Oregon Department of Transportation

2023

Bridge Condition Report & Tunnel Data

Oregon Department of Transportation

The Alsea Bay Bridge is a major bridge on the Oregon Coast Highway.

2023 BRIDGE CONDITION REPORT & TUNNEL DATA

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EXECUTIVE SUMMARY

The 2023 Bridge Condition Report provides a snapshot of the condition of bridges in Oregon that are on state highways. Condition information is measured by Oregon's Bridge Key Performance Measure and by the National Bridge Performance Measure. In addition to condition information, there is information on bridge programs that are in place to manage and preserve state highway bridges. These include Major Bridge Maintenance, Bridge Preservation, the Seismic Program, and Load Rating. Efforts to maintain and preserve existing bridges are critical, as an average of just three bridges are replaced each year. With adequate funding, approximately 27 state highway bridges could be replaced annually which is consistent with a 100-year service life.

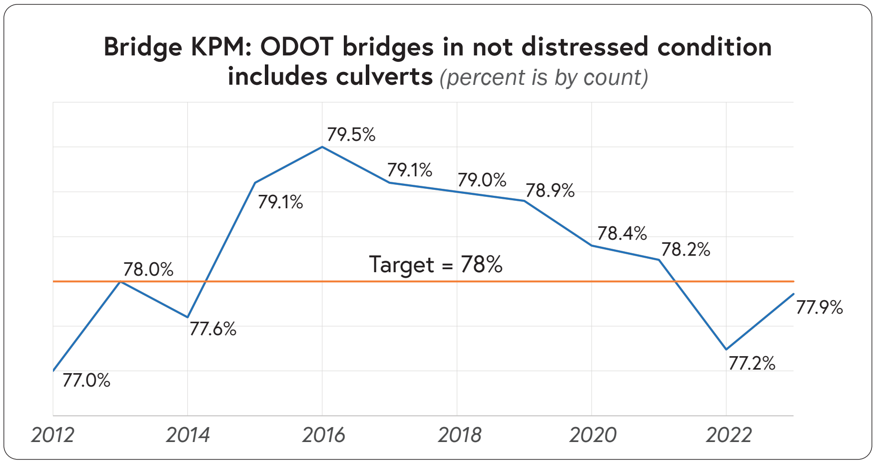
The highlight for this year's report is scour. Scour is when hydraulic forces of fast-moving water remove materials such as sand and gravel from around bridge foundations. Bridge scour and flooding are the number one cause of bridge failures worldwide. It is an important issue for Oregon, as many older bridges are potentially vulnerable due to foundations that don't meet current scour design standards.

The John Day River Bridge on I-84 was newly built in 1963. The next year, following a series of extreme storm events, the bridge failed due to scour surrounding one of the piers. The pier eventually washed away taking a portion of the bridge with it.

2023 Bridge Condition Report Content

Bridge Conditions: With only an average of three bridges replaced annually ODOT continues to lose ground in the effort to manage the system. Although a significant portion of these bridges are in fair condition at this time, in the following decades, the agency will be burdened with a huge responsibility to maintain or replace the 40% of the inventory built between 1951-1970, as they continue to deteriorate.

Bridge Key Performance Measure (KPM): The slight increase in the percentage of state highway bridges that are not distressed is primarily due to the three bridge replacements in 2023 and the Major Bridge Maintenance program. The overall trend since 2016 has been down and is consistent with a decrease in the percentage of bridges in good condition that are reported in the National Bridge Performance Measure.



ODOT bridges in not distressed condition. Larger percentages are better.

National Bridge Performance Measure (NBPM): Oregon is meeting the requirements of the National Bridge Performance Measure, especially in the low percentage of deck area for bridges in poor condition. At the same time, Oregon has the lowest percentage of deck area for bridges in good condition when compared to six other western states.

Major Bridge Maintenance (MBM): The MBM Program continued to provide tremendous value to the bridge program in 2023 by repairing nine bridges in poor condition and addressing 49 other bridges with high priority maintenance recommendations. The program also funded projects to seal concrete bridge decks to protect them from winter chemicals, replaced deteriorated asphalt, and performed routine maintenance on many other bridges.

Bridge Preservation: The Preservation Program includes preserving historic coastal bridges that were built in the 1930's, and economic-focused preservation of high-value bridges statewide. Oregon is a leader in the use of impressed current cathodic protection to preserve bridges in a coastal environment. A major cathodic protection project on the Yaquina Bay Bridge was completed in 2023 and four more will be addressed by 2027.

Seismic Program: Seismic retrofit construction is underway on the southern portion of US-97, which is designated as a primary north-south lifeline in the aftermath of a major earthquake. Construction is also underway on Oregon 58 and the Southern Oregon Seismic Bridge Retrofit project. Also, construction activities are in full swing on I-205 Abernethy bridge and design is underway for the Oregon 22: Center St. Bridge Project.

Bridge Load Rating: Our Load Rating Program assessed 53 structures during 2023 and placed new or revised restrictions on three structures. Of our total inventory, 15.3% of our structures have at least one weight restriction. Efforts to legalize larger and more robust vehicles – to haul freight and deliver emergency services – pose an ongoing concern. While these vehicles are more efficient, they pose a significant challenge to older bridges.

When new vehicle configurations are approved at the national level, we must evaluate our structures individually for the capability to carry these heavier trucks. Load rating structures – assessing, signing, and enforcing – comes at a cost. Conducting engineering reviews on nearly 3,000 structures can cost upwards of $20 million – an expense incurred every time state or national standards change. While it is critical that we assess our structures for their capabilities, funds spent to load rate bridges come from the same reserve as those used to improve bridge conditions.

ABBREVIATIONS AND DEFINITIONS

Bent – Supports at the ends or intermediate points of a bridge used to retain approach embankments and vertical and horizontal loads from the superstructure.

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 inventoring, inspecting and load rating 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**

Poor Detail Bridge – Bridges identified in the state bridge inventory that have critical design issues related to rail, decks, and reinforcement locations. Bridges with poor details have a higher incidence of shear cracking that may grow rapidly, holes in thin bridge decks developing without warning, low reserve load capacity, and instability during seismic events.

Scour – The removal of sediment such as sand and gravel around the bridge foundations caused by hydraulic forces of fast-moving water.

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.

Service Life – The time duration during which the bridge element, component, subsystem, or system provides the desired level of performance or functionality, with any required level of repair and/or maintenance.

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.

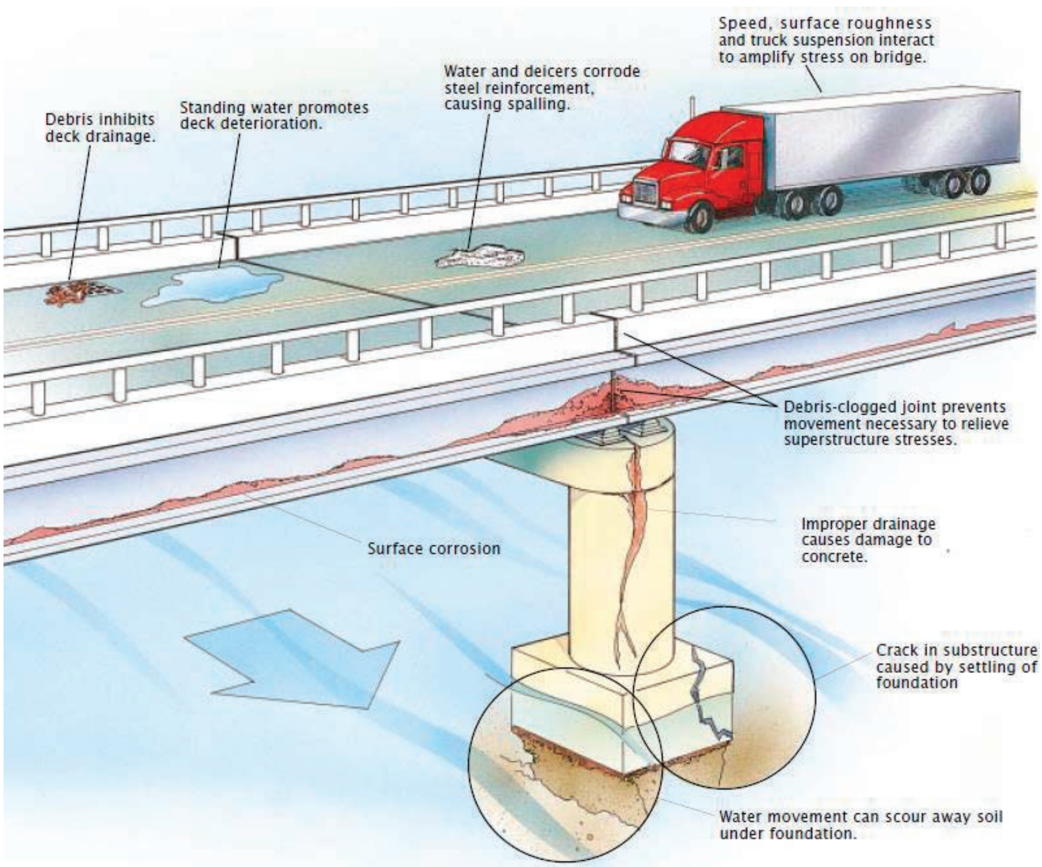
A classification of "structurally deficient" does not imply that bridges are unsafe. When an inspection reveals a safety problem, the bridge is posted for reduced loads, scheduled for repairs, or in unusual situations, closed until repairs can be completed. Structural deficiency is one of the many factors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

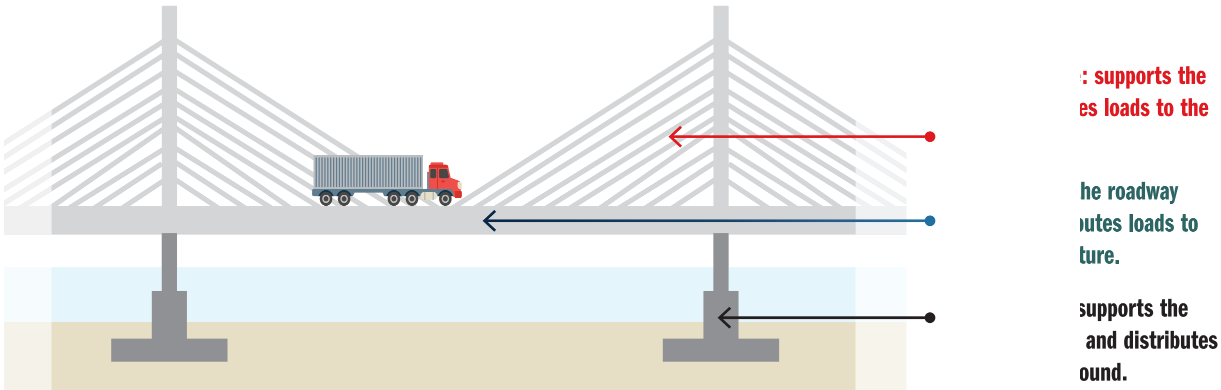


Adapted from "Why America's Bridges are Crumbling," by K.F. Dunker and B. G. Rabbat, 1993, March, Scientific American, 268, no. 3, p. 69. Permission for use courtesy of Jana Brenning, illustrator.

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 20 feet and longer 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 o\
conditions of their bridge populations and the overall effectiveness
bridge programs. The critical rating is when a highway bridge is classified as **structurally deficient (SD).**

NBI Component	NBI Rating	
• Deck • Superstructure • Substructure • Culvert rating (if applicable)	Lowest condition NBI rating of all components (scale =0-9)	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.

BRIDGE SCOUR

What is a bridge scour and why it is important?

