

Multimodal Asset Performance Report

WSDOT's annual summary of transportation asset management performance reports

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Secretary of Transportation



2017

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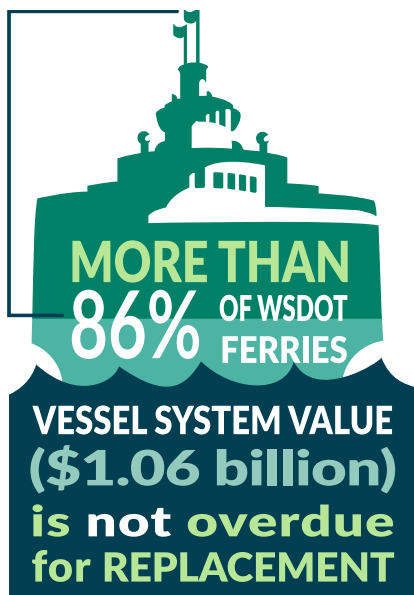
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MULTIMODAL ASSET PERFORMANCE HIGHLIGHTS



77 PERCENT of highway maintenance asset condition targets were achieved by WSDOT in 2017

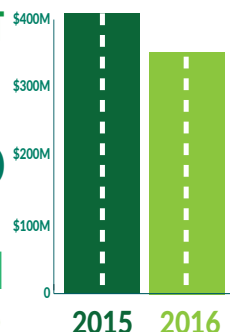
24 million

visits to WSDOT's statewide network of **safety rest areas** in 2016, a 3% increase from 23.1 million in 2015

35 PERCENT

of WSDOT-owned **primary buildings** are more than 50 years old

WSDOT'S PAVEMENT PRESERVATION BACKLOG DECREASED BY 18.1% BETWEEN 2015 & 2016



91.8% OF WSDOT BRIDGES BY DECK AREA



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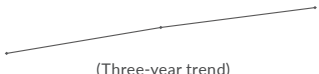


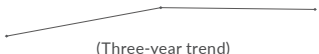

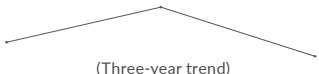






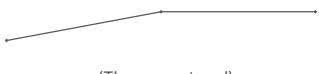


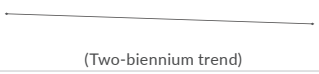

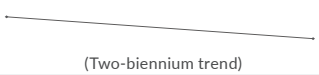

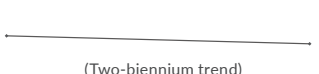

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WSDOT performance measure	Previous period	Current period	Goal	Goal met	Five-year trend (unless noted)	Desired trend
Highway Assets						
Bridges						
Percentage of WSDOT-owned bridges in fair or better condition by bridge deck area (Fiscal years 2016 & 2017)	91.2%	91.8%	≥90%	✓		↑
Number of WSDOT-owned bridges load restricted or load posted (Fiscal years 2016 & 2017)	126	119	*	N/A		↓
Current WSDOT-owned steel bridge painting backlog in millions of dollars (Fiscal years 2016 & 2017)	\$414.5	\$460.8	*	N/A		↓
Projected 10-year WSDOT owned steel bridge painting backlog in millions of dollars (Fiscal years 2016-2025 & 2017-2026)	\$706.6	\$740.8	*	N/A		↓
Current WSDOT-owned bridge deck area due or past due for replacement in millions of dollars (Fiscal years 2016 & 2017)	\$115.6	\$99.2	*	N/A	 (Three-year trend)	↓
Projected 10-year WSDOT owned bridge deck area due or past due for replacement in millions of dollars (Fiscal years 2016-2026 & 2017-2027)	\$726.5	\$831.1	*	N/A	 (Three-year trend)	↓
Percentage of NHS bridge deck area located on structurally deficient bridges (locally- and WSDOT -owned) (Fiscal years 2016 & 2017)	9.3%	8.6%	≤10%	✓		↓
Pavement						
Percentage of WSDOT-owned pavement in fair or better condition ¹ (Calendar years 2015 & 2016)	93.0%	91.7%	≥90%	✓		↑
Highway Pavement Asset Sustainability Ratio; long term service replenishment rate ² (Calendar years 2015 & 2016)	0.57	0.68	≥0.90	—		↑
Highway Pavement Deferred Preservation Liability (backlog) in millions of dollars (Calendar years 2015 & 2016)	\$403	\$330	\$0	—		↓
Highway Pavement Remaining Service Life as percentage of total useful life (Calendar years 2015 & 2016)	47.1%	48.6%	45%-55%	✓		↑
Percentage of lane miles of interstate pavement in poor condition (Calendar years 2015 & 2016)	4.0%	3.2%	≤5%	✓	 (Three-year trend)	↓
Safety Rest Areas						
Safety rest area score through the Maintenance Accountability Process ³ (Calendar years 2015 & 2016)	B	B	B	✓		↑
Total visitors at safety rest areas in millions of visitors (Calendar years 2015 & 2016)	23.1	24.0	*	N/A		N/A
Highway Maintenance						
Percentage of funded maintenance condition targets achieved ⁴ (Calendar years 2016 & 2017)	93%	77%	100%	—	 (Three-year trend)	↑

WSDOT performance measure	Previous period	Current period	Goal	Goal met	Five-year trend (unless noted)	Desired trend
Ferry Assets						
Vessels and Terminals						
Ferry vessel systems past due for replacement by value ⁵ (Fiscal years 2016 & 2017)	10.9%	13.3%	≤10%		 (Three-year trend)	
Ferry terminal systems past due for replacement ⁶ (Fiscal years 2016 & 2017)	5.3%	5.2%	≤6%		 (Three-year trend)	
Ferry vessel preservation needs as percentage backlog of total vessel value (Fiscal years 2016 & 2017)	30.6%	23.6%	*	N/A	 (Three-year trend)	
Ferry terminal preservation needs as percentage backlog of total terminal assets (Calendar years 2016 & 2017)	5.3%	5.2%	*	N/A	 (Three-year trend)	
Multimodal Assets						
Aviation						
Airport combined (federal, state, local) grant funding in millions of dollars ⁷ (Fiscal years 2016 & 2017)	\$59.7	\$88.5	*	N/A	 (Three-year trend)	
Percentage of airport Master Record inspections conducted by WSDOT ⁷ (Calendar years 2015 & 2016)	100%	100%	100%		 (Three-year trend)	
Other Assets						
Facilities						
Facilities Preventive Maintenance Plan completion rate ⁸ (Biennial measure: 2015-2017 & 2017-2019)	88%	82%	71%		 (Two-biennium trend)	
Percentage of primary buildings ⁸ in fair or better condition (Biennial measure: 2015-2017 & 2017-2019)	59%	56%	*	N/A	 (Two-biennium trend)	
10-year forecast of unmet needs (backlog) in millions of dollars ⁹ (Biennial measure: 2015-2017 & 2017-2019)	\$475.5	\$474.7	*	N/A	 (Two-biennium trend)	

Data source: WSDOT Office of Strategic Assessment and Performance Analysis.

Notes: N/A = not available or not applicable. Asterisk (*) = goal has not been set. Dash (—) = goal was not met in the reporting period. **1** Data includes only conditions for asphalt and concrete pavement; budget constraints prohibited data collection for chip seal pavement. Condition data is weighted by vehicle miles traveled. **2** Years of service life replenished through rehabilitation divided by service life consumed on an annual basis (long-term measure). **3** Safety rest areas are assigned a score according to the Maintenance Accountability Process on a level of service (LOS) scale, A through F. **4** Maintenance activities are assigned asset condition targets based upon an A through F level of service scale and funding levels; actual conditions are compared to funded asset condition levels on the LOS scale. See [GNB 32, p. 19](#) for additional information on LOS standards. **5** WSDOT Ferries Division uses a risk assessment matrix, which combines the probability of system component failure with information on the failure's impact on ferry operations to gauge when ferry systems are past due for replacement; systems in condition rating 3 are past due for replacement. **6** WSDOT Ferries Division uses an economic-based model for assessing terminal needs; the model has been updated each subsequent year to improve accuracy and is not directly comparable to previous data. **7** Asset condition data is not currently available for the WSDOT aviation programs; grant funding and inspections for the Airport Master Record are being used as stand-in measurements until data is available. The airport grant funding measurement applies to all public-use airports. The Airport Master Record inspection measurement only applies to public-use non-primary commercial airports. **8** The Preventive Maintenance Plan is developed biennially and ranks maintenance activities based upon a criticality assessment scale. Funding is insufficient to complete all activities; completion rate is measured only for funded work categories. **9** Measured as backlog of unmet needs over the next 10 years as identified by the capital facilities strategic plan.

66 ASSET MANAGEMENT: BRIDGES ANNUAL REPORT

Bridge conditions improve from 2016 to 2017

As of June 2017, 91.8% of WSDOT-owned bridges by deck area were in fair or better structural condition. This is an improvement over June 2016, when 91.2% of bridges by deck area were in fair or better condition (see chart below). WSDOT uses a Practical Solutions approach to maintenance, applying bridge preservation treatments at the most cost-effective time (see p. 11).

Measuring bridge conditions by deck area provides a more comprehensive view of system-wide conditions than only counting the number of bridges. For example, at the end of fiscal year (FY) 2017, 163 (4.9%) of WSDOT's 3,312 bridges were in poor condition, but reporting that figure alone would cause readers to underestimate the need for bridge repairs. Reporting bridge conditions by deck area allows WSDOT to clearly communicate that 8.2% of its bridge assets are structurally deficient.

This reporting method also aligns with the federal Moving Ahead for Progress in the 21st Century Act (MAP-21, see [Gray Notebook 66, p. 9](#)), and the state's Results Washington performance management system. The state and federal targets are identical, and apply only to the 2,272 WSDOT bridges and 204 locally owned bridges on the National Highway System (NHS). The targets require Washington to maintain its bridges so that less than 10% of bridges weighted by deck area are rated structurally deficient (in poor condition); Washington performed better than this standard.

WSDOT has 91.8% of its bridges by deck area in fair or better condition, meeting performance goals

Fiscal years 2012, 2016, 2017; Number of bridges and percent of bridges by deck area and condition category;
Deck area in millions of square feet

STRUCTURAL CONDITION		2012	2016	2017	Trend (2016-17)	Desired trend
GOOD/VERY GOOD Bridges in good condition range from those with no problems to those having some minor deterioration of structural elements.	Bridge deck area	17.4	19.8	20.3	↑	↑
	Percent of deck area	33.1%	36.9%	37.3%	↑	↑
	Number of bridges	1,547	1,678	1,699		
FAIR Primary structural elements are sound; may have minor section loss, deterioration, cracking, spalling or scour. This is the most cost-effective time to rehabilitate before the underlying structure is damaged.	Bridge deck area	33.0	29.1	29.7	↑	*
	Percent of deck area	63.0%	54.3%	54.5%		
	Number of bridges	1,581	1,462	1,450		
GOOD/VERY GOOD & FAIR TOTALS: Goal = 90% or more deck area in fair or better condition	Bridge deck area	50.4	48.9	49.9	↑	↑
	Percent of deck area	96.1%	91.2%	91.8%		
	Number of bridges	3,128	3,140	3,149		
POOR (Structurally Deficient) A bridge in poor condition has advanced deficiencies such as section loss, deterioration, scour, or seriously affected structural components, and may have weight restrictions. A bridge in poor condition is still safe for travel.	Bridge deck area	2.1	4.7	4.5	↓	↓
	Percent of deck area	3.9%	8.8%	8.2%		
	Number of bridges	117	154	163		

Data source: WSDOT Bridge and Structures Office.

Notes: All years are state fiscal years (July 1–June 30). The above data shows WSDOT-owned bridges, culverts, and ferry terminals longer than 20 feet that carry vehicular traffic. All numbers shown in the table above are based on the revised “out-to-out” calculation method (which includes curbs and rails on the bridge) instead of the bridge width from curb to curb. The 2012 data was updated using this revised calculation method.

Notable results

- At the end of FY2017, 91.8% of WSDOT-owned bridges by deck area were in fair or better condition, a slight increase from 91.2% in 2016
- Washington continues to meet the MAP-21 and Results Washington goals of having less than 10% of bridges in poor condition
- WSDOT conducted 1,435 bridge inspections during FY2017, 89% of which were routine
- WSDOT assembled a temporary Bailey bridge over the San Poil River on SR 21 in four days in April 2017

WSDOT owns 163 bridges in poor condition (structurally deficient) in 2017, of which 106 are located on the NHS. From July 2016 through June 2017, 21 WSDOT-owned bridges totaling 673,505 square feet of deck area in poor condition were repaired, transitioning them to good condition. Additionally, 30 WSDOT-owned bridges—with a net total of 491,206 square feet of deck area—deteriorated to poor condition.

Statewide structurally deficient bridges by deck area remain below 10% goal

As of June 2017, 7.6% (5.5 million square feet) of Washington's 72.1 million square feet of bridge deck area was located on structurally deficient bridges.

There are currently 370 structurally deficient bridges in Washington state, 163 of which are owned by WSDOT (see table below). This is an increase from FY2016, when 154 out of 342 statewide structurally deficient bridges were WSDOT-owned. WSDOT's 163 structurally deficient bridges account for 8.2% (4.5 million square feet) of WSDOT-owned bridge deck area. The remaining 207 structurally deficient bridges account for 5.9% (1 million square feet) of bridge deck area owned by local agencies.

Total (state and local) structurally deficient bridge deck area on the NHS in Washington state decreased from 4.6 million square feet in FY2016 to 4.3 million square feet in FY2017.

Condition of locally owned bridges improves in FY2017

Of the 7,373 bridges across Washington, 4,061 are locally owned and support an average of 10 million crossings per day. Approximately 96% of all Washington's locally owned bridges by deck area were in fair or better condition during the Federal Highway Administration 2017 reporting period (April 2016 through March 2017), improving from the 2016 reporting period.

WSDOT funds and administers the Local Bridge Program, which provides grants to local agencies to preserve and improve the conditions of city and county bridges that are physically deteriorated or structurally deficient. Grants

The National Highway System (NHS)

The National Highway System (NHS) is a network of strategic highways in the United States, and includes both state and local highways as well as roads serving major airports, ports, rail and/or truck terminals, and other transport facilities. Washington's NHS network includes 49.7 million square feet of bridge deck area, of which 90.9% is state-owned and 9.1% is owned by local agencies. The bridge performance targets in both Results Washington and MAP-21 (see p. 9 and p. 15) apply specifically to bridges on the NHS.

Washington achieves goal of keeping structurally deficient bridge deck area below 10% statewide

As of June 2017; Percent of bridge deck area considered structurally deficient (SD); Deck area in millions of square feet

	National Highway System		Statewide	
	Deck area ¹	Number of bridges	Deck area ¹	Number of bridges
WSDOT-owned	45.1	2,272	54.4	3,312
Amount SD (%)	4.0 (8.9%)	106	4.5 (8.2%)	163
Locally owned ²	4.5	204	17.7	4,061
Amount SD (%)	0.3 (5.7%)	23	1.0 (5.9%)	207
Total	49.7	2,476	72.1	7,373
Amount SD (%)	4.3 (8.6%)	129	5.5 (7.6%)	370

Data source: WSDOT Bridge and Structures Office and WSDOT Local Programs Office.

Notes: Structurally deficient (SD) is equal to the state's poor condition rating; for locally owned bridges, SD also includes load-restricted bridges, even if those bridges are in fair or better condition.

¹ Due to rounding, some figures are not computable based on numbers in the table.

² Bridges owned by counties and cities.

from this program may fund bridge replacements or bridge rehabilitation and preservation projects such as scour repair, painting, seismic retrofit, deck overlay or joint replacement.

WSDOT is currently reviewing local agency project applications received in response to the Local Bridge Program's most recent call for

projects. Funds will be awarded to projects selected for the program in late fall 2017.

Cities and counties are responsible for managing local bridges, and are held to the same standards as WSDOT. Federal, state and local funding sources continue to help local agencies build new and maintain existing bridges.

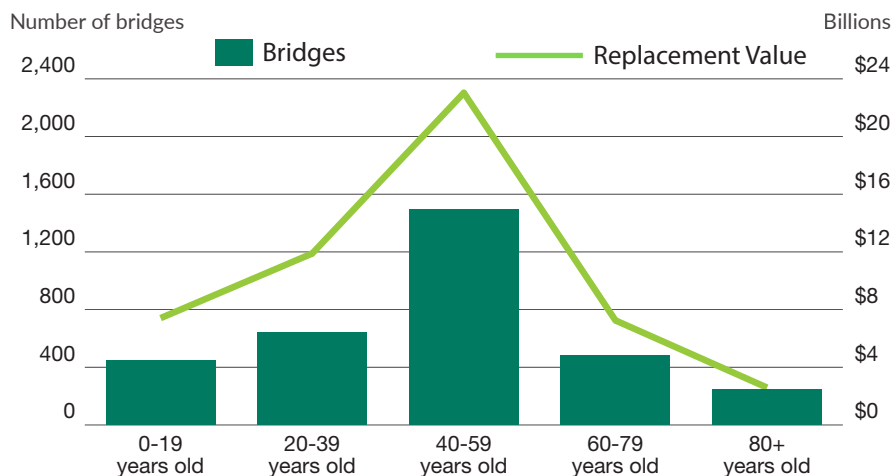
Replacing all Washington state bridges 80 years old or older would cost WSDOT \$2.6 billion in next 10 years

WSDOT owns 246 bridges that are 80 years old or older. Replacing these bridges as they near 100 years of age would cost nearly \$2.6 billion over the next 20 years, or approximately \$130 million per

year (in 2017 dollars). Many of these bridges will remain in use during the next 10 years—currently 24 of them (6% by deck area) are in poor condition—and WSDOT will continue to focus on their preservation.

