

# Asset Management: Bridge Assessment Annual Update

## Bridge Preservation Highlights:

For FY 2008, 97% of WSDOT's bridges are in good or fair condition.

WSDOT's bridge inventory increased from 3,559 to 3,607 total structures between FY 2007 and FY 2008.

As of June 30, 2008, 3% of WSDOT bridges over 20 feet in length have federal sufficiency ratings of less than 50.

Currently, 372 of 922 bridges in the Seismic Retrofit Program have been fully or partially retrofitted, or replaced.

In 2007, 27 state owned bridges were damaged by over-height trucks.



Sunrise over the Hood Canal Bridge

WSDOT is responsible for managing over 3,500 bridges and structures. WSDOT manages all state-owned bridges using the Washington State Bridge Inventory System, which tracks the condition of all bridges statewide. It is WSDOT policy that the structural condition of 95% of its bridges rate fair or better, meaning that all primary structural elements are sound. The condition rating is based on the structural sufficiency standards established in the FHWA *Recording and Coding Guide for the Structural Inventory and Appraisal of the Nation's Bridges* (NBIS). This rating relates to the evaluation of bridge superstructure, deck, substructure, structural adequacy, and waterway adequacy. For more information on FHWA and WSDOT bridge condition ratings, please see the June 30, 2007 *Gray Notebook*, pp. 58-64.

WSDOT's bridge preservation program consists of the following four main program elements that ensure that state-owned bridges remain in safe and operational condition:

- **Inspection** – Inspect one-half of all bridges every year.
- **Replacements and rehabilitations** – Repair bridges with deteriorated bridge elements such as concrete columns or floating bridge anchor cables. Rehabilitate mechanical and electrical operating systems on moveable bridges. Replace bridges as needed.
- **Preservation** – Extend bridge service life by repainting steel structures; also repair and overlay concrete bridge decks.
- **Risk reduction** – Seismic retrofit of bridges and scour repair of bridge piers in rivers. This work provides a proactive approach to minimizing damage to bridges due to earthquake and high water events.

## 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 in accordance with reporting standards set by the Governmental Accounting Standards Board (GASB). The Governor's Government Management Accountability and Performance (GMAP) goal is to maintain 97% of all bridges statewide at a condition rating of good or satisfactory (fair). This measure is consistent with data provided in the Comprehensive Annual Financial Report (CAFR), which groups together the number of bridges, ferry terminal structures, and culverts. For FY 2008, 88% of WSDOT bridges were in good condition, and 9% were in fair condition. Roughly 3% of bridge structures (2.99%) had a condition rating of poor, a slight increase compared to FY 2007 (2.60%). No bridge currently rated as "poor" is unsafe for public travel.

## Bridge structural condition ratings

Condition ratings by fiscal year (based on the number of bridges)

Category	Description	2002	2003	2004	2005	2006	2007	2008
Good	A range from no problems to some minor deterioration of structural elements.	87%	86%	87%	89%	88%	88%	88%
Fair	All primary structural elements are sound but may have deficiencies such as minor section loss, deterioration, cracking, spalling, or scour.	10%	11%	10%	9%	9%	9%	9%
Poor	Advanced deficiencies such as section loss, deterioration, cracking, spalling, scour, or seriously affected primary structural components. Bridges rated in poor condition may have posted truck weight restrictions.	3%	3%	3%	2%	3%	3%	3%

Source: WSDOT Bridge Office. Data as of June 30 of each calendar year

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### Bridge Replacement and Rehabilitation

#### Bridge inventory: changes from 2007 to 2008

The number of vehicular bridges over 20 feet in length has increased from 2,990 to 2,995 since July 2007. This increase is due to new bridges being built and older bridges being replaced within the highway system. In addition, the number of bridge structures less than 20 feet long has increased from 325 to 336 primarily due to the inclusion of more of these structures in the inventory. The numbers for the ferry terminal structures has also increased mainly due to an increase in the number of parts at each terminal location in the inventory. 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.

#### Inventory of WSDOT bridge structures

As of June 30, 2008	No. of Structures	Square Footage
Vehicular bridges greater than 20 feet in length <sup>1</sup>	2,995	44,418,060
Structures less than 20 feet in length	336	n/a
Border bridges (maintained by border state)	6	n/a
Culverts greater than 20 feet in length	91	n/a
Pedestrian structures	63	295,690
Tunnels and lids	39	n/a
Ferry terminal structures <sup>2</sup>	71	711,704
Buildings (I-5 Convention Center)	1	n/a
Railroad bridges	5	n/a
Total of all structures	3,607	45,425,454

Source: WSDOT Bridge Office

<sup>1</sup>The Comprehensive Annual Financial Report (CAFR) reports 3,140 which includes culverts and passenger ferry terminals.

