Oregon Department of Transportation

2018 BRIDGE CONDITION REPORT & TUNNEL DATA

Bridge Section | Oregon Department of Transportation

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2018 BRIDGE CONDITION REPORT & TUNNEL DATA

Editing and Data Analysis by Liz Hunt
Bridge Project Data by Rachelle Nelson
Major Bridge Maintenace Program Data by Travis Kinney
Data Analysis by Corey Withroe
Maps by Corey Withroe and Geographic Information Services Unit
Photos courtesy of Flickr, ODOT Photo Services or as noted
Publication Design by Chittirat Amawattana

TABLE OF CONTENTS

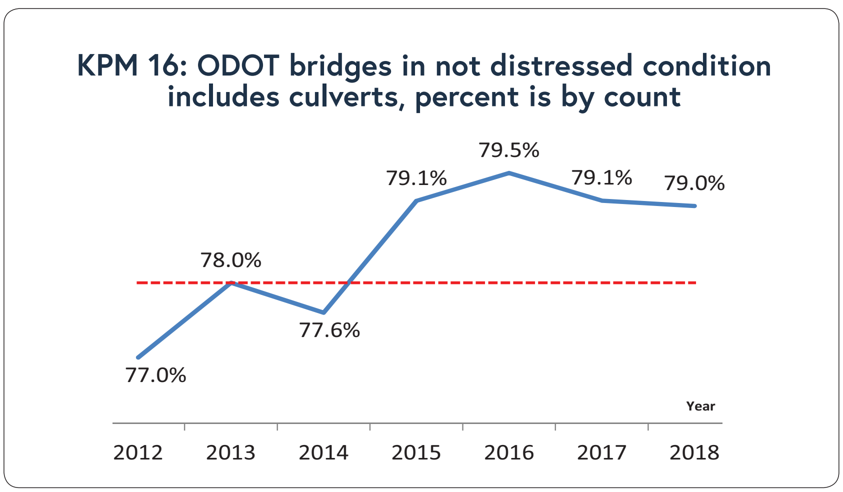



EXECUTIVE SUMMARY

Maintaining bridges in good condition is critical to Oregon's economy and to preserving safe and reliable travel. The increased funding from HB 2017 will help address deteriorating bridges, especially on major state highways, that could impede mobility or force trucks to detour.

This year's Bridge Condition Report details five Bridge Program Updates including 2021-2024 STIP development, Major Bridge Maintenance accomplishments, Bridge Preservation highlights, Seismic Program status, and an on-going Bridge Deck Study with a focus on chlorides. The condition data is based on the April 2018 submittal provided annually to the Federal Highway Administration.

Overall, there was a slight decrease in KPM 16. While gains were made addressing substandard rail, declines were noted in painting conditions and low service life which can be attributed to the aging bridge population.



ODOT bridges Not Distressed condition. Larger percentages are better.

National Performance Measure

The Moving Ahead for Progress in the 21st Century Act (MAP-21) requires states to establish bridge condition targets and report conditions based on specified performance measures for the National Highway System (NHS) including:

Percent of NHS bridges by deck area classified in Good condition

Percent of NHS bridges by deck area classified in Poor condition.

Currently 12.7% of NHS bridges are in good condition, 1.9% are in poor condition, and 85.4% are in fair condition. With so many bridges in fair condition on the cusp of becoming poor, maintaining bridge conditions in the future will be challenging.

Bridge Program Updates

Five bridge program updates are presented to provide an overview of the on-going tasks associated with maintaining and preserving ODOT's bridge infrastructure.

2021-2024 STIP Development

The development of the 2021-2024 STIP began the summer of 2017 when the Oregon Transportation Commission started discussing the program funding allocations which were decided upon in December 2017. In order to stay on track, the Bridge Section initiated their project selection in the fall of 2017, finalizing the 150% list project costs totaling about 150% of the anticipated allocation in June 2018. A final 100% Draft STIP list is expected in July 2019.

STIP development for bridge projects requires many steps to determine the scope and estimated cost of a project. After the bridge inspection data is queried for needs and prioritized, a desk scope is developed based on office information. The desk scope is used by the Regions to initiate an on-site or field scope based on more detailed information and input from other specialists around items like traffic control and environmental impacts. Once a field scope is refined, a final estimate is developed. The field scope and estimates are then evaluated at the Bridge Program level and pared down to match the available funding.

Major Bridge Maintenance (MBM)

The variety and volume of work performed by the Major Bridge Maintenance (MBM) program makes it a key component in maintaining Oregon's infrastructure. Accomplishments for 2017 include addressing 24 urgent bridge maintenance needs, 107 deck treatments and several other projects associated with movable bridge repairs, problematic joints, deteriorated timber elements, etc.

MBM projects can have a significant impact on the overall bridge condition rating, because the worst detail on the bridge is normally corrected. Often these repair projects can actually raise a bridge out of Structurally Deficient classification. However, this rise in condition is only temporary as the bridge will continue to deteriorate. These repair projects aren't intended to rehabilitate the entire structure, but rather just address the defects that must be corrected.

The repaired portions of a structure also tend to have a higher rate of deterioration. Bridge repair projects can be due to poor details in the original structure. Repairing the damage due to these details is challenging because the poor detail will usually remain after the repair is complete. The Harrison Boulevard Bridge in Corvallis is a good example of a bridge with poor details that generates repeated repairs.

> "CONDITION IMPROVEMENTS AS A RESULT OF MBM REPAIRS ARE ONLY TEMPORARY."

Bridge Preservation

ODOT is responsible for more than 370 painted steel bridges with over 27 million square feet of surface area. Painting steel bridges (applying a protective coating) is vital to preserving and extending the service life of the state's bridge system. Timely applications of protective coatings prevent steel corrosion and any subsequent structural capacity loss.

On average, the ODOT Bridge Program paints two bridges every year. However, in the next five years, ODOT plans to more than double that rate with painting an average of five bridges and over 750,000 square feet of steel every year. At this rate, the painting will keep up with the rate of corrosion and also reduce the inventory of bridge painting needs.

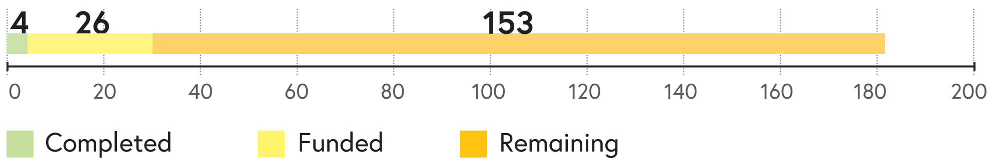
Seismic Bridge Program

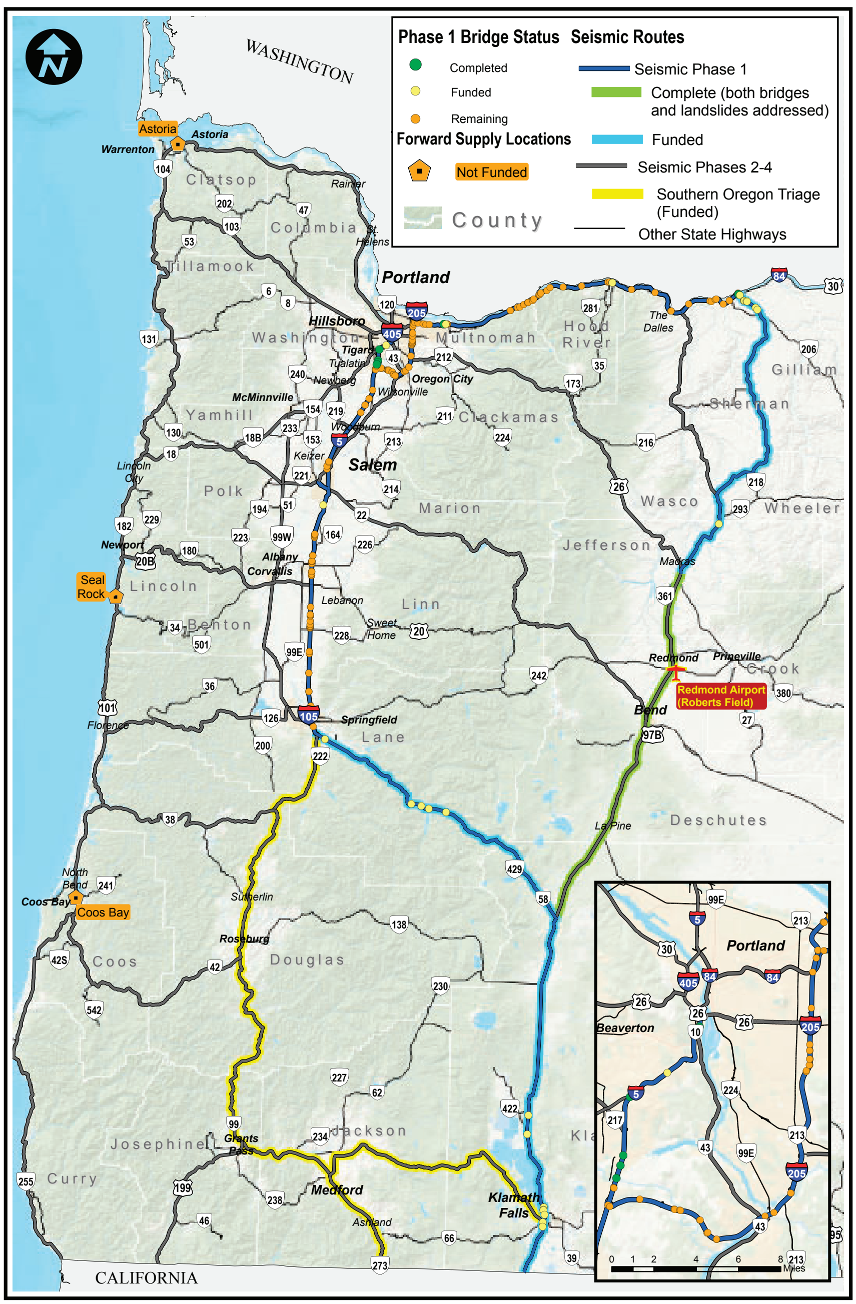
Additional funding to address seismic improvements related to highways and bridges is included with the recently passed HB 2017 transportation package, HB 2017. With the new funds, ODOT plans to work on Phase 1 bridges moving from Eugene, north on I-5 and finishing up on I-84 moving from east to west in 20 to 30 years. Projects are currently being scoped for seismic work on I-5 near Eugene for the 2021-2024 STIP.

ODOT Phase 1 Seismic Routes

Phase 1 Bridges Remaining:

Estimated Cost $600 M





HB 2017 provided funding for an additional seismic project entitled the Southern Oregon Triage strategy. The strategy focuses on mitigating seismic impacts along Interstate 5 south of Eugene, and OR 140 which are key lifeline routes to and from the Rogue Valley. The project is now officially underway with funding of $35M to provide seismic upgrades to 17 bridges and seven hillside slopes.

Further seismic efforts are underway with the Bridge Seismic Standards Engineer and other ODOT leadership working collaboratively with Oregon counties to develop planning reports documenting county routes and priorities for seismic resiliency. ODOT provides bridge data and technical support and the counties provide information about their network. While the information is useful for county planning, a comparison can be made to the state seismic bridge priorities to determine possible highway detour routes that may be more cost effective to seismically retrofit or replace.

> "ODOT IS COLLABORATING WITH WESTERN COUNTIES TO PRIORITIZE COUNTY SEISMIC RESILIENCY ROUTES."

Bridge Deck Study

In a November 2017 report detailing the ODOT Winter Salt Pilot Project, ODOT determined that salt can be used effectively in maintaining roads, achieving little to no packed snow and ice resulting in reduced crashes and improved mobility. Understanding the impact of salt on the infrastructure, including bridges, requires continuous investigation to ensure ODOT is managing the highway system in a safe and cost effective way while protecting the environment and infrastructure.

The Bridge Section has initiated deck testing to determine the extent of salt (chloride) contents present in critical locations. The key is to identify bridge decks without chloride contamination in order to make use of thin treatments to prevent damage and to better understand the potential needs for damaged decks from a program level.