Bridge scour is the removal of sediment such as sand and gravel around the bridge foundations caused by hydraulic forces of fast-moving water. Bridge scour and flooding has the potential to compromise the integrity of the foundation that supports the entire bridge and is the number one cause of bridge failures worldwide.

Definitions – Abutment: Support at the ends of a bridge.
Piers: Vertical supports at the end or intermediate locations of a bridge.
Scour critical: A bridge with a foundation element that has been determined to be unstable or with inadequate foundation information.

The two images below demonstrate scour caused bridge failures in Oregon.

The John Day River Bridge on I-84 was newly built in 1963. The next year, following a series of extreme storm events, the bridge failed due to scour surrounding one of the piers. The pier eventually washed away taking a portion of the bridge with it.

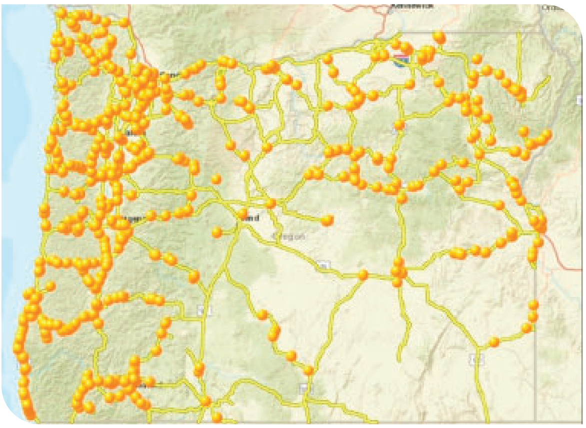
The Bridge Creek Bridge on Oregon 41 was built in 1953 and failed due to scour after major flooding in 1956. This bridge, while relatively new, was not able to withstand the erosive forces of extreme water velocity and debris flow and the resultant scouring of embankments and bridge foundations.

Federal regulations require bridge owners to:

1. Perform a scour appraisal of all bridges over water.
2. Prepare and document scour plans of action for bridges which are determined to be scour critical (a bridge with a foundation element that has been determined to be unstable or with inadequate foundation information), deploy scour countermeasures for known and potential deficiencies, and address safety concerns.

The purpose of these evaluations is to determine if the structure is at risk for scour.

Oregon has approximately 7,000 bridges, with nearly 5,800 bridges over water. This large number of bridges that cross waterways adds complexity to design, inspection, and maintenance programs.



Based on ODOT's inspection data, the State of Oregon owns 597 National Bridge Inventory (NBI) structures (bridges 20 feet and longer) that are evaluated as scour critical. Of these, 493 have been evaluated to be unstable and the other 104 do not have foundation information to evaluate them and are conservatively placed as scour critical. Although these bridges are listed as being scour critical, they are safe.

Rivers are dynamic and over time can change location, shape, and channel elevation. During major floods, significant changes in the river can happen in a short period of time. While rivers move and change, bridges do not.

There are several ways channels can change and jeopardize the stability and safety of bridges. The channel bed can erode (degrade) and lower the bed elevation, undermining the foundations of piers and abutments. Deposit of sediments on the channel bed (aggradation) can reduce capacity, resulting in flood waters advancing on roadway approaches, channel banks, and flood plains. Knowledge of the type and profile of a stream is essential to understand the hydraulics of the channel and its potential for change. Streambanks with raw soils lacking vegetation, active slumping, and undercutting of bank materials, are all indicators of active erosion that results in channel movement or migration. Bank stabilization methods must be implemented to minimize such problems and avoid bridge failures.

A major concern in bridge inspection is the safety of bridges that span active waterways. The type of inspection performed on a bridge that crosses a waterway depends on the characteristics of the waterway. These characteristics can influence the type of scour at the bridge. Factors include how the river has changed over time, physical characteristics (narrow, wide, steep, gentle, etc.), hydraulic conditions (velocity, volume, etc.), and bed and bank materials (gravel, clay, hard rock, etc.). Similarly, the bridge location, design, and materials combine with the characteristics of the waterway to determine the scour conditions of the bridge.

While performing inspections, the inspectors must follow these three important steps:

1. Inspection of channel protection
2. Inspection of channel alignment/misalignment
3. Inspection of hydraulic opening/s

Types of Scour

When scour is observed it is important to classify the type of scour. There are three forms of scour that must be considered in evaluating the safety of bridges. For scour evaluations, specific factors must be identified depending on the form of scour:

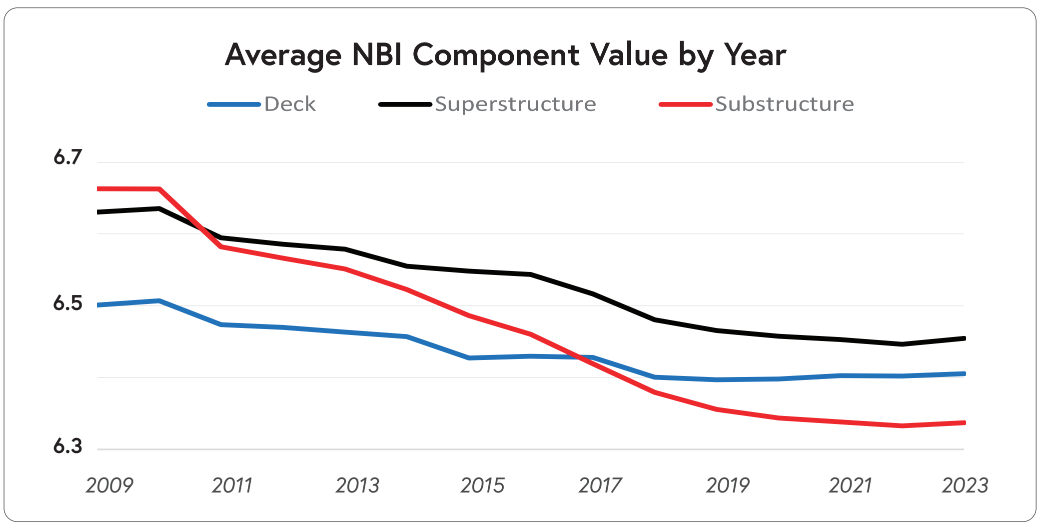
1. General scour is degradation of the riverbed along some considerable length of the river. It can be caused by:
   - Water resource development, such as upstream diversions and dams.

- ► Changes in channel alignment.
- ► Changes in channel dimensions.
- ► Watershed urbanization (a change from a natural or agricultural to an urbanized area.)
- ► Other land use changes.

2. Contraction scour results from the acceleration of flow due to either a natural contraction, a bridge contraction, or both.
   The inspector inspects for constriction and contraction scour by comparing the width of the bridge opening to the width of the river upstream and downstream of the bridge.
3. Local scour results from erosion of materials adjacent to the abutments and around piers.
   The inspector carefully documents any of the bridge foundation that is exposed due to material erosion.

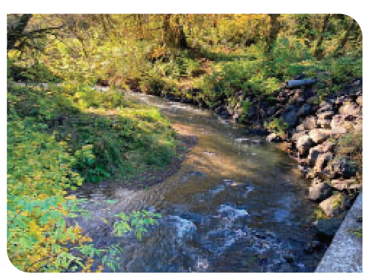
Bridge Condition Changes

In the graph below, the component NBI values are plotted to indicate bridge rating changes over time (rating: 8-9 = very good, 7 = good, 5-6 = fair, 4 = poor, < 3 = very poor.) All ratings have declined over time, but the substructure rating (red) decline is more significant than the other two criteria.



Examples of scour problems: Although scour can occur intermittently and over a long period of time, large storm events can cause severe scour damage and result in catastrophic failures. Many unanticipated scour events occur across the state following large storms, heavy rain, snow melt or snow events during the winter months that necessitate maintenance staff to react quickly and perform repairs to keep bridges safe. Discharge from an underground pipe and overland flows caused serious scour after a single large storm event and threatened the safety of the bridge, as seen in the pictures below.

Seasonal scour damage.



Emergency repairs completed by placing large rock to protect the embankment and the bridge.

The bridge over Little Humbug Creek on Oregon 47 at milepost 8.22, was built in 1935 and re-built in 1956. The bridge performed well between 1935 -2018 with only minor maintenance. ODOT plans to replace this bridge in the summer of 2025.

However, the scour ratings worsened sharply between 2019-2022. The bridge required immediate attention — both in engineering and repairs — to shore and protect the footings to prevent the bridge from a catastrophic failure. The four pictures below show the damage and the temporary shoring required to rehabilitate and restore the structure to make it safe for the public to use.

Many years of scour activity weakened the foundation support.

Stay-in place form work placed to protect and support the foundations.

ODOT maintenance crew performing emergency work.

Foundation protected for safe public use.

As a result of bridge failures in Oregon and others across the world, the bridge design community has consistently updated design standards to protect foundations against scour. Modern bridges are designed using these new standards and advanced techniques to study bed rock materials, hydraulic analysis of streams and scour analysis of foundations.

Federal and state transportation agencies have established inspection guidelines and maintenance requirements to protect bridges and operate them safely. At a minimum, all bridges are required to be inspected every two years by certified inspectors. Bridges with known deficiencies are inspected more frequently. Oregon also has a team of certified divers who perform underwater inspections. With advances in design, better use of materials, regular inspections and maintenance practices in place, Oregon's bridges are safe. In fact, many older bridges can remain in service beyond their intended design life.

2023 BIDGE CONDITIONS

"In 2023, ODOT replaced three bridges."

ODOT's 2023 Bridge Condition Report summarizes bridge condition ratings on state highways and performance measures based on National Bridge Inventory (NBI) 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 March 2023 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 conditions for decision-making purposes. The most common and those presented here, are the NBI ratings for the 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.

Deck deterioration can include cracking, scaling and surface spalling which results in safety concerns and increased wear and tear on vehicles that use the bridge.

Superstructure deterioration can include corrosion, cracking, and fatigue damage for steel bridges.

Substructure deterioration can include damage from high water events and can result in the need to replace the bridge.

Inventory Changes

ODOT currently manages 2,773 bridges. This year, **seven new bridges were added to the inventory, of which three are replacements** and one is a new wildlife crossing. The bridges that were replaced were to improve condition. Three new bridges were added as the replacement of structures formerly not in the inventory with structures eligible to be included in the inventory. For example, there are many culverts that have openings that are too small to be included in the National Bridge Inventory. When one of these culverts is replaced with a bridge, the bridge is added to the inventory. Finally, two existing bridges in the state inventory were transferred to their respective local agencies.

With only three new bridges replaced, ODOT continues to lose ground in the effort to manage the system. Current funding levels pay on average for only three bridge replacements a year. At this rate, an Oregon bridge will need to stay in service for over 900 years which is well beyond an expected service life of 75 to 100 years.