Replacing WSDOT's 246 bridges that are 80 years or older would cost \$2.6 billion over the next 20 years

As of June 2017; Number of bridges by age; Replacement value in billions of dollars

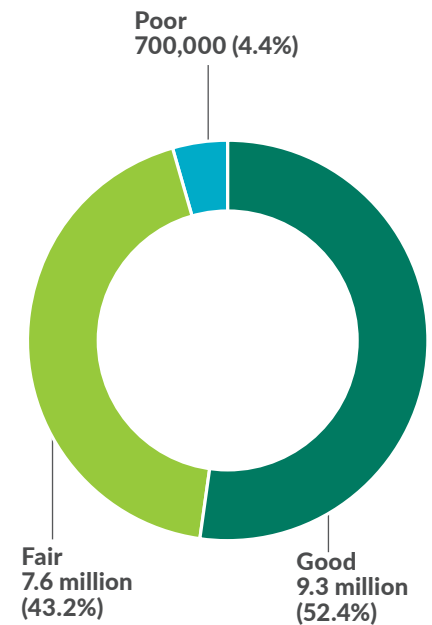


Data source: WSDOT Bridge and Structures Office.

Notes: The graph shows WSDOT-owned bridges only. Replacement value describes the cost to replace all bridges in each age range.

Majority of locally owned bridges in good condition in FY2017

Local agency bridge conditions by deck area for FY2017; Deck area in square feet



Data source: WSDOT Local Programs Office.

Note: This chart shows conditions for all locally owned bridges, both on and off the National Highway System.

WSDOT's bridge inventory grows by 32 structures

As of June 2017, the WSDOT-owned bridge inventory includes 3,897 structures. In addition to WSDOT's 3,312 vehicular bridges over 20 feet long, the inventory includes structures that are less than 20 feet long and structures not open to vehicular traffic (see table below). The replacement value of all WSDOT-owned bridges is estimated to be about \$58.2 billion.

Additionally, there are 5,734 locally owned bridge structures in Washington as of June 2017, a decrease of 195 structures from June 2016. This drop is due to the some duplicate entries that were removed when the state and local inventories were combined into one database. Vehicular bridges longer than 20 feet account for 71% of the local bridge

inventory, and total 17.7 million square feet of deck area.

The new State Route (SR) 520 floating bridge across Lake Washington was added to the WSDOT bridge inventory in FY2017, and is included in the table below. Although the bridge has been open to traffic since April 2016, it was not added to the inventory until the replacement contract was formally closed.

A contract to replace the SR 99 Alaskan Way Viaduct in Seattle with a tunnel is in progress. The existing double-decker bridge will be removed from the state's bridge inventory once the new tunnel opens to traffic and the viaduct can be removed.

Notes for graph at right:

- 1 The drop from FY2016 to FY2017 is due to the removal of duplicate entries which were discovered when combining state and local inventories into a single database during FY2017.
- 2 Locally owned culverts longer than 20 feet are included in the number of vehicular bridges longer than 20 feet.
- 3 WSDOT funds 50% of preservation for 11 border bridges.
- 4 Five of the border bridges are maintained by Oregon and one by Idaho.
- 5 The locally owned border bridge count is included in the number of vehicular bridges longer than 20 feet; therefore the one locally-owned border bridge is not included in the total bridge structures count.
- 6 Four of these bridges are shared with Oregon and one with Idaho.
- 7 Inventory totals do not equal the total number of state and local bridges on p. 17 or p. 18 because inventory includes miscellaneous structures that the Federal Highway Administration does not require to be inspected. FHWA requires states to report on conditions for all vehicular bridges, ferry terminals and culverts longer than 20 feet, which are the 3,312 WSDOT-owned and 4,061 locally owned structures in the chart on p. 18.

Washington's bridge inventory increases by 32 WSDOT-owned structures

Fiscal years 2016 and 2017; Inventory of WSDOT and local bridges

	WSDOT		Local	
	2016	2017	2016	2017
Vehicular bridges longer than 20 feet	3,109	3,124	4,041	4,061
Structures less than 20 feet long	418	431	1,465	1,251 ¹
Culverts longer than 20 feet	125	130	-. ²	-. ²
Pedestrian structures	81	80	264	264
Ferry terminal structures	69	69	9	9
Tunnels and lids	47	47	8	8
Border bridges³				
Maintained by border state	6 ⁴	6 ⁴	1 ⁵	1 ⁵
Maintained by Washington	5 ⁶	5 ⁶	-	-
Railroad bridges	5	5	142	141
Total Bridge Structures⁷	3,865	3,897	5,929⁵	5,734⁵

Data source: WSDOT Bridge and Structures Office and WSDOT Local Programs Office.

Majority of bridge inspections required by Federal Highway Administration in FY2017 are routine

WSDOT performed 1,435 bridge inspections in FY2017, 89% (1,278) of which were routine inspections. In addition, WSDOT conducted 89 inspections of fracture critical structures (bridges that contain support pieces or members that are under tension, where failure would likely cause a portion of or the entire bridge to collapse), 36 special (discretionary as-needed) inspections, and 32 underwater inspections.

Most of WSDOT's bridges are inspected on a two-year cycle as mandated by FHWA, but there are 118 bridges and ferry terminals which are inspected every year due to specific watch items (such as elements that are in need of repair or having a Bailey bridge installed). Additionally, a total of 523 concrete bridges that are in good condition and meet specific FHWA criteria are inspected on a four-year cycle.

WSDOT performs federally required inspections on all WSDOT-owned bridges as outlined in the National Bridge Inspection Standards to determine bridge conditions, maintain bridge safety, and identify preservation and maintenance needs.

Local agencies inspect 2,892 bridges

Local agencies performed 2,892 bridge inspections in FY2017, 96% (2,780) of which were routine. Local agencies follow the same federal guidance for inspections as the state.

Although most local governments inspect their own bridges, WSDOT conducts field reviews and provides training and technical assistance to Washington cities and counties for inspecting bridges on local roads.

WSDOT performs 1,278 routine bridge inspections and 20 routine ferry terminal inspections; Local agencies perform 2,780 routine inspections

Fiscal year 2017; Number of inspections by inspection type

Inspection type	WSDOT	Ferry terminals ¹	Local
Routine	1,278	20	2,780
Fracture critical	89	8	71
Special ²	36	8	17
Underwater	32	8	24
Total	1,435	44	2,892

Data source: WSDOT Bridge and Structures Office.

Notes: FHWA requires inspections on vehicular bridges and ferry terminals longer than 20 feet. WSDOT performs inspections on all structures included in the inventory on p. 20 but only reports on the inspections required by FHWA.

1 Ferry terminals owned by WSDOT. 2 These are discretionary and based on known or suspected deficiencies.



Leading indicator

Control the percent of National Highway System bridges, state and locally owned, in poor condition from increasing over 10% by 2020.

Status: On plan (green)

Strategies:

1. Replacing deteriorated bridge elements: WSDOT performs major preservation repairs by addressing specific bridge elements (such as floating bridge anchor cables, expansion joints and concrete columns) to improve bridges with low condition ratings.

Percent of bridges on the NHS that are structurally deficient (by deck area)

WSDOT owned	8.9%
Locally owned	5.7%
Combined	8.6%

2. Repainting steel bridges: A protective paint coating on a steel bridge is essential to prevent corrosion, extend the bridge's service life and keep the bridge in fair or better condition. Continuing to keep up with painting can prevent the number of bridges in poor condition from increasing.

3. Repairing concrete bridge decks: WSDOT is working to reduce the number of bridges classified as structurally deficient by addressing bridges with the highest benefits and the most cost savings. One strategy is to repair and rehabilitate concrete bridge decks to extend their service life.



Agency Emphasis Area PRACTICAL SOLUTIONS

By load restricting certain bridges, WSDOT uses Practical Solutions to reduce the risk of further damage to the structure while ensuring traveler safety. The practice also allows WSDOT to develop sound, cost-effective repair or replacement strategies.

WSDOT decreases number of load restricted and posted bridges to 119 in fiscal year 2017

A total of 119 WSDOT-owned bridges longer than 20 feet were load restricted or posted at the end of FY2017, down from 126 in FY2016. Nearly half (56) of WSDOT's load posted or restricted bridges are on the National Highway System, and 13.4% (16) were considered structurally deficient in FY2017. Two bridges (the SR 520 floating bridge and the SR 142 Klickitat River Bridge) were replaced in FY2017, removing the need for load restriction; the other five were repaired by either WSDOT maintenance crews or through contracts.

There were 216 locally owned bridges in Washington that were load restricted in FY2017 (of which 14 were on the NHS), an increase from 186 in FY2016.

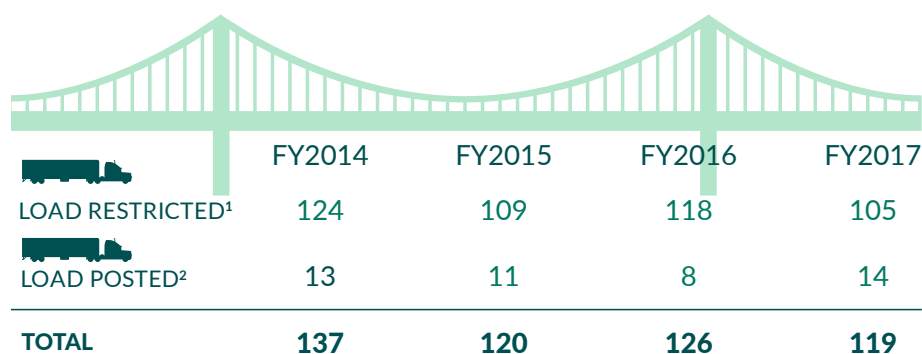
As part of the bridge inspection program, WSDOT performs load rating evaluations to verify whether

bridges can safely carry the weight of the trucks using them. Some bridges are weight restricted because they were designed and built at a time when the standard truck weight was lower. If a load rating evaluation result shows that the structure cannot safely carry certain loads because of bridge deterioration, damage or when it was built, WSDOT implements weight restrictions to reduce the risk of further damage and to ensure bridges are safe for the traveling public.

A bridge may first be load restricted, making it illegal for any overloaded truck to use the bridge. If the condition worsens and the bridge's capacity to carry heavy loads decreases, then the bridge will be "load posted." This limits the allowable weight of trucks to below typical legal weights. Preservation activities are required to correct load restricted or posted bridges.

WSDOT has 119 load restricted or load posted bridges

Fiscal years 2014 through 2017; Number of bridges with weight restrictions



Data source: WSDOT Bridge and Structures Office.

Notes:

¹ A "load restricted" bridge cannot be legally used by an overloaded truck

² A "load posted" bridge limits the allowable weight of trucks to below typical legal weights.

WSDOT takes a Practical Solutions approach to bridge preservation and asset management

WSDOT completed \$15.7 million in maintenance work on bridge decks and structures during FY2017. Maintenance repairs—a key element of WSDOT's Practical Solutions approach to bridge asset management—can substantially extend the amount of time bridges can be used before rehabilitation (more extensive repair) or replacement is needed.

As of June 2017, WSDOT had a statewide bridge maintenance backlog of 1,589 repairs, which it would need an estimated \$16 million to complete. Additionally, the agency has identified 133 larger repairs (estimated to cost \$36.5 million) which will need to be completed through contracts.

Repairing elements extends bridge service life

WSDOT hires contractors to address specific bridge element deterioration beyond what its maintenance crews can accomplish. Examples of this work include replacing steel anchor cables on floating bridges, repairing deteriorated concrete columns, replacing large steel expansion joints, and rehabilitating movable bridge mechanical and electrical systems.

During FY2017, WSDOT awarded contracts on bridge projects that included repairing concrete on a bridge on I-90 in Spokane, replacing anchor cables on the I-90 and SR 104 floating bridges, and repairing concrete columns on several bridges on SR 153. WSDOT currently has a project under

contract to replace gear boxes in the movable span of the SR 104 Hood Canal floating bridge.

WSDOT weighs multiple factors before making bridge repairs

When prioritizing bridge repair needs, WSDOT considers the severity of the issue, the importance of the route, and the risks involved in delaying repairs.

For the 2017-2019 biennium, there is \$41.5 million in planned funding for bridge repairs. Additionally, there are \$400,000 and \$4.6 million reserves for as-needed preservation work on the SR 520 floating bridge and the SR 16 Tacoma Narrows Bridge, respectively. Total funding for bridge repairs in the 2015-2017 biennium (July 2015 through June 2017) was \$37 million.

WSDOT kicks off Systematic Preventive Maintenance program

WSDOT has allocated \$6.0 million to perform systematic preventive maintenance (SPM) on bridges during the 2017-2019 biennium; this additional funding represents a 38.2% increase in the agency's maintenance budget. SPM is an asset management strategy that focuses on using planned maintenance treatments to extend the useful life of existing bridges in a cost-effective way. Work completed as part of SPM may include sealing bridge deck joints on steel truss bridges, filling in ruts on bridge decks, and spot-painting steel bridges.



Agency Emphasis Area **PRACTICAL SOLUTIONS**

Systematic preventive maintenance is a cost-effective asset management strategy that supports Practical Solutions. Applying bridge preservation treatments at the appropriate time can extend a bridge's useful life at a lower lifetime cost.



Strategic Plan Goal 1: **STRATEGIC INVESTMENTS**

Strategic Investments Strategy

Create a process to identify strategic preservation and maintenance investments and strategic operational and multimodal capacity improvement investments in corridors to achieve performance levels.

Asset Management Strategy

Define a strategic, agency-wide asset management policy.

In support of these strategies, WSDOT has implemented a Strategic Bridge Preservation program for the 2017-2019 biennium. The agency will also incorporate strategic preservation into its agency-wide asset management plan, a draft of which is currently in development.



Agency Emphasis Area PRACTICAL SOLUTIONS

By rehabilitating concrete bridge decks using modified concrete overlays rather than replacing them with new decks, WSDOT saves approximately \$220 per square foot of bridge deck area.

Spalling

When reinforcing steel in concrete bridge decks starts to corrode (for example, due to winter weather or the use of deicing salt), the concrete starts to “spall” (pothole) and deteriorate. WSDOT crews repair spalled areas annually, but these repairs are temporary and typically last one to three years. Once the total area of repairs and/or patching exceeds 2% of the total deck area, the bridge is added to the list of future needs projects and classified as structurally deficient. Bridge deck overlay projects are prioritized based on the total square footage of deterioration and the type of freight route on which the bridge is located, with bridges on vital freight routes and those leading to islands getting higher priority.

WSDOT expects concrete bridge deck repairs to cost \$867.9 million over 10 years

WSDOT has 13 bridges under contract to receive a deck repair and overlay, and plans to have an additional 14 bridges either completed or under contract in the 2017-2019 biennium. WSDOT spent \$11.3 million on concrete bridge deck rehabilitation during the 2015-2017 biennium and plans to spend \$35.8 million on similar rehabilitation projects during the 2017-2019 biennium. These planned expenditures will cover 4.1% of the \$867.9 million WSDOT expects to need for concrete bridge deck repairs over the next 10 years (see table at right).

Most WSDOT-owned bridges have reinforced concrete decks. The agency’s comprehensive bridge deck program aims to economically repair and overlay these decks to prolong their lifespan and avoid expensive deck replacements. Deck repairs and protective overlays extend bridges’ service lives by at least 25 to 30 years and are more cost-effective than replacing the entire deck; rehabilitating decks with a concrete overlay costs about \$80 per square foot, while replacing the deck entirely costs \$300 per square foot.

This Practical Solution to bridge deck deterioration substantially reduces overall project costs, and has allowed WSDOT to extend the service life of 343 bridge decks (8.2 million square feet) by 25-30 years. As a result, WSDOT has only had to fully replace 16 bridge decks since the agency was created in 1905 (when it was known as the State Highway Board).

303 bridges will need repairs to concrete decks in next 10 years

As of June 2017; Dollars in millions

Bridge deck status	Number of bridges	Cost to repair
Contract work in progress	13	\$36.8
Past due for Repair ¹	32	\$44.9
Due for Repair ²	42	\$54.3
To be due in next 10 years	216	\$731.9
Total 10-year needs	303	\$867.9

Data source: WSDOT Bridge and Structures Office.

Notes: **1** Bridges with more than 5% of deck area patched or spalled are classified as “past due.” **2** Bridges with 2% to 5% of deck area patched or spalled are classified as “due.”

WSDOT paints steel bridges to extend service life

WSDOT completed two painting projects on steel bridges during FY2017, and a total of five during the 2015-2017 biennium. WSDOT also provided 50% of the funds to paint a portion of the US 101 Columbia River Bridge to Astoria, Oregon.

WSDOT has three bridges currently under contract to be painted and another 17 funded to begin work during the 2017-2019 biennium. The agency has a total of \$82.6 million in funding for steel bridge painting in 2017-2019. WSDOT will need to repaint 184 steel bridges within the next 10 years (see table on p. 13).

WSDOT will need to paint 184 steel bridges in next 10 years

As of June 2017; Dollars in millions

Bridge painting status	Number of bridges	Cost to paint
Contract work in progress	3	\$9.3
Past due for Painting ¹	36	\$159.1
Due for Painting ²	73	\$301.7
Border Bridges ³	4	\$31.0
To be due within 10 years	68	\$280.0
Total 10-year needs	184	\$781.1

Data source: WSDOT Bridge and Structures Office.

Notes: **1** Steel bridges with more than 5% of steel exposed are classified as "past due for painting." **2** Steel bridges with 2% to 5% of steel exposed are classified as "due for painting." **3** Includes all border bridges expected to need painting with 10 years.

Sixteen WSDOT-owned bridges need replacement

As of June 2017; Dollars in millions

Bridge status	Number of bridges	Cost to repair
Contract work in progress	1	\$9.3
Current replacement need	16	\$159.0
Current rehabilitation need	17	\$101.6
Rehabilitation/ Replacement need within 10 years	60	\$319.8
Total 10-year needs	94	\$589.7

Data source: WSDOT Bridge and Structures Office.