Tunnels

Tunnel conditions this year are based on the new National Tunnel Inspection Standards (NTIS). For the eleven ODOT managed tunnels:

- **7** are in Good Condition
- **3** are in Fair Condition
- **1** is closed following the Eagle Creek Fire

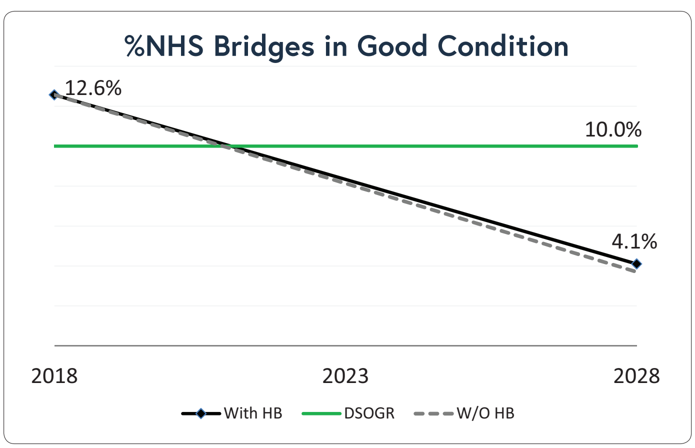
Oregon Bridge Condition Projections: 2018 to 2028

An analysis was done as part of the ODOT Transportation Asset Management Plan (TAMP) to project bridge conditions in ten years for three funding scenarios:

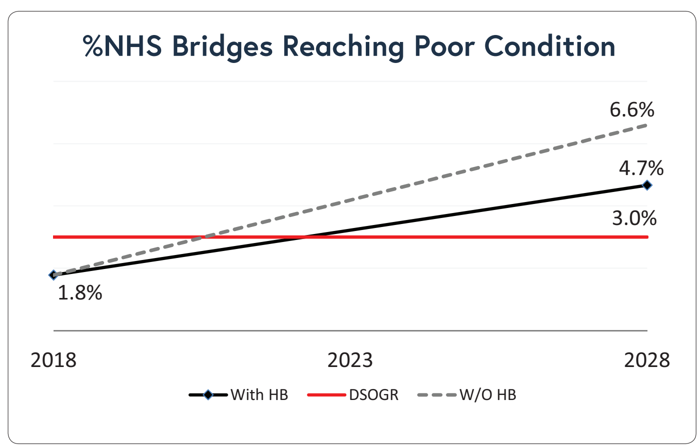
PROJECTIONS		
• Percent NHS bridges in good condition • Percent NHS bridges in poor condition • KPM 16 (percent not distressed) all ODOT bridges	$85M/year	Pre-HB 2017 funding levels
	$122M/year	HB 2017 funding levels, includes seismic funding
	$350M/year	Desired State of Good Repair funding (DSOGR) based on OTC 2017 investment strategy

The percentage of bridges in good condition will continue to decline even with the new HB funding. By 2021 the percentage is predicted to dip below the desired state of good repair (DSOGR), which has been established to be 10% based on an assessment of the level of funding allocated to preservation of bridges in good condition.

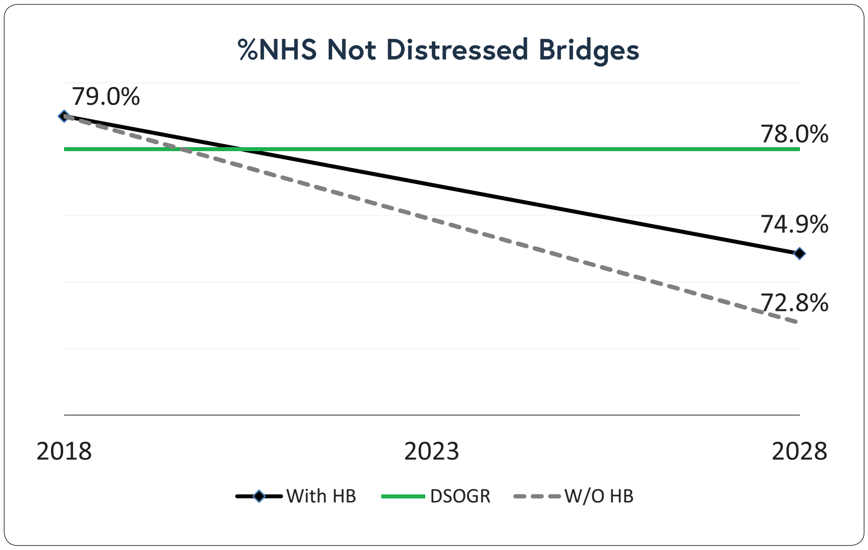
Projections for bridges becoming poor show a steady increase in the next ten years. However, the HB 2017 funding is projected to slow the decline. By 2020-2021 the percentage is predicted to rise above the DSOGR, which has been established at 3% based on an assessment of ODOT's ability to respond quickly to the anticipated resulting critical and urgent bridge needs at that level of poor condition.



Projected good conditions for NHS bridges.



Projected pood conditions for NHS bridges.



Projected Not Distressed bridges (KPM 16) for all state owned bridges.

The HB funding is expected to slow the decline of the % Not Distressed for the ODOT bridge population; however, the decline will continue. The decline is primarily due to the aging bridge system and a long history of underfunding in the Bridge Program that precluded systematic replacement of deteriorated bridges, which is captured in the KPM as Low Service Life and also in bridge conditions with more bridges projected to become structurally deficient.

ABBREVIATIONS AND DEFINITIONS

Distressed Bridge – A bridge condition rating used by the Oregon Department of Transportation to indicate that the bridge has been identified as either structurally deficient or as having other deficiencies. A classification of "distressed bridge" does not imply that the bridge is unsafe.

Functionally Obsolete (FO) – A bridge assessment rating used by the Federal Highway Administration to indicate that a bridge does not meet current (primarily geometric) standards. The rating is based on bridge inspection appraisal ratings. Functionally obsolete bridges are those that do not have adequate lane widths, shoulder widths, vertical clearances, or design loads to serve traffic demand. This definition also includes bridges that may be occasionally flooded.

Key Performance Measure (KPM) – A measure used to evaluate the progress of an organization in managing to a particular goal.

Major Bridge Maintenance (MBM) – One of three funding approaches the Bridge Program uses to manage the bridge system. The MBM program typically addresses smaller scale bridge preservation needs and emergency bridge repairs that are outside the scope of work that can be accomplished by an ODOT District.

National Bridge Inventory (NBI) – The aggregation of structure inventory and appraisal data collected to fulfill the requirements of the federal National Bridge Inspection Standards (NBIS).

National Bridge Inspection Standards (NBIS) – Federal regulations establishing requirements for inspection procedures, frequency of inspections, qualifications of personnel, inspection reports, and preparation and maintenance of a state bridge inventory. The NBIS apply to all structures defined as bridges located on all public roads

National Highway System (NHS) – The National Highway System comprises approximately 225,000 miles of roadway nationwide, including the Interstate Highway System as well as other roads designated as important to the nation's economy, defense, and intermodal mobility. The NHS was developed by the United States Department of Transportation in cooperation with the states, local officials and metropolitan planning organizations. Congress approved the NHS in 1994. National Tunnel Inspection Standards (NTIS) – Federal Highway Administration guidelines for the inventory, inspection and load rating of tunnels.

Non-National Highway System (NNHS) – Routes not designated as part of the NHS.

Other Deficiencies (OD) – A bridge condition rating used by the Oregon Department of Transportation to indicate that a bridge has identified needs in one or more of nine factors and is a candidate for repair or replacement. This condition rating is specifically designed to address specific bridge needs such as freight mobility, deterioration, serviceability, and safety. A classification of "other deficiencies" does not imply that the bridge is unsafe.

Types of ODs include:
- **Rail = Bridge Rail**
- **LC = Load Capacity**
- **LSL = Low Service Life**
- **MB = Movable Bridge**
- **DG = Other Geometric Clearances (Deck Geometry)**
- **Paint = Paint**
- **Scour = Scour**
- **TS = Timber Structures (Substructure)**
- **VC = Vertical Clearance**

Scour Critical Bridge – A scour critical bridge is one with an abutment or pier foundation rated as unstable due to (1) observed scour at the bridge site or (2) a scour potential as determined by an engineering scour evaluation study.

State Transportation Improvement Program (STIP) – Oregon's four-year transportation capital improvement program. The STIP document identifies the funding for, and scheduling of, transportation projects and programs.

Structure Condition Abbreviations –
- **VG = Very Good**
- **GD = Good**
- **FR = Fair**
- **PR = Poor**
- **VP = Very Poor**

Structurally Deficient (SD) – A bridge condition rating used by the Federal Highway Administration to indicate deteriorated physical conditions of the bridge's structural elements (primarily deck, superstructure, and substructure) and reduced load capacity. Some of these bridges are posted and may require trucks of a certain weight to detour.

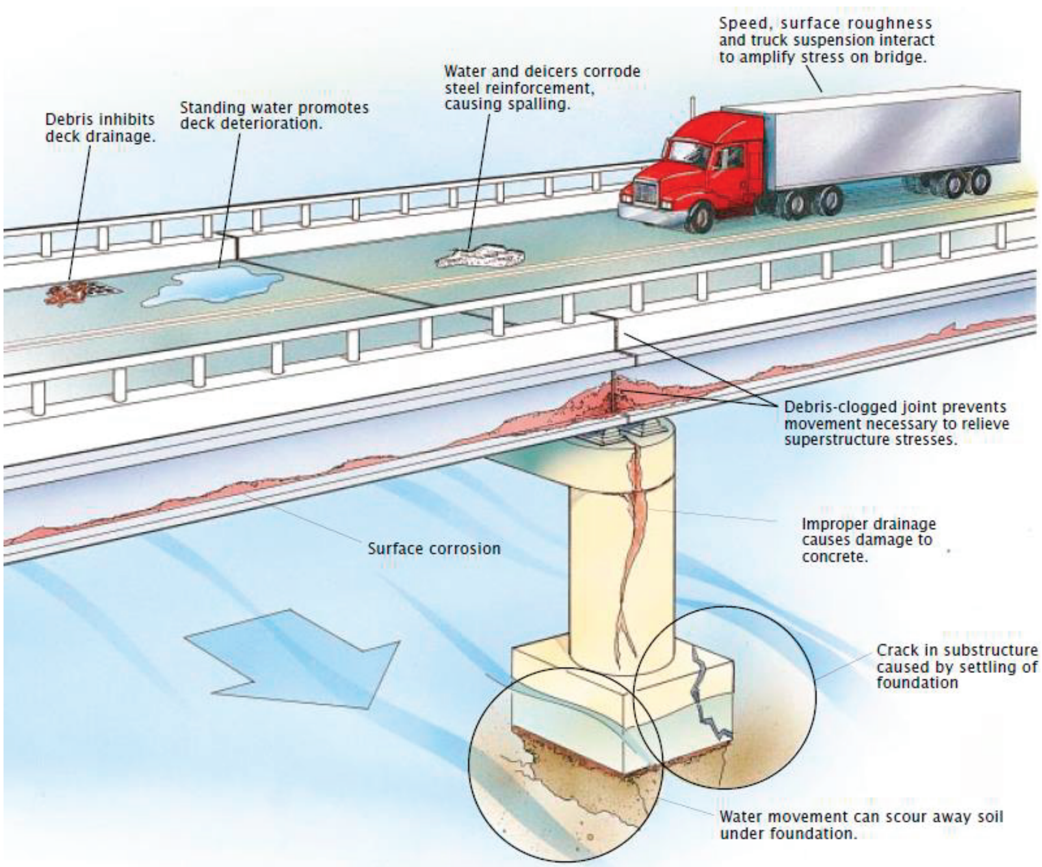
A classification of "structurally deficient" does not imply that bridges are unsafe. When an inspection reveals a safety problem, the bridge is posted for reduced loads, scheduled for repairs, or in unusual situations, closed until repairs can be completed. Structural deficiency is one of the many factors that are used in the ODOT State Bridge Program for project ranking or selection.

BRIDGES 101

General Deterioration Factors

Experience has shown that bridge deterioration is dependent on complex interactions of multiple factors as shown.

Extreme events (earthquakes, flooding, vehicle impacts) are another cause of bridge distress not considered as general deterioration, but result in the need for quick response and investment to restore mobility.

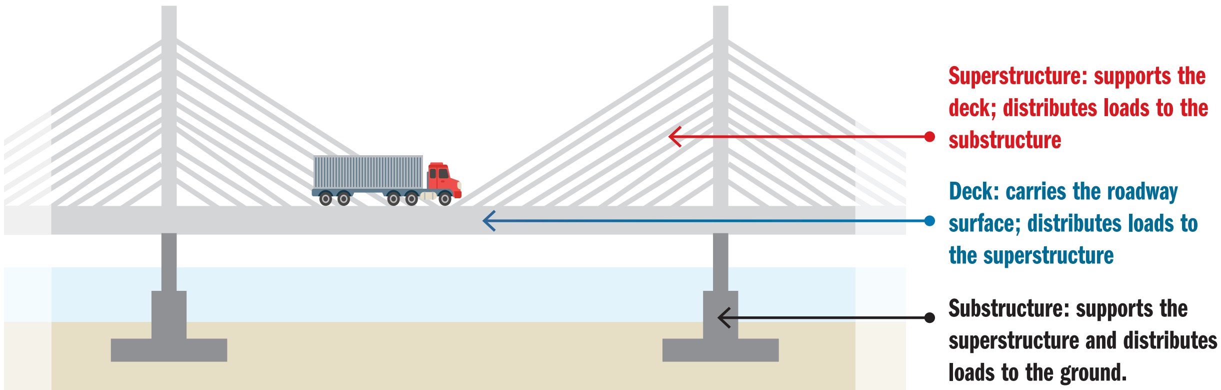


Adapted from "Why America's Bridges are Crumbling," by K.F. Dunker and B. G. Rabbat, 1993, March, Scientific American, 268, no. 3, p. 69. Permission for use courtesy of Jana Brenning, illustrator.

Bridge Condition Ratings

Bridge conditions are categorized by evaluating bridge components (deck, superstructure, and substructure) as shown in the graphic.

National bridge inspection standards (NBIS) were established in 1968 to monitor existing bridge performance to ensure the safety of the traveling public. The NBIS regulations apply to all publicly owned highway bridges longer than twenty feet located on public roads. To comply with the NBIS and assess bridge conditions, ODOT manages a statewide bridge inspection program that includes both routine and specialized inspections. Bridge condition ratings are described on the next page.