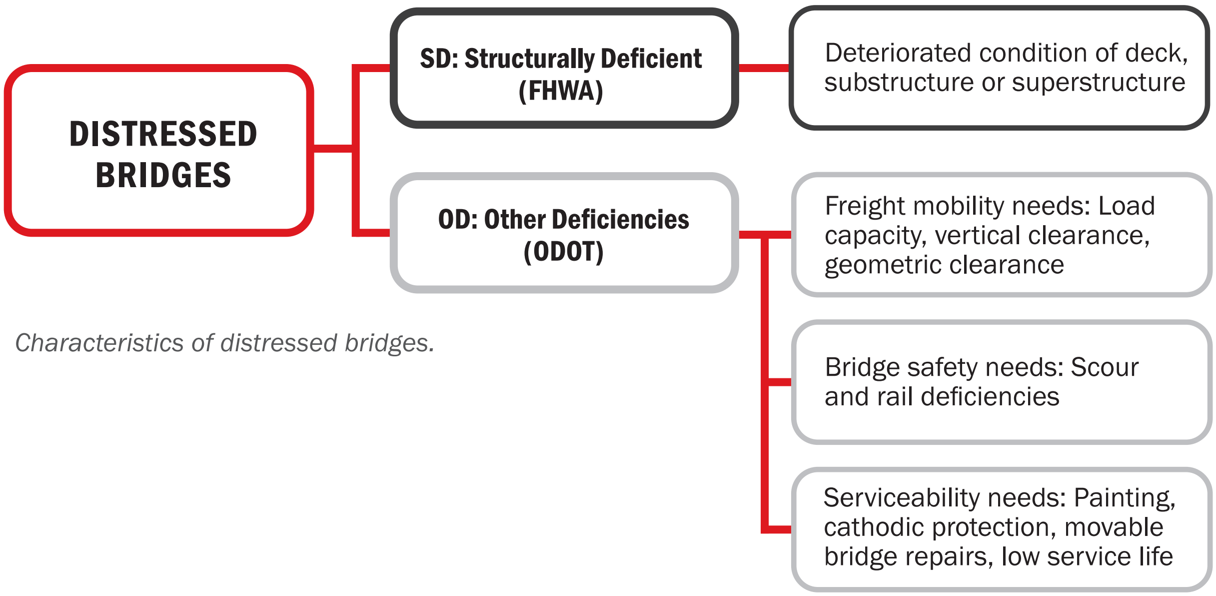
Bridge Key Performance Measure (KPM)

(Percent of bridges not distressed)

ODOT measures bridge conditions based on the bridge key performance measure (KPM) – percent of bridges not distressed. The KPM includes two categories of bridges:

1. The percent of bridges not structurally deficient (SD) as defined by FHWA.
2. The percent of bridges without other deficiencies (OD) as defined by ODOT. Structurally deficient and other deficiency components capture different characteristics of bridge conditions as shown on the following page.

A condition of distressed indicates that the bridge is rated as structurally deficient or has at least one *other deficiency*. ODOT considers both structural deficiency and *other deficiency a*spects in determining bridge needs and selecting projects for the Statewide Transportation Improvement Program.



Characteristics of distressed bridges.

The number of bridges with other deficiencies fluctuates with time due to bridges being repaired where a deficiency is removed or deteriorating where a deficiency is added.

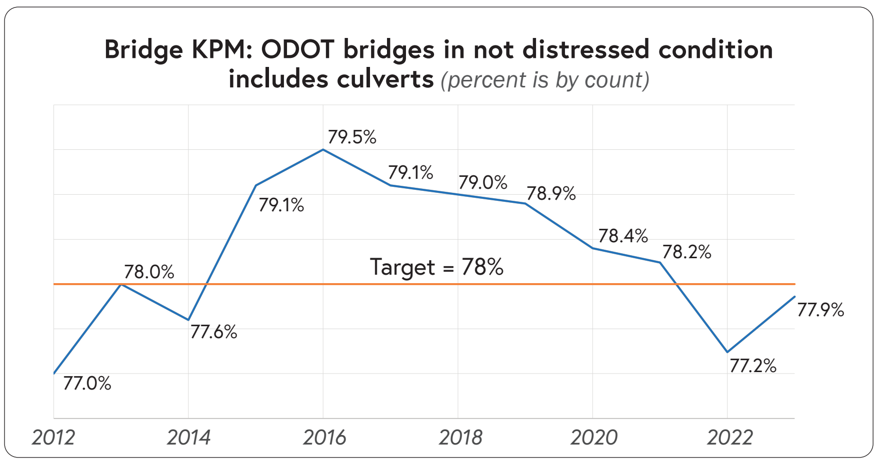
In reviewing the chart on the next page, there is a large spike propelling bridge KPM from a 2014 low of 77.6% to a 2016 high of 79.5%. This spike was due to the Oregon Transportation Investment Act-III and special federal funding sources enabling large number of bridges being built and replaced at higher-than-normal levels for a short period of time.

During the period between 2016 through 2021, the number of ODOT bridges in distressed condition increased gradually, with a corresponding average decline of 0.25% in Bridge KPM. However, in 2022, the Bridge KPM dropped a full percentage point to 77.2%. This is the first time since 2014 that the Bridge KPM was below the target.

The primary cause of the significant drop in the Bridge KPM was due to changes in load rating. In 2022, ODOT load rated bridges at a higher rate than usual to meet federal requirements that all load ratings include the specialized hauling vehicles. While these bridges had load ratings, these ratings were done using older methods. ODOT now uses the same load rating method for all bridges, which can result in lower rating factors for older bridges that were designed to the standards in place at the time. The percentage of ODOT bridges rated not-distressed continues to be below our target of 78%, however, 2023 data shows an increase from 2022 to 77.9% and is again approaching the target level (see graph next page.) The increase is a result of three bridges replacements, one new bridge, and Major Bridge

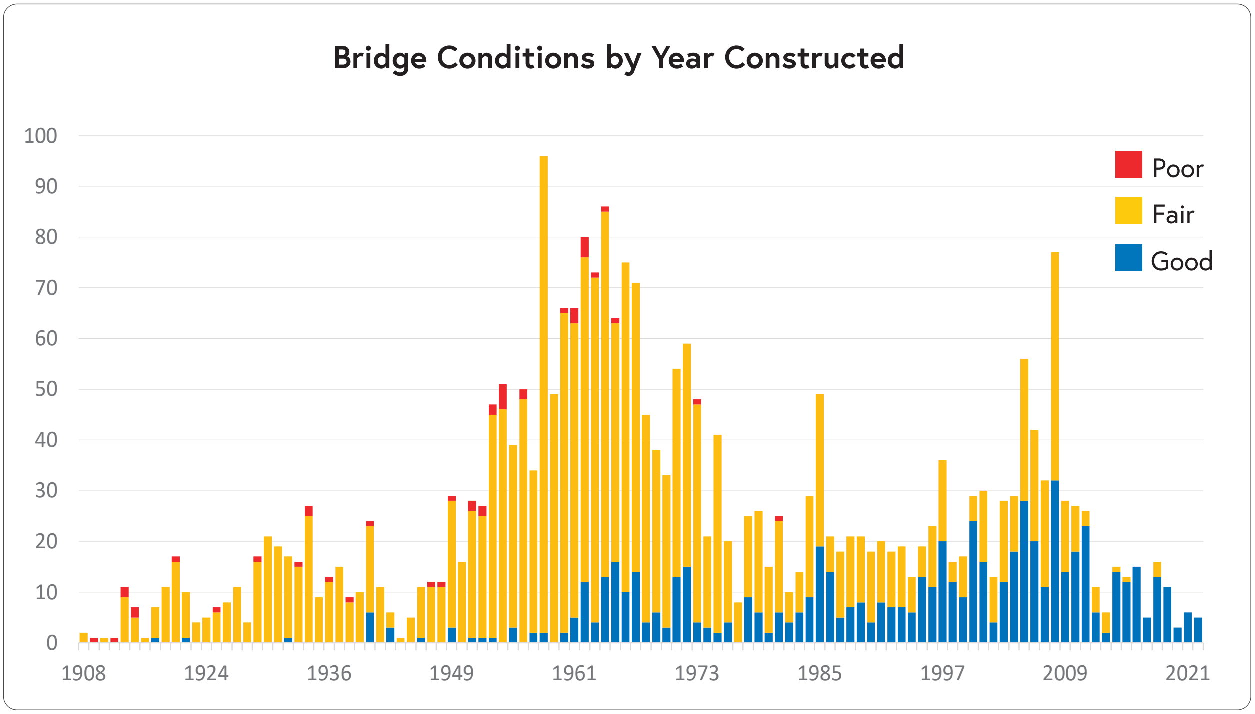
Maintenance (MBM) program work. The MBM program helped pave 53 bridges and address many additional repairs and maintenance thereby increasing the bridge KPM. Rehabilitation efforts include replacing aging timber elements with steel and concrete to bring the bridge out of distressed status. The MBM program also funded and completed 49 bridges with urgent or high priority needs such as deck rehabilitation, scour protection, and strengthening load restricted bridges. As a result of MBM work, 11 timber and two scour deficiencies were addressed. The additional funding the State Bridge Program received as part of the Infrastructure Investment and Jobs Act (IIJA) and House Bill 2017 will have a positive effect, however, we anticipate it will be more than offset by the continued deterioration of the state bridge inventory.

"Current evaluations indicate a decline in bridge conditions since 2016."



ODOT bridges in not distressed condition. Larger percentages are better.

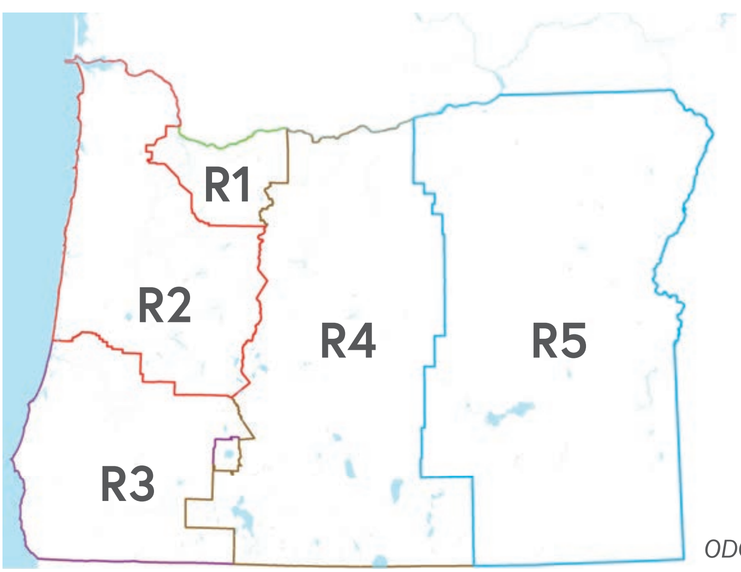
An alternate approach to understand the system needs is to compare bridge conditions by the construction year. The graphic below provides a picture of the looming wave of bridges constructed in the 1960s (now over 60 years old) that are in fair condition and approaching the end of their service lives. While fair bridges are safe, as they continue to age the maintenance and rehabilitation needs increase.



The graph above shows a large number of bridges built in 1950s and 1960s that are now 60 plus years old and most of them have exceeded their design life. Although operating in fair condition, they will eventually move to poor condition if not maintained or replaced.

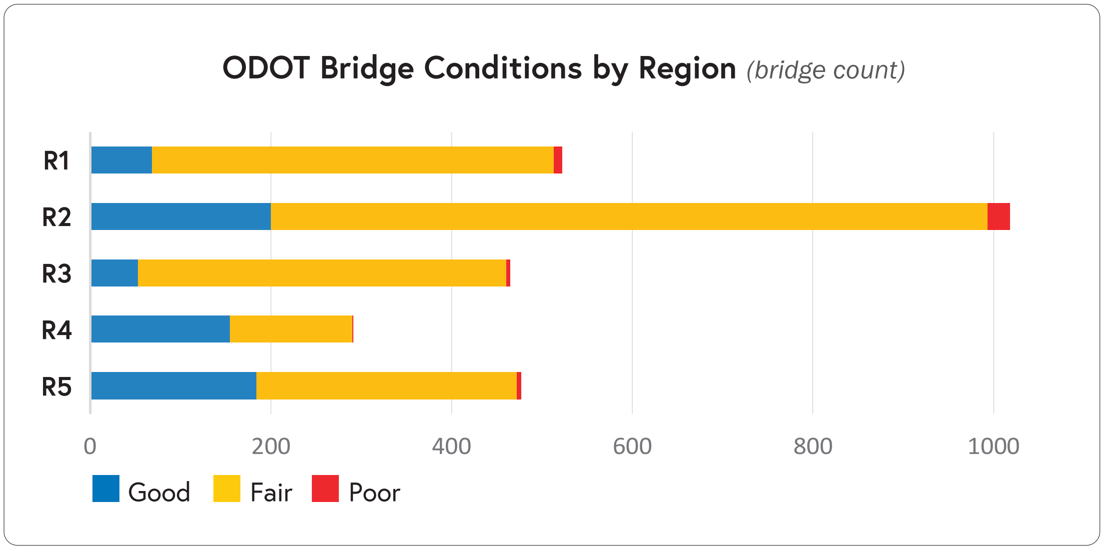
Bridge Conditions by Region

The distribution of bridges by bridge count and deck area are shown in the two graphics following the map. Region 1, which includes the Interstate Bridge over the Columbia, the Marquam and Fremont Bridges over the Willamette in downtown Portland have more deck area than Regions 3, 4 and 5 combined.