<sup>2</sup>CAFR reports only the number of Ferry Terminal Structures that carry vehicular traffic only.

#### Replacement and rehabilitation

The bridge preservation program includes funding for the replacement and rehabilitation of selected bridges. The 2005 TPA includes funding for the replacement of 25 bridges and the SR 104 Hood Canal bridge. There are an additional 33 bridges identified and prioritized for replacement or rehabilitation using pre-existing funding. The bridge replacement budget for the June 2007-2009 biennium is \$245.4 million with the Hood Canal bridge having the largest single project budget at \$141.5 million. Funds from the 2005 TPA for these bridge replacements totaled \$41.5 million excluding the Hood Canal bridge.

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 less than 50 and classified as SD. As of June 30, 2008, 90

#### FHWA bridge ratings and federal funding

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. In 2007, of 7,717 Washington state, city, and county owned bridges reported statewide, 415 (5%) were classified as SD and 1,911 (25%) were classified as FO. As of June 2008, 142 WSDOT bridges were classified as SD.

**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):** The bridge is in a structurally deteriorated condition and does not adequately carry its intended traffic loads.

**Functionally Obsolete (FO):** The bridge does not have adequate approach alignment, geometry or clearance to meet the intended traffic needs and is below accepted design standards.

#### Percent of all bridges classified as structurally deficient <sup>1</sup>

All states, District of Columbia, and Puerto Rico

Rank	State	No. of bridges	Number SD	Percent SD
1	DELAWARE	857	20	2%
2	ARIZONA	7,389	187	3%
3	FLORIDA	11,666	306	3%
4	NEVADA	1,704	48	3%
5	TEXAS	50,272	2,186	4%
<b>6</b>	<b>WASHINGTON</b>	<b>7,717</b>	<b>415</b>	<b>5%</b>
11	OREGON	7,261	560	8%
16	MINNESOTA	13,068	1,158	9%
52	PENNSYLVANIA	22,325	5,588	25%
<b>TOTAL</b>		<b>600,022</b>	<b>72,274</b>	<b>12%</b>

Source: FHWA (2007) <sup>1</sup> Includes all state, city, and county bridges reported to NBIS.

bridges over 20 feet in length meet these criteria (roughly 3% of the total inventory of bridges over 20 feet). The current priority list is obtained from this group of candidates. The current list of 33 bridges were prioritized based on their traffic volumes, structural condition, and any load restrictions in place.

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### Bridge Replacement and Rehabilitation

WSDOT constructed 109 bridges over 20 feet in length that carry vehicular traffic from 2002-2007, 22 of these were funded through the bridge preservation program. On average WSDOT builds 22 bridges per year, with just over four per year built under the bridge preservation program.

#### **Bridge replacement projects:**

- U.S. 97 Columbia River Biggs Rapids Bridge (near Goldendale, Klickitat) Project details: <http://www.wsdot.wa.gov/projects/us97/biggsbridge>
- SR 542 Boulder Creek Bridge (near Glacier, Whatcom) Project details: <http://www.wsdot.wa.gov/Projects/SR542/BoulderCreekBridgeReplacement/>
- U.S. 101 Walker Creek Bridge (near Brinnon, Jefferson)
- U.S. 101 West Fork Hoquiam River Bridge at milepost 98.13 (near Humptulips, Grays Harbor)
- U.S. 101 West Fork Hoquiam River Bridge at milepost 99.49 (near Humptulips, Grays Harbor) Project details: <http://www.wsdot.wa.gov/Projects/US101/ForkHoquiamRiverBridge/>
- U.S. 101 Purdy Creek Bridge (near Shelton, Mason) Project details: <http://www.wsdot.wa.gov/Projects/US101/PurdyCreekBridge/>
- SR 6 South Fork Chehalis River Bridge (near Adna, Lewis) Project details: <http://www.wsdot.wa.gov/Projects/SR6/ChehalisRiverBridge/>
- U.S. 12 Tieton River West Crossing (near Naches, Yakima) Project details: <http://www.wsdot.wa.gov/Projects/US12/TietonRiverBridge/default.htm>

#### **Major bridge repair**

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, 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 would be used.