The NBI ratings provide simple tools for agencies to describe the overall conditions of their bridge populations and the overall effectiveness of their bridge programs. The critical rating is when a highway bridge is classified as **structurally deficient (SD).**

NBI Component
- Deck
- Superstructure
- Substructure
- Culvert Rating (if applicable)

NBI Rating
Lowest Condition NBI Rating of All Components (Scale =0-9)

Condition Rating Description
8-9: Very Good Condition
7: Good Condition
5-6: Fair Condition
4: Poor Condition
≤ 3: Very Poor Condition

Bridge condition rating description.

Beginning in 2018, a bridge is classified as structurally deficient only if any component (deck, superstructure, substructure) has an NBI rating of 4 or less. Previously load capacity and hydraulic opening below the bridge could result in an SD classification.

Maintenance Needs and Cost Impacts

Keeping a bridge in fair to good condition requires routine inspections, proactive maintenance and preservation treatments. Examples of proactive maintenance are:

- Sealing or replacing leaking joints to minimize the deterioration of superstructure and substructure elements beneath the joints;
- Painting/coating or overcoating structural steel to protect against corrosion;
- Installing scour countermeasures to protect the substructure from undermining and failure due to scour below the bridge.

Timing is critical when performing the work since the longer the deterioration occurs, the more extensive/expensive the required treatment.

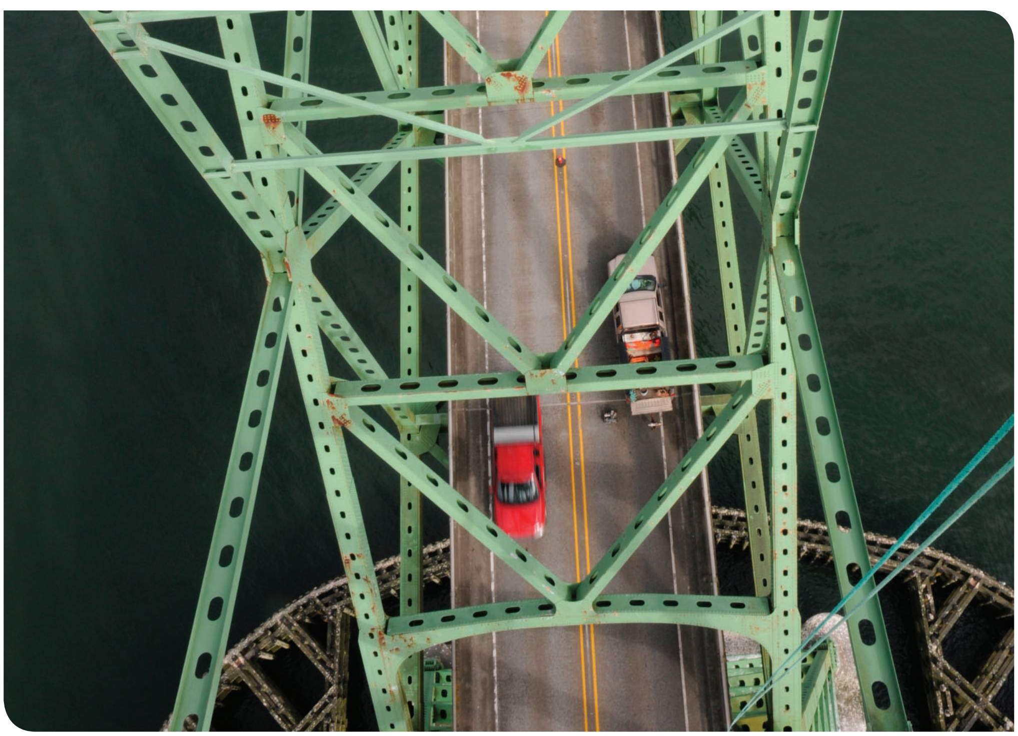
2018 BRIDGE CONDITIONS

ODOT's 2018 Bridge Condition Report summarizes bridge condition ratings on state highways and performance measures based on National Bridge Inventory and ODOT data. As a consistent reference point for evaluation, ODOT uses the bridge conditions snapshot provided annually to the Federal Highway Administration. Data from the April 2018 submittal is the basis of this report.

Bridge conditions are reported in a number of different measures, none of which stands alone in the communication of bridge condition for decision making purposes. The most common and those presented here, are the NBI ratings for the three major structural components of the bridge (deck, superstructure, and substructure, or the culvert rating), deficient bridge classification, and structural condition rating.

The structural condition rating ranging from 'Very Good' to 'Very Poor' is based on the lowest of the deck, superstructure, substructure, or culvert ratings.

> "THE MAJORITY OF THE 2,737 BRIDGES THAT ODOT MANAGES ARE IN FAIR CONDITION."



Inventory Changes

ODOT currently manages 2,737 bridges. This year, in comparison to 2017, the inventory decreased by five bridges due to the following changes:

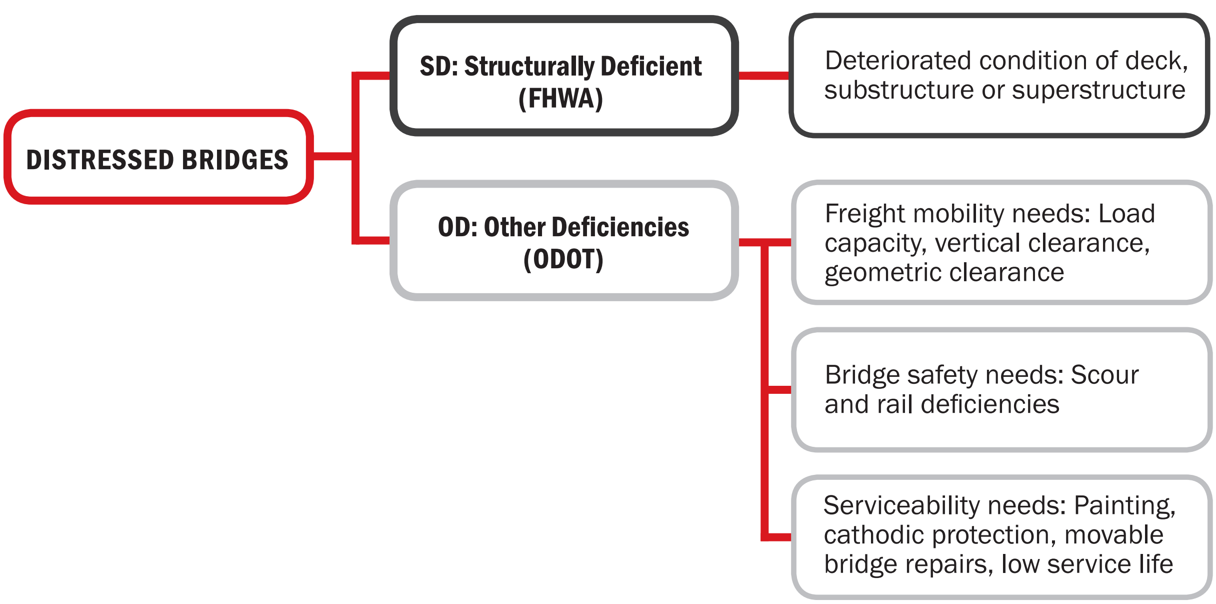
- **8** Bridges were removed due to updated jurisdiction information
- **2** Bridges that were 97 years old were replaced with 2 new bridges
- **2** Bridges were replaced with 1 new bridge as part of a modernization project
- **3** New bridges were added for modernization
- **1** New bridge was added as a replacement for a non-NBI culvert

Key Performance Measure 16 (Percent of Bridges Not Distressed)

ODOT measures bridge conditions based on Key Performance Measure (KPM) 16 – Percent of Bridges Not Distressed (%ND). KPM 16 includes two categories of bridges: 1) the percent of bridges not SD as defined by FHWA and 2) the percent of bridges without other deficiencies (OD) as defined by ODOT. SD and OD components capture different characteristics of bridge conditions as shown.

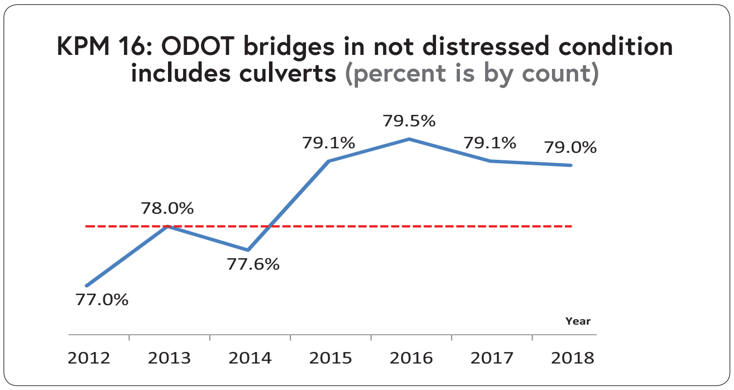
A condition of distressed indicates that the bridge is rated as SD or has at least one OD. ODOT considers both SD and OD aspects in determining bridge needs and selecting projects for the statewide Transportation Improvement Program (STIP).

> "ODOT ADDED SEVEN NEW BRIDGES TO THE INVENTORY IN 2018 – ONLY TWO AS A RESULT OF DETERIORATING CONDITION."



Characteristics of distressed bridges.

For 2018, KPM 16 equals 79.0% indicating a 0.1% drop from 2017 exceeding the target of 78%. While the KPM indicates that bridge conditions are generally holding steady, the small change can be attributed in part to an update in the data to reflect rail retrofits and replacements on 17 bridges. The Bridge Program sets aside about $1,500,000 annually to address substandard bridge rail across the state. Significant progress has been made and will continue increasing safety for the traveling public.

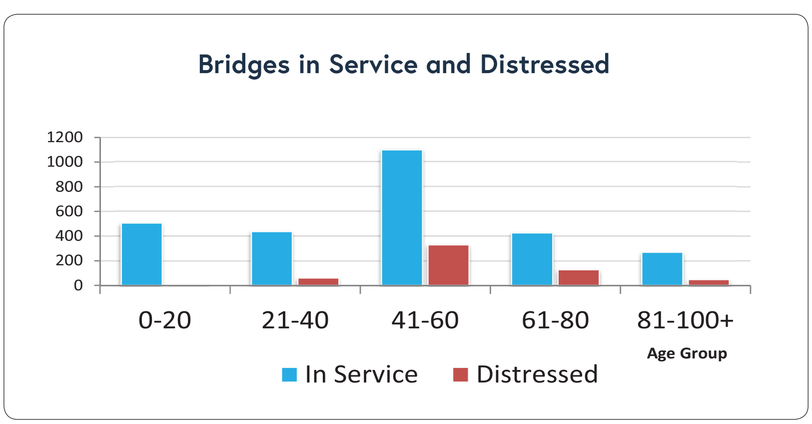


ODOT bridges Not Distressed condition. Larger percentages are better.

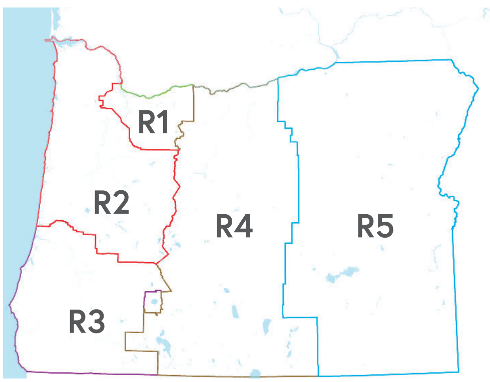
> **"CURRENT EVALUATIONS INDICATE A SLIGHT DECLINE IN THE PERCENT NOT DISTRESSED BRIDGES."**

While gains were made addressing rail, declines were noted in painting conditions and low service life. Note that cathodic protection(CP) was dropped as a distress as it does not impact program management. All of the bridges with CP as a distress had other distresses so the change did not impact the overall KPM.

The population of bridges in service and distressed is shown below for five age groups. The largest number of in service bridges is 41-60 years old (built between 1958 and 1977) which corresponds with the largest number of distressed bridges. The predominant distresses in the 41-60 year old bridges are low service life and other geometric clearances. The low service life is based on the structural adequacy and serviceability of the bridge and the other geometric clearances is based on the bridge dimensions and the average daily traffic. Both distresses represent the aging infrastructure and in many cases a lack of major bridge rehabilitation work.

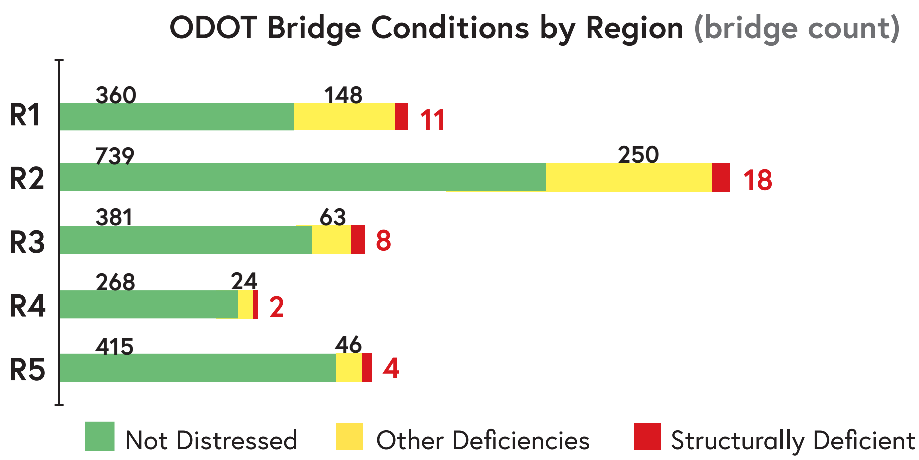


ODOT Distressed bridge by age group.