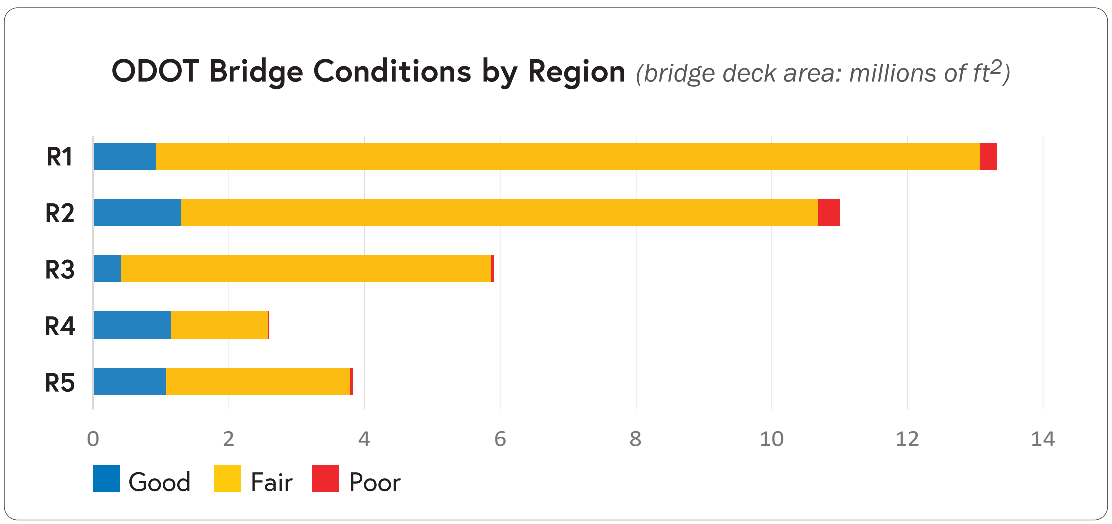


ODOT Region Map.

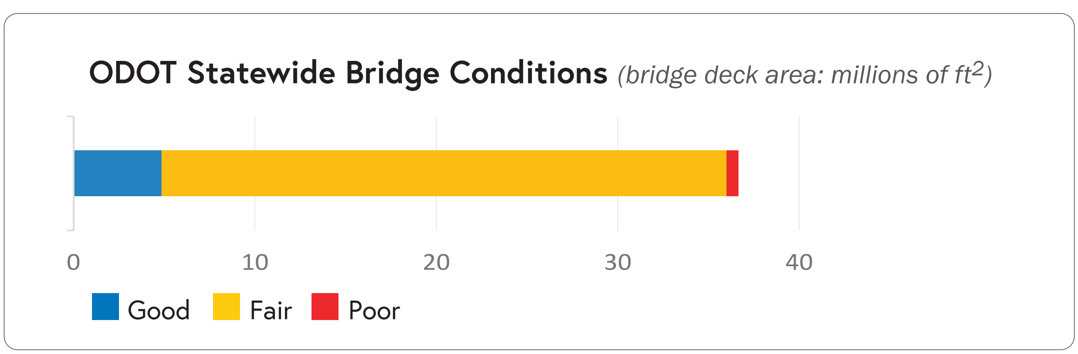
While the bridge system includes only 44 bridges in poor condition (structurally deficient), bridge conditions are slowly declining as noted by the bridge KPM.



ODOT bridge conditions by count. Bridge total count by region is R1 - 522 | R2 - 1,018 | R3 - 465 | R4 - 291 | R5 - 477.



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



The total bridge condition statewide deck area is 36.6 mil ft^2:
Good=4.87 mil ft^2, Fair=31.12 mil ft^2, Poor= 0.65 mil ft^2

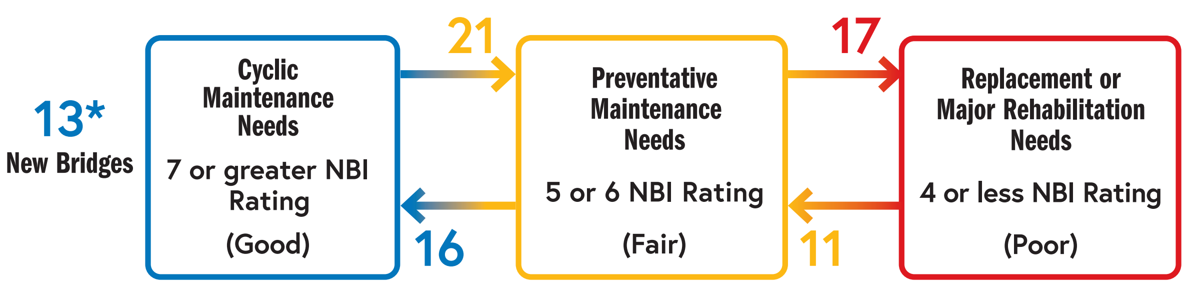
2021-2023 Changes in Condition Ratings

The following chart shows both the dynamic nature of bridge conditions and the growing backlog of work for those bridges that have changed conditions. The period from 2021 to 2023 reflects bridge conditions over one full inspection cycle (24 months.) In a balanced state, the number of bridges moving from blue to yellow and red (deteriorating conditions) would be equal to the number moving from red to yellow and blue (improving conditions.)

The chart shows that we are managing the poor (red) bridges reasonably well, but the number of bridges moving from good (blue) to fair (yellow), indicates that bridge preventative maintenance actions are not occurring at a rate necessary to maintain current conditions. Overall, in the last two years, 38 bridges had lower (declining) overall condition ratings versus only 27 bridges with higher (improving) condition ratings.

2021-2023 Changes in Minimum NBI Ratings

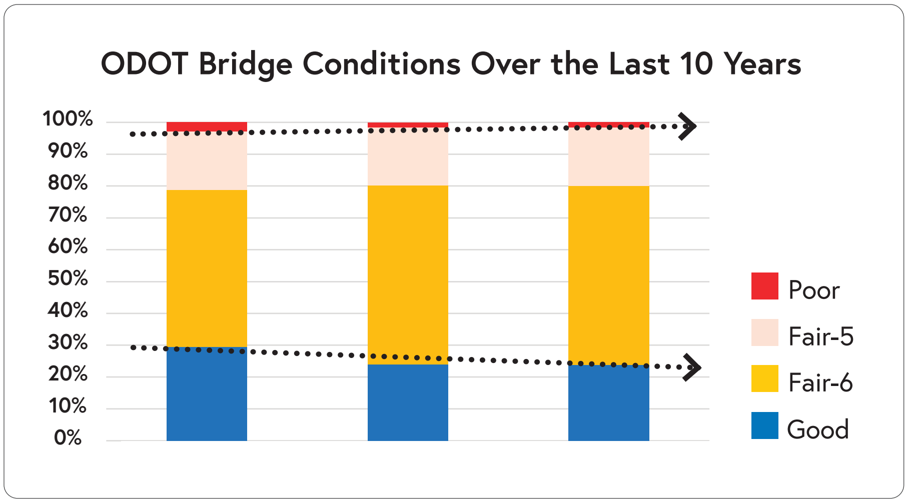
*(*4 new bridges, 8 replacements, and 1 transfer)*



More bridges had deteriorating conditions (21+17=38, top line) than bridges with improving conditions (16+11=27, bottom line.)

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.

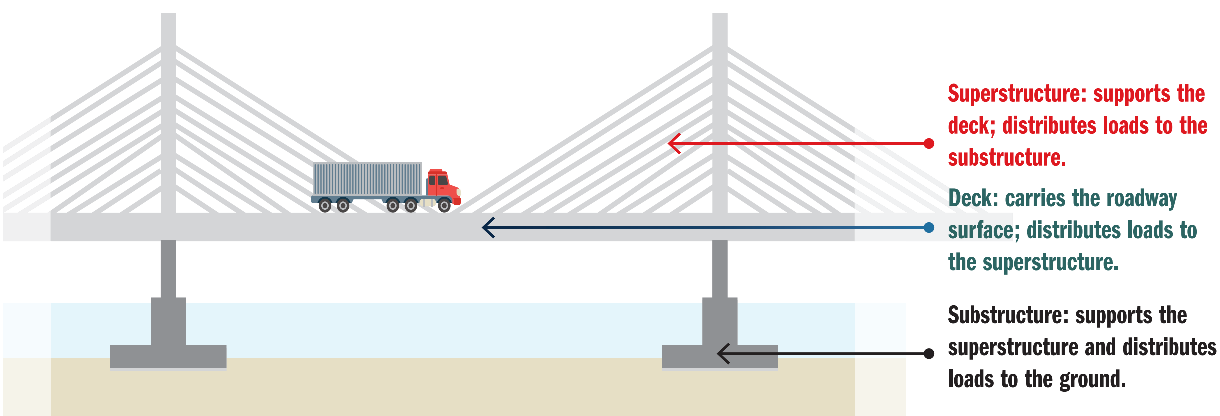


The ten year chart shows percent of good bridges continuing to move to fair condition due to aging inventory. If more bridges are not maintained or replaced, the poor inventory will continue to increase and put stress on the transportation system.

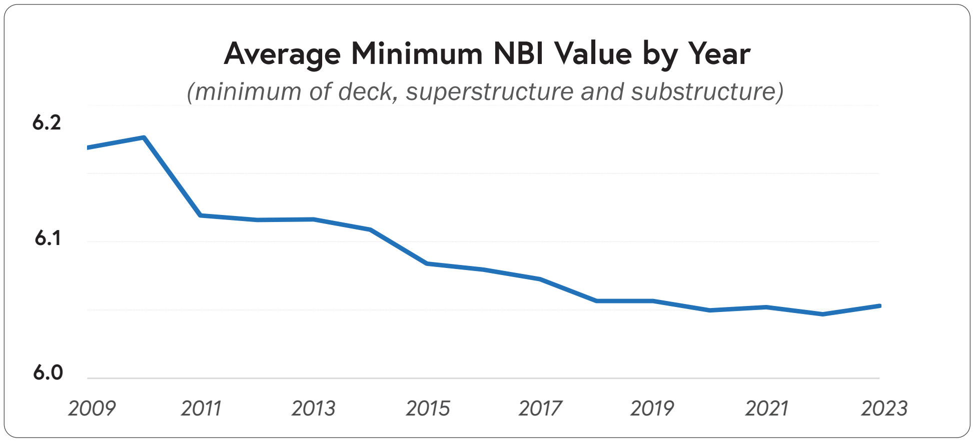
Of concern is the increasing number of bridges moving out of good condition into fair condition. The population of fair bridges continues to age and will require more and more rehabilitation and maintenance over time. Many fair condition bridges have already exceeded their service life but remain in place due to regular maintenance.