#### **Major bridge repair projects include the following:**

- U.S. 101 Mud Bay bridges - Column repair (near Olympia, Thurston) Project details: <http://www.wsdot.wa.gov/Projects/US101/MudBayBridges/>
- SR153 Methow River Bridges - Rail replacement (near Methow, Okanogan) Project details: <http://www.wsdot.wa.gov/Regions/NorthCentral/projects/SR153MethowRiverBridge/>

- I-5 McAllister Creek Bridge - Column repair (Thurston)
- I-90 Homer M. Hadley Floating Bridge – Expansion joints (near Mercer Island, King) Project details: <http://www.wsdot.wa.gov/Projects/I90/HomerHadleyBridgeRepair/>
- U.S. 12 Touchet River Bridge - Concrete apron repair (near Touchet, Walla Walla)
- U.S. 2 Deep Creek Bridge - Rail replacement (near Spokane, Spokane) Project Details: <http://www.wsdot.wa.gov/Projects/US2/DeepCreekBridge/>
- I-5 North Fork Lewis River Bridge southbound – Expansion joint replacement (near La Center, Clark)
- I-5 Nisqually River Bridge northbound – steel truss rehabilitation (near Olympia, Thurston)

#### **Movable bridge repair**

WSDOT owns and operates 17 movable bridges on state highways, and shares funding responsibility for the maintenance and operations of three additional movable span bridges with Oregon and Idaho. Twelve of these bridges are over 50 years old, and only two are less than 40 years of age. A program to update the antiquated mechanical, electrical, and control operating systems of the WSDOT's movable span bridges was approved by the legislature in 1993.

Movable bridge repairs include corrective work on electrical and mechanical systems that cannot be accomplished within the typical maintenance program. A prioritized list of movable bridge repair needs is developed each biennium.

The U.S. 101 Simpson Avenue Bridge near Hoquiam in Grays Harbor County was recently completed in the spring of 2008. The \$9.2 million project rehabilitated the electrical and mechanical systems on the bridge, which was built in 1928.

#### **Local bridge conditions**

Of the 7,717 Washington State bridges, 4,800 belong to local governments. More than 90% of these county and city bridges are currently in fair or good structural condition. WSDOT is responsible for the training and certification of local agency bridge inspectors. WSDOT monitors condition ratings to ensure federal bridge funds are used efficiently based on structural condition and the best long-term financial investment for the replacement, rehabilitation, or preventative maintenance of local agency bridges. For more information on the condition of city and county owned bridges, please see the Attainment Report, p. 10 at: [http://www.ofm.wa.gov/performance/trans\\_progress\\_report\\_draft012908.pdf](http://www.ofm.wa.gov/performance/trans_progress_report_draft012908.pdf).

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### Bridge Preservation

#### Bridge preservation

Preservation is a statewide goal to keep transportation facilities in sound operational condition. The objective is to achieve the best long term financial investment for a transportation facility and prevent failure of the existing system. In keeping with this, 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.

#### Steel bridge painting

Protective paint coatings on steel bridge elements are essential to prevent corrosion that can reduce the steel's capacity to carry truck loads. Bridge painting can become a major project with significant cost due to the size of the steel structure and the complexity of safety, environmental, and containment system requirements. WSDOT owns 270 existing painted steel bridges that require routine painting. Washington pays equal shares to repaint seven steel bridges over the Columbia River, four of which are owned and maintained by Oregon, and one over the Snake River in Clarkston, owned and maintained by Idaho. The Tacoma Narrows Bridge is painted by maintenance personnel at the bridge. Twenty-six steel bridges that are scheduled for replacement will not be painted again before replacement.

Bridge inspection data is used to determine the condition of the paint coatings on steel bridges. Inspectors use three condition states to rate the paint (see photos below). If a bridge has 2% or greater steel area in condition state 3 then it is programmed for repainting. Previously painted steel bridges typically need to be repainted every 15 to 20 years. New steel bridges can last 30+ years before the original paint system needs to be replaced. Currently, there are 49 steel truss or arch-type bridges with paint more than 15 years old, and 70 steel girder or box-type bridges with paint more than 20 years old. The oldest documented paint system is 37 years, on three bridges built in 1971.

