Asset Management: Bridge Assessment Annual Report

Bridge Condition Ratings

Bridge Preservation Highlights:

For FY 2009, 97% of WSDOT's bridges were in good or fair condition.

WSDOT's bridge inventory increased from 3,607 to 3,628 total structures between FY 2008 and FY 2009.

The Hood Canal f oating bridge is open and the rehabilitation project is nearly complete (see p. 86 for more information).

Hood Canal Bridge

WSDOT has 11 "load posted" and 140 "load restricted" bridges as of June 30, 2009.

WSDOT has 99 steel bridges that are due or past due for repainting.

WSDOT is responsible for managing more than 3,600 bridges and structures. To do so, WSDOT utilizes the Washington State Bridge Inventory System, which provides a way to record all inspection-related information. The Federal Highway Administration (FHWA) requires WSDOT to also gather, store, and report bridge information from other public agency bridge-owners in the state such as cities and counties.

National bridge structural condition standards have been established by the FHWA and outlined in the *Recording and Coding Guide for the Structural Inventory and Appraisal of the Nation's Bridges*. The FHWA provides a method to determine if a bridge is classified as "Structurally Deficient" or "Functionally Obsolete." These ratings relate to the evaluation of the bridge superstructure, deck, substructure, structural adequacy, and waterway adequacy codes. For a more detailed description of the Structurally Deficient and Functionally Obsolete ratings, please see p. 22. Necessary, non-structural preservation activities, such as bridge painting and replacing expansion joints, do not directly affect this rating.

WSDOT uses a separate performance measure method to classify a bridge's condition as either "Good" or "Fair" or "Poor". This measure uses only the National Bridge Inspection Standards (NBIS) bridge superstructure and substructure codes to determine the Good/Fair/Poor rating, since they provide the best direct means to asses the structural condition of the bridge. The deck code is not used because in only the most severe cases will the deck condition affect a bridge's structural condition. Nor are the structural and waterway adequacy codes used, since they only provide an appraisal of the bridge in these two areas. Additional information is available at http://www.wsdot.wa.gov/Bridge/Reporting/default.htm.

Bridge condition update: 97% of WSDOT bridges in good or fair condition

Each year, WSDOT reports on the condition of its bridges to the Office of Financial Management as part of the Comprehensive Annual Financial Report (CAFR) in accordance with reporting standards set by the Governmental Accounting Standards Board (GASB), which groups together the number of bridges, ferry terminal structures, and culverts. The Governor's goal is to maintain 97% of all bridges statewide at a condition rating of good or fair. For fiscal year (FY) 2009, 89% of WSDOT bridges were in good condition, and 8% were in fair condition. Roughly 3% of bridge structures (2.47%) had a condition rating of poor, a slight improvement compared to FY 2008 (2.99%). No bridge that is open to traffic and rated as "poor" is unsafe for public travel. There is only one WSDOT bridge that is closed to the public, the Murray Morgan Bridge in Tacoma.

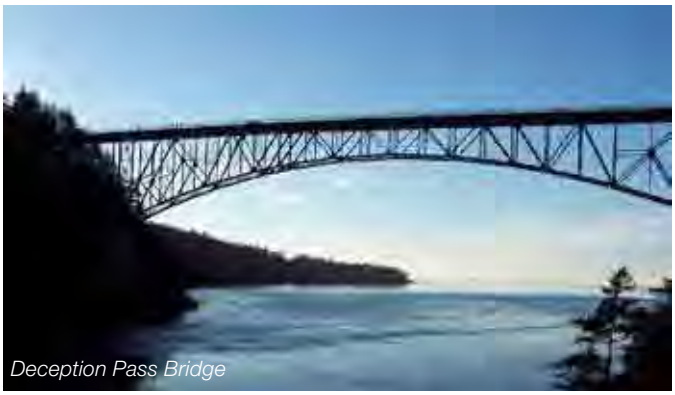
Bridge structural condition ratings

Condition ratings by f *scal year (based on the number of bridges)*

	Description	2004	2005	2006	2007	2008	2009
Good	A range from no problems to some minor deterioration of structural elements.	87%	89%	88%	88%	88%	89%
Fair	All primary structural elements are sound but may have deficiencies such as minor section loss, deterioration, cracking, spalling, or scour.	10%	9%	9%	9%	9%	8%
Poor	Advanced deficiencies such as section loss, deterioration, cracking, spalling, scour, or seriously affected primary structural components. Bridges rated in poor condition may have truck weight restrictions.	3%	2%	3%	3%	3%	3%

Source: WSDOT Bridge and Structures Office.