Substructure Conditions Deteriorating

The NBI value is a simplified measure of bridge conditions, reflecting only the lowest of the superstructure, deck and substructure conditions. To get a clearer picture of bridge condition changes over time, FHWA submittal data was pulled for 2009 to 2023 to compare the overall, deck, superstructure and substructure conditions of ODOT bridges.

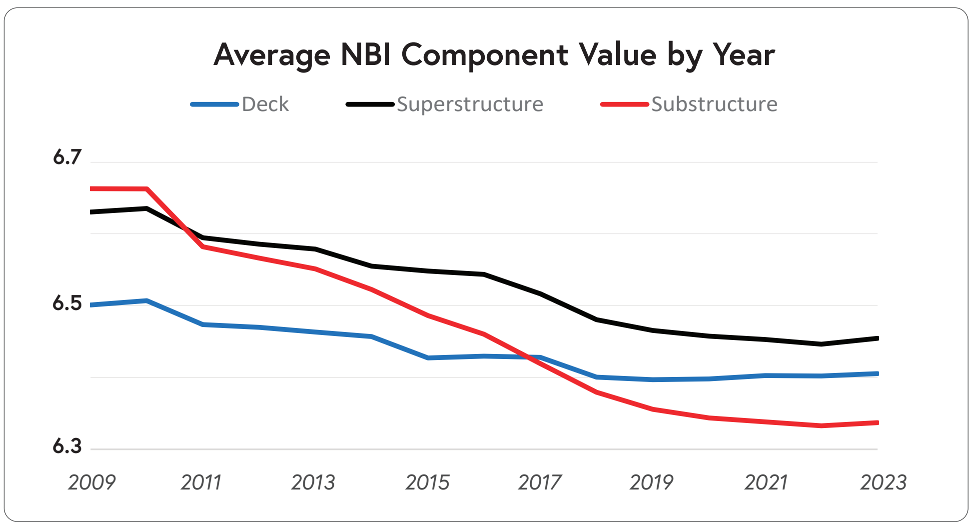


As shown in the graph on the next page, the overall NBI conditions (lowest of the superstructure, deck and substructure conditions) have declined since 2010, which would have been close to the end of the Oregon Transportation Investment Act (OTIA) work. Understanding which components of a bridge are deteriorating, is also shown on the next page.



The yearly average NBI value for all bridges has declined since 2010 but has remained relatively steady since 2020.

In this graph, the component NBI values are plotted to indicate changes over time. In 2009, substructure (red) conditions started out in the best condition, relative to the other components, but by 2017, they were in the worst condition. The average substructure NBI value indicates more bridge substructures have moved out of good condition into fair condition.



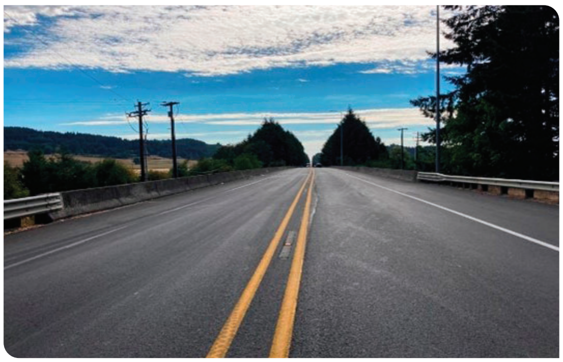
The graph indicates that averages of all three NBI components that indicate bridge conditions have trended downward from 2010-2022, however, it is important to note that substructure decline is steeper than others. When a bridge has a poor substructure, it is generally more cost-effective to replace than to maintain it. Poor substructure condition leads to bridge postings and potentially closures, if not replaced.

While a substructure deteriorating from good to fair condition is not a major concern at this time, as substructure conditions continue to decline, it will become 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. As bridge substructures approach poor conditions, expect more bridge postings and potentially closures.

NATIONAL BRIDGE PERFORMANCE MEASURE

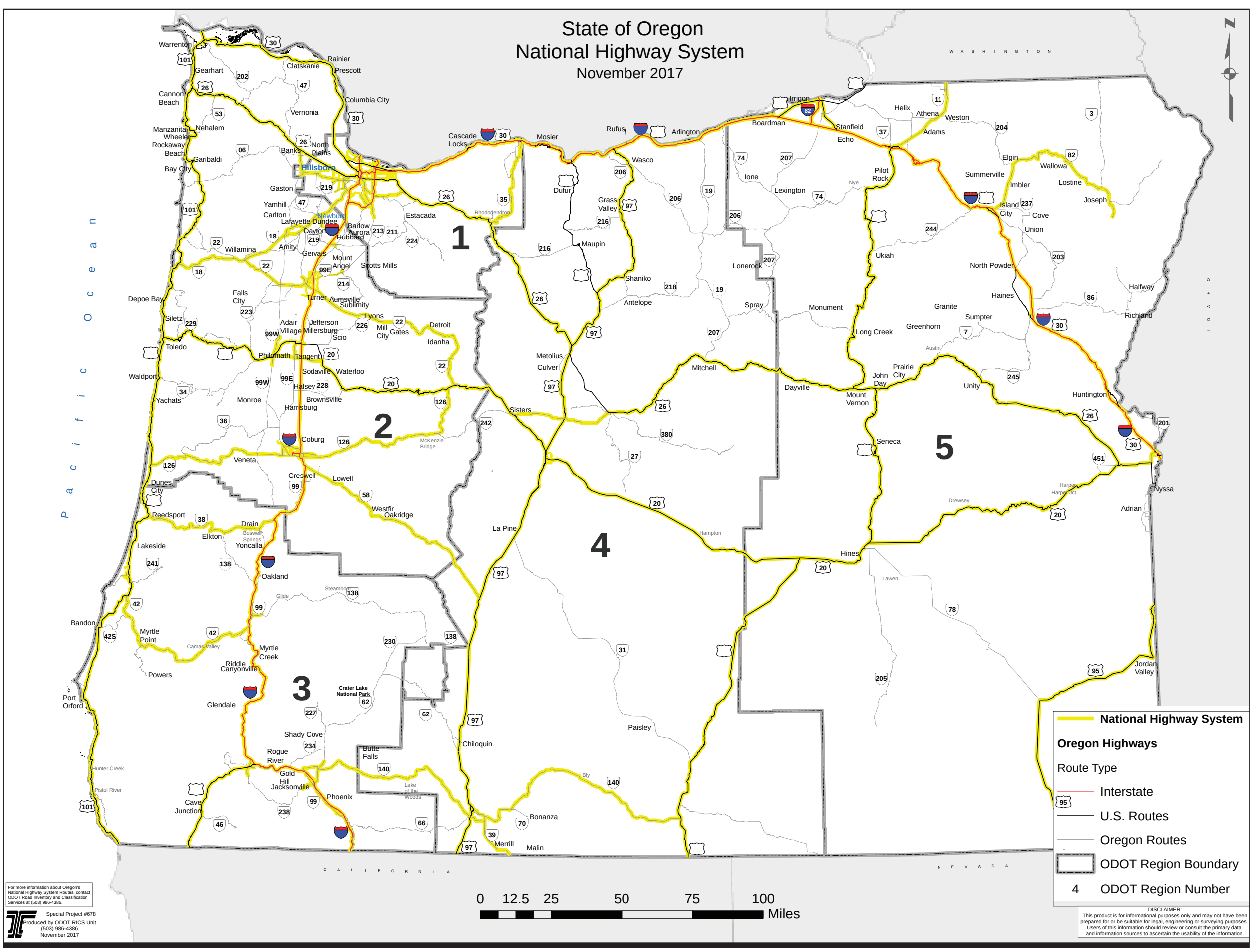
Condition Based Performance

The Infrastructure Investment and Jobs Act (IIJA) 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



State of Oregon National Highway System.

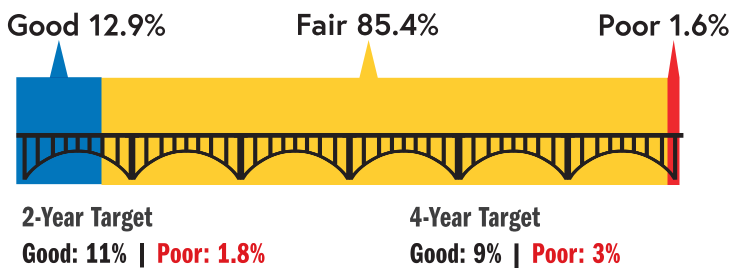
National Bridge Performance Measure Details

The graph below indicates that Oregon is exceeding the targets set for the National Performance Measure. The percentage of good bridges by deck area increased from 12.4 % in 2022 to 12.9% in 2023. This increase is attributed to the addition of five new NHS bridges and rehabilitation of eight existing bridges.

However, the percentage of poor bridges by deck area also increased from 1.1% in 2022 to 1.6% in 2023. This increase can be attributed to the normal deterioration of bridges as they age, spending the majority of their service life in fair condition.

2023 Oregon National Bridge Performance Measure Values

(percentage of deck area)

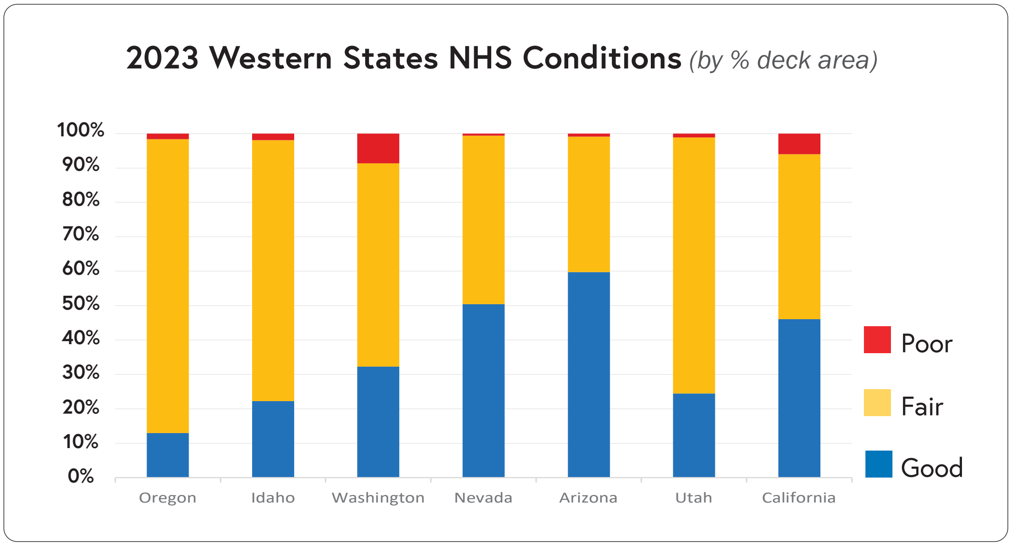


ODOT has a large inventory of aging bridges, as a result, more bridges are likely to transition to poor condition in the future.

Oregon's NHS bridge conditions and two-and four-year targets are shown above. Oregon expects NHS bridge conditions to decline but be under the 10% threshold for poor bridges 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.

Performance Relative to Neighboring States

Compared to neighboring states, Oregon has the least quantity of NHS bridges in good condition. The graph shows northwest states' bridge conditions using 2022 data submitted to FHWA. While Oregon ranks among the best for the least percentage of poor bridge conditions, it includes the smallest percentage of bridges in good condition as a result of few bridge replacements. Due to a large number of aging bridges in Oregon's inventory, some of the fair condition bridges continue to slide into poor condition due to limited funding resources required for bridge replacement and maintenance.