There are two basic options to repaint a steel bridge either overcoat the existing paint or remove all the old paint to bare metal and then apply a new paint coating. The cost to overcoat is the least expensive about 10% of a bridge's replacement cost. The cost to remove the existing paint down to bare metal is 2 to 3 times more than overcoating or typically 20-30% of the bridge's replacement cost. The decision to overcoat or to specify full removal of the existing paint is dependent on the condition of the existing paint coating. WSDOT uses a target of 2-5% paint failure to determine when a bridge should be repainted. Nationally, it has been accepted that if 20% or more of the existing paint coating has failed with evidence of corrosion then full removal is recommended.

There are 60 WSDOT bridges identified for repainting based on their condition. The cost to repaint these bridges is currently estimated to be \$170.5 million. This estimate could increase if more bridges need full paint removal instead of an overcoat. The current funding needed over the next 10 years is \$18 million in the 2009-11 biennium and then \$38 million in the following four biennia.

There is currently one bridge under contract, SR 105 Johns River Bridge (near Westport, Grays Harbor). Work will begin in the summer of 2008 which includes removing all the paint and applying a new three-coat system.

#### *Other bridge painting projects scheduled to begin prior to July 2009 include:*

- U.S. 101 Columbia River Astoria Bridge (North Spans in Washington)
- SR 433 Columbia River Lewis & Clark Bridge (near Longview, Cowlitz,)
- SR 542 North Fork Nooksack River (near Glacier, Whatcom)

#### Bridge paint condition states



Condition State 1: Paint is in good condition.



Condition State 2: Paint is failing but no steel exposure.



Condition State 3: Paint has failed with steel exposure.

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### Bridge Preservation / Bridge Risk Reduction



The Lewis and Clark Bridge is the only crossing from Washington to Oregon between Astoria and Portland.

#### Bridge deck protection

Nationally, concrete bridge deck deterioration (from corrosion of the reinforcing steel) is the single biggest bridge preservation issue. WSDOT has been working since the early 1980's on a systematic program to prevent concrete deck deterioration by using corrosion resistant epoxy-coated rebar in new bridges and by the repair of deterioration and traffic-related wear in existing bridges with new durable protective overlays. WSDOT inspects and performs concrete deck testing to determine which bridges require repair and overlay through a construction contract. A threshold criteria of 2.5% deterioration has been established to determine when a bridge without an existing overlay should be programmed for a future contract. Statewide, there are 57 bridges that have been identified for future repair and overlay by contract. WSDOT is able to address 7 to 10 bridges per biennium based on current funding levels for this work.

For the 2007-2009 biennium, WSDOT has been given \$20.8 million to repair and overlay 14 bridges. The 2005 Transportation Partnership Account provided \$15.4 million for the I-5/Spokane Street viaduct in Seattle that was completed in 2007. Currently, there are two bridges under construction, and there are four bridges scheduled to go to contract in the fall of 2008.

#### **Bridge deck protection projects under construction or scheduled to begin before July 2009 include:**

- SR 153 Methow River Bridges deck repair (Okanogan) <http://www.wsdot.wa.gov/Regions/NorthCentral/projects/SRI53MethowRiverBridge/>
- U.S. 97 Okanogan River Bridge deck repair (South of Tonasket - Okanogan) <http://www.wsdot.wa.gov/Projects/US97/STonasketBridgeDeck/>
- I-90/Medical Lake Rd. Bridge deck repair (Spokane)
- SR 26/Palouse River Bridge - deck repair (Whitman)

#### Safety

#### Bridge Risk Reduction

Earthquakes and high-water events pose substantial risks to transportation infrastructure in Washington State. As part of its bridge preservation program, WSDOT uses seismic retrofit of bridges and scour repair to mitigate the potential risks associated with these events.

#### Seismic retrofit

The purpose of the bridge seismic retrofit program is to minimize the risk of catastrophic failures from future earthquakes through seismic retrofitting. In the early 1990's, WSDOT engineers reviewed the details on all state owned bridges in western Washington to determine which bridges need to be retrofitted. WSDOT initially grouped the deficiencies by type: 1) simple spans with limited support width, 2) Major bridges, 3) Bridges with single column supports, and 4) bridges with multiple columns. The first three groups were given the highest priority based on their higher risk. With these three groups nearing completion, the priority will be focused on the remaining bridges with multiple columns in the Puget Sound Region.

New seismic criteria was adopted by AASHTO for bridges in January 2008. The new criteria is based on a 1,000 year earthquake return interval versus the previous code that used a 475 year return interval.