Bridge Inventory / Bridge Inspections


Deception Pass Bridge

Bridge inventory increases during FY 2009

The number of vehicular bridges more than 20 feet in length has increased from 2,995 to 3,023 since July 2008. The increased inventory primarily relates to new bridges being built and older bridges being replaced within the highway system. In addition, the number of pedestrian bridge structures has increased from 63 to 65. WSDOT has 21 ferry terminal locations, but for inspection purposes 54 structures that carry vehicles and 17 that do not carry vehicles have been identified in the inventory.

WSDOT inventory of bridges and structures
As of June 30, 2009

	Number	Square feet
Vehicular bridges greater than 20 feet in length	3,023	44,755,754
Structures less than 20 feet in length	336	n/a
Border bridges maintained by the border state	6	n/a
Culverts greater than 20 feet	90	n/a
Pedestrian structures	65	309,773
Tunnels and lids	39	n/a
Ferry terminal structures	71	819,726
Buildings (I-5 Convention Center)	1	n/a
Railroad bridges	5	n/a
Totals of all structures	**3,630**	**45,885,253**

Data Source: WSDOT Bridge and Structures Office.

Bridge preservation program aims to ensure WSDOT bridges are safe and operational

WSDOT's bridge preservation program consists of categories of work that ensure state-owned bridges remain in safe and operational condition. In doing so, there may be some shared responsibilities between WSDOT maintenance and preservation programs. Bridge preservation work is performed by contractors and is in addition to normal maintenance work performed by WSDOT regional personnel.

The primary elements of the program include:

- **Inspection** – Perform Federally required inspections on state-owned bridges and structures (pp. 17-18).
- **Replacements and rehabilitations** – Repair deteriorated bridge elements, such as concrete columns, expansion joints or floating bridge anchor cables. Rehabilitate and replace bridges when needed (p. 18).
- **Preservation** – Extend bridge service life by repainting steel structures; also repair and overlay concrete bridge decks. (pp. 19-21).
- **Risk Reduction** – Seismic retrofit of bridges and scour repair of bridge piers in rivers. This work provides a proactive approach that minimizes damage to bridges due to earthquakes and flooding (p. 21-22).

Inspection program vital for the effective management of WSDOT bridge assets

Inspection of the state's bridges is vital to ensure public safety, determine a bridge's condition, and so provide a basis for determining future maintenance and preservation needs. The FHWA first published the National Bridge Inspection Standards (NBIS) in 1971 following the collapse of the Silver Bridge on December 15, 1967 over the Ohio River which killed 46 people. The NBIS defines what each state must do to have a qualified bridge inspection program. The FHWA, WSDOT, and cities and counties work together to ensure the quality of the overall program, and FHWA evaluates each state's inspection program annually. Joint agency bridge inspection classes are available each year to train bridge inspectors.

WSDOT's local bridge inspection program

Local governments are responsible for the preservation and maintenance of 4,942 bridges statewide. More than 90% of these county- and city-owned bridges are currently in good or fair structural condition. WSDOT is responsible for the training and certification of local agency bridge inspectors, and was recently recognized by the Washington State Association of County Engineers for working very closely with county staff to meet federal requirements. Partly due to their efforts, Washington is regarded as a national model for a high-caliber bridge preservation program. WSDOT monitors condition ratings to ensure federal bridge funds are used efficiently based on structural conditions. This allows for the best long-term financial investments for the replacement, rehabilitation, and preventative maintenance of local agency bridges.