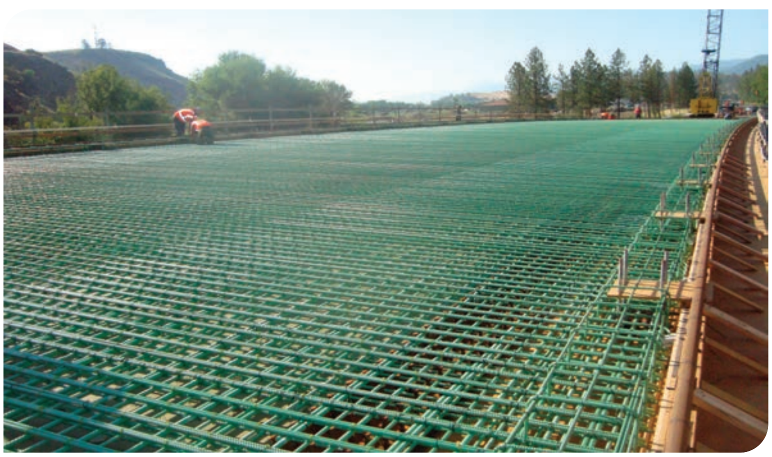


Oregon has the lowest percent of good bridges and highest percent of fair bridges compared to its neighbors. If not replaced, fair bridges will attain poor status over a period of time.

The National Performance Measure 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.

BRIDGE PROGRAM UPDATES

		FOCUS	
1	Major Bridge Maintenance		► Funding ► Accomplishments ► Repair of Older Bridges ► Repair of Bridges for Scour
2	Bridge Preservation		► Preserving Oregon's Big Bridges-Cathodic Protection ► Painted Steel Bridges ► Preserving High-Volume Bridge Decks
3	Seismic Program Status		► I-205 Abernethy Bridge ► Van Buren Bridge ► US 97: Oregon 58-California Border Bridge
4	Bridge Load Rating		► History ► Basics ► SHVs and EVs



Preparing reinforcement for a new deck on a new bridge.

Milling work to remove worn concrete and replace with new surface.

1 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.
- Starting in 2021, funding increased to $12,000,000/year.

One of the primary objectives of the MBM program is to address urgent maintenance recommendations. Urgent maintenance recommendations are defects identified during the routine bridge inspection that need to be corrected as soon as possible or pose a traffic safety concern. In 2022, the MBM program funded 18 projects to address urgent maintenance recommendations at a total cost of $1,814,130. Examples of these projects include repairing damaged pavement, replacing deteriorated timber members, deck repairs, and scour.

Typical Distresses Addressed by MBM

Failed deck.

Damaged bridge joint.

Distressed timber.

Rusted bearing.

Preventative maintenance activities are widely considered a cost-effective way to extend the service life of bridges. The deck is the highest value item on a bridge and 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 and reach the reinforcing steel. Once the reinforcing steel begins to corrode, costly deck rehab or replacement projects are required. However, if the deck can be sealed quickly, the deck service life can be significantly extended. In 2022, the MBM program funded projects to seal 16 bridge decks at a total cost of $1,878,000. This work helped protect approximately 531,000 square feet of bridge deck from degradation.

Maintaining the asphaltic concrete pavement (ACP) on bridge decks and approaches has become a growing challenge for the state. Deferred maintenance on secondary highways has resulted in more bridge only paving projects. These smaller volume paving projects tend to attract high bids. In 2022, the MBM program funded paving work on 53 bridges at a total cost of $4,389,780. This is over one third of the funding that the MBM program has to meet bridge maintenance needs and has a negative impact on our ability to fund repair or strengthening projects. Maintaining ACP represents a significant expenditure and will be a continued challenge for the agency into the future. The balance of the $12 million is used for other miscellaneous maintenance projects as necessary.

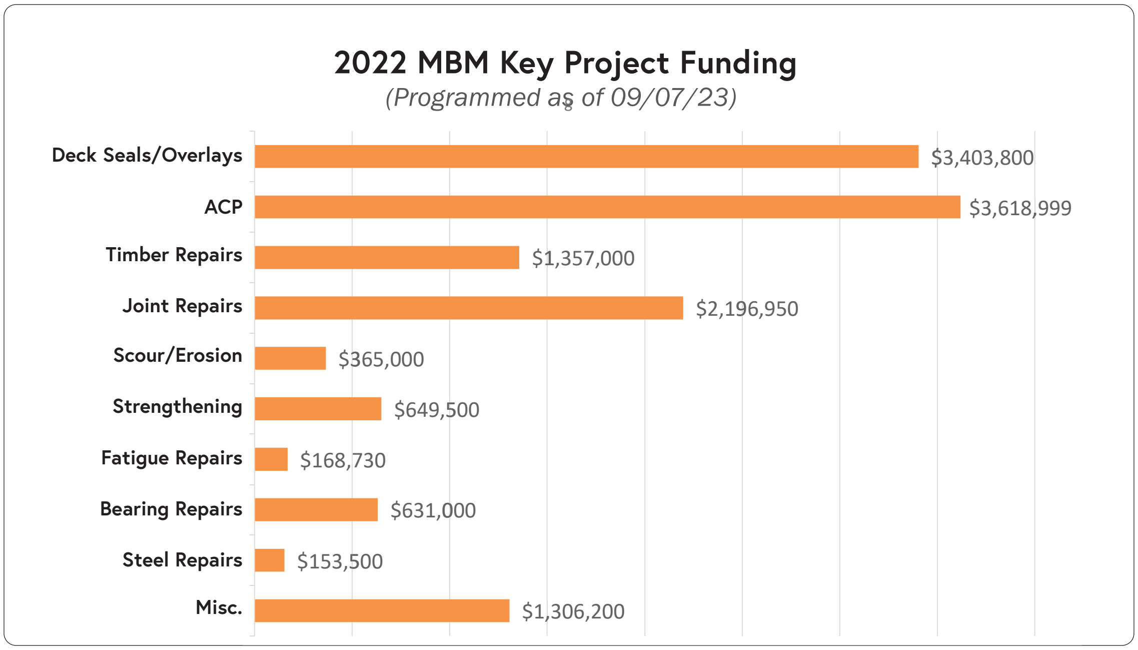
In addition to addressing urgent defects and performing preventative deck maintenance, the MBM program addressed deck joint repairs, timber repairs, approach repairs, bearing replacements, and maintenance on the moveable bridges. The variety and volume of work performed by the MBM program is what makes it a key component in maintaining Oregon's infrastructure.

2022 MBM Project Accomplishments

In 2022, ODOT repaired nine bridges in poor condition through the MBM program. In addition, we repaired 49 bridges with urgent or high priority needs. These are bridges with defects identified during routine bridge inspections that need to be corrected as soon as possible since they may pose a traffic safety issue.

There is a detailed list of MBM expenditures in the graphic below, which includes eight bridges that were not strong enough to support modern truck weights and were therefore strengthened.

ODOT is updating the load carrying capacity calculations of all existing bridges in the state. By doing so, MBM will add more strengthening projects to avoid load postings and closures. You can find more details on ODOT's load rating efforts in this report.



2022 annual funding distribution by project type, with about $3.4 million for deck seals/overlays, $3.6 million for ACP, $1.3 million for timber repairs and $2.2 million for joint repairs.

MBM Focus on Older Bridges

Each year the Major Bridge Maintenance Program funds approximately 200 bridge repair projects typically in response to a localized defect on the bridge:

- Damaged joints
- Rusted bearings
- Rotted timber pile
- Spalling concrete, etc.

Localized MBM repairs can raise the bridge condition rating from poor to fair, however, the rise 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 we must correct. Many of the bridges that require the repairs should be replaced, however, the upfront replacement costs simply aren't available as funding is allocated to higher priority bridges and spread around to keep more bridges in service.

As resources continue to shift toward maintaining deteriorating bridges that should be replaced, fewer resources are available for cost effective preservation and maintenance treatments. Eventually bridges on lower priority routes will not be serviceable leading to load restrictions or even closures, posing a significant risk to Oregon's mobility in the coming decades.

MBM Scour Project

Little Humbug Creek, Oregon 47

U.S. 26 (Oregon 47) is a major arterial highway and an emergency services route between Portland and the coast. The Little Humbug Creek crossing is at milepost 8.22 and is a two-span bridge structure supported on shallow spread footing foundations and is classified as scour critical. Since there are no original plans, we can only speculate on the design. It appears to have been built with square concrete columns supported on individual pier block pedestals and later linked with a concrete skirt.

For several years, scour has been monitored by the bridge inspector after initially discovering the signs of active erosion. In early December 2022, after a high-water event, the Seaside Bridge Maintenance crew checked in on the bridge and discovered major scour under two footings supporting the bridge. Later that morning the region bridge inspector discovered that one of the support footings was completely exposed and mostly undermined with very minimal bearing remaining. The scour extended beyond the footing and into the roadway approach fill.

Scour problem threatening the bridge structure.

By early afternoon, shortly after drawing attention to the critical finding, the district manager authorized an emergency repair due to the potential hazard and loss of the bridge. The Seaside Bridge Maintenance crew had temporary shoring in place by the end of the day and performed 24-hour surveillance until an engineered solution was installed.

Temporary support provided as part of the emergency repair to prevent catastrophic failure.

The creek flows all year with enough volume to complicate excavation and concrete work. The crew observed several large segments of grouted cobble from a previous revetment in the channel and determined it was an accelerant for the scour as it directed a turbulent flow into the embankment. The crew broke up the grouted cobble masses to calm the flow, and placed plastic and sandbags to help redirect the creek away from the bents to facilitate construction. To reestablish bearing under the footings, they placed steel reinforcement and concrete into the large open voids with stay-in-place formwork and covered with a protective layer of large rocks.

2 Bridge Preservation: Next Steps in Cathodic Protection

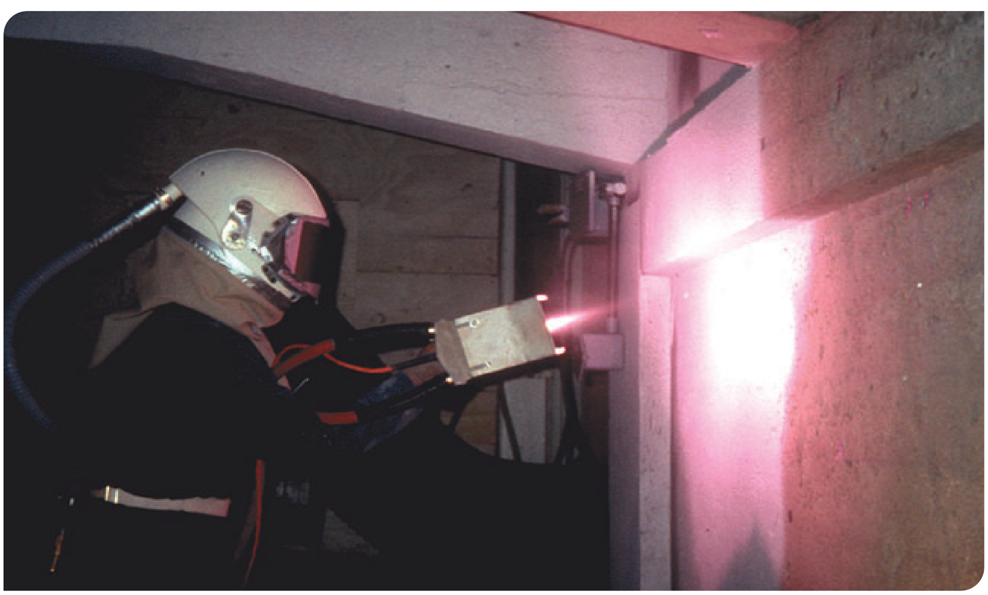
Bridge preservation covers any actions taken to extend the lifespan of a bridge. These actions range from small maintenance level projects such as sealing a bridge deck to large projects such as painting steel structures or protecting concrete with cathodic protection.