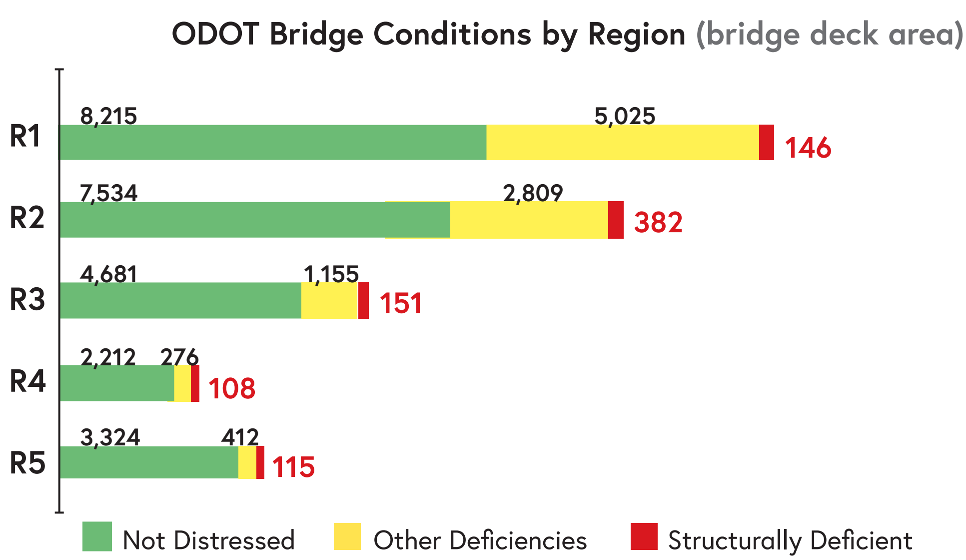


Bridge Conditions By Region

The distribution of bridge conditions by ODOT Region is presented below. Region 2 which includes a large portion of the Willamette Valley, major coastal and high elevation bridges has the greatest number of distressed structures in Oregon. Of the 268 distressed bridges in Region 2, 53 are timber bridges requiring frequent maintenance and Major Bridge Maintenance funding. The second chart includes the percent of the total state deck area in not distressed or distressed condition. Region 1 which includes the Portland area has the largest amount of deck area in Oregon and the largest amount of distressed bridges by deck area.



ODOT bridge conditions by by count.

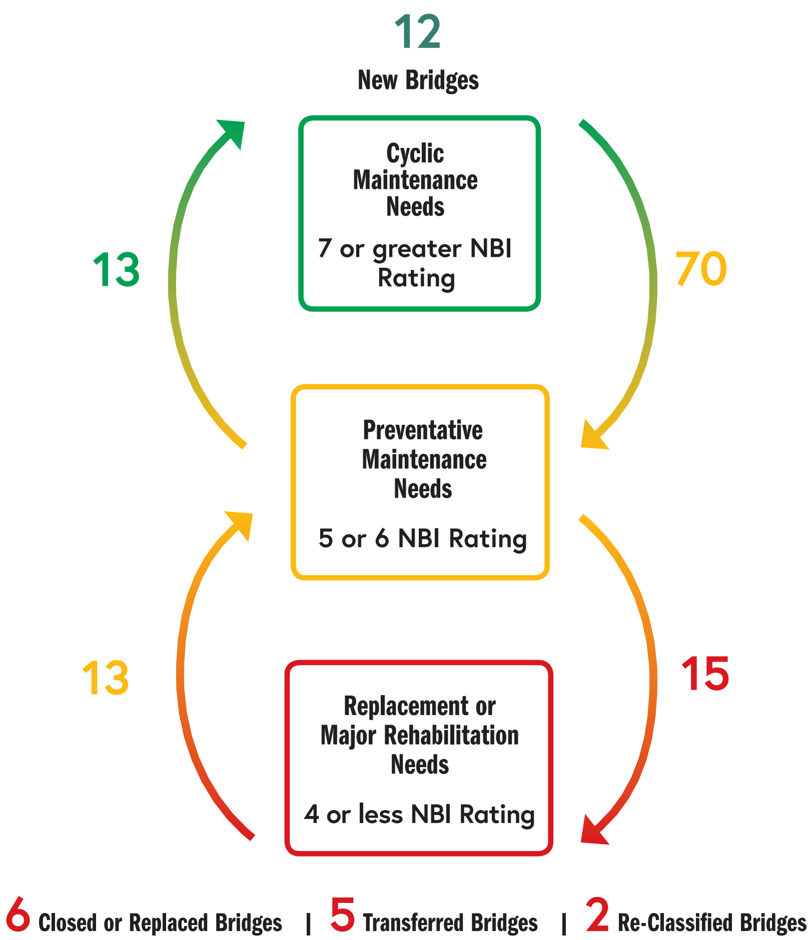


ODOT bridge conditions by 1,000 square feet of deck. Note that Region 1, which includes the Portland Metro area, includes the greatest quantity by bridge deck area.

2016-2018 Changes In Condition Ratings

The chart below shows both the dynamic nature of bridge conditions and the growing backlog of work, for those bridges that have changed conditions. The period from 2016 to 2018 reflects bridge conditions over one full inspection cycle (24 months). In a balanced state, the number of bridges moving from green to yellow and red (deteriorating conditions) would be equal to the number moving from red to yellow and green (improving conditions).

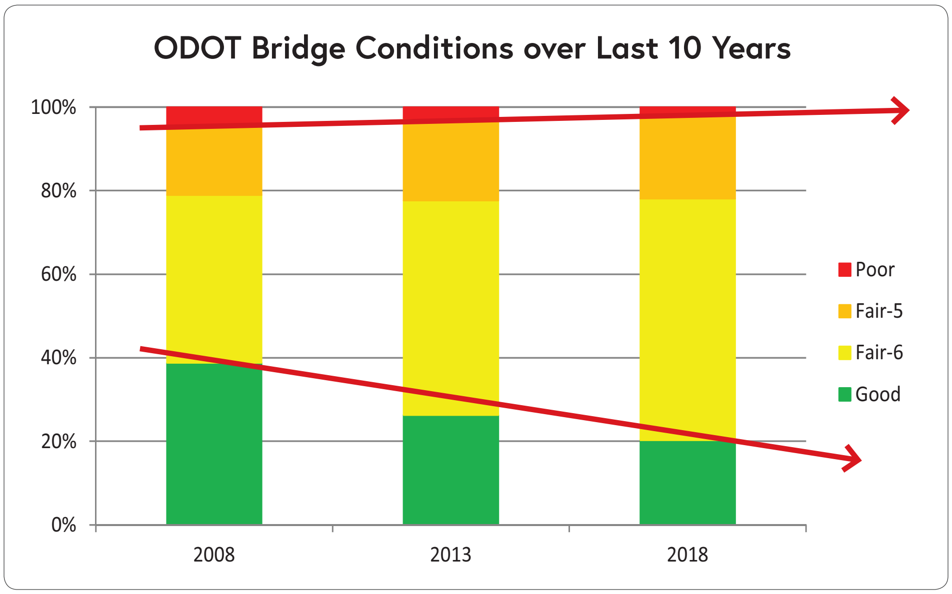
The chart shows that we are managing the Poor (Red) bridges reasonably well, but the transition of bridges from Good (Green) to Fair (Yellow), indicates that bridge preventative maintenance actions are not occurring at a rate necessary to maintain current conditions. Totals reflect two-year counts based on comparison of 2016 and 2018 snapshots.



2016-2018 Changes in minimum ratings of superstructure, substructure, or deck condition ratings.

Condition Changes Over The Last 10 Years

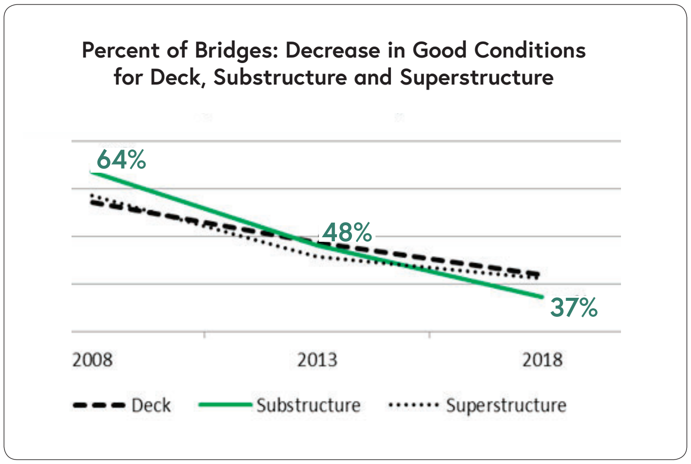
An overall assessment of bridge condition changes can be determined by comparing previous to current NBI ratings. The chart below provides the percentage of bridges in good, fair and poor condition in the last ten years. Bridges are classified as fair if the NBI value is 5 or 6, however, a value of NBI=5 indicates more distress. Of concern is the increasing number of bridges moving out of good condition into fair condition and the slightly increasing number of bridges in fair (NBI=5) condition which are the bridges most at risk of becoming structurally deficient.



Bridge conditions over last 10 years.

A further comparison was done based on the deck, superstructure, and substructure conditions for the majority of bridges over the last ten years. To provide a comparative analysis, only bridges with complete inspection data available were used. The remaining number of bridges for comparison was 2,352 or 86% of the bridges now in service.

The analysis focused on the change in good conditions over time. The data indicates that substructure good ratings have been decreasing (generally to fair condition) more rapidly than deck or superstructures. Reasons for the decrease in good substructure ratings can be attributed to the aging bridge population and the lack of preventative maintenance options for substructures.

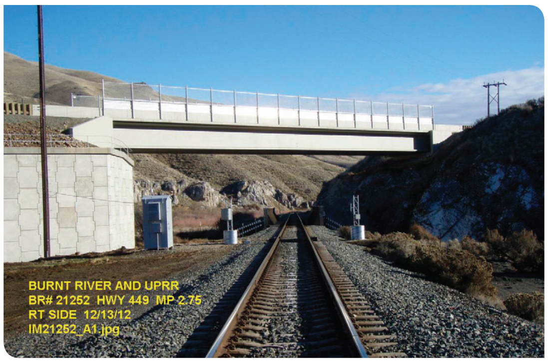


While a bridge substructure deteriorating from good to fair condition is not a major concern at this time, as substructure conditions continue to decline it becomes more problematic. Replacing a deck or strengthening the superstructure can be done multiple times, however, if a substructure deteriorates from fair to poor the most cost effective treatment is generally replacement.

NATIONAL BRIDGE PERFORMANCE MEASURE

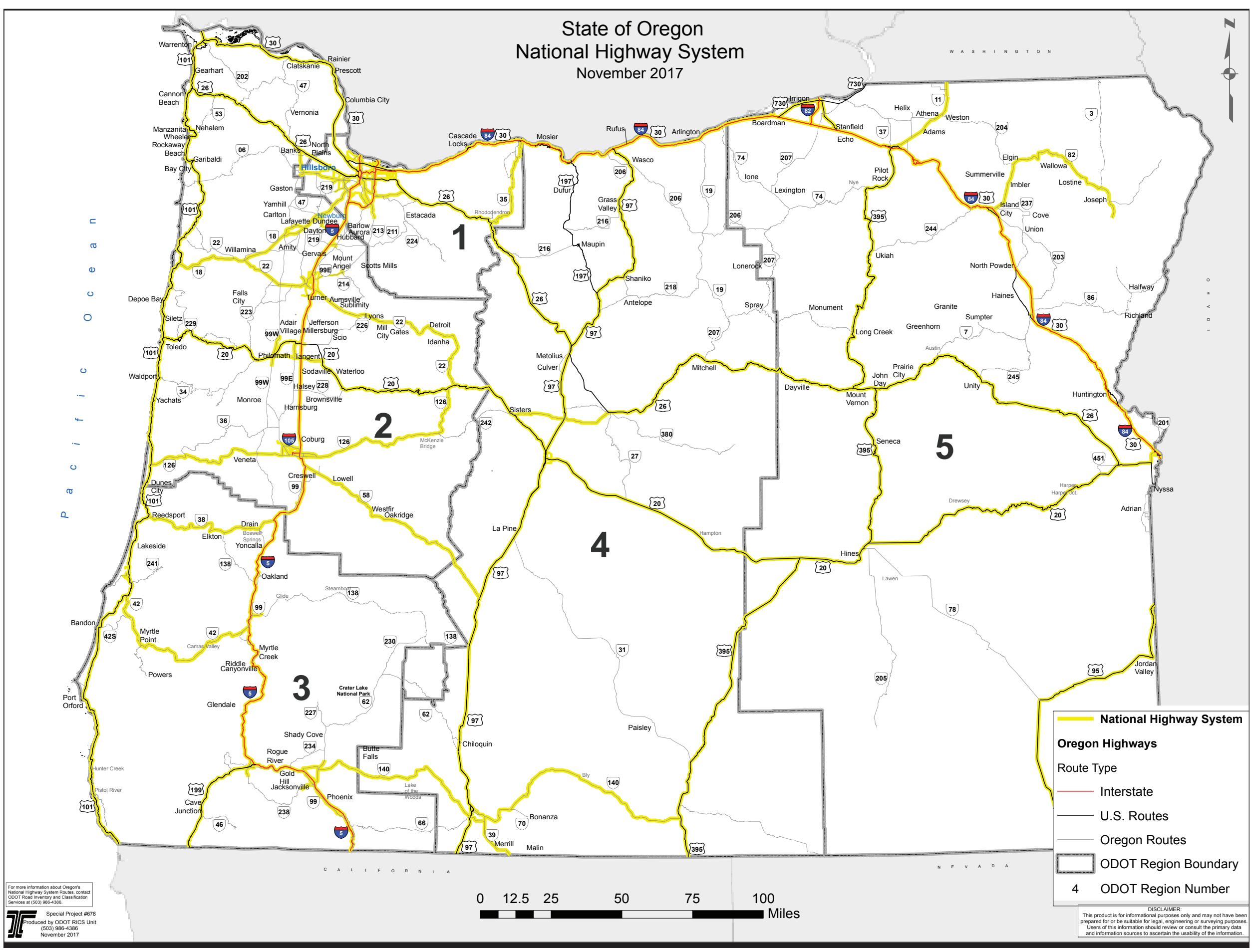
Condition Based Performance

The Moving Ahead for Progress in the 21st Century Act (MAP-21) requires states to establish bridge condition targets and report conditions based on specified performance measures including:



1. Percent of NHS bridges by deck area classified as in Good condition

2. Percent of NHS bridges by deck area classified as in Poor condition

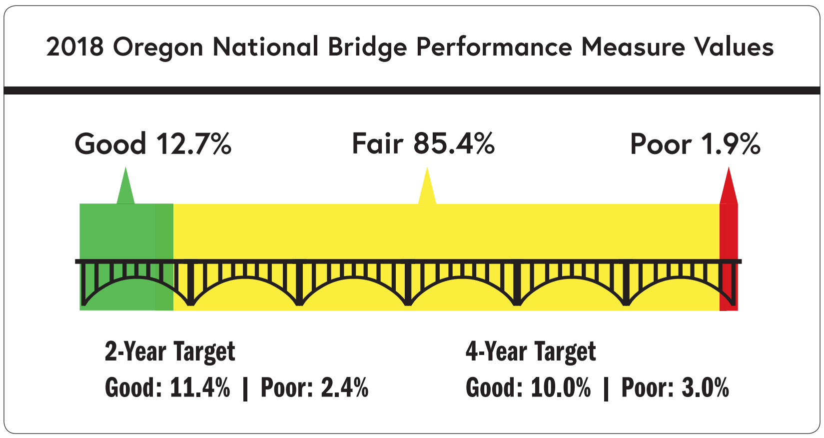


National Highway System

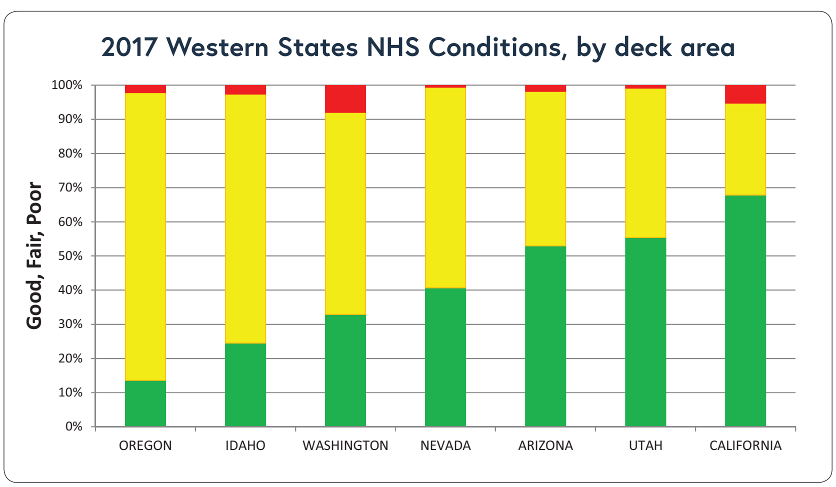
National Bridge Performance Measure Details

Oregon is required to develop condition targets determined from asset management analyses and procedures that reflect investment strategies that work toward achieving a state of good repair over the life cycle of assets at minimum practicable cost. Penalties are assessed if for 3 consecutive years more than 10.0% of a state DOT's NHS bridges are classified as poor.

Oregon expects to be able to maintain bridge conditions and not exceed the 10% threshold in the near future. However, with so many bridges in fair condition on the cusp of becoming poor, maintaining bridge conditions in the future will be challenging. Oregon's NHS bridge conditions and 2 and 4 year targets are shown below.



For perspective, a comparison of the Northwest states' NHS bridge conditions was developed using 2017 data submitted to FHWA. While Oregon ranks among the best in the least amount of poor bridge conditions, it includes the smallest percentage of bridges in good condition as a result of few bridge replacements.



The NPM does not include penalties around the percent of good condition bridges, it does recognize the importance of having a range of bridge conditions in the statewide inventory providing a balanced approach to managing the bridge system.

MAKING AN OLD BRIDGE NEW AGAIN

The Mosier Creek Bridge was designed by the Oregon Highway Department under Conde McCullough and built in 1920. The bridge is considered a premier historic bridge and a National Historic Landmark located on the Historic Columbia River Highway in Mosier.

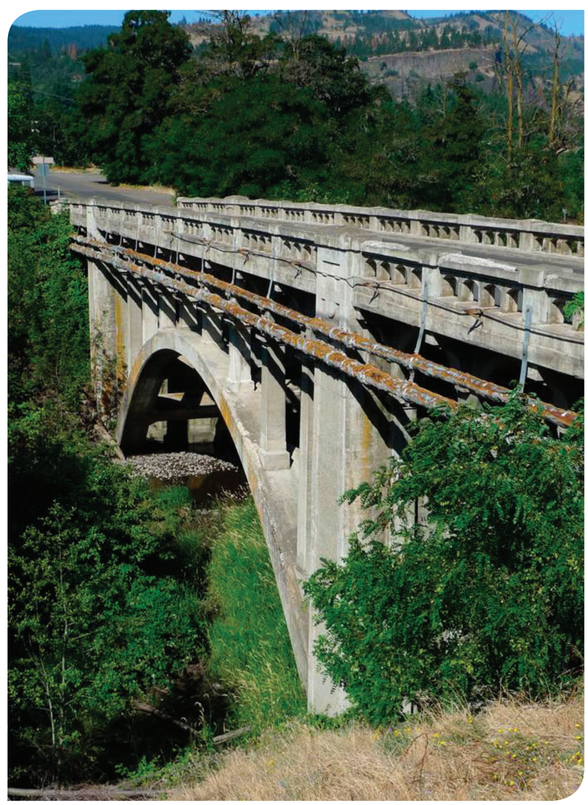
Over the years, the concrete deteriorated and the bridge columns required significant repairs. In addition, the utility line was shedding asbestos insulation and the narrow roadway did not accommodate pedestrian traffic. A project was initiated to rehabilitate the bridge while maintaining the historic integrity.

A project was initiated in 2017 that included installing new utility lines and relocating them closer under the bridge overhang, reducing visibility. The old asphalt was removed and replaced on the bridge deck which was restriped as a single lane for two-way traffic. The new alignment allows the shoulders to be used for pedestrian and bicycle traffic, without altering the bridge layout.

The most significant improvement was an electrochemical concrete treatment called realkalization used to improve the concrete density, making it more durable and resistant to corrosion. After the electrochemical treatment, a cement based paint was used to seal the surface. The rehabilitation is not only beautiful but is also anticipated to extend the life of the bridge more than 50 years.

Original bridge construction in 1920.

New Mosier Creek bridge



Recent bridge photo prior to rehabilitation.

BRIDGE PROGRAM UPDATES

		FOCUS
1	2021-2024 STIP	Bridge Work Identification for future funding
2	Major Bridge Maintenance	• Funding • Accomplishments • Repair of Older Bridges
3	Bridge Preservation	• Painted Steel Bridge Inventory • New advancements
4	Seismic Bridge Program	• Phase 1 Seismic Plus Bridges • Region 3 Triage Program • Coordination with Counties
5	Bridge Deck Study	Chloride investigation

Retrofitted bridge rail.

Painting preparation on the Astoria Megler Bridge.

Failed paint on steel member.

Distressed bridge deck.

1 2021-2024 STIP Bridge Work Identification

The development of the 2021-2024 STIP began in the summer of 2017when the Oregon Transportation Commission started discussing the program funding allocations which were decided upon in December 2017. In order to stay on track, the Bridge Section initiated their project selection in the fall of 2017, finalizing the 150% list project costs totaling about 150% of the anticipated allocation in June 2018. A final 100% Draft STIP list is expected in July 2019.

Identification of bridge work needs for the 2021-2024 STIP starts out as a data driven effort using information acquired from bi-annual bridge inspections. Input is also collected from the maintenance offices, bridge inspectors and the Bridge Preservation Unit which tracks performance of the protective bridge systems. Once a list of potential projects is identified, the projects are assigned to Bridge Section engineers to develop a desk scope based strictly on paper information.

When desk scoping is complete, the Bridge Section reviews the list and with input from the Regions narrows the list down to 150% of the anticipated STIP funding. The 150% list is then forwarded to the Regions to field scope considering more site specific impacts the project might have. The Region develops a more refined estimate that is then provided back to the Bridge Section that again with the Region determines the final list of projects that matches the 100% funding. A generalized flow chart is shown.

Review Bridge Inspection Data

- **Data from BrM database**
- **Input from Inspectors, Maintenance, Preservation Unit**

Desk Scoping

- **Office Review of bridge needs**
- **Initial prioritization**
- **Initial rough estimates**
- **Initial business cases**

Field Scoping

- **Region multi-disciplinary teams review projects in field**
- **Region Teams review/modify scope**
- **Region refines estimates**
- **Region develops final business cases**

Final List

- **Bridge Section reviews work using various analyses**
- **Bridge Section with input from Regions prioritizes work**
- **Bridge Section matures projects with available budget**

2 Major Bridge Maintenance

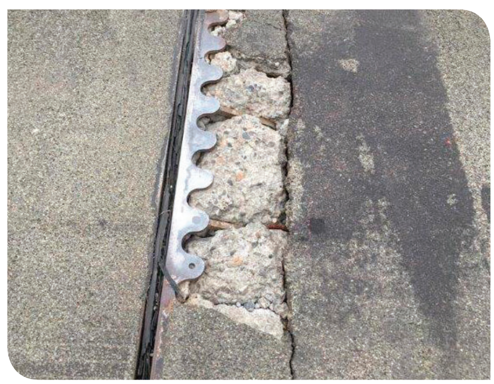
In 1990, the state of Oregon established the Major Bridge Maintenance (MBM) Program, to specifically address major and emergency bridge repairs. These repairs are typically large enough to be outside the scope of work that can be funded at the district level, but are too small or can't wait to be included in the STIP. MBM highlights include:

- Approximately 200 projects are selected annually.
- Starting in 2018, funding increased to $10,000,000/year.

Significant effort goes into deck treatments as the deck is typically the highest value item on a bridge. It is also at the highest risk due to its exposure to weather, de-icing chemicals, and wear from traffic. When concrete decks are cracked, the risk to the deck is elevated because there are now pathways for water and de-icing chemicals to get deep into the concrete to the level of the reinforcing steel. Once the reinforcing steel begins to corrode costly deck rehab or replacement will be required.

Typical Distresses Addressed by MBM

Failed Deck



Damaged Bridge Joint

Distressed Timber

Foundation Scour

2017 MBM Accomplishments

Activity Type	Objective	Action(s)	Number	Total Cost
Urgent maintenance	Address defects identified during routine bridge inspections that need to be corrected as-soon-as-possible or pose a traffic safety concern	Repair damaged joints, replace deteriorated timber members, and fix fatigue cracks in steel beams	24	$1,010,000
Deck Treatments	Preventive maintenance: Seal cracks on decks in good condition to reduce exposure to weather and de-icing chemicals	Deck seals	62	$1,440,000 (720,000 sf)
	Preserve/seal the decks of bridges with asphalt concrete wearing surfaces	Waterproofing membranes	45	$3,640,000
Miscellaneous	Address issues associated with scour, joints, timber, approaches, bearing replacements, and maintenance on the movable bridges		Many	~$2,000,000

Repairing Older Bridges is Challenging

Each year the MBM program funds approximately 200 bridge repair projects. These projects are typically in response to a localized defect on the bridge:

- damaged joints,
- frozen bearings,
- rotted timber pile,
- spalling concrete, etc.

The projects can have a significant impact on the overall bridge condition rating, because the worst detail on the bridge is corrected. Often these repair projects can actually raise a bridge out of Structurally Deficient classification. However, this rise in condition is only temporary as the bridge will continue to deteriorate. These repair projects aren't intended to rehabilitate the entire structure, but rather just address the defects that must be corrected.

The repaired portions of a structure also tend to have a higher rate of deterioration. Bridge repair projects can be due to poor details in the original structure. Repairing the damage due to these details is challenging because the poor detail will usually remain after the repair is complete.

The Harrison Boulevard Bridge in Corvallis is a good example of a bridge with poor details that generates repeated repairs.