WSDOT paints its steel bridges on state highways as needed to protect them against premature corrosion. The agency currently maintains 311 steel bridges that require painting on a regular basis. Washington also has eight steel bridges that cross state lines, and while WSDOT does not directly manage all eight, the agency shares painting costs equally with the bordering states.

Overall, WSDOT needs to replace or rehabilitate 32 bridges statewide

WSDOT replaced one bridge (the SR 142 bridge over the Klickitat River) during FY2017.

WSDOT currently manages 16 bridges that are structurally deficient and require replacement (excluding the State Route 99 Alaskan Way Viaduct Bridge, which has an active replacement contract). An additional 16 structurally deficient bridges need rehabilitation—major preservation repairs—with three of those requiring full bridge deck replacement.

WSDOT's total planned 2017-2019 biennial funding for bridge replacement/rehabilitation is \$84.6 million. WSDOT always estimates the cost of both rehabilitating a bridge and replacing it before deciding on a course of action. If the cost of rehabilitation is 60% or more of the cost of replacement, the agency will replace the bridge.



Agency Emphasis Area PRACTICAL SOLUTIONS

Painting steel bridges supports Practical Solutions by minimizing bridge life cycle cost. Painting a steel bridge extends its service life by 20 to 25 years, and costs approximately 20-25% as much as replacing it.



Agency Emphasis Area PRACTICAL SOLUTIONS

WSDOT always estimates the cost of both rehabilitating a bridge and replacing it before deciding on a course of action. If the cost of rehabilitation is 60% or more of the cost of replacement, the agency will replace the bridge.

Connecting Washington addresses bridge preservation needs

As part of the \$16 billion Connecting Washington transportation revenue package, \$1.2 billion is allocated to state highway preservation, which includes maintaining pavement, bridges and traffic operations. WSDOT is working to identify bridge preservation projects as part of this investment. Three bridge projects identified by the Legislature will be addressed in the next six years:

- SR 241 Yakima River bridge near Mabton—\$12 million
- US 12 Wildcat Creek bridge near White Pass—\$12 million
- SR 107 Chehalis River bridge near Montesano—\$12.5 million

In addition to the \$1.2 billion, another \$57.5 million from Connecting Washington is allocated to bridge preservation and repair projects over the next 16 years. No specific projects have been identified as part of this investment.

Connecting Washington funding will not allow WSDOT to restore all of its structurally deficient bridges to fair or better condition. Structurally deficient does not mean that a bridge is unsafe or in need of replacement; typically, one or more of the bridge's components requires either repair or preservation. Using a lowest life cycle cost approach to delivering preservation strategies means that there will continue to be bridge components that need work.

Connecting Washington will help address the most critical needs for bridges. In particular, it will help eliminate most of the weight restrictions on many of the deficient bridges and help prevent new weight restrictions from being imposed.

WSDOT will replace US 101 Elwha River Bridge near Port Angeles

Engineers are designing a bridge to replace the US 101 bridge over the Elwha River near Port Angeles. The new bridge will meet current standards and resist future river scour and earthquakes.

The existing Elwha River Bridge was built in 1926, after the original Glines Canyon and Elwha dams were constructed. When the dams were removed in 2012 as part of a National Park Service project to restore the Elwha River to its pre-dam state, the river began aggressively removing loose rock in the riverbed, leading to severe scour around the bridge's foundations (see photo at right).



The US 101 bridge over the Elwha River.

the highest-priority scour repairs needed. Scour repair projects for the three highest-priority bridges (the US 101 Chehalis River bridge, the SR 529 Union Slough bridge and the US 2 South Fork Skykomish River bridge) are currently in the design phase, with construction planned to begin in 2018. Total funding for scour repair in the 2017-2019 biennium is \$6.6 million.

WSDOT constructs temporary bridge over San Poil River after closure due to flooding

In April 2017, a flood on the San Poil River severely scoured the approaches and foundations of the SR 21 West Fork San Poil River Bridge (located south of Republic on the Colville Indian Reservation in rural eastern Washington), leading WSDOT to close the bridge.

WSDOT maintenance crews came from all over the state—including Spokane, Vancouver and the Tacoma Narrows Bridge—to install a temporary Bailey bridge (a steel bridge made of pre-fabricated, re-usable parts). Installing the Bailey bridge took four days, after which WSDOT engineers worked with a contractor to repair the approach roadways. The Bailey bridge, which allows one lane of alternating traffic to cross the river, opened 13 days after the original bridge was closed.

Bridge Scour

Bridges experience “scour” when high volumes of water cause soil erosion around their foundation. Foundation scour is the leading cause of bridge failures in Washington and nationwide.

WSDOT has 268 bridges at risk for scour

WSDOT manages 1,557 vehicular bridges and culverts longer than 20 feet that cross over water. Of these, 268 (17%) are “scour critical,” meaning they are at risk for future scour. All scour critical bridges are inspected every two years as part of routine bridge inspections.

In 2016, WSDOT reviewed the conditions and original plans of all scour critical bridges, and established

WSDOT is prioritizing I-405 bridges for seismic retrofits

WSDOT suspended bridge seismic retrofit projects during FY2017 in order to reassess its use of available funding. Following the “Cascadia Rising” earthquake drill (see [Gray Notebook 62 pp. 21-22](#)) and ongoing updates to the Resilient Washington initiative, WSDOT determined that it will further develop its network of seismically resilient routes in the Puget Sound region (see [bit.ly/SeismicLifeline](#)).

WSDOT has previously prioritized retrofitting bridges on I-5 between Joint Base Lewis McChord and the I-405 interchange near Renton. Most of these retrofits are now complete,

WSDOT completes 316 seismic retrofits to its bridges

As of June 2017

Bridge status	Number of bridges
Retrofit complete ¹	316
Partially retrofitted	119
Retrofit needed	474
Total	909

Data source: WSDOT Bridge and Structures Office.

Notes: ¹ Excluding foundations.

and the agency's next priority will be retrofitting bridges on I-405. During the 2017-2019 biennium, WSDOT will plan retrofits of one remaining bridge on I-5 (in Olympia) and of bridges on SR 518 and I-405.

WSDOT's Bridge Seismic Retrofit Program, launched in 1991, is a plan to make 909 bridges in the western

half of Washington state resilient to earthquakes. So far, 316 bridges have been retrofitted to withstand earthquakes, most commonly by putting steel jacketing around columns or by adding concrete-and-steel reinforcing to pier caps.

Contributors included Chris Keegan, Roman Peralta, Tim Rydholm, Ernie Sims, DeWayne Wilson, Helen Goldstein and Joe Irwin

A closer look at MAP-21, Results Washington and GASB bridge condition targets

The federal Moving Ahead for Progress in the 21st Century Act (MAP-21, see [Gray Notebook 66, p. 9](#)) requires states to maintain their bridges so that less than 10% of National Highway System (NHS) bridge deck area in each state is located on bridges classified as structurally deficient (in poor condition). The Results Washington goal mirrors this federal requirement (see p. 9).

WSDOT also follows infrastructure asset reporting policies of the Governmental Accounting Standards Board (GASB), which establishes reporting standards for state and local governments that follow Generally Accepted Accounting Principles. For GASB reporting, WSDOT has set a condition goal of 90% of WSDOT-owned bridge deck area in fair or better condition.

Bridge condition reporting requirements

Condition targets by performance reporting system

Reporting system	Target	Included bridges
Moving Ahead for Progress in the 21st Century	≤10% of deck area on structurally deficient (poor condition) bridges	All NHS bridges (WSDOT- and locally owned)
Results Washington	≤10% of deck area on structurally deficient (poor condition) bridges	All NHS bridges (WSDOT- and locally owned)
Governmental Accounting Standards Board	>90% of bridge deck area in fair or better condition	All WSDOT-owned bridges (NHS and non-NHS)

Data source: WSDOT Office of Strategic Assessment and Performance Analysis.

Note: NHS = National Highway System.

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ASSET MANAGEMENT:
PAVEMENT ANNUAL REPORT

Notable results

- WSDOT pavement lane miles in fair or better condition declined, going from 93.1% in 2015 to 92.2% in 2016
- Estimated cumulative savings from resurfacing asphalt pavement with chip seal reached \$100 million in 2016
- WSDOT's pavement Deferred Preservation Liability decreased from \$403 million in 2015 to \$330 million in 2016
- The average remaining service life of WSDOT pavement increased from 47.1% in 2015 to 48.6% in 2016

Pavement conditions decline slightly in 2016

In 2016, 92.2% of WSDOT-managed pavement lane miles were in fair or better condition, declining slightly from the 93.1% reported in 2015. Despite this drop, the agency met its goal of having at least 90% of pavement lane miles in fair or better condition.

WSDOT determined that 91.7% of vehicle miles traveled in 2016 were on pavement in fair or better condition, a decrease from 93.0% in 2015. Weighting measures by vehicle miles traveled (VMT) allows WSDOT to better capture the experience of the typical road user.

The agency evaluates the condition of asphalt and concrete pavement on state-managed roadways annually using three indicators:

- Surface cracking (an indicator of structural deterioration);
- Rutting (which is monitored for safety and structural reasons); and,
- Smoothness (measured using the International Roughness Index).

These criteria are used to classify pavement conditions into four categories: good/very good, fair, poor and very poor.

WSDOT meets targets for short-term pavement conditions despite decline; long-term measures improve
2015 and 2016


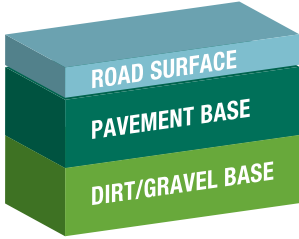



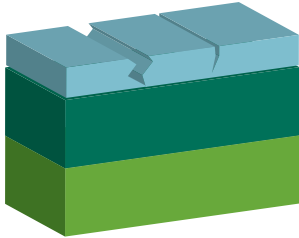



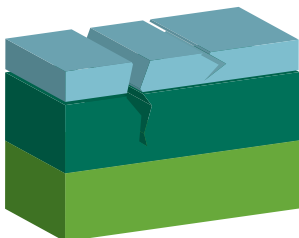



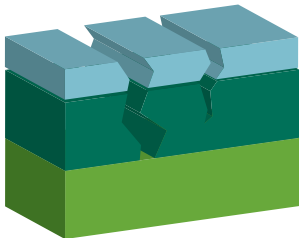


PAVEMENT ANNUAL PERFORMANCE MEASURES ¹		2015	2016	Agency Goal ²	Goal met ³	Trend	Desired trend
Short term	Percent of pavement in fair or better condition						
	Measured for asphalt and concrete pavement (chip seal data was not collected in 2015 or 2016 due to budget constraints). Condition is shown by lane miles and by vehicle miles traveled to reflect road use.	Lane Miles 93.1%	92.2%	90.0%	✓	↓	↑
		VMT 93.0%	91.7%				
	Asset Sustainability Ratio⁴ Years of pavement service life added to the pavement network through rehabilitation in a given year divided by the service life consumed in that same year.	0.57	0.68	0.90	—	↑	↑
Long term	Remaining Service Life⁴ Average percentage of original total useful life remaining before rehabilitation or replacement is needed; average years remaining before rehabilitation or replacement is needed.	47.1% (7.4 yrs)	48.6% (7.6 yrs)	45% to 55%	✓	↑	↑
	Deferred Preservation Liability (backlog) An estimate of the accumulated cost (in current dollars) to fund the backlog of past-due (deferred) pavement rehabilitation work.	\$403 million	\$330 million	\$0	—	↓	↓

Data source: WSDOT Pavement Office.

Notes: **1** Calculations for all measures, excluding percent of pavement in fair or better condition, include all pavement types (asphalt, chip seal and concrete). **2** Agency also has goals for Results Washington and the Governmental Accounting Standards Board—see pp. 24-25 for more information. **3** Check indicates goal met, dash indicates goal not met. **4** Measure is weighted by vehicle miles traveled to better capture the typical road user's experience.

Percentage of WSDOT's pavement in good condition decreases; percentage in poor condition increases

Actual values for 2012 and 2016; Percent of lane miles and vehicle miles traveled (VMT) by condition category; Characteristics of pavement at each condition

WHAT DRIVERS SEE	WHAT IS HAPPENING	2012	2016	Trend ¹	Desired trend
GOOD/VERY GOOD 		By lane miles 75.8% By VMT² 73.6%	By lane miles 73.8% By VMT² 73.3%	 	
FAIR 		By lane miles 16.1% By VMT² 18.4%	By lane miles 18.4% By VMT² 18.4%	 	*
POOR 		By lane miles 5.2% By VMT² 5.9%	By lane miles 5.8% By VMT² 6.6%	 	
VERY POOR 		By lane miles 3.0% By VMT² 2.1%	By lane miles 2.0% By VMT² 1.7%	 	

Data source: WSDOT Materials Lab, WSDOT Capital Program Development and Management.

Notes: Percentages may not add to 100 due to rounding. Condition figures do not include chip seal pavement, also known as Bituminous Surface Treatments (BST), which has not been evaluated since 2010 due to budget reductions. Chip seal pavement accounts for 35% of lane miles on the state's highway network (up from 33% in 2015), yet because chip seal roads have less traffic than asphalt or concrete, they account for only 7% of the vehicle miles traveled on WSDOT's roadway network. Projections of future conditions are not included in this edition of the Gray Notebook because WSDOT's Transportation Asset Management Plan is still in development. ¹ Trends are based on observed condition trends between 2012 and 2016. ² When pavement condition is weighted by VMT, roadways with more traffic are weighted more heavily than less traveled roads. Weighting pavement condition by VMT better accounts for the higher costs to maintain and preserve roads with more traffic.

The categories very good, good and fair show pavement conditions that are considered adequate. Pavement in poor condition is deficient and needs repair, while very poor condition indicates failure and the need for substantial restoration and possibly reconstruction.

These short-term condition indicators provide a snapshot of the current state of the pavement network, but they do not inform WSDOT about long-term trends or capture the impacts of long-term investments on the pavement network.

For example, resurfacing a section of asphalt pavement with new asphalt would take it from poor to fair or better condition, as would resurfacing it with chip seal. However, while chip seal can increase service life by an average of nine years, resurfacing with new asphalt typically adds about 14 years. Unlike the short-term condition ratings, long-term pavement performance indicators reflect this difference, with asphalt resurfacing resulting in larger increases in Remaining Service Life and the Asset Sustainability Ratio than chip seal resurfacing.

Long-term pavement performance measures reflect increased preservation investment in 2016

Asset Sustainability Ratio improves but remains below target in 2016

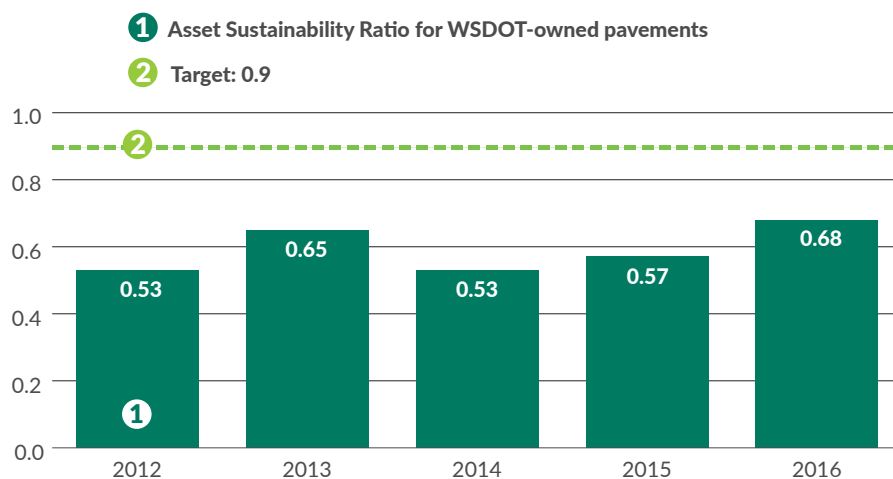
The Asset Sustainability Ratio (ASR) is the ratio between years of pavement life added to the pavement network in a given year and years of pavement life used up in that same year.

The ASR for WSDOT's pavement network was 0.68 in 2016, indicating that for each year of pavement life consumed in 2016, 0.68 years were added. This represents an improvement from 2015, when the ASR was 0.57, but remains below the target value of 0.90. The increase is one of the initial effects of Connecting Washington, a 2015 funding package that increased the level of pavement preservation funding.

The ASR indicates whether the annual level of investment in the pavement network is sustainable. If the ASR is below 1.0 for a particular year, then fewer years of service life were added to the pavement network in that year than were consumed. For example, a network of 18,700 lane miles will consume 18,700 lane-mile years of pavement life every year; if fewer than 18,700 lane-mile years are added to that network in any one year, then the level of investment in the pavement network is not sustainable and the ASR will be below 1.0.

Asset Sustainability Ratio improves but does not reach goal in 2016

2012 through 2016



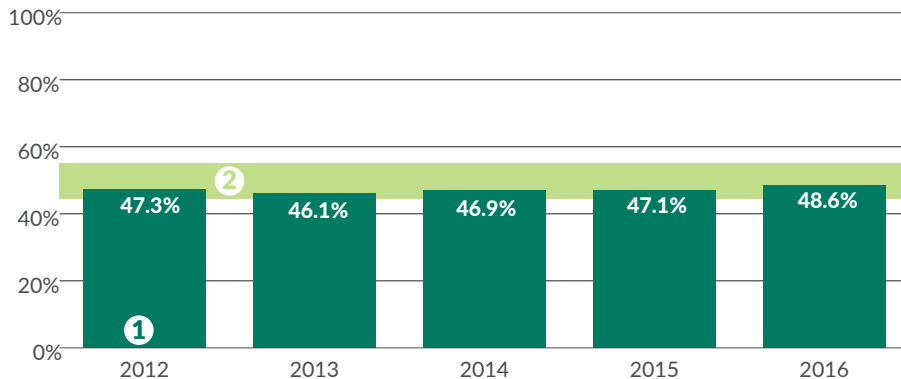
Data source: WSDOT Materials Lab.