In the past couple of years there have been several cathodic protection projects in the Bridge Preservation Program. Two major projects have been completed and four more are in design, with two of those beginning construction before the end of the biennium. Because there's been an uptick in these projects recently it helps to understand the history of cathodic protection in Oregon.

What is Cathodic Protection?

When reinforced concrete ages, especially in saltwater environments, the steel inside the concrete starts to rust. This is called corrosion and is the result of a chemical reaction between the chlorides in the saltwater and the steel. Corrosion causes the concrete to crack, reducing the strength and allowing more salt in. There are multiple ways to combat corrosion-caused damage, including replacing the affected concrete, using corrosion resistant reinforcement, or cathodic protection.

At its most basic level, cathodic protection is created by supplying an alternative material for the salt to corrode. In the extremely corrosive environments of the Oregon Coast, we often apply a zinc coating over the surface of the concrete as the alternative material and supply a small electrical current to encourage the chemical reaction to protect the steel. This system is known as impressed current cathodic protection (ICCP.)



Arc-spraying zinc onto concrete for impressed current cathodic protection system.

History of ICCP

Oregon first started experimenting with cathodic protection in response to the severe corrosion of the Alsea Bay Bridge in Waldport. The original bridge at that location was built in 1936 and included poorly washed beach sand as part of the concrete mix which supplied chlorides and resulted in early corrosion. By the 1970s the bridge was in poor condition. The engineers of the time began looking at new technologies, such as cathodic protection. Because it was experimental at the time, ICCP was not applied to the entire structure — only to one pier. The high level of corrosion eventually led ODOT to replace the bridge. However, we learned enough to realize cathodic protection could be the answer for saving other magnificent coastal bridges.

The demolition of the Alsea Bay Bridge in 1991. The replacement bridge is in the background.

ICCP Bridges of Oregon

Bridge	Year Built	Surface Area	Current CP Applied	First CP Activated
Tenmile Creek, U.S. 101	1931	14,769	2008	
Hunter Creek, U.S. 101	1959	16,500	2013	
Pistol River, U.S. 101	1962	34,350	2013	
Big Creek, U.S. 101 at MP 175.02	1931	20,075	2014	
Fogarty Creek, U.S. 101	1955	12,400	2015	
Siuslaw River, U.S. 101 (Florence)	1936	173,000	2018	
Coos Bay, U.S. 101 (McCullough Memorial Bridge)	1936	119,392	2018	
Devils Lake Outlet, U.S. 101 (D River)	1949	17,300	2022	
Cape Creek, U.S. 101	1931	102,399	2020	1991
Cape Perpetua Half Viaduct, U.S. 101	1931	1,838	2020	1998
Yaquina Bay, U.S. 101 (Newport)	1934	90,673	2023	1997
Depoe Bay, U.S. 101	1927	63,958	2024-2027	1996
Rocky Creek, U.S. 101 Frontage Road (Ben Jones)	1927	40,149	2024	2001
Cummins Creek, U.S. 101	1931	19,106	2024-2027	2001
Rogue River, U.S. 101 (Gold Beach, Isaac Patterson)	1930	180,511	2024-2027	2005

Table of all the active ICCP bridges in Oregon.

Focus on the Yaquina Bay Bridge

The Yaquina Bay Bridge crosses Yaquina Bay in Newport. The total length of the structure is just over two-thirds of a mile, composed of three primary structure types: steel arches, concrete arches and concrete girders. The first ICCP project on the bridge was installed on the south end from 1994-1997. The much shorter north approach, made up of concrete girders, was left untreated during that project. In 2023, ODOT, with the contractor Wildish Construction Company, wrapped up a new ICCP project, this time treating all of the concrete spans on the bridge.

The project allowed a clear window into the effectiveness of ICCP. Despite being only 8% of the length of the bridge, the untreated north approach contributed to 95% of the concrete repairs in the project. It's clear the system from 1997 provided significant protection to the south end of the bridge, despite an inconsistent power supply. As a result, ODOT was able to preserve the bridge with a $26 million ICCP project, rather than a much more disruptive bridge replacement, expected to cost nearly $1 billion.

Yaquina Bay Bridge after original construction in 1936.

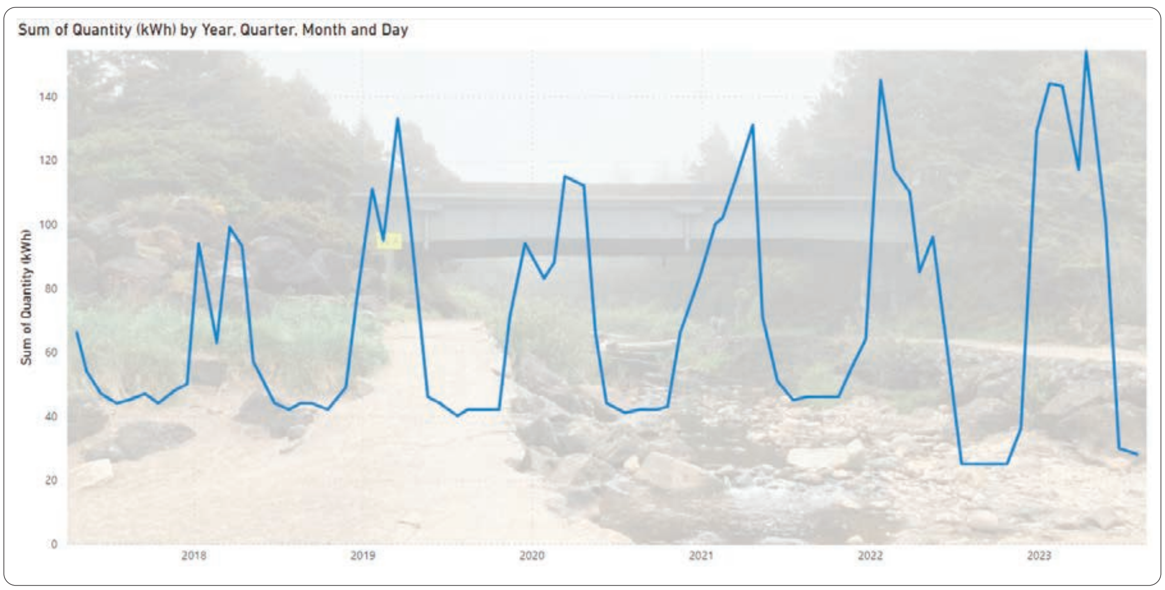
What's next in ICCP?

When applying ICCP to a bridge, the first step is to sandblast the surface of the concrete to remove any contaminants, such as grease or paint that would prevent the zinc from fully adhering to the surface. Doing this removes the outer layer of the concrete, slightly thinning the concrete element.

Depending on the aggressiveness of the environment, zinc coating can last nearly 30 years with supplied power year-round. When zinc is consumed by the chemical reaction, the bridge must be sandblasted again to ensure that the next layer will stick, once again thinning the concrete cover.

Over a couple of cycles, the resulting concrete is extremely rough looking, and may provide inadequate protection of the internal steel in some locations. This can also cause electrical faults in the ICCP system. It may not be possible to apply surface zinc a third time unless the concrete surface is restored. Presently, we don't know what we will do in 20 years when these current systems wear out, but now is the time to start researching the answer, before we lose another bridge like Alsea Bay.

The first step in the process is to look for ways to extend the lifespan of the current systems. To that end, we are implementing better tracking on the ICCP systems. This will allow the power supply to be more finely tuned to the exact needs of the bridge, reducing the wear and tear on areas that are not seeing as much corrosion. In addition, some systems may reduce the corrosion rate enough to allow the power to be shut off for extended periods of time.



The chart shows the power usage for the ICCP system on Fogarty Creek Bridge. The seasonal cycle of high and low humidity impacts the power demand. A photo of the Fogerty Creek Bridge is in the background.

3 Seismic Program Status

Seismically retrofitting existing bridges can be more challenging than building new structures, especially when an existing bridge foundation needs to be strengthened, enlarged, or totally replaced. Combined with increased construction costs over the last three years, the seismic program faces some significant challenges to stay on its original course.

In early 2023, the Seismic Advisory group evaluated investment alternatives that help build resiliency while addressing other immediate bridge needs along Phase 1 routes. Several bridges on Phase 1 routes are experiencing significant distress due to deterioration of important structural components. The Seismic Advisory group recommended replacing Bridge 02443 (I-84 westbound over Union Pacific Railroad). The bridge will be funded from the seismic program and preliminary design for the new structure is currently underway.

This Seismic program strategy adjustment necessitated putting all the bridge retrofit work that was previously scoped for the I-5 northbound bridges on hold starting near Eugene. Active seismic bridge retrofit projects will still move forward and will be funded through completion.

Construction is underway on U.S. 97: Oregon 58-California Border Bridge Retrofits project, consisting of six bridge retrofits and one complete bridge replacement. This project will improve the seismic resiliency of U.S. 97 which is designated as a primary north-south lifeline route in the aftermath of a major earthquake.

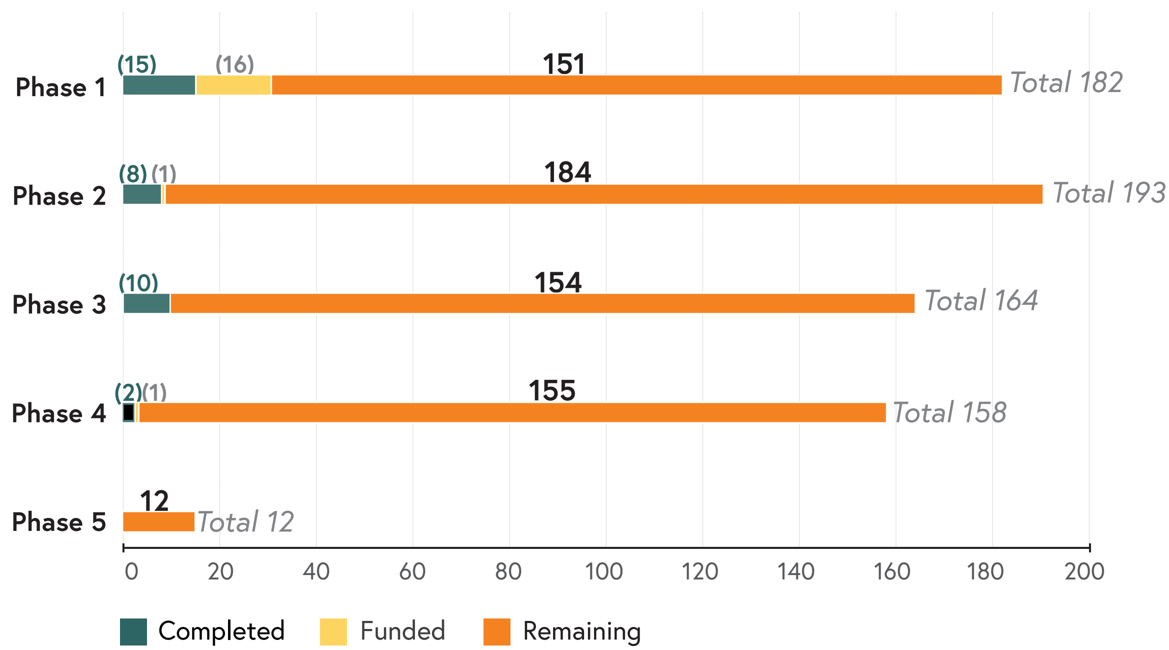
Link River & Hwy 20, Hwy 4: Strengthening existing foundations requires installation of micropiles.