The Harrison Blvd Bridge was originally built in 1964. The bridge has an open joint above a concrete pier. Water runs through this joint and lands on the pier below. This poor detail is exacerbated by the original design not accommodating thermal movement without cracking the concrete. Either one of these details alone would likely not create a significant maintenance issue. However, the combination of these poor details results in rapid deterioration of the pier below requiring repeated repairs.

Water seeping through support wall from the open joint above.

Close up of crossbeam under the support wall. Concrete is spalling leaving exposed reinforcement.

> **"CONDITION IMPROVEMENTS AS A RESULT OF MBM REPAIRS ARE ONLY TEMPORARY."**

Several repair projects have been mobilized over the years to address the deterioration but each has had only limited success.

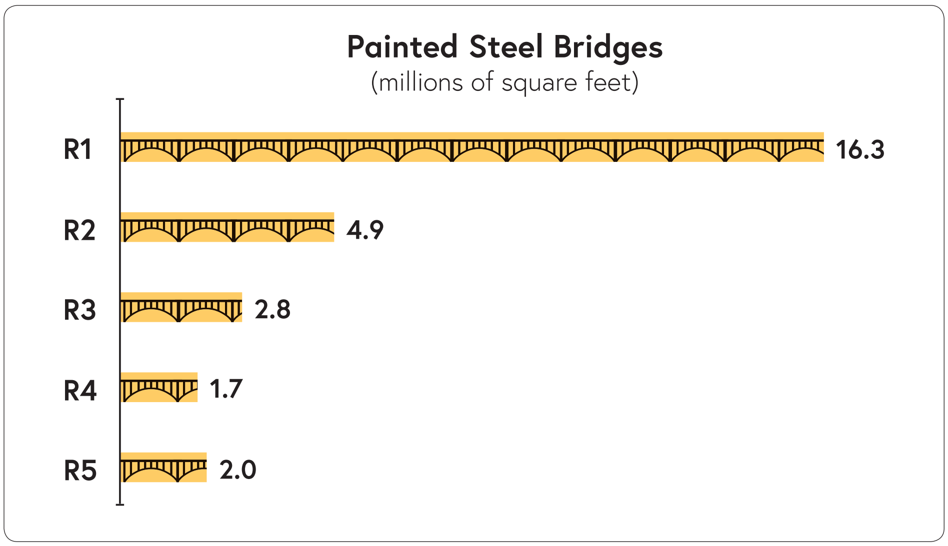
- In 2015 a repair project was completed at a cost of $85,000 dollars. The photos above show significant deterioration that occurred quickly outside the repaired area.
- In 2018 the MBM program funded a larger repair project with larger repair limits. This project is expected to perform longer than the 2015 project, but unfortunately it isn't expected to be the last repair.

The support wall and crossbeam are prepared for patching. Poor concrete is saw cut and removed leaving neat lines for the new patching material.

Repair complete. The poor concrete has been patched and the wall sealed to keep water from reaching the reinforcement.

3 Bridge Preservation: Painted Steel Bridges

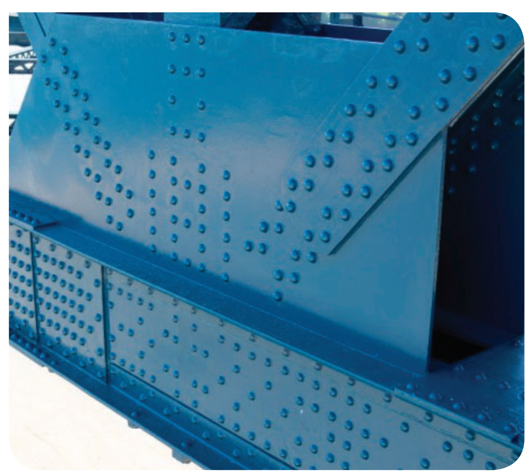
ODOT is responsible for more than 370 painted steel bridges with over 27 million square feet of surface area. Painting steel bridges (applying a protective coating) is vital to preserving and extending the service life of the state's bridge system. Timely applications of protective coatings prevent steel corrosion and any subsequent structural capacity loss. The current steel bridge surface area distribution is shown.



When Do We Paint Our Bridges?

The factors that determine whether or not a bridge needs to be painted include the corrosion location, the paint failure mechanism, and the bridge environment. For long term planning purposes the bridge inspection element, Element 390 Painted Steel, was selected to track over time on regular intervals.

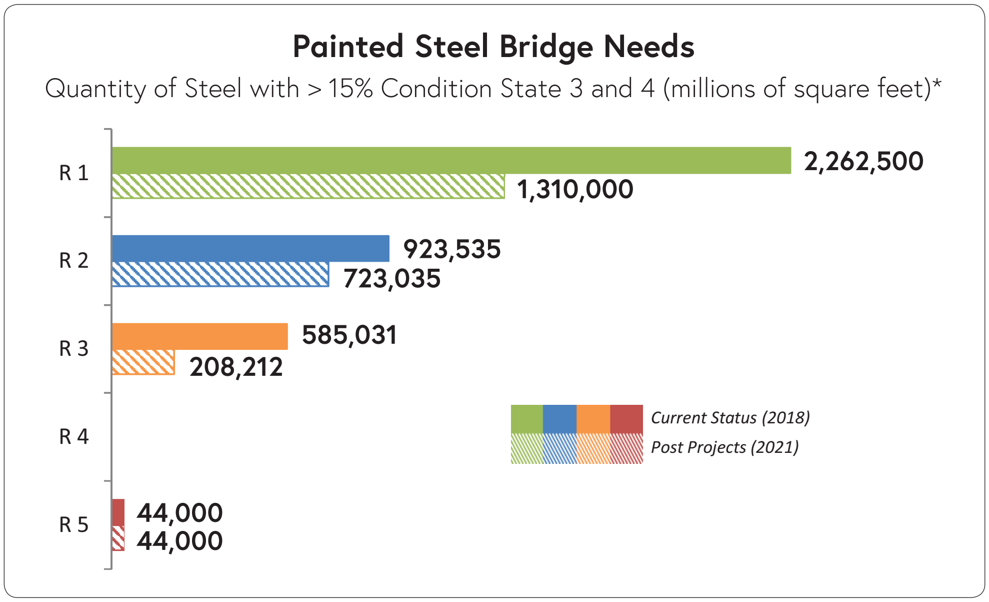
The threshold for painting needs is when 15% of the total area of painted steel is at Condition State 3 (poor) or 4 (failed). Once 15% of the painted steel has moved to Condition State 3 or 4, the entire bridge's surface area is added to the list of in-need bridges.



Newly painted Ross Island Bridge

Region 1, with more steel bridges than any other region has the highest quantity of steel in Condition State 3 or 4. Significant progress is being made, however, to improve the conditions with the completion of the Ross Island Bridge project. In addition, more area will be improved with future painting on the Fremont Bridge.

The graphic below shows the current and future bridge paint conditions based on what projects have been done and those that are currently programmed for construction.



*If 15% or more of the total area of painted steel on a single bridge is in Condition State 3 or 4 (Element 390), then the entire surface area of the bridge is included in these figures.

Sandy River Bridge Inspection

Bridge Painting Program Components for Success

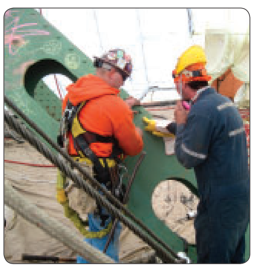
With limited funding, Bridge Preservation carefully plans every painting project in order to minimize costs and maximize the service life of the new coatings systems. ODOT continues to use some well proven techniques and processes incorporating new advancements made in the past few years.

Advancements in coating technologies

- Coatings may contain micaceous iron oxide that acts as an additional barrier, increasing the service life. The modified coatings are also more surface condition tolerant, so they can be used to limit the risk of future corrosion in areas that are difficult to prepare.
- The Ross Island Bridge Painting utilized a UV-resistant topcoat that will increase gloss retention, improve the aesthetics and increase the service life.

Preparation

SSPC SP-10, is the gold standard by which steel surfaces are prepared. The process creates a superior coating surface and reduces chlorides and maximizes the life of the coating. Service life has been significantly improved, especially on the coast where chlorides that remain on the steel prior to painting can be detrimental to a new coating system.



Inspection

Third party inspection required in some ODOT painting contracts, provides independent impartial inspection services by a qualified company. NACE Level II and III certified inspectors add expertise to the Project Manager's team to ensure a project is constructed to the specifications.

Future Bridge Paint Condition Projections – Next 5 Years

On average, the ODOT Bridge Program paints two bridges every year. However, in the next five years, ODOT plans to more than double that rate with painting an average of five bridges and over 750,000 square feet of steel every year.

Future conditions can be estimated based on the planned work and expected corrosion rates. Projections on expected corrosion rates can be made using bridge inspection reports over the past few years. Every year, about 400,000 square feet of painted steel is added to the list as needing maintenance painting. Compared to the 750,000 square feet of planned painting, this shows that not only will we keep up with the rate of corrosion, but we will reduce the inventory of bridge painting needs.

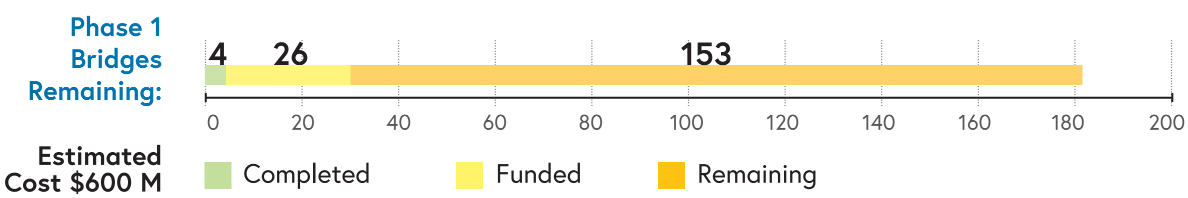
4 Seismic Program Status

The 2014 Seismic Plus report identified five phases of bridge seismic work to "provide the maximum degree of mobility with reasonable investments spread over several decades." The goal of the phasing is to "retrofit all seismically vulnerable bridges and address unstable slopes on key lifeline routes in a strategic and systematic program to allow for rescue and recovery following a major earthquake.

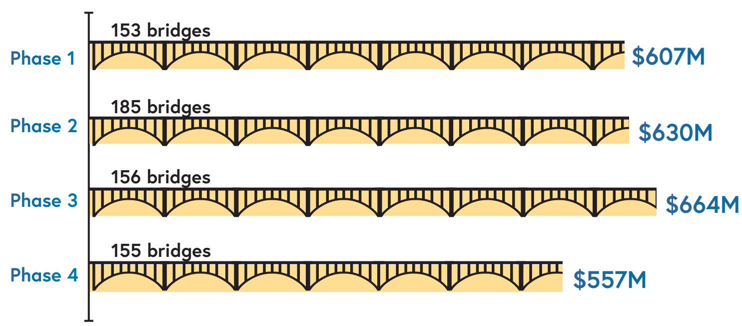
Additional funding to address seismic improvements related to highways and bridges is included with the HB 2017 transportation package. With the new funds, ODOT plans to work on Phase 1 bridges moving from Eugene, north on I-5 and finishing up on I-84 moving from east to west in 20 to 30 years. Projects are currently being scoped for seismic work on I-5 near Eugene for the 2021-2024 STIP. Phase 1 Seismic Routes are shown on the next page.

Phase 1 **Provides a connection to the Redmond Airport; east-west freight movement and a north-south corridor on US97 -- the cornerstone of the program.**

ODOT Phase 1 Seismic Routes



Seismic Bridge Costs Remaining by Phase



Phase 5 includes 12 bridge replacements like the Medford Viaduct, the Ross Island Bridge, several historic coastal bridges and other large bridges. The estimated replacement costs total $1.5 billion.