Notes: The Asset Sustainability Ratio is calculated by dividing the years of pavement service life added to the network in a given year by the years of pavement service life consumed in that same year. Projections of future performance measures are not included in this edition of the Gray Notebook because WSDOT's Transportation Asset Management Plan is still in development.

Remaining service life of WSDOT pavements sees improvement in 2016

2012 through 2016; Remaining service life shown as a percent of original pavement life

- ① Remaining service life as a percentage of original pavement life
- ② Target range: 45% to 55%



Data source: WSDOT Materials Lab.

Notes: For 2016, the Remaining service life of 48.6% is equivalent to an average of 7.6 years remaining before rehabilitation is needed. Projections of future performance measures are not included in this edition of the Gray Notebook because WSDOT's Transportation Asset Management Plan is still in development.

Remaining Service Life improves

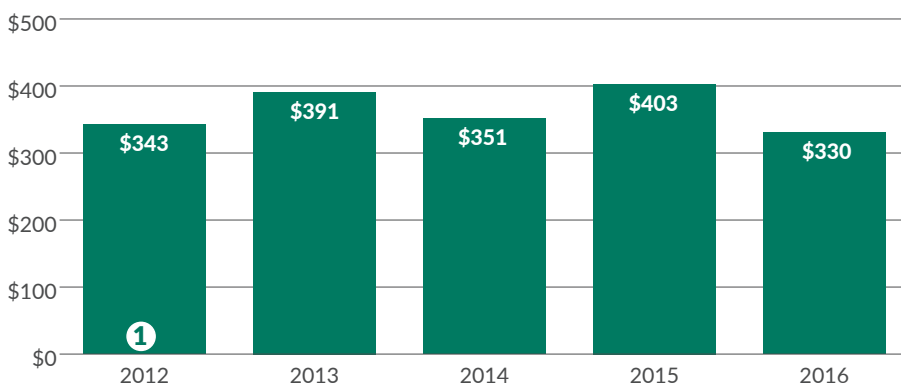
The Remaining Service Life (RSL) of state-owned pavement increased between 2015 and 2016, going from 47.1% to 48.6%. The RSL remained within WSDOT's target range of 45% to 55%.

Remaining service life is a measure of the average remaining pavement life across the roadway network. It is calculated by first estimating the number of years remaining before the condition of a pavement section is expected to become unacceptable (poor or very poor), and then dividing by the pavement section's total expected lifetime. This number is then averaged over all of the pavement sections in the network to yield the statewide RSL.

WSDOT's Pavement Deferred Preservation Liability decreases in 2016

2012 through 2016; Dollars in millions

- ① Deferred Preservation Liability (backlog) for WSDOT-owned pavement



Data source: WSDOT Materials Lab.

Notes: Deferred Preservation Liability is defined as the funding necessary to address past due pavement rehabilitation for all pavement types. WSDOT's goal is to have \$0 in Deferred Preservation Liability. Projections of future performance measures are not included in this edition of the Gray Notebook because WSDOT's Transportation Asset Management Plan is still in development.

Preservation backlog drops in 2016

WSDOT's pavement Deferred Preservation Liability (also known as the pavement preservation backlog) decreased from \$403 million in 2015 to \$330 million in 2016. This reduction was due partly to the completion of a large transportation project on Interstate 405, as well as to the increase in preservation funding that accompanied Connecting Washington. WSDOT's goal is to have a Deferred Preservation Liability of \$0.

WSDOT uses Deferred Preservation Liability—an estimate of the accumulated cost of performing all past-due pavement rehabilitation work—to track how much investment is needed to restore the entire pavement network to fair or better condition.

WSDOT developing Transportation Asset Management Plan

WSDOT is currently developing an Transportation Asset Management Plan in order to comply with federal requirements first established under the Moving Ahead for Progress in the 21st Century Act (MAP-21; see [Gray Notebook 68, p. 9](#)). As part of this development process, which also includes establishing performance measures and targets, the agency must estimate future performance based on available funding and investment strategies. Because the process is not yet complete, projected pavement performance measures are not included in this edition of the Gray Notebook.



Results WSDOT Goal PRACTICAL SOLUTIONS

Preventive Maintenance:

WSDOT's policy is to not program any large-scale pavement resurfacing projects without first using a maintenance treatment. This policy started in 2014 and has been very successful, with maintenance treatments extending pavement life by up to four years.

WSDOT uses strategic asset management to maintain pavements

WSDOT manages almost 18,700 lane miles of highway pavement (excluding bridge decks), as well as just over 2,000 lane miles of ramps and special use lanes, and approximately 7,500 lane miles of shoulders.

WSDOT uses a Practical Solutions approach to managing its pavement assets by focusing on lowest life cycle cost (LLCC), aiming to achieve the highest benefit at the lowest cost over the life of the pavement. In support of this goal, WSDOT uses strategically timed maintenance treatments to extend the lifespan of its asphalt pavements.

Optimally timed maintenance treatments can reduce the average annual cost of a section of pavement substantially. For example, a one-lane-mile section of asphalt pavement costs \$250,000 to resurface. Under certain conditions, spending \$20,000 on maintenance can increase the lifespan of a lane mile of pavement from 12 years to 15, reducing the average annual cost of the pavement by 12% overall.

WSDOT has been using strategic maintenance (the practice of using capital budget funds to perform maintenance at a strategic time) to cost-effectively increase pavement life spans since 2010. Evaluating the effect of different pavement treatments on the average annual cost of the pavement has led the agency to increase its use of strategic maintenance over the last several years (see chart at right).

Preliminary study results support use of preventive maintenance treatments

Preliminary results from WSDOT's research into preventive maintenance treatments (such as sealing cracks, chip sealing short sections of pavement, and using asphalt to either patch the surface of a roadway or replace a section of pavement) show that all of the studied treatments are effective. These treatments can stabilize the condition of pavement sections for between two and four years, often reducing the annual cost by between 10% and 15%.

WSDOT has been studying the use and timing of preventive treatments to extend pavement service life since 2012. As of 2017, the agency has tested a variety of preventive maintenance treatments at 69 quarter-mile test sites (located throughout the state on roads with a variety of weather and traffic conditions). WSDOT will continue to monitor performance data from these test sections for several more years to compare the effectiveness of each type of maintenance treatment. A preliminary Research Report on these tests was published in October 2017, and is available at bit.ly/PrevMaintReport.

WSDOT using more strategic maintenance

Lane miles on which WSDOT used strategic maintenance, by biennium.

Biennium	Maintenance lane miles
2009-2011	599
2011-2013	1,118
2013-2015	1,701
2015-2017	3,374

Data source: WSDOT Pavement Office.

WSDOT monitors pavement conditions to help determine optimal time for rehabilitation treatments

WSDOT makes pavement asset management decisions (such as when to re-surface a section of pavement) based on data collected annually by a van equipped with lasers, cameras and other equipment (see image at right).

WSDOT analyzes the data collected and uses it to assign condition ratings for roughness, cracking and rutting to every one-tenth of a mile segment of state-owned pavement. WSDOT then uses this data to forecast the year in which each segment of pavement will be due for rehabilitation.

This level of annual pavement monitoring, which costs approximately \$55 per lane mile every year, is extremely cost-effective; the data it generates inform decisions about renewal and preservation for the entire pavement network, which costs an

average of \$13,400 per lane mile. Monitoring provides WSDOT the information needed to rehabilitate pavement at the optimal time—when the pavement's condition makes it necessary, but not before.

Due to the high variance in the lifespans of asphalt and chip seal pavements, simply scheduling each section of pavement to be resurfaced at the end of its average lifespan is inefficient. Asphalt pavement lasts an average of 14 years before needing rehabilitation; however, resurfacing a 14-year-old section of asphalt pavement that would have remained in acceptable condition for a fifteenth year increases the average annual cost per lane mile from \$16,800 to \$18,000 (see chart below). Conversely, rehabilitating pavement too late causes the pavement to deteriorate further, increasing the cost of the rehabilitation process.

Average annual cost of one lane mile of pavement depends on life span
Average annual cost of one lane mile of asphalt or chip seal pavement by lifespan of the pavement.

Asphalt		Chip Seal	
Life	Average Annual Cost	Life	Average Annual Cost
13 years	\$19, 200	8 years	\$6,250
14 years	\$18,000	9 years	\$5,600
15 years	\$16,800	10 years	\$5,000

Data source: WSDOT Pavement Office.

Pavement treatments

Pavement treatments are divided into three categories:

- **Maintenance** treatments, such as crack sealing, are the least expensive, but also provide the shortest extension of pavement life.
- **Rehabilitation**, such as resurfacing asphalt pavement, is more expensive than maintenance but can extend pavement life by 10 to 20 years, depending on surface type.
- **Reconstruction**, the most expensive option, extends pavement life by between 15 and 50 years, depending on surface type.



WSDOT's pavement monitoring van.



Results WSDOT Goal PRACTICAL SOLUTIONS

Annual pavement monitoring supports Practical Solutions by providing data that allows WSDOT to rehabilitate each lane mile of pavement at the optimal time.

Chip Seal Resurfacing

Resurfacing an asphalt road with chip seal involves coating the surface of an existing road with a thin layer of liquid asphalt emulsion and then covering it with gravel chips that bond to the surface.

Chip seal comprises 35.2% of WSDOT pavement

2016; Lane miles of WSDOT-owned pavements by surface type



Data: WSDOT Highway Log

Notes: Includes bridge decks. Does not include on-ramps, off-ramps, collector/distributor lanes or some special-use lanes (such as chain-up lanes, two-way turning lanes, bicycle lanes, transit lanes and truck climbing lanes).

Estimated cumulative savings from resurfacing asphalt pavement with chip seal reach \$100 million

In 2016, WSDOT's estimated cumulative savings from resurfacing asphalt roads with chip seal surfacing (also known as Bituminous Surface Treatment, or BST) reached \$100 million. The agency has converted almost 2,000 lane miles of asphalt pavement to chip seal since 2010—approximately two-thirds of the 3,000 lane miles planned. Approximately 35% of WSDOT's pavement network is now made up of chip seal pavement (see graph at left).

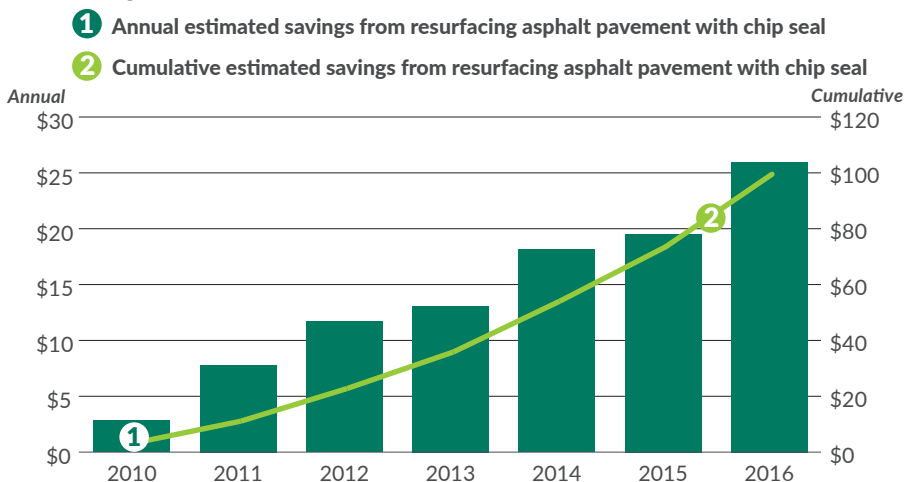
Roads resurfaced with asphalt last about twice as long as those resurfaced with chip seal, but the cost of chip seal resurfacing is only about one-fifth the cost of asphalt resurfacing. WSDOT estimates that it saves approximately \$13,000 per year for each lane mile of asphalt pavement that is resurfaced with chip seal.

Because of this substantial savings, WSDOT has prioritized resurfacing asphalt pavement with chip seal where appropriate (roads with average daily traffic over 10,000 vehicles, roads in urban areas and roads on which trucks frequently make turns are generally not appropriate for chip seal resurfacing). The graph below shows the cumulative savings from chip seal resurfacing since 2010.

WSDOT expects to finish converting the remaining 1,000 lane miles by 2024. Once all 3,000 lane miles have been converted to chip seal, the agency

Estimated savings from chip seal conversion reach \$100 million in 2016

2010 through 2016; Dollars in millions

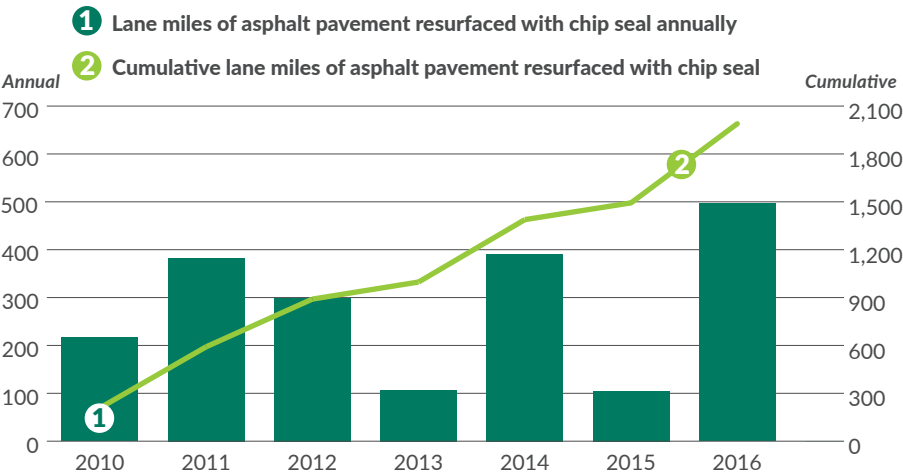


Data source: WSDOT Pavement Office

Notes: Savings are calculated based on an estimate of \$13,000 saved per lane mile per year.

expects to save \$40 million annually. The progress of the conversion effort is shown in the figure above. This conversion process will take WSDOT's pavement network from 25% chip seal in 2010 to 40% seal in 2024.

WSDOT resurfaces nearly 2,000 lane miles of asphalt pavement with chip seal
2010 through 2016; lane miles of pavement resurfaced



Data source: WSDOT Pavement Office.

WSDOT researching new technologies to help better evaluate pavement construction at a reduced cost

WSDOT is evaluating two new pavement technologies that may result in more cost-effective methods for measuring concrete pavement thickness and asphalt pavement density.

The thickness of a concrete slab has a significant impact on the performance of concrete pavement; therefore accurately measuring the thickness of a newly constructed concrete slab is essential.

The current method for measuring concrete thickness requires removing a 6-inch diameter core from the pavement, leaving behind a hole in the new pavement that must be filled. WSDOT is investigating the cost-effectiveness of using magnetic inductance tomography (MIT) to determine the thickness of new concrete pavement instead. MIT is

much quicker than coring and does not damage the pavement.

WSDOT is also evaluating a potential new method for measuring the density of new asphalt pavement, which significantly effects the pavement's lifetime performance.

A rolling density meter (RDM) can measure the density of asphalt pavement using ground-penetrating radar much more quickly than the current method, which requires using a nuclear densometer. Complying with the regulations regarding handling nuclear material increases the cost of using nuclear densometers. Because there are no special regulations on the use of ground-penetrating radar, using an RDM may improve WSDOT's ability to ensure that new asphalt pavement is compacted to the proper density at a lower cost.



Results WSDOT Goal
PRACTICAL SOLUTIONS

Resurfacing asphalt pavement with chip seal supports Practical Solutions by reducing the average annual cost of resurfaced pavement.



Results WSDOT Goal
PRACTICAL SOLUTIONS

Investigating new technologies supports Practical Solutions by ensuring that WSDOT is using the best and most cost-effective methods available.

WSDOT receives third Perpetual Pavement Award

In 2016 WSDOT received a Perpetual Pavement Award from the Asphalt Pavement Alliance for a 5.01-mile section of State Route 512 in Pierce County. The 2016 award was WSDOT's third Perpetual Pavement Award.

To qualify for a Perpetual Pavement Award, a pavement must be at least 35 years old and have never suffered a structural failure. It must also demonstrate excellence in design, quality construction, and high value to taxpayers.



Leading indicator

Control the percent of National Highway System pavement, state- and locally-owned, in poor condition from increasing over 10% by 2020.

Status: On plan (green)

Percent of NHS pavement in poor condition (by VMT)

WSDOT-owned	6.6%
Locally owned	11.4%
Total	7.4%

Strategies:

- 1. Convert asphalt surfaces to chip seal:** The life-cycle annual cost for a chip seal surfaced pavement is approximately one-third the cost of an asphalt surface. As of 2016, the estimated cumulative savings from chip seal conversion is \$100 million.
- 2. Implement Practical Solutions:** WSDOT uses the practical design approach to make project decisions that focus on the specific problem that the project is intended to address. This performance-based approach looks for lower cost solutions in order to meet specific performance criteria.
- 3. Strategic pavement maintenance:** Performing maintenance treatments at the appropriate time (before rehabilitation is needed) can extend pavement life by up to four years and lower annual costs. WSDOT's policy is that no pavement rehabilitation takes place until strategic maintenance has been used to extend pavement life.

WSDOT meets Results Washington target

Results Washington, Gov. Jay Inslee's performance management system for the state, includes a measure about the condition of state- and locally-owned pavement on the National Highway System (NHS). The target for this measure is to have no more than 10% of pavements (weighted by vehicle miles traveled) on state and NHS roads in poor condition by 2020. In 2016, 7% of NHS pavements were in poor or very poor condition—the same as in 2015. See box at left for more information.

WSDOT working to meet MAP-21 requirements

The Federal Highway Administration has released two rules under the Moving Ahead for Progress in the 21st Century Act (MAP-21) that apply to pavement. One rule requires states to develop and implement a risk-based asset management plan, referred to as the Transportation Asset Management Plan (TAMP). The TAMP covers a 10-year period and includes all roadways on the National Highway System. The rule requires each state to submit an initial TAMP by April 30, 2018, and a final plan (following a review process) by June 30, 2019. WSDOT's TAMP is currently in development.