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Bridge Replacement and Rehabilitation

Under bridge inspection trucks

WSDOT owns four Under Bridge Inspection Trucks (UBITs), costing nearly $1 million each. The trucks include a UB30 which has a horizontal reach of 30 feet and weighs 30,000 lbs., two UB50s which have a horizontal reach of 50 feet and weigh 62,000 lbs., and a UB60 which has a horizontal reach of 60 feet and weighs 65,000 lbs. The UBITs operation requires a truck driver trained on the safety and operation of the UBIT and two bridge inspectors with one operating the bucket and one inspecting the bridge elements. UBITs are used by inspectors to get within two feet of the bridge elements. They are also used by region maintenance crews to perform scheduled bridge repairs. Operation of the UBIT requires short-term lane closures during daylight hours.

WSDOT bridge inspectors using a UBIT on the Lewis and Clark Bridge.

WSDOT has scheduled for 2,002 bridges to be inspected in 2009. Under bridge inspection trucks (UBITs) will be required on 346 of these inspections.

Bridge replacement and rehabilitation

The bridge preservation program includes funding for the replacement and rehabilitation of selected bridges. The 2005 Transportation Partnership Account (TPA) included funding for the replacement of 25 bridges and the SR 104 Hood Canal bridge. An additional 33 bridges were identified and prioritized for replacement or rehabilitation using Pre-Existing Funds (PEF). The list of 33 bridges was prioritized based on traffic volumes, structural condition, and any load restrictions in place. The bridge replacement/rehabilitation budget for the 2009-2011 biennium is $148.1 million.

In order to qualify for federal funds for replacement or rehabilitation, a bridge must first have a sufficiency rating less than 50 and be classified as Structurally Deficient (SD) or Functionally Obsolete (FO). To select candidates for replacement and rehabilitation, WSDOT considers only those bridges with a sufficiency rating of less than 50 and classified as SD.

As of June 30, 2009, 146 bridges over 20 feet in length were classified as SD (roughly 4% of the total inventory of bridges over 20 feet). WSDOT constructed 109 bridges more than 20 feet long that carry vehicular traffic from 2002-2007, 22 of these were funded through the bridge preservation program. On average, WSDOT builds 22 bridges a year, with just over four per year built under the bridge preservation program.

Bridge replacement projects currently under contract include:

- U.S. 101 West Fork Hoquiam River Bridges at milepost 98.13 and milepost 99.49 (near Humptulips, Grays Harbor Co.)
- U.S. 101 Purdy Creek Bridge (near Shelton, Mason Co.)
- SR 6 South Fork Chehalis River (near Adna, Lewis Co.)
- U.S. 12 Tieton River West Crossing (near Naches, Yakima Co.)

Major bridge repairs

The major repair category of the bridge preservation program includes corrective work that cannot be accomplished within typical maintenance programs and must be done through contracts. This work addresses a specific bridge element in need of repair and is not intended to upgrade all deficiencies to current standards. The most common types of repairs include: expansion joint replacement, concrete column repair, floating bridge anchor cable replacement, and bridge rail replacement. A prioritized list of major repair needs for bridges is developed each biennium. If an unexpected problem arises on a bridge that needs to be repaired as soon as possible, an emergency contract may be needed. WSDOT has been given $17 million for the 2009-2011 biennium to address repair needs. Most of the funds will be used on the I-90 Homer Hadley floating bridge, replacing expansion joints and selected anchor cables, and the SR 520 Evergreen Point floating bridge, to replace selected anchor cables.

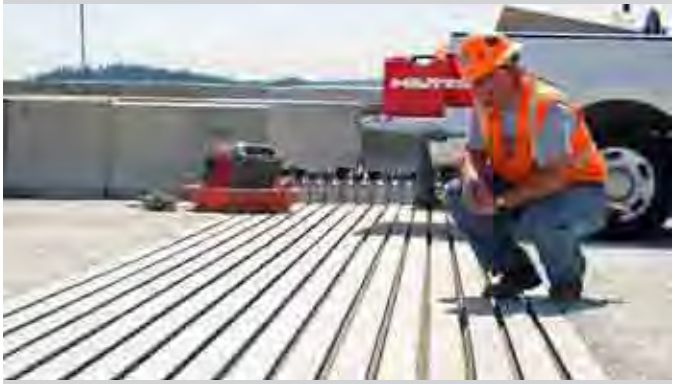
Major bridge repair projects include the following:

- I-90 Homer M. Hadley Floating Bridge – Expansion joints (near Mercer Island, King Co.) Project details: http://www.wsdot.wa.gov/Projects/I90/HomerHadleyBridgeRepair/
- I-90 Homer M. Hadley Floating Bridge – Anchor Cables
- I-5 North Fork Lewis River Bridge southbound – Expansion joint replacement (near LaCenter, Clark Co.)
- I-5 Nisqually River Bridge northbound – Steel truss rehabilitation (near Olympia, Thurston Co.)

Bridge Preservation

What are modular expansion joints?

Modular expansion joints consist of steel and rubber seals working together to accommodate large movements in a bridge due to temperature changes. These joints are like mini-bridges that must support repeated bending cycles from heavy truck loads while being able to expand and shrink in ranges up to 48 inches; they are constructed in one piece to provide long-term service life. WSDOT has 50 bridges with modular expansion joints. The construction process may require extended lane closures on a bridge. The four largest modular expansion joints on the I-90 Homer Hadley bridge were replaced in May and July of 2009.



New expansion joint on the I-90 Homer Hadley Floating Bridge.

Preservation strategies that help extend the life of WSDOT bridges

Preservation is a statewide policy goal to keep transportation facilities in sound operational condition. The objective is to achieve the best long-term financial investment while preventing failure of the existing system. WSDOT's bridge preservation program aims to extend bridge service life through strategies including the repainting of steel structures and the repair and overlay of bridge decks.

Border bridge preservation: Washington and Oregon

Washington and Oregon share the maintenance and operation of nine bridges over the Columbia River between the two states, seven of these are made of steel. These bridges represent some of the biggest bridges in each state's inventory. Preservation and maintenance costs and decisions are shared for these bridges. The lead agency role has been assigned for each bridge with the Oregon Department of Transportation (ODOT) as the lead agency for five bridges and WSDOT as the lead for four bridges. The two states will meet in July 2009 to coordinate future preservation actions for each bridge. Both states will add the bridge preservation needs to their Statewide Transportation Improvement Plans.

Washington-Oregon border bridges:

US 101 Astoria Megler Bridge – ODOT lead agency

Built in 1966, the bridge is 21,650 feet long with two sections made of steel and one section in the center made of concrete. The steel spans on the Washington side (3,826 feet) are currently under contract to be painted with a total project cost of $10.5 million. The steel spans on the Oregon side (6,624 feet) will be painted starting in 2011 with a total project cost of $24.3 million.

SR 433 Lewis and Clark Bridge – WSDOT lead agency

Built in 1930 the bridge is 5,478 feet long; a steel bridge, it will be painted in several stages. Stage 2 is under contract with a total project cost of $18.3 million. The main steel truss span will be painted in future stages over the next two to three years at an estimated cost of $47 million. The Recovery Act stimulus funding directed $12.5 million towards the next painting contract.

I-5 Columbia River Bridges – ODOT lead agency

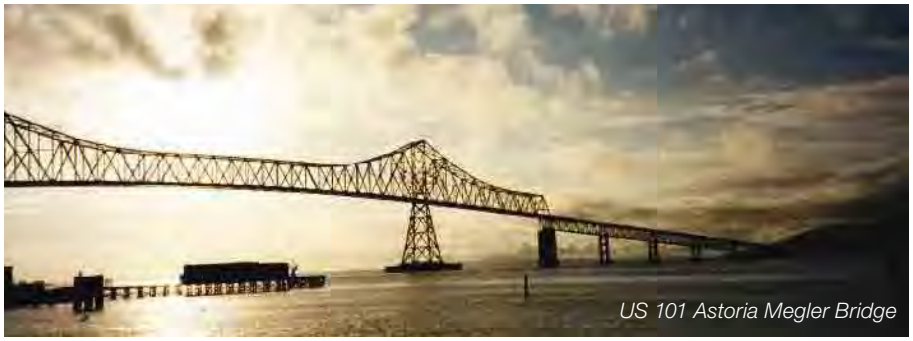
These two steel bridges were built in 1917 and 1958. Each has a movable span and is 3,528 feet long. A project to build a new bridge at this location is in the planning stages.