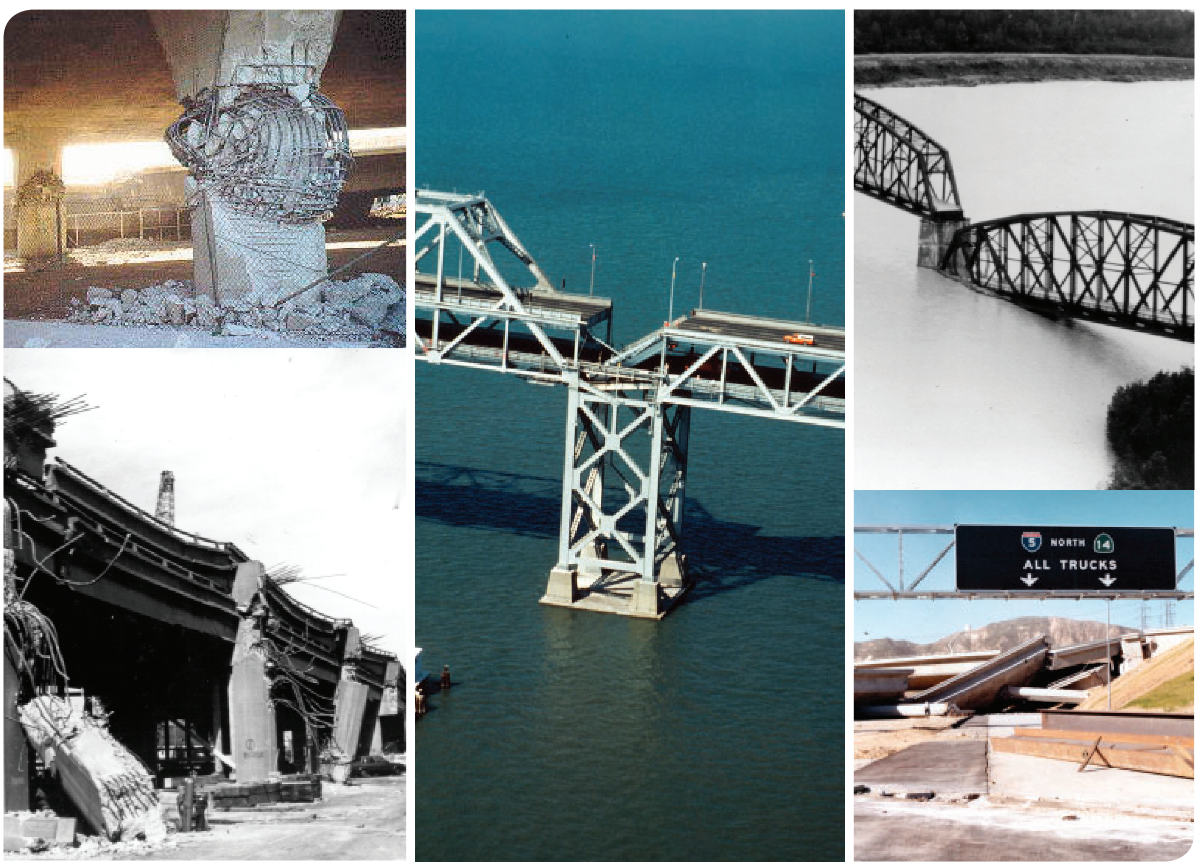
The costs for Phases 1-4 reflect an update from 2017. An error was made in the 2017 report where Phase 2-4 bridges identified for reconstruction were not accounted for. The costs presented here include all bridges remaining by Phase with updated retrofit and replacement costs in 2018 dollars. These estimates are still planning level, however, they do provide a relative measure by phase. Also, with Phase 1 bridge work estimated at about $600 million, funding at $20M/year results in 30 years to complete Phase 1 bridges or at $30M/year, 20 years.

ODOT Phase 1 Seismic Routes

Other Funded Seismic Projects

HB 2017 provided funding for an additional seismic project entitled the Southern Oregon Triage strategy. The strategy focuses on mitigating seismic impacts along Interstate 5 south of Eugene, and OR 140 which are key lifeline routes to and from the Rogue Valley. Most of the seismic impacts on the routes are expected to be addressed through quick repairs or temporary detours. The funding will be used to address those bridges and potentially unstable slopes that are more problematic or where a feasible detour does not exist.

Seismic Response Kits to be located at maintenance station facilities on the coast at Astoria, Seal Rock and Coos Bay are being considered but are currently not funded. The purpose of the Seismic Response Kits is to stockpile key materials and supplies that can be used to assist local communities in the early days following a seismic event. The kits will include culvert pipes of various sizes; construction materials; solar power generators and trailer mounted solar light panels; diesel and unleaded fuel storage tanks; survival supplies (water, field rations, first aid supplies); power tools; batteries; portable boats; flat railroad cars; and satellite phones and Ham radios.

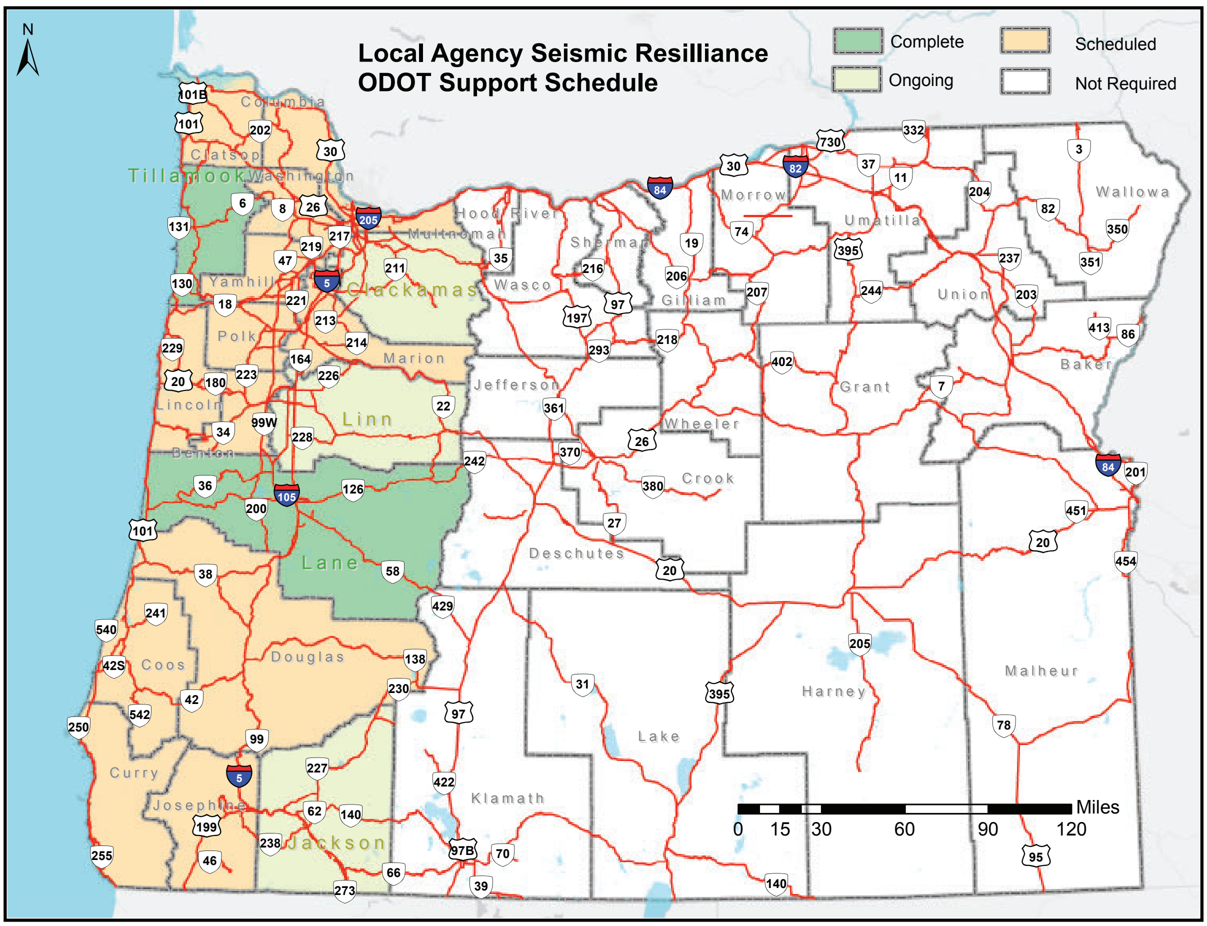


Bridge damage caused by historic earthquakes. Photos courtesy of USGS.

Local Agency Seismic Resilience Support

The Bridge Seismic Standards Engineer and other ODOT leadership, is working collaboratively with Oregon counties to develop planning reports documenting county routes and priorities for seismic resiliency. ODOT provides bridge data and technical support and the counties provide information about their network. While the information is useful for county planning, a comparison can be made to the state seismic bridge priorities to determine possible state highway detour routes that may be more cost effective to seismically retrofit or replace. Eventually the planning reports may provide an opportunity for seismic resiliency funding from either state or federal funds.

Currently Tillamook and Lane counties have completed reports; Linn, Jackson, Washington and Clackamas counties have reports underway. The goal is to coordinate with all western counties by June 2020. The map shows the status of the collaborative reports by county.



5 Bridge Deck Study

In a November 2017 report detailing the ODOT Winter Salt Pilot Project, ODOT determined that salt can be used effectively in maintaining roads, achieving little to no packed snow and ice resulting in reduced crashes and improved mobility. Understanding the impact of salt on the infrastructure, including bridges, requires continuous investigation to ensure ODOT is managing the highway system in a safe and cost effective way while protecting the environment and infrastructure.

Bridge Deck Chloride Testing

As ODOT's bridge inventory ages and the use of rock salt to deice highways expands, increasing numbers of bridge decks are being found to have salt or chloride contents above a critical corrosion threshold. Once this threshold is exceeded, steel reinforcement begins to corrode resulting in delamination of concrete cover and eventual spalling which exposes the deck to additional damage as well as provides hazards to motorists, as shown.

Thin overlay failing due to corrosion.

Spalled deck concrete.

Crowson Creek deck replacement.

Region 5 thin deck treatment.

Proactive Approach

ODOT has become proactive about placing thin, epoxy-based wearing surfaces on decks in good condition to protect them from wheel rutting, impact on joint details, and future chloride contamination. Once chloride induced corrosion damage is observed, however, the only options to restore the deck are a structural overlay or deck replacement. The key is to identify bridge decks without chloride contamination in order to make use of thin treatments for prevention and to better understand the potential needs from a program level.

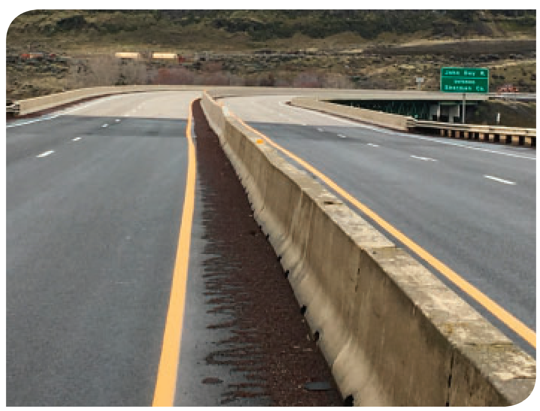
At the program level, ODOT Bridge is working on two studies:

1. The Strategic Highway Research Program 2 (SHRP2) R19A project, used to determine remaining service life of bridge decks and appropriate preservation/rehabilitation methods sponsored by the FHWA. Bridges were chosen on a program level for a variety of reasons ranging from signs of deterioration to age of construction or geographic location. In a lot of cases, high chloride content was not expected.

2. The Salt Pilot Program Phase II program level testing, sponsored by ODOT. Bridges were selected to be distributed evenly throughout the mile points where rock salt is being used to deice the highway. They were also chosen to capture structures with diversity of age and detailing such as having previous structural overlays or widening work performed.

The data from these projects and additional information collected from cores taken during project level testing will continuously be evaluated and updated to improve the understanding of timing and treatment type of bridge deck projects.

John Day River Bridge deck overlay preparation.



John Day River Bridge deck overlay completed.

2018 TUNNEL DATA

Oneonta Tunnel following the 2017 Eagle Creek Fire

Tooth Rock Tunnel being inspected following the 2017 Eagle Creek Fire

Keeping ODOT tunnels functioning with regular monitoring and timely maintenance is critical to ensure safe passage for all users. In addition, minimizing tunnel closures is critical to prevent hardship for the travelling public in the area served by the tunnel.

ODOT manages nine state-owned vehicular tunnels and is responsible for all inspection, maintenance, and major rehabilitation of the structures. ODOT also provides inspection of two pedestrian tunnels that were formerly vehicular tunnels and starting in 2017, six vehicular tunnels owned by other road agencies.

Inspections have been performed on ODOT tunnels for more than 20 years based on the National Bridge Inspection Standards (NBIS), modified by Oregon DOT Tunnel Inspection Procedures. Under the ODOT program, tunnels were on a two-year regular inspection cycle, with in depth inspections on a 10-year cycle and drainage inspections each year by the ODOT district maintenance crews.

New National Tunnel Inspection Standards (NTIS) Implementation

Federal Highway Administration (FHWA) guidelines require state DOTs to follow the new National Tunnel Inspection Standards (NTIS) for the inventory, inspection and load rating of tunnels. In March 2018 and annually, thereafter, ODOT is required to provide a snapshot of Oregon tunnel conditions to the FHWA.

The data provided in the table on the next page is based on the new NTIS standards. As a result of updating to the new standards, ODOT has developed a revised assessment of the structural condition for the tunnels.

Putting the element condition information together to determine the overall tunnel condition (good, fair or poor) provides a new challenge as there is no established national standard. The old method of rating generally considered one tunnel element, the liner. With the new NTIS implementation additional elements are individually assessed like ceiling slab, anchors, ceiling girder, wearing surfaces, etc.