A second rule related to pavement defines the methods and minimum acceptable criteria to be used to measure pavement condition on the NHS. The rule also requires states to coordinate with metropolitan planning organizations (MPOs) to set pavement performance targets for both interstate and non-interstate NHS roadways (WSDOT- and locally-owned).

Pavement condition reporting requirements

Condition targets by performance reporting system

Reporting system	Target	Included pavement
Moving Ahead for Progress in the 21st Century Act (MAP-21)	Not yet established	All NHS pavement (WSDOT- and locally owned)
Results Washington	<10% of pavement (by VMT) in poor condition	All NHS pavement (WSDOT- and locally-owned)
Governmental Accounting Standards Board	>85% of VMT traveled on pavement in fair or better condition ¹	All WSDOT-owned pavement (NHS and non-NHS)

Data source: WSDOT Office of Strategic Assessment and Performance Analysis, WSDOT Capital Program Development and Management.

Note: NHS = National Highway System.¹ In Gray Notebook 60 and Gray Notebook 64, the GASB target was incorrectly listed as "85% of state-owned lane miles in fair or better condition."

WSDOT has collaborated with Washington state MPOs to establish multiple teams to work on setting targets for MAP-21. These teams are analyzing proposed targets and their implications for WSDOT, MPOs, and the 102 cities and counties that own pavement on the NHS; the teams will also make recommendations based on their analyses. For more information on MAP-21, see [Gray Notebook 68, p. 9](#).

WSDOT following Governmental Accounting Standards Board direction

The state is also required to follow Generally Accepted Accounting Principles, which include pronouncements from the Governmental Accounting Standards Board (GASB). This board governs the financial reporting of

infrastructure assets, and requires WSDOT to maintain an up-to-date inventory of assets and to document condition assessments.

For the purpose of GASB reporting, WSDOT's pavement condition goal is to have 85% of state-owned pavement weighted by VMT be in fair or better condition. WSDOT submits reports to GASB on a two-year cycle. In 2015, the most recent year in which WSDOT reported to GASB, 93.2% of pavement weighted by VMT was in fair or better condition, exceeding the target. Pavement conditions for GASB are evaluated based on roughness (assessed using the International Roughness Index), cracking and rutting.

Contributors include Jianhua Li, David Luhr, Tim Rydholm, Jeff Uhlmeier, Kim Willoughby, Helen Goldstein and Joe Irwin

The National Highway System (NHS)

The National Highway System (NHS) is a network of strategic highways in the United States, and includes both state and local highways as well as roads serving major airports, ports, rail and/or truck terminals, and other transport facilities. Washington's NHS network includes 14,789 lane miles of pavement, of which 77% is state-owned roadway and 23% is owned by local agencies. The pavement performance targets in both Results Washington and MAP-21 (see p. 24) apply specifically to pavement on the NHS.

67 ASSET MANAGEMENT: FERRIES VESSELS & TERMINALS ANNUAL REPORT

Vessel systems needing replacement remain steady at 11%

WSDOT retired the Motor/Vessel (M/V) *Klahowya* from service in fiscal year (FY) 2017. The retirement of the 59-year-old vessel was made possible by the delivery of the M/V *Chimacum*. The M/V *Chimacum* is the third of four new 144-vehicle Olympic Class vessels, and made its first sailing in May 2017.

The percentage of vessel systems needed replacement remained steady at 11% from the end of FY2016 to the end of FY2017. This the net effect of the M/V *Chimacum* replacing the M/V *Klahowya*, investments to renew vessel systems, additional systems coming due, and changes of system conditions based on inspections.

WSDOT uses a risk assessment guide to help rate the condition of its vessel systems at the end of each fiscal year, which runs from July 1 through June 30. The agency assigns each system a Condition Rating of 1, 2 or 3 depending on the likelihood of failure and the impact a failure would have on ferry service (see risk assessment matrix below).

The number of vessel systems included in Condition Rating 1 (systems not currently needing replacement) increased from 52% in FY2016 to 57% in FY2017. This increase was due to the retirement of the aging M/V *Klahowya* and the arrival of the new M/V *Chimacum*, as well as WSDOT replacing systems that were due for replacement.

The number of vessel systems in Condition Rating 2 (approaching the need for replacement) decreased from 37% to 32%, and the number of systems in Condition Rating 3 (overdue for replacement) stayed the same at 11%, between FY2016 and FY2017. Condition category ratings include the 22 vessels operating at the end of FY2017, with 1,997 total vessel systems tracked at the end of FY2017. This is 31 more systems than there were at the end of FY2016.

Notable results

- The number of WSDOT Ferries vessel systems needing to be replaced held steady at 11% between FY2016 and FY2017
- The value of WSDOT Ferries vessel systems needing to be replaced is \$162.2 million or 13.3% of the total value of the fleet systems
- Approximately 88% of WSDOT Ferries terminal systems were in fair or better condition at the end of calendar year 2016
- WSDOT removed the M/V *Klahowya* from service in FY2017 and replaced it with the M/V *Chimacum*

WSDOT risk assessment criteria helps prioritize ferry vessel preservation

Based on the likelihood of the system failing combined with the likely consequences of the system's failure

Percent of life cycle remaining (Probability of failure factor)	Consequence of failure factor				
	Minimal impact: does not affect sailing	Marginal impact: less than 24 hours to repair	Moderate impact: one or more days to repair	Critical impact: one or more weeks to repair	Catastrophic: long-term, unscheduled impacts to sailings during repairs
Beyond life cycle (nearly certain to fail)	Condition Rating 2:		Condition Rating 3:		
0% - 9% (likely to fail)	System is approaching the point at which replacement should occur in the current or ensuing biennia		System is overdue for replacement		
10% - 24% (failure possible)					
25% - 49% (unlikely to fail)	Condition Rating 1:				
50% - 100% (very unlikely to fail)	System does not currently need replacement				

Data source: WSDOT Ferries.

Emergent regulatory work on vessels impacts preservation efforts

When multiple vessels' sprinkler systems failed inspection in the beginning of FY2017, WSDOT conducted additional targeted sprinkler inspections and testing on other vessels with aging systems. The results led to increased regulator scrutiny and the replacement of sprinkler systems on six vessels during the second half of FY2017. These dockside visits to the shipyard to perform unplanned sprinkler work deferred other planned preservation work.

WSDOT spent \$19.4 million preserving 41 inventory items on 12 vessels during FY2017. These efforts included:

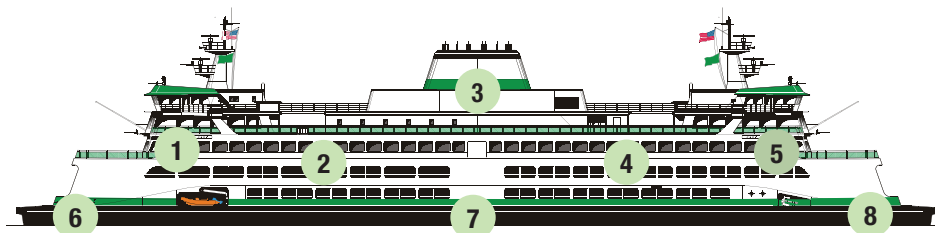
- Replacing piping on five vessels
- Replacing auto deck steel on the M/V *Tacoma*
- Replacing propeller blades and completing structural preservation of steel on the M/V *Sealth*, and
- Replacing marine evacuation slides on the M/V *Hyak*, M/V *Yakima*, and M/V *Chelan*.

At the end of FY2017, there were 22 vessels in operation with an average age of 29 years old, compared to 31 years of age at the end of FY2016. This change was affected mainly by the new vessel M/V *Chimacum* replacing the decommissioned M/V *Klahowya* (built in 1958).

WSDOT is expecting the delivery of a new 144-vehicle Olympic Class vessel, the M/V *Suquamish*, in summer 2018. This vessel will join

Percentage of WSDOT ferry vessel systems that do not currently need replacement remains steady from FY2016 to FY2017

Fiscal years 2016 and 2017; Results by type of vessel system



			Percent of systems in Condition Ratings ¹		
	Types of ferry vessel systems	Number of systems	OK 1	Monitor 2	Past due 3
1	Communications, navigation, lifesaving systems	631	70%	20%	10%
2	Piping systems	150	49%	35%	17%
3	Structural preservation (paint)	220	74%	20%	6%
4	Passenger and crew spaces	76	59%	38%	3%
5	Security systems	101	59%	22%	19%
6	Steel structures	175	66%	26%	7%
7	Mechanical/electrical systems	350	55%	34%	11%
8	Propulsion systems	294	16%	69%	15%
Total/average FY2017		1,997	57%	32%	11%
Total/average FY2016		1,966	52%	37%	11%

Data source: WSDOT Ferries.

Notes: Percentages may not add to 100 due to rounding. 1 Systems included in Condition Rating 1 do not currently need to be replaced; those in Condition Rating 2 should be monitored for replacement within the current or ensuing biennium; those in Condition Rating 3 are past due for replacement.

the fleet's most recent additions in the Olympic Class, the M/V *Tokitae* (2014), M/V *Samish* (2015), and M/V *Chimacum* (2017) to further reduce the average age of the fleet as they replace older vessels.

Security, piping systems have higher percentage of past due items

Security and piping systems had the highest percentage of items that were past due for replacement in FY2017 (Condition Rating 3), with 19% and 17%, respectively (see chart

above). The largest increase from FY2016 was security systems which went from 0% to 19% overdue for replacement by the end of FY2017. This was because 10 systems became due, and none were replaced due to their lower consequence of failure.

Due to repair work, the percentage of piping systems in Condition Category 3 had the largest drop, going from 23% in FY2016 to 17% in FY2017.

WSDOT weights ferry systems that are critical to service more heavily than those that do not immediately

impact travel. Major mechanical and electrical systems are considered high priority because repairs can require removing the vessel from service, which can result in trip cancellations or delays in service if a suitable, spare vessel is not available.

Due to this high consequence of failure and to ensure continued service, these systems are elevated to Condition Rating 3 earlier in their life cycle than other, less critical systems. This can result in ferries having more critical systems (like propulsion and piping systems) in Condition Rating 3. Systems with the very highest consequence of failure can become Condition Rating 3 while still having just under 25% of their life cycle remaining. Meanwhile, systems like passenger and crew spaces are less critical because the probability of disrupting service is low, even as they pass the end of their useful life.

Applying dollar values to systems helps determine preservation funding needs

When weighted by the total dollar value of the vessel systems, Condition Rating 1 items not currently needing replacement comprised \$553.3 million (45.4%) of the total in FY2017, an increase of \$34.6 (6.25%) million from FY2016.

This change was due to items moving from Condition Rating 1 to the other two condition ratings during FY2017, and the replacement of the M/V *Klahowya* that had 33% of systems in Condition Rating 1, with the M/V *Chimacum* that has all of its systems in Condition Rating 1.

Super, Evergreen State class vessels have higher percentage of systems needing replacement in FY2017

Fiscal years 2016 and 2017; Inspection results by vessel

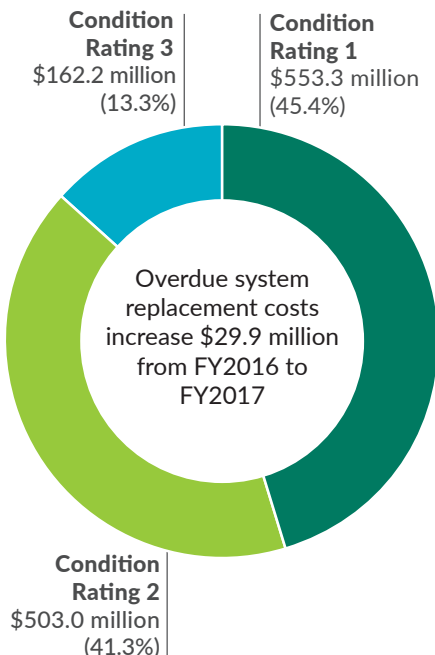
Vessel classes and vessels	Number of vessel systems	Year built	Percent of systems in Condition Ratings ¹		
			1	2	3
Jumbo Mark II Class					
M/V Tacoma	100	1997	56%	30%	14%
M/V Wenatchee	100	1998	47%	45%	8%
M/V Puyallup	100	1999	50%	40%	10%
Jumbo Class					
M/V Spokane	94	1972	53%	36%	11%
M/V Walla Walla	94	1973	44%	45%	12%
Super Class					
M/V Hyak	92	1967	29%	48%	23%
M/V Kaleetan	93	1967	49%	39%	12%
M/V Yakima	91	1967	46%	44%	10%
M/V Elwha	95	1967	33%	34%	34%
Olympic Class					
M/V Tokitae	89	2014	85%	15%	0%
M/V Samish	89	2015	87%	13%	0%
M/V Chimacum	89	2017	100%	0%	0%
Issaquah Class					
M/V Issaquah	87	1979	47%	37%	16%
M/V Kitsap	87	1980	53%	31%	16%
M/V Kittitas	89	1980	43%	43%	15%
M/V Cathlamet	88	1981	53%	31%	16%
M/V Chelan	93	1981	58%	32%	10%
M/V Sealth	88	1982	43%	38%	19%
Evergreen State Class					
M/V Tillikum	83	1959	36%	49%	14%
Kwa-di Tabil Class					
M/V Chetzemoka	84	2010	81%	15%	4%
M/V Salish	86	2011	81%	19%	0%
M/V Kennewick	86	2011	85%	15%	0%
Fleet wide FY2017	1,997	Avg. 1988	57%	32%	11%
Fleet wide FY2016	1,966	Avg. 1985	52%	37%	11%

Data source: WSDOT Ferries.

Notes: M/V = Motor/Vessel. The M/V *Klahowya* was removed from service in fiscal year 2017 and the M/V *Chimacum* was added. Percentages may not add to 100 due to rounding. 1 Systems included in Condition Rating 1 do not currently need to be replaced; those in Condition Rating 2 should be monitored for replacement within the current or ensuing biennium; those in Condition Rating 3 are past due for replacement.

More than 86% of vessel systems value are not overdue for replacement

FY2017; Percent of total dollar value



Data source: WSDOT Ferries.

Notes: Percentages may not add to 100 due to rounding. 1 Results Washington measure. 2 Systems included in Condition Rating 1 do not currently need to be replaced; those in Condition Rating 2 should be monitored for replacement within the current or ensuing biennium; those in Condition Rating 3 are past due for replacement.

Condition Rating 2 items were \$503.0 million (41.3%), a decrease of \$62.9 million from FY2016 (see chart at left). The decrease was also due the decommissioning of the M/V *Klahowya* that had 49% of its systems in Condition Rating 2. At the end of FY2017, the dollar value of items in Condition Rating 3 was \$162.2 million (13.3%), marking a \$29.9 million increase from FY2016 in the dollar amount of items that are overdue for replacement. The increase was associated with WSDOT updating the replacement costs being applied to some of the more critical systems and having more systems move from Condition Rating 2 to 3 than the Condition Rating 3 systems being replaced.

With the total vessel systems valued at approximately \$1.219 billion in FY2017, the valuations indicate that \$1.056 billion (86.7%) of items have Condition Ratings of 1 or 2 and are not currently overdue for replacement.

WSDOT monitors the dollar value of its systems in Condition Rating 3 to determine the success of its ongoing efforts to reduce the number of past due systems. WSDOT reduces the number of Condition Rating 3 items by obtaining extended or extra shipyard periods and reprioritizing work prior to established shipyard visits.

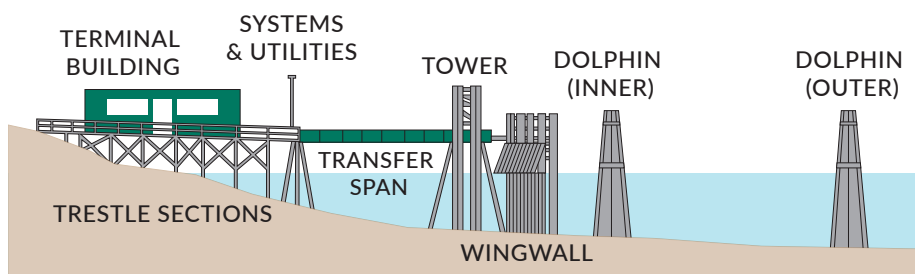


The Olympic Class M/V *Chimacum* during its christening event.



Agency Emphasis Area
PRACTICAL SOLUTIONS

WSDOT Ferries Vessels program focuses its capital preservation and operating programs maintenance resources on vessel systems affecting vessel reliability. WSDOT applies cost benefit analyses based on the Life Cycle Cost Model to determine how long systems should be operated beyond their life cycles.



Structural system conditions of WSDOT Ferries terminals decrease from 2015 to 2016

Facility or system type	Number of systems	Good or fair (70-100)	Poor or substandard (0-69)	Not rated
Buildings	138	97.8%	1.4%	0.7%
Landing aids ¹	176	82.4%	17.6%	0.0%
Overhead loading systems	66	80.3%	19.7%	0.0%
Passenger-only ferry facilities	14	78.6%	21.4%	0.0%
Pavement	84	85.7%	14.3%	0.0%
Trestles and bulkheads	69	94.2%	5.8%	0.0%
Vehicle transfer spans	210	88.1%	11.9%	0.0%
Total/average 2016	757	88.0%	11.9%	0.1%
<i>Total/average 2015</i>	<i>760</i>	<i>87.0%</i>	<i>12.8%</i>	<i>0.3%</i>

Data source: WSDOT Ferries.

Notes: Percentages may not add to 100 due to rounding. ¹ Landing aids ensure the ferry vessels are aligned correctly at the terminals, and include wingwalls and dolphins. The condition categories do not indicate whether systems are safe or unsafe, but rather how closely their condition should be monitored prior to spending funds on preservation.