I-205 Glenn Jackson Bridge – ODOT lead agency

Built in 1982, this 11,760 foot bridge is made of concrete. A project to replace the expansion joints is scheduled for 2009, at a total project cost of $1.6 million.

US 197 Dalles Bridge – ODOT lead agency

This 3,342 foot-long steel bridge was built in 1954. The bridge will need deck replacement and repainting by 2016, at an estimated cost of $37 million.



US 101 Astoria Megler Bridge

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Bridge Preservation

US 97 Biggs Rapids Bridge – WSDOT lead agency

Built in 1962, this steel bridge is 2,567 feet long. A $15 million deck replacement project was completed in 2008. The bridge will need to be repainted by 2015, at an estimated cost of $12 million.

I-82 Umatilla Bridges – WSDOT lead agency

There are two bridges at this location. The oldest is a 3,380 foot steel bridge built in 1955. This bridge will need to be repainted by 2017 at an estimated cost of $24 million. The other is a 3,433 foot concrete bridge that was built in 1988.

Steel bridge painting

Protective paint coatings on steel bridge elements are essential to prevent corrosion and extend service life. Bridge painting is a major project with significant costs due to the complexity of safety, environmental, and containment system requirements. WSDOT owns 273 existing painted steel bridges that require routine painting. In addition, WSDOT shares the costs with Oregon and Idaho for repainting steel bridges on their respective borders. The Tacoma Narrows Bridge is painted by maintenance personnel at the bridge.

Bridge inspection data is used to determine the condition of the paint coatings on steel bridges. During routine bridge inspections, the inspectors visually rate the condition of the paint. If a bridge has 2% or more of the steel area exposed (no longer covered with paint), then it is programmed for repainting, which typically needs to be done every 15 to 20 years. The original paint systems on new steel bridges can last 30-40 years before they need to be repainted.

The decision to overcoat versus full removal of the existing paint depends on the condition of the existing paint coating. Nearly all of the bridges on WSDOT's future paint list will require full paint removal. There are 99 WSDOT steel bridges that are either due or past due for painting. The cost to repaint these bridges, plus the Astoria Bridge, is estimated to be $388 million. The funding needed to address these bridges over the next 10 years will be $78 million per biennia. WSDOT repainted four bridges between 2005 and 2009 compared to 37 bridges between 2000 and 2004.

Status of painting needs for WSDOT steel bridges
As of June 30, 2009

	Number of bridges	Cost to repaint
Past due for painting	32	$178 million
Due for painting	67	$176 million
Not due for painting	178	$364 million

Data source: WSDOT Bridge and Structures Office.

Bridge painting projects under contract:

- SR 433 Columbia River Lewis and Clark (near Longview, Cowlitz Co.)
- US 101 Columbia River Astoria (near Astoria, Oregon)
- I-5 Capitol Blvd. I-5 Overcrossing (Olympia, Thurston Co.)
- US-12 Black River (near Oakville, Grays Harbor Co.)
- SR 542 North Fork Nooksack River (near Olympia, Thurston Co.)
- SR 509 F.B. Hoit and Joes Creek (near Tacoma, Pierce Co.)

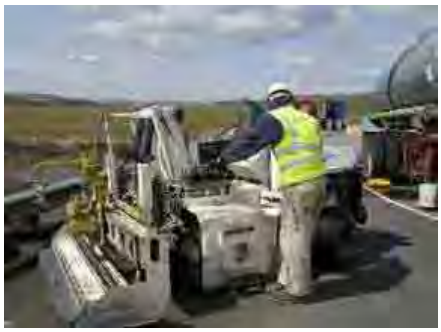
Bridge deck repair and overlay

WSDOT has been working since the early 1980s on a systematic program to prevent concrete bridge deck deterioration. WSDOT performs concrete deck testing to determine which bridges require repair and overlay.