The seismic retrofit program identified 922 bridge structures in need of retrofit or replacement. Of these, 217 have been completely retrofitted, 153 have been partially retrofitted, with an additional 19 under contract. In addition, two bridges have been replaced, and 13 are planned for replacement. As of June 30, 2008, 506 bridges have had no retrofit work done. Additional analysis revealed that 12 of these bridges do not require retrofit.



WSDOT will retrofit 15 bridges on or near I-5 in South Seattle and on SR 900 in Renton to withstand major earthquakes. Crews will install steel jackets to reinforce the bridge columns.

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### Bridge Risk Reduction

The 2005 Transportation Partnership Account provided \$87 million to complete projects for 172 high and moderate risk bridges in the Puget Sound area. This work has begun and is scheduled to be complete within 8 years. The planned 2007-09 biennium budget allocates \$39.2 million for the seismic retrofit of bridges. This includes \$27.2 million using TPA funds and nearly \$12 million using existing preservation funding. The cost to retrofit all the remaining bridges is estimated to be nearly \$500 million.

WSDOT has collaborated with Federal, State and Local Agencies to determine how the remaining seismic retrofits should be prioritized. The conclusion was to focus on the bridges on I-5 from the McCord Air Force Base near Lakewood to the I-5 and I-90 interchange in Seattle. Retrofitting these bridges along I-5 will provide a systematic plan that will begin to provide an earthquake resilient route that could be used to speed a recovery following a major seismic event.

#### Seismic bridge retrofit projects under contract:

- I-5 South Seattle vicinity seismic retrofits (near Seattle, King) <http://www.wsdot.wa.gov/Projects/I5/SSeattleSeismic/>
- I-405 bridges, Renton vicinity, 4 bridges (King)
- I-5 / Burlington vicinity bridge seismic retrofits, 2 bridges (Snohomish)

#### Seismic bridge projects under design:

- I-90 / Richards Rd to Winery Rd mileposts 9.88 to 26.87, 19 bridges originally included, 16 bridges require retrofit (King)
- I-90 and I-5 to 12th Avenue South, 3 bridges (King)
- I-5 Central King to South Snohomish, 26 bridges originally included, 19 bridges require retrofit (King, Snohomish)
- SR 99 Aurora Avenue George Washington Memorial Bridge (Seattle, King)
- I-5 236th Street SW and 228th Street SW, 2 bridges originally included, 1 bridge requires retrofit (King)
- US 12 / 3rd street Elma vicinity, 1 bridge, engineering analysis determined retrofit was not required.

#### Scour mitigation

“Scour” is defined as the eroding away of the stream bed material from under bridge foundations. Scour generally happens when a river is experiencing high water flows. Nationally as in Washington State, more bridges have collapsed from the scour of bridge foundations than from any other cause. Each biennium, a list of bridges requiring scour mitigation is developed, including the type of scour repair needed for each bridge. During the preliminary engineering phase of a project, WSDOT coordinates with the Washington State Department of Fish and Wildlife and 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 include the following:

- U.S. 101 Humptulips River (near Humptulips, Grays Harbor)
- SR 20 Coal Creek (near Sedro-Woolley, Skagit)
- SR 9 Thunder Creek (near Sedro-Woolley, Skagit)

#### Over-height trucks pose increasing risk for WSDOT bridges

Bridge damage caused by over-height truck impacts is a significant issue on state highways which can create disruptions to the system and potentially high financial impacts. When a bridge is impacted by an over-height truck a request is made to the Bridge and Structures Office to send engineers to the site to assess the damage, determine the type of repairs needed, and establish if the bridge needs to have load restrictions in order to remain open to the public. Maintenance crews are on site to set up traffic control and perform any emergency repairs soon after the damage is reported. WSDOT has set up procedures to temporarily repair damaged prestress girders and determine if full girder replacement is needed.

In 2007, 27 bridges were damaged with two bridges being hit multiple times. In 2007 and 2008, contracts were advertised and awarded to replace prestress girders on four bridges. Recently, the SR 11 Chuckanut Drive bridge over I-5 was hit in July 2008 and will require girder replacement by contract in 2009.



On 10/31/2007 a truck pulling an oversized load on I-90 struck an overpass near Easton. The overpass was damaged beyond repair and was removed on 11/1/2007. A new bridge was completed on 12/15/2007.