Agency Emphasis Area PRACTICAL SOLUTIONS

WSDOT Ferries Terminals program increases maintenance actions to extend the useful life of systems that have been targeted for deferral by the Economic-based Needs Model.

WSDOT improves terminal conditions in 2016

Approximately 88.0% of WSDOT Ferries terminal systems—which assist in the safe, efficient movement of people and vehicles to and from ferry vessels—were in fair or better condition at the end of calendar year 2016. This is an increase of one percentage point from the 87.0% in 2015. WSDOT saw a decrease in the number of systems in the poor or substandard condition category by 0.9 percentage points, from 12.8% in 2015 to 11.9% in 2016.

Terminal system ratings are based on inspections that are mandated

by state law to occur at least once every three years. Increases to system condition ratings occur after preservation work has been completed under the capital program, or after maintenance work is finished under the Ferries operating program. Decreases to the ratings occur after normal use or weather conditions degrade an asset to a lower level of functionality or safety.

Systematic inspections do not always occur during the same year work takes place on an asset. As a

Based on current funding levels, control the percent of ferry vessel systems that are past due for replacement from increasing to over 10% by 2020.

Status: Off target (red) – 13.3% as of June 30, 2017

Strategies:

- 1) Maintaining vessel systems
- Focus capital program preservation and operating program maintenance resources on vessel systems designated to maintain vessel reliability and apply cost benefit analysis based on the Life Cycle Cost Model to determine how long other systems should be operated beyond their life cycles.
- 2) Efficiently using resources
- Integrate capital program preservation and operating program maintenance planning and contracting to achieve the best use of resources.
- 3) Using flexible planning to achieve goals - Minimize loss of preservation and maintenance opportunities by maintaining highly flexible project planning and execution that facilitates adjusting the biennial preservation and maintenance work plans to react to changes in vessel and shipyard availability.
- 4) Keeping policy makers in the loop - Inform policy makers about the strategic resource situation by applying the Life Cycle Cost Model to establish preservation performance objectives and program delivery.

result, repairs and improvements to terminal systems or individual assets may not be reflected in the reporting period the work was accomplished.

Most buildings at WSDOT terminals in good/fair condition in 2016

Buildings at WSDOT terminals continued to have the highest percent (97.8%) of inventory items in good or fair condition in 2016, a slight increase from the 97.1% in 2015.

The condition of trestles and bulkheads had the largest increase of systems in the good or fair category, improving from 85.9% in 2015 to 94.2% in 2016. Preservation and maintenance work on the trestle and bulkhead at the Vashon Island terminal was the major reason for that increase. Work on landing aids (wingwalls and dolphins) improved

their system condition rating from 80.2% in 2015 to 82.4% in 2016.

Vehicle transfer spans had the largest decrease of inventory items in good or fair condition, dropping from 89.5% in 2015 to 88.1% in 2016. Electrical systems on transfer spans that earned a poor rating at the Lopez Island and Bainbridge Island terminals were responsible for the drop.

At 21.4%, passenger-only facilities had the highest percentage of inventory items with a poor or substandard condition rating at the end of 2016. This is the same percentage as in 2015. Passenger-only facilities are located at Colman Dock in Seattle, the Vashon Terminal and the Eagle Harbor maintenance facility on Bainbridge Island and include transfer spans, floating docks, trestles and aprons.

Ferries uses life cycle costs, condition ratings to prioritize its preservation work annually

WSDOT invested \$21.7 million in vessel and terminal preservation projects during FY2017 in an effort to reduce the number of systems in the preservation backlog.

In order to estimate future terminal and vessel preservation needs per Legislative mandate, WSDOT uses a Life Cycle Cost Model (LCCM). The LCCM is an inventory database of systems, which includes information like the year systems were built and their standard life cycles.

WSDOT uses the LCCM to develop budget requests for preservation funding to address the backlog

of ferries maintenance and repair projects. In FY2017, there were 1,997 vessel systems and 757 terminal systems. This number can change when systems are added or removed, or when new vessels are added or old ones retired.

WSDOT vessel backlog decreases due to new Olympic Class ferry

The 2015-2017 biennial vessel preservation plan forecasted an increase in the backlog of needed preservation work from 26.3% at the beginning of the 2015-2017 biennium (July 2015) to 28.1% at the end of the

Gauging preservation needs at Ferries

WSDOT has implemented an asset management model with economic inputs to screen which preservation items fiscally make sense to replace. While the standard condition-based preservation backlog from the Life Cycle Cost Model (LCCM) is dependent on when items are past their life cycles, the economic model's backlog are items whose maintenance cost, risks, and financial impacts of failure are higher than the cost of replacement.

WSDOT updates the economic model annually, reviewing and reassessing the costs of risks, impacts of failure, system replacement, and maintenance. Conditions of systems are updated based on inspections, and systems are also added or removed from the model to match the inventory database in the LCCM.

biennium (June 2017). If no vessel systems due for replacement were renewed in the biennium, the vessel preservation backlog would have risen to 32.3%.

At the end of the biennium (June 2017), completed work and vessel replacement accounted for an 8.7% reduction of the vessel preservation backlog. The backlog at the end of the biennium was 23.6%, which was 4.5% below the original plan entering the biennium (July 2015). This drop is primarily accounted for by the decommissioning of the M/V *Klahowya* and introduction of the M/V *Chimacum*.

Fewer vessel emergencies reduce impacts to service

Fiscal year 2017 had only one emergency that kept a vessel out of service, and two emergencies that required visits to the shipyard. This is down from 11 emergency events in FY2016, reducing the overall impact to planned preservation work.

Annual fleet wide inspections of fire suppression sprinkler systems—which were at the end of the usable life—found many needed to be replaced. These priority replacements resulted in six unscheduled, non-emergency dockside shipyard visits of WSDOT vessels in the final six months of FY2017. These visits ultimately replaced other planned preservation work that had been scheduled in FY2017.

WSDOT completed \$49.3 million of vessel preservation work in FY2017 from a supplemental biennial budget of \$68.6 million. The M/V *Kaleetan* had the most preservation work completed (\$6.9 million) in FY2017, with the replacement of propellers, saltwater piping and sprinkler systems, draft indicator systems, and hull steel.

The M/V *Sealth* also had propellers, saltwater piping and sprinkler systems, draft indicators, and hull steel replaced as a major part of preservation work (\$3.1 million) performed in FY2017.



Leading Indicator

Based on current funding levels, control the percent of ferry terminal systems that are past due for replacement from increasing to over 6% by 2020.

Status: On plan (green) — 5.2% as of June 30, 2017

Strategies:

- 1) Reprioritize projects as needed
- Use economic based life cycle model to prioritize projects to match available capital budget.
- 2) Extend the useful life of systems - Increase maintenance actions to extend the useful life on systems targeted for deferral by the economic model.
- 3) Reduce reliability risks - Target preservation dollars to reduce risk to degradation of service reliability.
- 4) Review asset conditions - Periodically review system asset conditions and adjust the years of replacement, then compare results to planned budget amounts in future biennia to confirm program sizing.

How the Preservation Needs Percentage works

The preservation backlog is measured as a Preservation Needs Percentage, which is the percent of the value of terminal or vessel systems needing replacement.

The PNP differs from the vessels' condition categories and terminals' condition ratings because it only tracks whether a system is past its originally planned year of replacement based on its life cycle. WSDOT makes adjustments as needed to the life cycle of terminals by comparing an item's condition to historical information of a similar item in similar condition.

WSDOT determines the baselines for the backlog at the beginning of each biennium, projecting what the backlog will be at the end of the biennium while considering the value of systems coming due for replacement.

The success of both the terminal and vessel preservation budgets is measured by comparing the target percent of the value of terminal assets beyond their condition-based life cycle at the end of the biennium to the actual percent of value achieved. To achieve this, WSDOT must reduce the backlog of preservation needs over the biennium so the value of systems preserved exceed the value of systems coming due for replacement during the two-year period.

Terminal preservation backlog sees increases from beginning of biennium

Using the terminal Economic Based Model preservation plan, the preservation backlog of the value of systems past due for replacement would have increased from 3.7% at the beginning of the 2015-2017 biennium (July 2015) to 5.4% at the end of the biennium (June 2017) if no preservation inventory items are addressed. See chart below for details.

WSDOT budgeted \$66.5 million to support the terminal preservation plan and to reduce the economic-based terminal needs backlog to 5.1% in the 2015-2017 biennium. At the end of the biennium (June 2017), with the investment, the backlog was at 5.2%.

During the second half of the 2015-2017 biennium WSDOT replaced over 20% of the Vashon trestle, removing more than 121 tons of creosote piles.

WSDOT also replaced the transfer span towers at Coupeville, and the slip 2 wingwalls at Bremerton. Terminal preservation ended the 2015-2017 biennium spending \$46.0 million (69.2%) of the \$66.5 million biennial preservation budget. Delays in contracts on the Seattle Terminal Building and North Trestle Replacement project were the main reason for underspending the preservation budget.

Contributors include John Bernhard, Tim Browning, Tom Castor, Jim Hasselbalch, Nicole McIntosh, Mehrdad Moini, Sio Ng, Kynan Patterson, Manny Quinteiro, Dustin Motte and Joe Irwin

Vessel and terminals backlog overview: Ferries vessel preservation needs decrease while terminal needs increase

Through June 2017; Based on Life Cycle Cost Model and economic-based needs

Backlog status	Life cycle-based vessel needs	Economic-based terminal needs ¹
Original backlog at beginning of biennium	26.3%	3.7%
Additions to backlog during the biennium	6.0%	1.7%
Total backlog prior to preservation investments	32.3%	5.4%
Projected impact of planned preservation investments	4.2%	0.3%
End of biennium backlog based on preservation plan	28.1% ²	5.1%
Preservation spending as of June 2017 – mid-biennium (percent of biennial budget)	\$49.3 million of \$68.6 million (71.9%)	\$46.0 million of \$66.5 million (69.2%)
Actual backlog as of June 2017	23.6%	5.2%

Data source: WSDOT Ferries.

Notes: ¹ WSDOT Ferries economic-based model was fine-tuned in FY2016, while inspection and maintenance efforts were updated. As a result, the information above is not directly comparable to that provided for FY2015 in Gray Notebook 58. This measure is also used for Results Washington. ² Projections for biennium backlog did not include the early retirement of the M/V *Klahowya* and the arrival of the M/V *Chimacum*.

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ASSET MANAGEMENT: CAPITAL FACILITIES ANNUAL REPORT

As WSDOT's primary buildings continue to age, majority are in "fair" or "poor" condition

WSDOT strives to keep agency buildings and systems operating smoothly to support its workforce as it delivers services to the public. Twenty-two (7.8%) of WSDOT's 283 primary buildings (agency-owned buildings larger than 2,000 square feet) achieved a condition rating of "good" in 2017. The "good" rating means they are new construction and/or meet current industry standards. This is an increase from 6.7% (19) in 2014. Facility condition data, normally assessed biennially, was unavailable in 2016.

Forty-eight percent (135) of WSDOT's primary buildings received a condition rating of "fair" indicating that the facility does not meet current standards but remains functional and is in adequate condition, with some component deficiencies. This compares to 52% (147) in 2014. Forty-five percent (126) of WSDOT's primary buildings earned a condition rating of "poor." A poor rating indicates that a building is at or beyond its service life, with multiple major deficiencies that could lead to unexpected repairs and resulting costs. This value increased from 42% (118) in 2014, continuing a 10-year upward trend.

Out of its inventory of nearly 1,300 owned and leased buildings and structures, WSDOT owned 283 primary buildings as of September 2017. These buildings support the majority of agency staff. They may also provide shop and storage space for vehicles, equipment and supplies. Primary buildings represent approximately 21% of WSDOT capital facilities and 63% of total building area by square footage.

Majority of WSDOT's primary¹ buildings in "fair" or "poor" condition

Number and percent of WSDOT primary buildings by condition as of September 2017, compared to July 2014

Condition rating	July 2014	Sept 2017
Good	19 (6.7%) ²	22 (7.8%) ²
Fair	147 (52%) ²	135 (48%) ²
Poor	118 (42%) ²	126 (45%) ²
Total	284	283

Data source: WSDOT Capital Facilities Office.

Note: 1 Primary buildings are agency-owned buildings 2,000 square feet or larger.

2 Percentages do not add to 100 due to rounding.

WSDOT's primary buildings average 44 years old; 98 (35%) are more than 50 years old

The average age of WSDOT's 283 primary buildings is 44 years old. Less than one-third of the primary building inventory (29%; 81 buildings) is 25 years old or younger, and 37% (104) of primary buildings fall into the 26-50 years old

Notable results

- WSDOT-owned primary buildings have an average age of 44 years; 35% are more than 50 years old
- WSDOT's 10-year unmet needs backlog for capital facilities is \$475 million
- Pilot projects are underway to remove tall cubicle walls in an effort to modernize WSDOT's work environment



Agency Emphasis Area PRACTICAL SOLUTIONS

WSDOT's Capital Facilities program applies practical space design to existing and new offices, streamlining offices to achieve a modern work environment, with a focus on flexibility and choice.

Approximately one-third of WSDOT's primary buildings are more than a half-century old; 55% will be older than 50 years by 2027

Number and percent of WSDOT primary buildings by age as of September 2017, compared to September 2016 and projected for September 2027

Building age	Sept 2016	Sept 2017	Sept 2027 ²
25 years or less	84 (30%) ¹	81 (29%) ¹	28 (10%)
26 to 50 years	102 (36%) ¹	104 (37%) ¹	99 (35%)
Older than 50 years	98 (35%) ¹	98 (35%) ¹	156 (55%)
Total	284	283	283

Data source: WSDOT Capital Facilities Office.

Note: 1 Percentages do not add to 100 due to rounding. 2 Projected based on current inventory.

category. The number of primary buildings older than 50 years stayed the same between September 2016 and September 2017; with 35% (98) of WSDOT's inventory in this category. Three buildings aged into the "26 to 50 years" category, including the Mount Saint Helens office and storage building, the Union Gap vehicle and storage building, and the Union Gap project development modular office. The Wenatchee project engineering field office was removed from this category when it was demolished to make room for the new North Central Region administration building in December 2016.

Many WSDOT primary facilities are functionally obsolete

Within 10 years, 90% of WSDOT's current primary building inventory will be 26 years old or older. By 2027, 156 primary buildings will be older than 50 years.

As buildings age beyond 25 years, design features become outdated and typically cannot be changed without major renovation or replacement. Many older maintenance shops cannot accommodate modern roadway work equipment such as larger trucks, wider plow blades or taller cranes and hoists that WSDOT road

crews use to maintain the highways. Outdated office and crew spaces are less flexible to operational changes, which may lead to inefficient facility use or operational impacts to the program being supported. Crew rooms, supervisor offices, restrooms, data outlets and electrical service may be undersized or inadequate to support a modern work environment.

Emergency repair costs for WSDOT's aging facilities continues to rise

The current WSDOT Facilities Preventive Maintenance Plan completion rate is 82%. This exceeds the target goal of 71%, but is down from the 88% reported in 2015 (see [Gray Notebook 59, p. 10](#)).

Under the current maintenance model, only the most critical preventive maintenance activities are planned. As facilities continue to age, costs for emergency repairs continue to significantly increase. Emergency repairs include but are not limited to broken water lines, leaking roofs and non-functioning heating systems.

One example of an emergency repair was failed boilers at WSDOT's Northwest Region Headquarters in Seattle that left the building without heat for several days. Fixing the boilers at the Northwest Region Headquarters meant diverting funding from other facility programs.

During the 2013-2015 biennium, funding was diverted from other facility maintenance programs—such as preventive maintenance—to increase emergency repair funding to \$4 million (a 12% increase from the

As WSDOT's primary buildings age, preservation and replacement backlog increases to \$235 million

Number and percent of WSDOT primary buildings by age as of September 2017, compared to July 2014; backlog and replacement cost in millions of dollars

Building age	July 2014		Sept 2017		
	Number	Total backlog	Number	Total backlog	Replacement cost
25 years or less	90	\$24.6	81	\$33.2	\$127.8
26 to 50 years	109	\$107.8	104	\$116.0	\$280.6
Older than 50 years	85	\$76.3	98	\$86.2	\$182.4
Total	284	\$208.7	283	\$235.4	\$590.9

Data source: WSDOT Capital Facilities Office.

prior biennium). Before the biennium was done, another \$500,000 was needed. A total of \$4.5 million was spent on emergency repairs, up from \$2 million two biennia ago (a 125% increase).

When costs for emergency repairs exceed available resources, funding from other facility activities and planned preventive maintenance is diverted. The overall trend of emergency repair is comparable to not changing the oil in your car so that you can instead buy a used tire to replace a blown out tire; it is simply not sustainable.

As primary facilities age, total backlog increases

The current total preservation and replacement backlog for WSDOT's 283 primary buildings increased to \$235.4 million in 2017, up nearly \$27 million, or 13%, compared to 2014 estimates.

Unmet needs backlog estimate confirmed at \$475 million

In 2015, WSDOT's Capital Facilities strategic plan identified a \$475.5 million backlog of unmet needs for the next 10 years for more than 800 facilities statewide, including the 283 primary buildings noted above (see [Gray Notebook 59, p. 9](#)). WSDOT completed its first round of primary building condition assessments using the Facility Inventory and Condition Assessment Program (FICAP) developed by Washington State University. The FICAP system generated a total backlog estimate of \$474.7 million; this data provides new and independent support for the 2015 estimate.

WSDOT makes progress on two new regional headquarters buildings

As reported in [Gray Notebook 63, p. 13](#), the 2015 Connecting Washington funding package includes two capital facilities projects.

WSDOT is in the construction phase of a new North Central Region administration building on Euclid Avenue in Wenatchee. The project's Design-Build contract was awarded in October 2016 and the project is on schedule for completion in spring 2018.