The process of repairing and applying a concrete overlay include the following steps:

1. Scarify (remove) ½ inch of existing concrete. Hydro-milling machines using up to 36,000 PSI water pressure are

Bridge deck repair and overlay process



Hydro milling machine used to prepare the deck.

Deck prior to repair or overlay.

Pouring a 1.5 inch thick concrete overlay.

Bridge Risk Reduction

commonly used to remove ½ inch of good concrete and any additional bad concrete.
2. Repair deteriorated concrete areas.
3. Apply and cure a concrete overlay. WSDOT allows a contractor to choose between three different concrete designs with different additives to add strength and increase durability: Fly-Ash, Microsilica or Latex.

For the 2009-2011 biennium, WSDOT has been provided $6.9 million to repair and overlay eight bridge decks. There are five bridges under construction with another three bridges scheduled to go to contract in 2010.

Bridge deck repair and overlay projects under contract:

- I-90 Medical Lake Bridges (near Spokane, Spokane Co.)
- US 97 Okanogan River (near Omak, Okanogan Co.)
- SR 532 BNSF Rail Road Overcrossing (near Stanwood, Snohomish Co.)

Bridge risk reduction

The seismic retrofit of selected bridges and the scour repair of bridge piers in rivers are proactive strategies that minimize the risk of damage to bridges due to earthquakes and flooding.

Seismic retrofit

The 2005 TPA package provided $87 million to high- and moderate-risk bridges in the Puget Sound area for seismic retrofit. This work is in progress. The planned 2009-11 biennium budget allocates $38.2 million for the seismic retrofit of bridges.

WSDOT has worked closely with federal, state, and local agencies to determine how the remaining seismic retrofits should be prioritized. The conclusion was that WSDOT should focus on the bridges along I-5 between McChord Air Force Base near Lakewood to the I-5 and I-90 interchange in Seattle. Retrofitting these bridges provides a systematic plan that will begin to provide an earthquake-resilient route that could be used to speed a recovery effort following a major seismic event.

Status of bridges in the seismic retrofit program
By number of bridges

Completed	230
In-progress	30
Partially completed	140
Not started	479
Total	**879**

Source: WSDOT Bridge and Structures Office.

Seismic bridge retrofit projects currently under contract:

- I-90 / Richards Rd to Winery Rd mileposts 9.88 to 26.87, 16 bridges require retrofit (King Co.)
- I-90 and I-5 to 12th Avenue South, 3 bridges (King Co.)
- I-5 Central King to South Snohomish Co., 19 bridges require retrofit (King, Snohomish Cos.)
- I-5 236th Street SW and 228th Street SW, one bridge requires retrofit (King Co.).

Seismic bridge projects under design:

- SR 99 Aurora Avenue George Washington Memorial Bridge (Seattle, King Co.)
- SR 520/I-405 vicinity Seismic Retrofit (Bellevue, King Co.)

Preserving a bridge's historic character using new technologies for seismic retrofit

WSDOT is currently partnering with Washington State University to perform seismic testing of scale model samples of the SR 99 Aurora Avenue bridge in Seattle. The testing will determine if the existing concrete columns (which have a "+" or cross shape) can be retrofitted with carbon fiber sheets. If the testing results in the laboratory verify that the carbon fiber retrofit will work, then engineers will proceed with the design. If the laboratory results show it will not work, then engineers will need to look at other options like steel jackets. The carbon fiber retrofit will most closely resemble the existing column shape and maintain the historical look of the bridge compared to a steel jacket retrofit.

WSDOT is currently testing the effectiveness of using carbon fiber to help reinforce columns on the SR 99 Aurora Avenue Bridge.

