it is done, not on the component. Writing work codes around purpose and condition, rather than around components, keeps the classification consistent and makes the preservation share of spending visible in agency reports and in the TAMP.

Where your agency's work codes differ from these answers, check whether the difference affects federal eligibility.

Key takeaways

- Worst-first programs are inefficient; FHWA recommends balancing preservation with rehabilitation and replacement.
- Bridge preservation prevents, delays or reduces deterioration, keeps bridges good or fair, and extends service life; it may be cyclical or condition-based.
- Routine maintenance (snow removal, litter, accident damage) is not eligible for federal funds; cyclical and condition-based preservation are, per the 2018 Guide.
- Preservation acts on good and fair components; once a component is poor, rehabilitation or replacement is generally needed first.
- Bridge Management Elements such as joints and coatings protect one or more National Bridge Elements, which is why they are prime preservation targets.

- Agency rules pair actions with intervals (cyclical) or condition triggers (condition-based), followed by evaluation of priority and benefit.
- 23 CFR 515.9 requires State TAMPs to include life-cycle planning, risk analysis, a financial plan and investment strategies over at least 10 years.
- Preservation is effective when flows from good to fair and fair to poor are minimized and restored quantities exceed deteriorated ones.

References

1. FHWA, Bridge Preservation Guide: Maintaining a Resilient Infrastructure to Preserve Mobility, FHWA-HIF-18-022, 2018
2. 23 CFR Part 515 — Asset Management Plans
3. FHWA, Bridge Preservation Guide: Maintaining a Resilient Infrastructure to Preserve Mobility, FHWA-HIF-18-022, Spring 2018
4. 23 CFR 515.9, Asset management plan requirements (as published by the Legal Information Institute, read October 2026)

Study text only; the final quiz is taken online. Verify all references against the edition your agency has adopted.