WSDOT is developing a design-build contract for the new Olympic Region headquarters to be located on Marvin Road in Lacey. The project is scheduled for completion in summer 2021.

WSDOT slates \$4.34 million for minor projects in the biennium

WSDOT allocated \$4.34 million in the 2017-2019 biennium to support ongoing preservation and repairs projects. For examples of projects, see [Gray Notebook 63, p. 14](#).

WSDOT begins project to reduce energy consumption

WSDOT began work in summer 2017 on a \$12.5 million energy conservation upgrade project that will reduce energy use in more than 60% of its buildings, utilizing an Energy Savings Performance Contract. Energy and water savings are projected to be nearly \$1 million each year once the project is complete in summer 2018.



Strategic Plan Goal 6 SMART TECHNOLOGY

Improve information system efficiency to users and enhance service delivery by expanding the use of technology.

WSDOT's first round of primary building condition assessments using the Facility Inventory and Condition Assessment Program (FICAP) is a departure from previous assessment processes. FICAP incorporates more detailed building profiles and infrastructure analysis. The system uses Web-based technology and allows for evaluation of facilities in real time, on site, and with a higher degree of accuracy. FICAP supports detailed assessment and cost estimating for:

- Building utility systems such as heating, ventilation, lighting, electrical, water and sewer, and
- Building components like structural beams, roofs, doors, windows, elevators, exterior siding and finishes.

The project is funded by a combination of grants (\$350,000), utility rebates and incentives (\$1.1 million), and a loan financed through the Office of the State Treasurer (\$11 million). Budget savings from reduced utility costs will be redirected from utilities to pay back the loan.

This project allows WSDOT to save energy and improve facilities, including lighting fixtures, plumbing components, mechanical systems and some minor building modifications, with no up-front capital costs.

Statewide building energy improvements are expected to have significant environmental and economic benefits. LED fixtures last for many years, while existing fluorescent fixtures may only last months. Having to change bulbs less often means maintenance staff will be able to reallocate hours to more critical tasks.

WSDOT expects 69% of total project savings to come from more efficient lighting, 24% from improved building heating and cooling, and 7% from reduced water usage. The project is also expected to avoid more than 10 million pounds of carbon dioxide equivalent (CO₂e) emissions annually.

WSDOT is building a Modern Work Environment

As reported in [Gray Notebook 65, p. 32](#), WSDOT has undertaken projects to implement Gov. Jay Inslee's Executive Order 16-07, "Building a Modern Work

Environment" initiative. The projects modernize the physical environment, provide greater workplace flexibility and enable a more mobile workforce.

Capital Facilities, Accounting & Financial Services host pilot projects

The agency's Capital Facilities office in Tumwater and the Accounting and Financial Services office at the Headquarters building in Olympia serve as pilot projects. Modern work environment changes were completed in September and October 2017.

WSDOT used employee survey results, and discussion and engagement tools to capture employee perspectives on space design. Staff input guides decisions on mobility options, space amenities and design elements; such input is the foundation of the new modern workplace process.

The Capital Facilities project removed tall and short modular panels, added fully adjustable sit/stand work surfaces to all work stations, repurposed offices into meeting areas, and more. Wireless connectivity was added to the work area, and laptop computers replaced some desktop computers. Internal as well as external mobility, such as working from home, is supported when possible.

In the Accounting and Financial Services project, no offices remain, open meeting areas were incorporated into wing conferencing for two to six people, tall cubicle



The photos above show the before and after, respectively, of the Modern Workplace Pilot at the Accounting and Financial Services office at WSDOT headquarters in Olympia.

walls were removed, and modular furniture panels were minimized. All work stations now have fully adjustable sit/stand work stations, and accent paint was added to walls for improved aesthetics.

Employees impacted by the pilot projects will have a follow-up survey next year to solicit feedback and suggestions for improvement. At least six more modern work environment projects are tentatively planned and in varying stages of development at WSDOT.

Contributors include Tim Hall, Steve Holloway, Jim Hurst, Zak Swannack and Yvette Wixson

67 ASSET MANAGEMENT: AVIATION ANNUAL REPORT

State contributes \$1.2 million to receive \$76.9 million in federal funds for Airport Aid

WSDOT awarded \$1.2 million for airport investments through its Airport Aid Grant Program for fiscal year (FY) 2018 (July 2017 through June 2018). Public-use airports in the state leveraged \$923,300 of these funds to secure \$76.9 million in federal grant funding. These grant awards will benefit 29 projects at 25 airports in FY2018. WSDOT's leveraged dollars make up 74.4% of the \$1.2 million in total state funds for the Airport Aid Grant Program (see table below). The remaining \$317,500 (25.6%) will go to airports not eligible for federal funding.

A total of \$88.5 million will be available for airport investment projects during FY2018. This figure includes \$10.3 million in local and other funding, in addition to state and federal funding. The majority of these funds (\$82.8 million or 94%) are slated for pavement projects, including \$41 million for runway realignment at the Pullman-Moscow Regional Airport. This project includes property acquisition, power line relocation and construction of airfield improvements. The work will further separate the runway and the taxiway to meet federal standards and reduce the potential for accidents.

Projects that improve safety at airports account for 3% of the total dollars (\$2.7 million), with the remaining 3% (\$3.0 million) allocated for security and other projects. For more information about WSDOT's Airport Aid Grant Program, visit: www.wsdot.wa.gov/aviation/Grants.

Majority of airport investment funding slated for pavement projects

Funding by source for fiscal year 2018; Dollars in millions

Project type	Total	Local	State	Federal
Pavement	\$82.8	\$10.0	\$0.9	\$71.7
Safety	\$2.7	\$0.1	\$0.1	\$2.5
Security	\$1.0	\$0.1	\$0.1	\$0.9
Other ¹	\$2.0	\$0.1	\$0.1	\$1.8
Total	\$88.5	\$10.3	\$1.2	\$76.9

Data Source: WSDOT Aviation Division

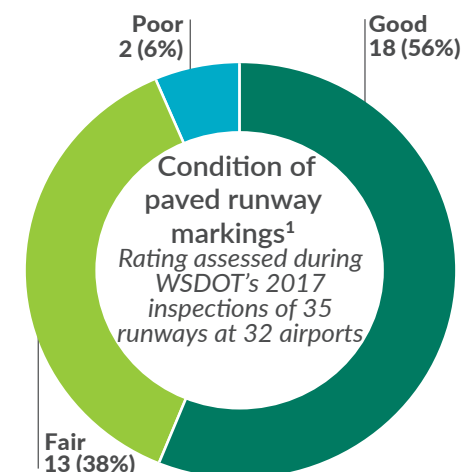
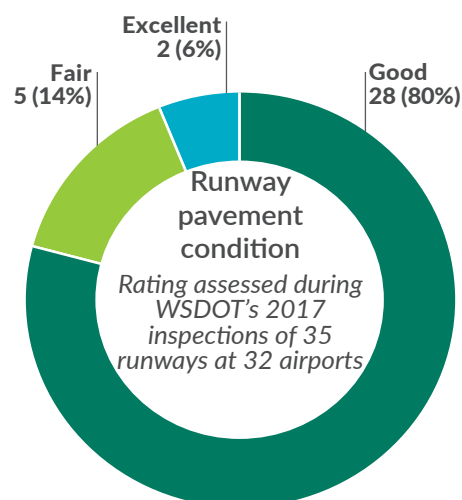
Notes: Some numbers do not add up due to rounding. 1 "Other" projects include planning, maintenance and equipment acquisition.

WSDOT finishes 100% of Airport Master Record inspections

WSDOT completed 100% of its airport inspections of the 42 airports scheduled in 2017. During these visual inspections, WSDOT determined that 86% of runway pavement at 32 airports (10 airports have turf, gravel or water runways) was in excellent or good condition (see chart at right). WSDOT inspectors, following Federal Aviation Administration (FAA) guidance on Master Records, also assessed runway markings. Inspectors found that of the 35 runways at the 32 airports—some airports have more than one runway—approximately 94% had markings that were in good or fair condition.

Notable results

- WSDOT's Airport Aid Grant Program leveraged \$923,300 in state funding to make \$76.9 million in federal funds available for airport investments in fiscal year 2018
- The Pullman-Moscow Regional Airport is slated for a \$41 million runway realignment project
- Airport inspections found that 86% of runway pavement at 32 airports was in excellent or good condition



Data Source: WSDOT Aviation.

Notes: Some airports have more than one runway. The condition of runway markings was assessed at 32 of the 42 inspected airports because runways at the other 10 locations were turf, gravel, or water surfaces. 1 Two runways had no markings.

WSDOT is developing a best management practices toolkit

In accordance with a proposed solution from the Airport Investment Study, WSDOT is developing a best management practices guidebook/toolkit for public-use airports. The guidebook will be a resource to use in employing successful airport management methods as well as meeting statutory requirements. These practices are based on airport management knowledge obtained from experts across the nation. The guidebook is expected to be available by December 2019.



Agency Emphasis Area PRACTICAL SOLUTIONS

WSDOT's development of a best management practices toolkit for public use airports in Washington state supports Practical Solutions by consolidating knowledge and best practices obtained from airport management experts across the nation.

Pavement work scheduled for Methow Valley Airport

WSDOT will undertake a \$5.9 million project at Methow Valley State Airport beginning in May 2018. The project at the state-managed airport will rehabilitate 21-year-old pavement on the primary runway, and will install new sub-drains, grade the runway safety area and rehabilitate surrounding taxiways and other pavement. Work at the airport will also expand and reconfigure the aircraft parking apron to meet FAA design standards.

The pavement at Methow Valley State Airport has reached the end of its useful life. The design and environmental work for the project began in January 2017 and went to bid in August 2017. The work is scheduled to begin in May 2018 and take approximately 100 calendar

days. The project will be completed in phases to minimize impacts on airport operations.

The Methow Valley State Airport is one of 16 airports that WSDOT operates. It is the only state-run airport eligible for federal funds because it is included in the Federal Aviation Administration's National Plan of Integrated Airport Systems (NPIAS). The NPIAS is the FAA's federal system of airports.

The airport is also home to a U.S. Department of Agriculture Forest Service Smokejumper Base. The base employs approximately 30 staff who use the airport to conduct forest fire fighting operations. The airport is also used for business and recreational travel.

WSDOT's Airport Investment Study identifies solutions for needed airport funding

The Airport Investment Solutions Handbook was released in 2015 as the second and final phase of WSDOT's Airport Investment Study. The study identified \$3.6 billion in needed investment, and a \$1.6 billion gap between needs and available funding over the next 20 years.

The handbook proposed solutions to cover the state's share—\$8.4 million annually—of the current airport investment funding gap. Among possible solutions resulting from the study were the need for a state-sponsored revolving aviation infrastructure loan fund and a best management practices guidebook/toolkit for state airports.

In 2017, the legislature considered an aviation revitalization revolving loan program reflected in House Bill 1656 and Senate Bill 5328. While neither bill passed, they are scheduled for further discussion in the 2018 session, as is \$5 million in possible start-up funding in the state capital budget.

The revolving loan would provide seed money for airports to complete projects that will generate long-term revenue streams. These revenue streams could allow airports to provide the 5% matching funds that are required of a WSDOT or FAA airport infrastructure grant.

Aircraft registration with WSDOT climbs to a record high

WSDOT registered a record 6,586 aircraft and provided 3,056 total exemptions to qualifying aircraft during the 2017 aircraft registration and renewal cycle (see sidebar on p. 14 for more information about exemptions). As a result, WSDOT surpassed its annual registration goal of 95%.

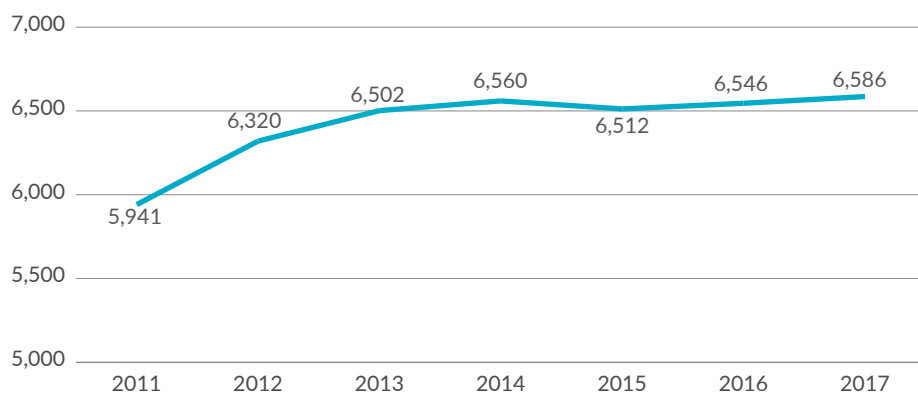
Washington state law requires that airworthy general aircraft be registered with WSDOT Aviation.

Annual aircraft registration fees are due January 1 each year and directly support airport preservation, maintenance and improvement programs.

In 2017, late registration fees were paid for 146 aircraft in Washington state. Gov. Jay Inslee signed a bill in 2016 which assesses a one-tier late registration penalty of \$100 per aircraft instead of the previous escalating penalty schedule.

Number of aircraft registered in Washington soars to record high in 2017

2011 through 2017; Number of aircraft registered with WSDOT per year



Data source: WSDOT Aviation Division.

FAA and WSDOT Partner for a statewide Disadvantaged Business Enterprise Program disparity study

The Federal Aviation Administration (FAA), WSDOT's Office of Equal Opportunity (OEO) and WSDOT's Aviation Division are collaborating on a statewide Disadvantaged Business Enterprise (DBE) Program Disparity Study. The study is projected to begin in January 2018 and be completed in June 2019. The structure of the study will eliminate redundant spending while benefitting airports and the state.

WSDOT OEO has successfully completed DBE studies in 2005, 2012 and 2017. Given this experience, the FAA requested that OEO manage this project on its behalf in conjunction with a consultant.

This DBE Program Disparity Study will evaluate contracting data for 64 of the 136 public-use airports in Washington state that are under WSDOT authority and determine

Most aircraft registered with WSDOT are single engine

Calendar year 2017; Number of aircraft registered by type

Aircraft type	Quantity
Single engine	4,681
Home built	1,085
Helicopter	228
Piston, multi-engine, small	213
Turbojet, multi-engine	135
Sail/glider	122
Turboprop, multi-engine	41
Lighter than air	36
Piston, multi-engine, large	23
Aircraft 8,001-9,000 lbs.	10
Aircraft 4,001-6,000 lbs.	7
Aircraft less than 4,001 lbs.	4
Aircraft 9,001-12,500 lbs.	1
Total	6,586

Data source: WSDOT Aviation Division.



Agency Emphasis Area INCLUSION

WSDOT is supporting Inclusion by partnering with the FAA to conduct a Disadvantaged Business Enterprise program disparity study. This study will examine utilization of minority- and women-owned businesses by the Airport Improvement Program in Washington state in relation to the availability of those businesses.

Aircraft registration exemption

In 2017, WSDOT provided 3,056 exemptions to aircraft that qualified. This means owners of those aircraft were not required to pay registration fees to WSDOT according to state law. Aircraft that qualify for exemption from WSDOT registration are still required to register with the FAA.

There are several criteria to qualify for aircraft registration exemption, all of which require approval by WSDOT. For more information about exemption qualification and how to apply, see <http://bit.ly/AircraftExemptions>.

Statewide general aviation passenger safety improves

WSDOT does not track passenger safety, but it assists the National Transportation Safety Board (NTSB) after aviation accidents, providing information to help NTSB investigations.

General aviation¹ fatalities in Washington state declining

2015 through 2017; General aviation passenger boardings and fatalities only

	2015	2016	2017
Total fatalities	14	7	3

Data sources: Federal Aviation Administration; National Traffic Safety Board, Aviation Accident Database.

Note: Data current through October 2017. ¹ General aviation includes all non-commercial passenger aviation.

the availability versus utilization of minority- and women-owned firms on airport projects. The study will provide these airports with sufficient information to implement their DBE program consistently with current regulatory standards.

The collaboration between the FAA, OEO and WSDOT Aviation provides several benefits to our airport stakeholders, including:

- Eliminating redundant spending and efforts by conducting the required DBE Disparity Study for 64 airports concurrently, instead of 64 separate studies and consultants;
- Ensuring that each airport's DBE Program Disparity Study will meet federal requirements;
- Ensuring that airports receive the benefit of WSDOT's experience from recently conducting a Federal Highway Administration-funded DBE Program Disparity Study;
- Providing each airport with the legal foundation to evaluate data and properly implement the DBE Program as required by federal law under the Code of Federal Regulations; and
- Developing specific areas for improvement and best practices for airports located in Washington state.

Aviation System Plan charts a new course for Airports

In July 2017, Transportation Secretary Roger Millar approved the Washington Aviation System Plan (WASP) final report, opening the way for WSDOT to begin implementing new programs designed to improve the state's system of public-use airports.

The WASP is a statewide study conducted approximately every five years. It examines and analyzes Washington's system of airports to identify changes that are needed to meet airport and aviation transportation needs.

Among the key findings of the study were modest growth in statewide commercial air service, air cargo, and general aviation. The study also explored several emerging issues such as alternative fuels, aircraft innovation and unmanned aircraft systems.

The study's results included a new airport classification system, new performance goals, objectives and measures, new performance metrics for airports, and strategic alternatives for enhancing aviation activities at the statewide, regional and individual airport levels.

WSDOT will work with airports, local governments and stakeholders to implement the new tools developed through the study. For more information about the WASP, visit: <http://bit.ly/WSDOTWASP>.

Contributors include Rob Hodgman, Eric Johnson, John MacArthur, Tracy Paul, Paul Wolf, Patrick Wright, Joe Irwin and Dustin Motte

Notable results

- *Visits to safety rest areas increased statewide by 3% between 2015 and 2016, to 24 million*
- *Aging rest area systems resulted in 13 unanticipated emergent needs projects totaling more than \$730,000*

Rest area use increases in 2016 to 24 million visitors

An estimated 24 million visitors used WSDOT safety rest areas in calendar year 2016, which is about 615,000 or 3% more than the 23.1 million estimated visitors in 2015, and the highest number in the past decade.