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Bridge Risk Reduction

Scour mitigation

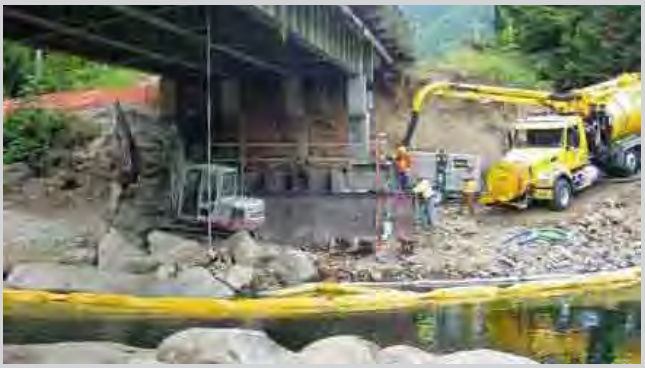
"Scour" is defined as the eroding away of streambed material from under bridge foundations. Scour generally happens when a river experiences high water flows. Nationally, as in Washington, more bridges have collapsed from the scour of bridge foundations than from any other cause. Bridge engineers prepare a list of bridges requiring scour mitigation each biennium based on current inspection information. During the preliminary engineering phase of a project, WSDOT coordinates with the Washington State Department of Fish and Wildlife and the Department of Ecology to obtain permits to perform any in-water work. Most repairs consist of adding rock "rip-rap" around bridge pier foundations to replace streambed material that has been removed over time.

Current scour mitigation projects under contract include:

- SR 508 Tilton River (near Morton, Lewis Co.)
- US 12 Touchet River Bridge (near Touchet, Walla Walla Co.)

Emergency scour repair

In March, WSDOT divers inspecting a void under pier 3 of the SR 508 Tilton River Bridge near Morton, found nearly half of the footing was undermined. The Bridge Office declared an emergency in April 2009 and restricted truck overloads over the bridge. The Southwest Region set up temporary traffic control and closed one lane on the bridge. An emergency contract was established to hire a contractor to build a coffer dam, de-water under the footing, remove loose material, and pour concrete under the footing to provide a firm foundation. The project is estimated to have a final total cost of nearly $700,000.

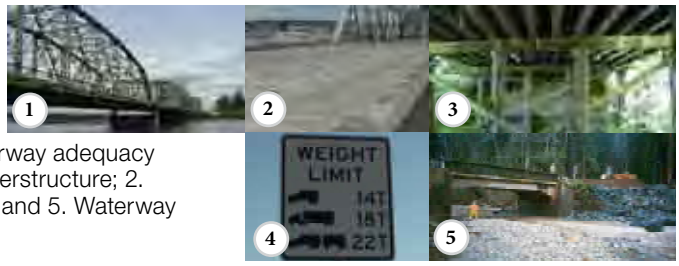


Overview of Federal Highway Administration bridge condition ratings

The Federal Highway Administration (FHWA) requires all state transportation agencies to report annual state, city, and county data concerning the structural condition, functional adequacy, and essentiality for public use of all bridges statewide. The FHWA uses these data to calculate sufficiency ratings for bridges and to determine if a bridge is Structurally Deficient (SD) and/or Functionally Obsolete (FO). Sufficiency ratings and SD/FO determinations are used to help allocate federal bridge replacement and rehabilitation funding to states.

Sufficiency rating: This is a qualitative value that measures the bridge's relative capability to serve its intended purpose. The value is generated from a formula that uses inspection data required by the NBIS program. A sufficiency rating will vary from 0 to 100, with a smaller value indicating a lower sufficiency and therefore a higher need of either repair or replacement.

Structurally Deficient (SD): This rating means a bridge is in a structurally deteriorated condition and does not adequately carry its intended traffic loads. The SD rating is applied if a bridge meets one of the following condition codes: super structure, deck, and/or substructure rates at "4" (poor condition) or less; or one of the two appraisal codes for structural adequacy and waterway adequacy is coded at "2" (very substandard). Condition categories are: 1. Superstructure; 2. Deck; 3. Substructure; 4. Structural Adequacy (appraisal category); and 5. Waterway Adequacy (appraisal category).



Functionally Obsolete (FO): This rating means the bridge does not have adequate approach alignment, geometry or clearance to meet the intended traffic needs and is below accepted design standards. The FO rating is applied if a bridge with an approach roadway alignment, deck geometry, underclearance, structural adequacy, or waterway adequacy appraisal code is rated at "3" or less (substandard). Appraisal Categories are: 1. Approach Roadway Alignment; 2. Deck Geometry; 3. Underclearances; 4. Structural Adequacy; and 5. Waterway Adequacy.