To classify the tunnel condition with the updated Oregon data ODOT borrowed a bridge condition parameter termed Health Index (HI) with values ranging from 0 to 100. The HI, in general, incorporates the condition of each element with a weighted average based on the importance of the element to the tunnel and the unit of measurement. The 2018 tunnel condition information reported is based on the updated HI method calibrated with a general assessment of the tunnel conditions and engineering judgement. Based on the new method, only the Cape Creek Tunnel condition changed moving from Good to Fair

Tunnel near Bonneville, 1937

Salt Creek Tunnel

TUNNEL CONDITIONS AS OF APRIL 2018

Region	District	MP	Tunnel	Tunnel Name	Year	Length, ft	Materials	Condition	Owner/Notes
1	22	73.5	09103	Vista Ridge Tunnel, Hwy 47 EB	1969	1002	Reinforced Concrete	Good	ODOT
1	22	73.6	9103B	Vista Ridge Tunnel, Hwy 47 WB	1970	1048	Reinforced Concrete	Good	ODOT
1	23	41.2	04555	Tooth Rock Tunnel, Hwy 2 EB	1936	827	Reinforced Concrete	Fair	ODOT
1	23	20.2	20318	Oneonta Tunnel (Bike/Ped), Hwy 100 at MP 20.15	2008	115	Shotcrete	Closed	ODOT (Pedestrian traffic only)
2	01	35.7	02247	Arch Cape Tunnel, Hwy 9	1937	1228	Shotcrete/ Concrete	Good	ODOT
2	01	40.9	02552	Sunset Tunnel, Hwy 47 (Dennis L Edwards Tunnel)	1940	772	Shotcrete/ Concrete	Good	ODOT
2	05	56.1	02539	Salt Creek Tunnel, Hwy 18	1939	905	Reinforced Concrete	Fair	ODOT
2	05	178.5	03961	Cape Creek Tunnel, Hwy 9	1931	714	Shotcrete/ Concrete	Fair	ODOT
2	05	19.7	07139	Knowles Creek Tunnel, Hwy 62 at MP 19.68	1958	1430	Reinforced Concrete	Good	ODOT
3	07	39.8	03437	Elk Creek Tunnel, Hwy 45	1932	1090	Shotcrete	Good	ODOT
4	09	56.0	00653	Mosier Tunnels	1920	369	Shotcrete	Good	ODOT (Pedestrian traffic only)
Other Agency Tunnels			51C26	W Burnside Tunnel	1940	230	Reinforced	Fair	PDX
Other Agency Tunnels			51C32	Rocky Butte Tunnel	1939	400	Reinforced Concrete	Fair	PDX
Other Agency Tunnels			25B125	Cornell Tunnel #1, NW Cornell Rd	1940	497	Reinforced Concrete	Fair	PDX
Other Agency Tunnels			25B127	Cornell Tunnel #2, (W), NW Cornell Rd	1941	247	Reinforced Concrete	Fair	PDX
			22476	Owyhee Tunnel, Owyhee Lake Rd	1929	200	Rock	Fair	Malheur County

OREGON BRIDGE CONDITION PROJECTIONS: 2018-2028

An analysis was done as part of the ODOT Transportation Asset Management Plan (TAMP) to project bridge conditions in ten years for three funding situations:

PROJECTIONS

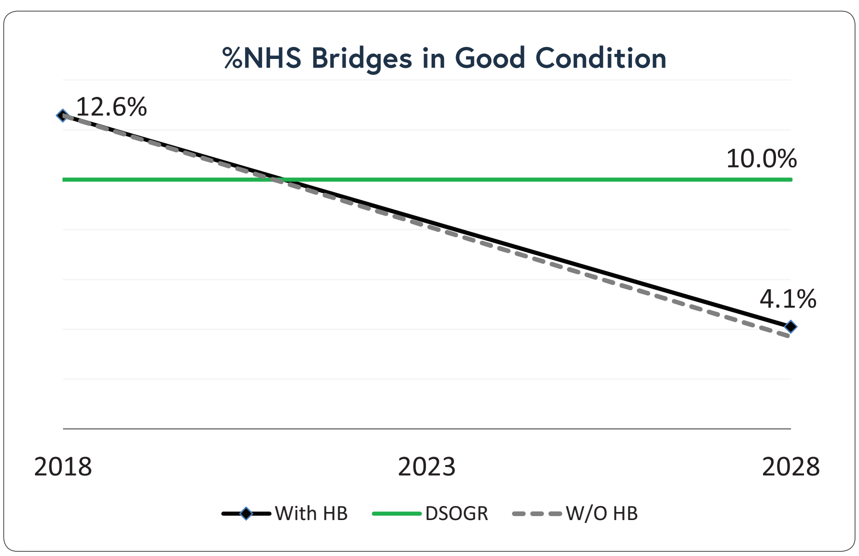
- Percent NHS bridges in good condition
- Percent NHS bridges in poor condition
- KPM 16 (percent not distressed) all ODOT bridges

$85M/year	Pre-HB 2017 funding levels
$122M/year	HB 2017 funding levels, includes seismic funding
$350M/year	Desired State of Good Repair funding (DSOGR) based on OTC 2017 investment strategy

NHS Bridges in Good Condition

NHS bridge condition projections indicate the percentage of bridges in good condition will continue to decline even with the new HB funding. By 2021 the percentage is predicted to dip below the desired state of good repair (DSOGR), which has been established to be 10% based on an assessment of the level of funding allocated to preservation of bridges in good condition.

Given the age of our system, the decline is inevitable as bridge replacement is taking place at a much slower rate than the decline in conditions. Bridge preservation or rehabilitation actions generally cannot raise a bridge rating to good condition. Bridge replacement is the primary action that results in a good rating. In addition there is a recent trend showing that new bridge decks are slipping from good to fair much earlier than normal that reflects a construction quality issue in concrete mixtures and placement.



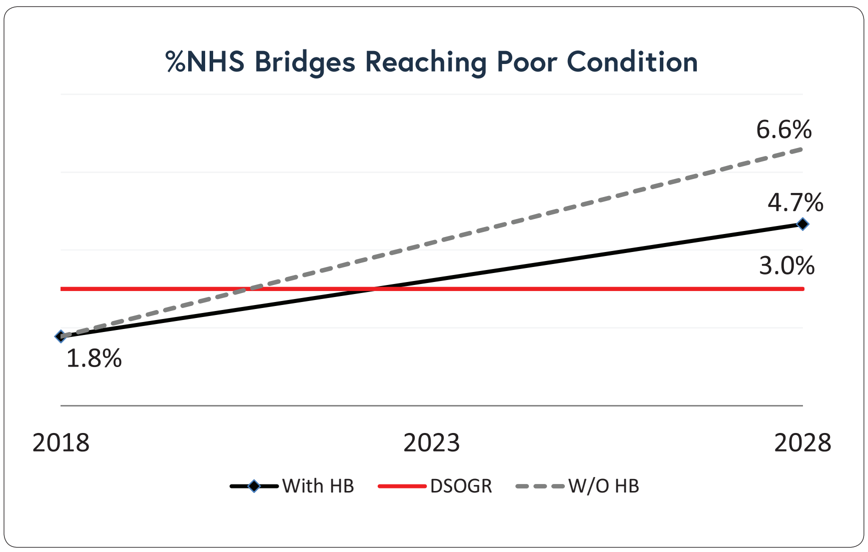
Projected good conditions for NHS bridges.

> "THE PERCENT OF NHS BRIDGES IN GOOD CONDITION IS PROJECTED TO DECREASE."

NHS Bridges in Poor Condition

Projections for bridges becoming poor show a steady increase in the next ten years. However, the HB 2017 funding is projected to slow the decline. By 2020-2021 the percentage is predicted to rise above the DSOGR, which has been established at 3% based on an assessment of ODOT's ability to respond quickly to the anticipated resulting critical and urgent bridge needs at that level of poor condition.

The decline is expected to be managed with the use of Major Bridge Maintenance (MBM) funding which addresses the immediate repairs needed to keep an at risk bridge from being classified as poor and the prioritization of NHS bridge work over non-NHS bridge work. However, this strategy continually increases the number of bridges with repairs that have a higher risk of additional deterioration and the need for future emergency actions to preserve public safety. As the number of state bridges with less than optimal repairs and less predictable behavior grows, the ability of state forces to manage public safety is reduced.

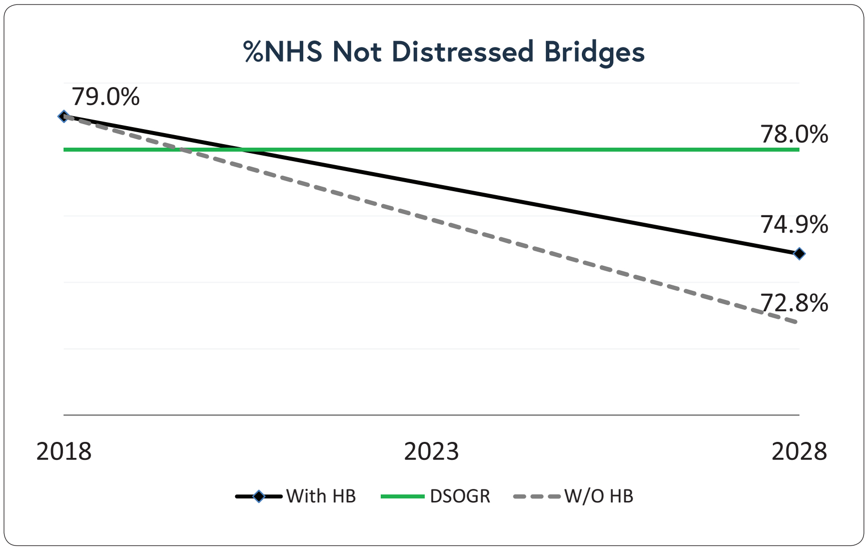


Projected poor conditions for NHS bridges.

> **"THE PERCENT OF NHS BRIDGES IN POOR CONDITION IS PROJECTED TO INCREASE."**

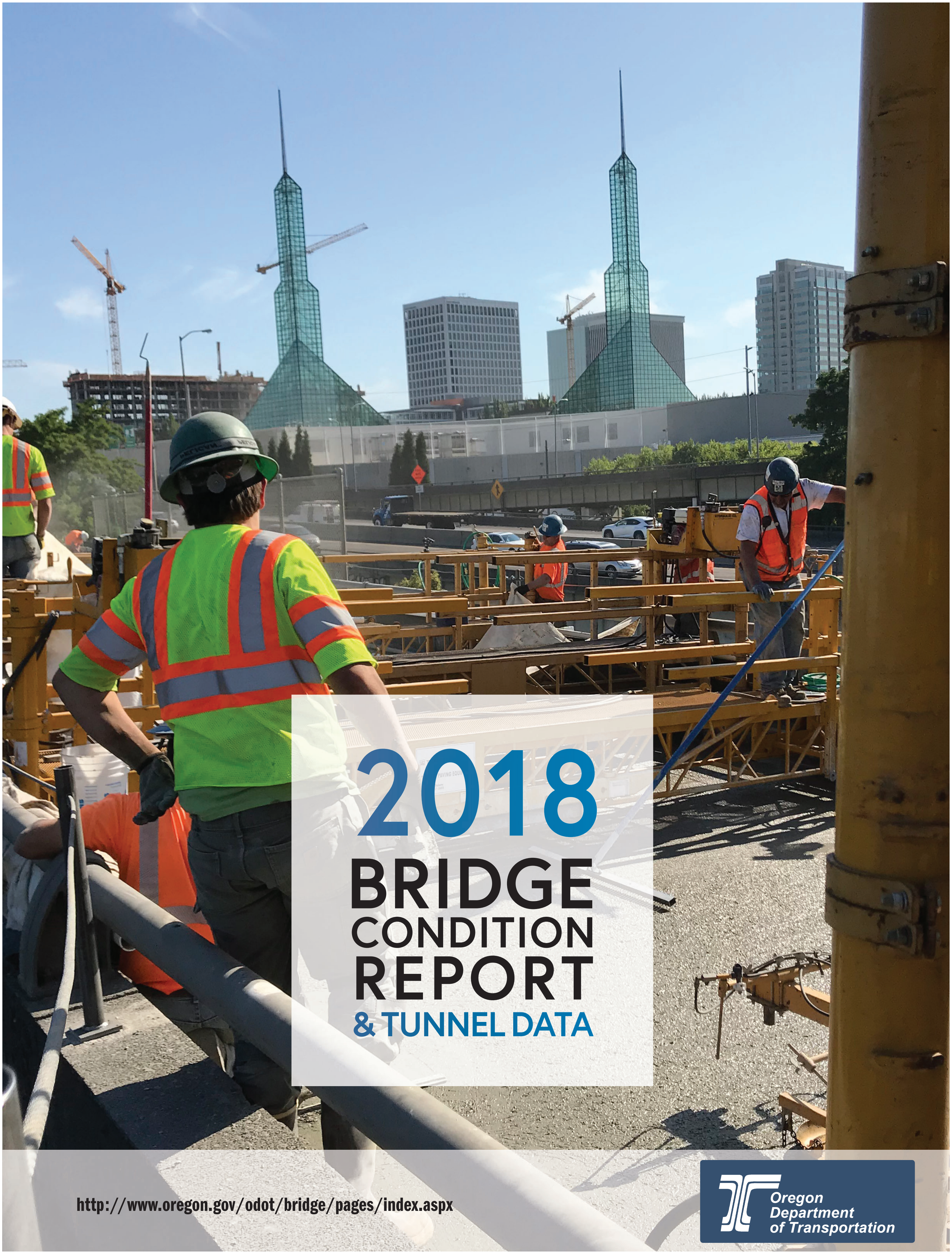
KPM 16 (Percent Not Distressed Bridges)

The HB funding is expected to slow the decline of the % Not Distressed for the ODOT bridge population; however, the decline will continue. The decline is primarily due to the aging bridge system and a long history of underfunding in the Bridge Program that precluded systematic replacement of deteriorated bridges, which is captured in the KPM as Low Service Life and also in bridge conditions with more bridges projected to become structurally deficient.



Projected Not Distressed bridges (KPM 16) for all state owned bridges.

> **KPM 16 IS PROJECTED TO CONTINUE TO DECLINE.**



2018 BRIDGE CONDITION REPORT & TUNNEL DATA

http://www.oregon.gov/odot/bridge/pages/index.aspx

Oregon Department of Transportation