Visitor estimates are generally based on water use. WSDOT is planning to install permanent traffic counters at rest areas to generate more accurate visitor and recreational vehicle (RV) dump station user information. WSDOT expects to add the counters as funding becomes available and anticipates the process will begin in 2018.

The 47 statewide rest areas provide safe places for travelers to take a break from driving. All rest areas provide bathroom facilities while most also have traveler information, picnic tables, pet areas, and may offer free coffee through a volunteer program.

WSDOT rest area operation costs per visitor increase slightly

WSDOT's rest area expenditures are within 1% of the \$13.2 million 2015-2017 biennial budget. The cost per visitor using WSDOT rest areas increased slightly from the previous biennium. In the 2013-2015 biennium, the cost ranged from 10 cents to 80 cents per visitor. The 2015-2017 cost is 14 to 90 cents per visitor. Costs vary due to both the volume of visitors and the fixed costs to maintain and operate rest area facilities, regardless of use. The slight increase in cost between the bienniums is due in part to increased labor costs. WSDOT continues to track individual rest area expenditures to identify operational efficiencies. Tracking expenditures and preventive and corrective maintenance tasks provides WSDOT the information it needs to develop and analyze scenarios for operations improvements and cost savings. Tracking repair costs helps WSDOT accurately identify future system replacement needs.



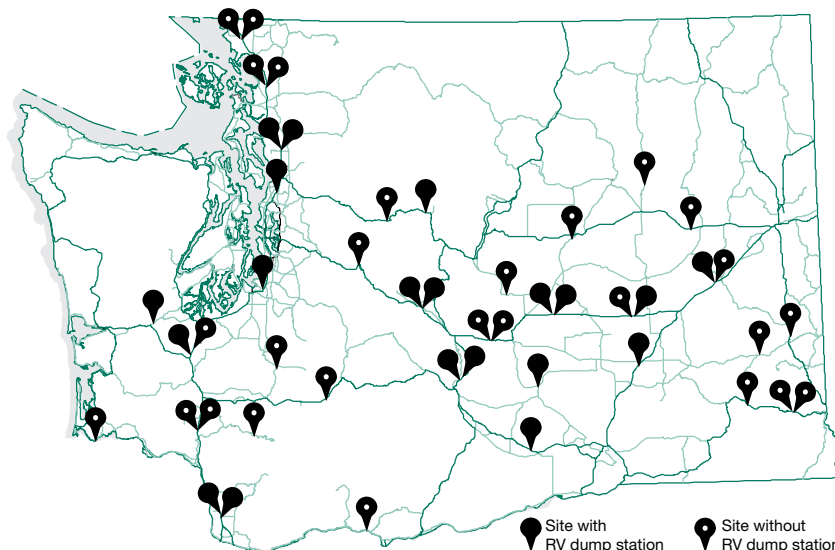
This map is interactive online and

is updated annually. Click anywhere

on the map to explore information on visitor use levels for each safety rest area or go to <http://bit.ly/GNBrestareasmap>.

WSDOT operates 47 safety rest areas in Washington state, 20 with recreational vehicle dump stations. Twenty-eight rest areas are located on the interstate highway system, each approximately 30 to 45 miles apart. This is consistent with the Federal Highway Administration's recommended spacing guidelines for safety rest areas on highways and major arterials. Another 20 rest areas are located on state routes and are particularly vital due to their more remote locations in areas with limited public services. The annual visitor use is much greater at the interstate sites, which are heavily used by commercial truck drivers.

WSDOT safety rest areas have 24 million visitors Calendar year 2016



WSDOT keeps its “B” grade for rest area maintenance

While visitor use increased, WSDOT safety rest areas again met their maintenance goal. As part of WSDOT’s Maintenance Accountability Process, staff conducts regular, random operational surveys of rest areas. Each survey examines the condition of a rest area at the time staff arrived on site. Survey items are scored and graded on an “A” through “F” scale. WSDOT rest areas continue to score a “B” grade on average. To earn a “B” grade a rest area site must appear clean, and have water and sewer systems that are operational. While the surveys indicate that the grounds and building are well cared for, some may show signs of wear, graffiti, or have minor damage.

Other factors that contribute to the grades include non-operational building utilities, fixtures, recreational vehicle dumps, and the appearance of landscaped areas, sidewalks and pavement. [Gray Notebook 60, p. 20](#) has a detailed overview of the grading scale for maintenance items.

Emergent needs projects total \$730,000 to date in current biennium

From July 1, 2015 through March 31, 2017, WSDOT executed 13 unanticipated emergent needs projects to repair or replace failed site infrastructure at a cost of more than \$730,000. These projects include repairs to failing rest area sewer systems at Elma, Maytown, and Quincy Valley, as well as repairs to failing water systems at Schrag Eastbound, Ryegrass Westbound, and Winchester Westbound. A major lagoon study is underway that will improve operation and maintenance and reduce emergent issues.

Thirty-nine of WSDOT’s 47 rest areas are 30 years old or older. This includes 31 restroom buildings that are at least 30 years old. The age of rest areas is a major contributing factor to the maintenance preservation backlog for buildings and the utilities that serve them. The highest priority is to maintain, operate and preserve building and system assets to extend their useful life and the service life of the safety rest area. As assets age, it is increasingly difficult to forecast needs for site infrastructure such as water, wastewater, and electrical



Renovations to winterize and replace components at the Silverlake rest area off Interstate 5 near Everett began in February 2017.

systems that are often underground. These deficiencies are typically detectable only upon system failure.

Silverlake rest area renovation to make it usable year round

Renovations began in February 2017 on the RV dump station at the Silverlake rest area near Everett. Renovations, expected to be complete in June 2017, include complete replacement and realignment and winterizing of the three existing dump stations to improve operations. An ongoing effort is underway to install effluent meters on the RV waste lines which are expected to more accurately assess system usage.

Twenty safety rest areas provide recreational vehicle dump station service. Recreational vehicle dump stations at safety rest areas are maintained and preserved with funds from a dedicated RV account (from RV license fees).

New condition assessment program data not yet available

The launch of a new Facility Inventory Condition Assessment Program for use in determining overall condition and preservation backlog of safety rest area facilities was reported in [Gray Notebook 61, p. 14](#). The data is not yet available and is expected to be reported in a future edition of the *Gray Notebook*.

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Notable results

- *WSDOT met 77% of its highway maintenance asset condition targets in 2017, down from the 93% achieved in 2016*
- *Maintenance crews processed approximately 188,000 maintenance records in 2017 using the Highway Activity Tracking System*
- *A customer survey showed 73% of respondents were generally satisfied with the level of overall highway maintenance in 2017*



A WSDOT maintenance crew performs snow and ice management on Snoqualmie Pass.

Extreme weather and incidents contribute to declining highway conditions in 2017

WSDOT met 77% of its highway maintenance asset condition targets in 2017, a 16 percentage point decline from the 93% achieved in 2016. An unusually cold, wet, and extended 2016-2017 winter, coupled with an increase in damage to roadway facilities prompted WSDOT to redirect allocated funds to prioritize safety-related work in 2017. Additionally, the agency redirected funds to cover unexpectedly high third-party repair costs (\$27.5 million), which are incurred when travelers cause damage to WSDOT property such as guardrail, signs, lighting systems or other equipment.

During the 2016-2017 winter, snow and ice management expenses increased by \$9 million (10.6%). This is in addition to the \$85 million planned for the 2015-2017 biennium for snow and ice management, for a total of \$94 million. During significant winter weather events, crew time and material use typically increase rapidly, stressing the budget.

WSDOT has an agency maintenance backlog of approximately \$98 million per biennium. While funding has remained relatively consistent, it does not keep pace with new construction projects or increasing unavoidable costs such as electrical bills, stormwater assessments and other fees paid to local utility providers. This leads to deferring maintenance activities and reducing levels of service, making it more difficult for WSDOT to achieve performance targets. The agency evaluates task completion by comparing the number of tasks planned each year for a specific maintenance activity to how many of those tasks were completed. To see a table that shows the desired results as indicated by the level of service and the task completion percentage for selected assets, go to <http://bit.ly/MaintTaskComp>.

WSDOT meets 20 of 26 maintenance targets in 2017

The table on the next page shows maintenance activities, ordered from highest to lowest priority; Level of Service (LOS) scores; and funded levels, condition targets for WSDOT. LOS scores use a letter grading scale, with A being the highest and F being the lowest.

The following LOS activities—which were heavily affected by the long 2016-2017 winter as well as recruitment and retention issues—received letter grades below target levels:

- **Regulatory/Warning Sign Maintenance** missed its target of a C, receiving a D. This is a result of third-party damage along with allocated preservation funding failing to keep up with the demand. This contributes to a growing backlog.
- **Slope Repair Maintenance** missed its target of an A, receiving a B rating. This is primarily a result of natural disasters such as landslides, floods and excessive erosion.

WSDOT meets 77% of highway maintenance asset condition targets

2015-2017; Funded level asset condition targets and scores achieved

	Funded level (MAP LOS target)	2015 results	2016 results	2017 results
Special Bridges and Ferry Operations ¹	A	A	A	A
Traffic Signal System Operations	C	B	C	B
Snow and Ice Control Operations	A	A	A	A
Bridge Cleaning	B	B	B	B
Urban Tunnel System Operations	B	B	B	N/A ²
Regulatory/Warning Sign Maintenance	C	D	C	D
Intelligent Transportation Systems	A	A	B	A
Slope Repairs	A	B	A	B
Catch Basins and Inlets Maintenance	A	A	B	A
Barrier Maintenance	A	B	A	B
Pavement Striping Maintenance	B	A	B	A
Raised/Recessed Pavement Marking Maintenance	C	C	C	C
Vegetation Obstruction Control	C	C	A	C
Rest Area Operations	B	B	B	B
Sweeping and Cleaning	A	A	A	C
Highway Lighting Systems	A	B	B	C
Ditch Maintenance	B	B	A	B
Guidepost Maintenance	D	D	D	D
Stormwater Facility Maintenance	A	A	A	A
Culvert Maintenance	D	D	B	C
Pavement Marking Maintenance	D	D	C	F
Shoulder Maintenance	C	C	C	C
Noxious Weed Control	B	B	B	A
Guide Sign Maintenance	C	C	C	C
Nuisance Vegetation Control	D	C	D	C
Landscape Maintenance	D	D	C	C
Litter Pickup	D	D	D	D
Percent of targets achieved or exceeded		85%	93%	77%
Percent of targets missed		15%	7%	23%

Data source: WSDOT Maintenance Office.

Notes: The 27 maintenance activities are listed in prioritized order. Highlighted boxes indicate failing scores. Asset condition Level of Service (LOS) is affected by maintenance activity, rehabilitation/reconstruction of highway infrastructure, third party damage, disaster events and new construction projects. LOS assessments occur throughout the reporting year, and scores are based on the asset condition at the time of assessment.

¹ This activity now includes the Keller Ferry. ² Urban Tunnel Systems Operations is represented by the I-90 tunnel which was under construction during the reporting period and is not included in calculations of targets achieved; hence, a total of 26 maintenance activities were scored.

■ **Pavement Marking Maintenance** missed its target of a C, receiving an F rating. This work suffered due to the wet spring in much of the state and recruitment and retention issues on the pavement marking crews.

■ **Barrier Maintenance** missed its target of an A, receiving a B. This is primarily a result of the above-average amount of third-party damage.

■ **Sweeping and Cleaning** missed its target of an A, receiving a C. This is primarily a result of natural disasters.

■ **Highway Lighting Systems** missed its target of an A, receiving a C rating. WSDOT's goal is to perform preventative maintenance on one-quarter of the roadway light structures in the state each year. In 2017, this work was deferred when funds were redirected to address roadway safety tasks, resulting in an increase of lighting systems that require repairs.



Results WSDOT Goal PRACTICAL SOLUTIONS

WSDOT's Maintenance Office demonstrated Practical Solutions by converting roadway lighting systems to longer-lasting, more cost-effective LED lights and removing lights when they are no longer necessary.



A WSDOT maintenance crew applies chip seal on U.S. Route 395. Chip seal, or bituminous surface treatment, is a cost-effective method used to extend the life of roads.



A WSDOT maintenance crew performs emergency repairs on State Route 534 after a sinkhole damaged the highway.

Maintenance customer survey shows uptick in satisfaction with highway roadway surface, snow and ice removal

WSDOT conducted a maintenance customer service survey in 2017; the sixth in a series (1996, 2000, 2005, 2010, 2012 and 2017). Surveys are conducted over the telephone, with the exception of the 2010 survey which was web-based and had a low response rate.

The surveys are designed to evaluate customer satisfaction and obtain customer input regarding maintenance activities and public priorities. WSDOT uses the survey results to help prioritize and align investment decisions in the maintenance program. The full results of this survey can be found at <http://bit.ly/MaintenanceSurvey2017>.

WSDOT reviews the key findings of its 2017 customer survey

Customers were asked about their satisfaction with the current level of

overall highway maintenance as well as individual maintenance activities.

Seventy-three percent of the 750 survey respondents were generally satisfied with the level of overall highway maintenance, a slight decrease from 74% in the 2012 survey.

Respondents were also asked to rate highway maintenance conditions on a scale of very poor to excellent. Fifty-two percent of the respondents rated Washington's overall highway maintenance above average or excellent. Thirty-eight percent of respondents gave WSDOT an average rating. A small percentage rated overall highway maintenance as fairly poor (8%) or very poor (3%). Roadway surfaces are still the top improvement desired by 74% of respondents.

Survey shows customer satisfaction has improved since 2012

2005, 2012, 2017; Maintenance activities ranked by importance; Percent of customers satisfied

	Maintenance activity	2005	2012	2017
1	Roadway Surfaces	76%	64%	72%
2	Road Stripes and Pavement Markers	78%	71%	80%
3	Drainage Features	79%	75%	80%
4	Snow and Ice Removal	71%	78%	86%
5	Roadway Signs	91%	90%	95%
6	Roadside Litter Removal	74%	77%	78%
7	Guardrail	88%	90%	89%
8	Traffic Signals	77%	85%	92%
9	Highway Lighting	76%	80%	87%
10	Rest Areas	73%	86%	87%
11	Roadside Vegetation	70%	75%	83%

Data source: WSDOT Maintenance Office.
Note: The 2010 survey results are not used for comparison because it was the only survey conducted via the internet instead of via telephone, resulting in a much lower response rate.

WSDOT maintenance emergency response rating improves in 2017

In general, customers' opinions of highway maintenance crew emergency response are extremely positive and have improved since 2012 (see graphs at right). Ninety-seven percent rate the agency as average or better. The percentage of respondents rating the agency as "excellent" have increased from 19% to 29% since 2012.

Highway Activities Tracking System big help at WSDOT

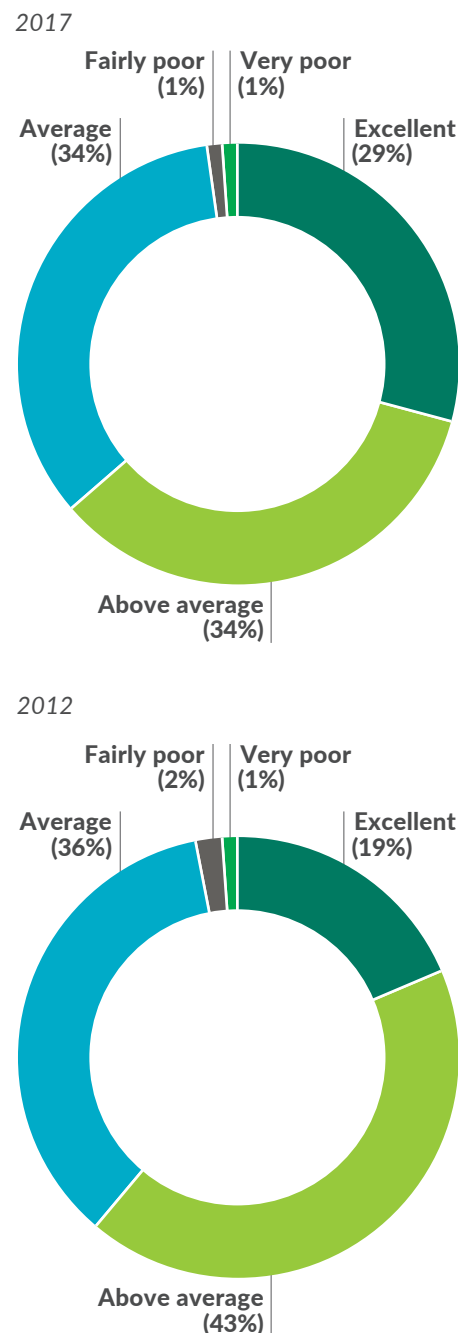
WSDOT continues to develop and enhance the Highway Activities Tracking System (HATS). HATS is a tool that documents work activities in the field through the use of 1,200 mobile devices now in service and used by frontline maintenance staff each day. Since the launch of HATS in 2008, and a major update in 2015, the agency has developed a clearer understanding of the condition of assets in the field, along with tasks performed. The system helps manage the funding the department receives each biennium.

In 2017, maintenance technicians added 30,788 assets to inventory and compiled approximately 188,000 records of work activities. Employees are averaging over 500 HATS record entries per day, a 40% increase from 2016.

A recent update to the HATS application includes a feature that allows planning of recurring work activities. These tasks are set by the agency on planned cycles, such as annual cable barrier inspections. Because of this change, users at all levels can now track progress and plan work in a more efficient and effective manner. An additional component of this is the "Feature Activity Coverage Dashboard." Users visually track their work completion in real-time using this tool.

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Customers give high marks to state highway emergency responses



Data: WSDOT Maintenance Office.

Note: Percentages are rounded and may not equal 100% as a result.