With work already completed on one bridge, (U.S. 97 over United States Bureau of Reclamation Canal, Bridge 08345), work continues on five other structures, with construction scheduled to begin in early 2024 on Bridge 02474B (U.S. 97 over UPRR (Lobert.) The most complex work for this project is strengthening existing bridge foundations, constructing new drilled shafts, working adjacent to railroad tracks and performing in-water work.

Bridge 08347 (U.S. 97 over Link River) is one of the most complex structures on this project. All bridge footings that are not affected by water have been either strengthened or widened. New footings and columns have or will be constructed at several support locations as means of seismic retrofit.

In early fall 2023, construction started on another seismic retrofit project; Oregon 58: Coast Fork Willamette River to Lower Salt Creek Bridges. This project will provide another seismically resilient corridor that will allow traffic flow from U.S. 97 to the Willamette Valley (via I-5) immediately after a major seismic event. Four bridges will be strengthened within this project.

ODOT Seismic Status



**Several bridges have been removed from the program after the field scoping or the preliminary design confirmed no need for seismic improvements.*

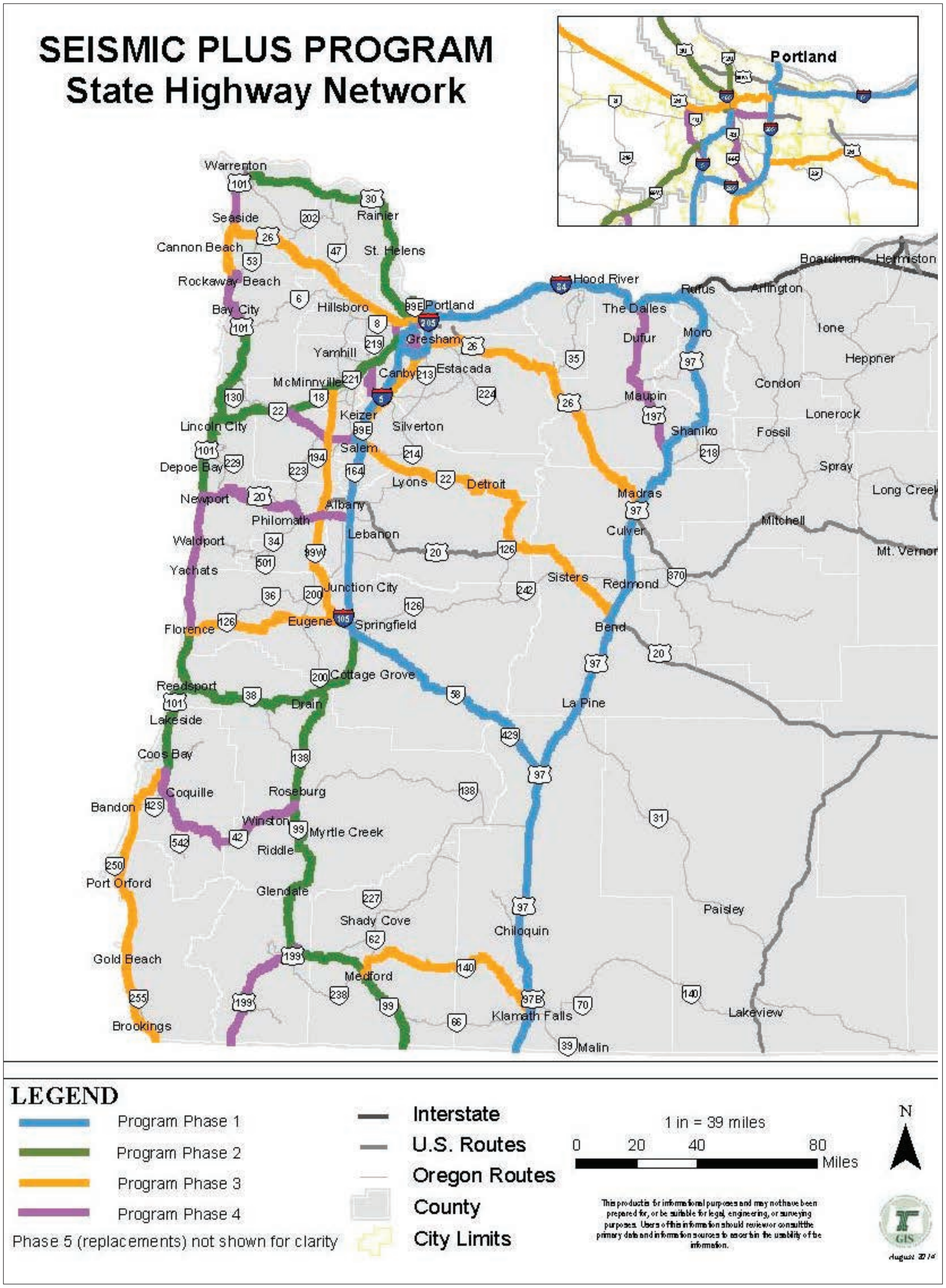
Phase 1 Provides a connection to the Redmond Airport; east-west freight movement and a north-south corridor on U.S. 97 -- the cornerstone of the program.

Phase 2 Connects the Willamette Valley with the coastal communities and southern Oregon (Rogue Valley).

Phase 3 Adds redundancy and capacity to the transportation network already strengthened in Phases 1 and 2 of the program.

Phase 4 Finalizes strengthening of all proposed Seismic Lifeline Corridors.

Phase 5 Includes 12 bridge replacements like the Medford Viaduct, the Ross Island Bridge, several historic coastal bridges and other large bridges.



The Bridge program has followed the guidelines and recommendations provided in "ODOT's Seismic Implementation: Policies and Design Guidelines," closely for allocating seismic program funds. Addressing seismic vulnerabilities of bridges on Phase 1 routes remains the program's priority, however, several bridges on other program phases have either been replaced due to poor condition or retrofitted/replaced as part of projects funded directly from the House Bill 2017 (e.g., Southern Oregon Seismic Bridge Retrofit.)

Other Funded Seismic Projects

Construction activities are in full swing on **I-205 Abernethy Bridge Project.** In addition to providing a wider structure and accommodating additional travel lanes for both northbound and southbound traffic, this project will improve the seismic performance of the existing bridge, making it the only reliable point for interstate traffic to cross the Willamette River after a major seismic event affecting the Portland Metro area.

This project consists of numerous seismic retrofit measures that can be categorized into three primary types of work; replacement of existing bridge supports, strengthening of supports, and replacement of bridge bearings.

The existing support replacement work is primarily associated with supports in the water or near the water's edge. These support replacements are reinforced by drilled shafts as large as 12 feet in diameter. As of September 2023, 13 of the 20 drilled shafts on the project associated with support replacement are complete.

Abernethy Bridge: Construction of new drilled shafts.

Strengthening work is being done to support the approach spans of the bridge, and consists primarily of micropile and footing anchor installation, and enlargement of some of the existing footings, columns, and pile caps. With the micropile installation complete at two of the bridge piers (Piers 9 and 10), construction is now underway for enlarging the existing bridge column at Pier 9. This work includes the installation of numerous resin bonded anchors between the existing concrete and new enlargement concrete section.

The existing bearings on the bridge will be replaced with triple friction pendulum isolation bearings. The new bearings are in fabrication at this time and we've completed a site visit to observe the testing required on bearings of this type.

Design is now underway for the **Oregon 22: Center St. Bridge Project.** This project will provide a much-needed resilient structure, not only for the City of Salem, but for emergency responders to be able to reach further west after a major Cascadia event. Although not exactly the same size as the Abernethy Bridge, complexity and the nature of seismic deficiencies make the retrofit design of Center St. Bridge as challenging as any major structure.

Poor soils, age variation for different sections of the bridge and high traffic volume are just a few of the challenges that the project team will be facing with this project. We performed a value engineering study for this project in March 2023. Based on the results and recommendations of the Value Engineering team, the scope of the project has been adjusted, as retrofitting the west approach structures no longer appear to be a viable option. Instead, the team recommended a full replacement of the west approach structures as the most cost-effective approach and it will be carried over by future project(s).

In addition to the emphasis ODOT is placing on addressing the seismic vulnerabilities along the Phase 1 routes, additional bridges throughout the state are also being made seismically resilient. This happens as older and vulnerable bridges are either replaced or modernized for capacity or condition-based reasons.

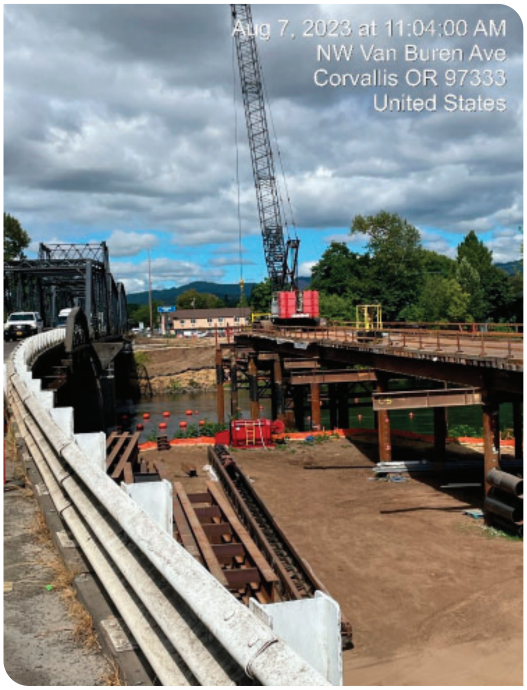
Construction has started to replace the **Van Buren Bridge** in Corvallis. Like most bridge replacements, construction began by building a temporary structure referred to as a "work bridge." The work bridge was completed by end of September 2023 and a second structure designed for traffic diversion was complete in November.

The traffic has since been shifted from the existing bridge onto the diversion structure and work will begin to remove the old bridge.

The last step will be removing the existing bridge piers so we can begin construction on the new bridge — expected to start summer of 2024.

Work on the new structure will continue through 2024 with the goal of completing the majority of it by late spring of 2025 and move traffic to the new bridge.

Later in 2025, we will remove both temporary structures and begin work on other elements of the project including retaining walls, sidewalks, and the rebuild of VanBuren on the west side of the river.



Van Buren Bridge: Temporary structures.

The Southern Oregon Seismic Bridge Retrofit is an additional seismic project funded by House Bill 2017. This project is divided into four separate projects. The first project coincided with a pilot project to evaluate the cost-benefit of using the buckling restraint bracing (BRB) system for seismic bridge retrofits. The BRB system proved to be a cost-effective retrofit method for bridges with multi-column bridge supports, especially for grade separation structures. It allowed ODOT to address the seismic vulnerabilities of the first two bridges of this project (I-5 northbound and southbound over Leland Road) at a relatively low cost. ODOT will continue exploring opportunities to use this retrofit strategy in future seismic retrofit projects.

The second project consists of five bridges. Four of the five are complete with the last one expected to be complete in November 2023. The remaining work requires the road under the bridge to be closed to through traffic during construction. The completion date for the entire bundle has been extended to January 2024.

Construction on the third project, also consisting of five bridges, was completed in November 2022. One of the bridges on the third project is supporting a detour route for several vulnerable bridges on I-5.

The fourth project includes replacing three bridges on another detour route for I-5. Design for all three bridges is complete and the contractor has been selected for the construction phase. Construction activities are expected to start in February 2024.

The Southern Oregon Seismic Bridge Retrofit supports a strategy that focuses on mitigating seismic impacts along the I-5 south of Eugene and Oregon 140, which are key lifeline routes to and from the Rogue Valley.

Bent strengthening on Southern Oregon Seismic Bridge Retrofit project.

Most of the seismic impacts on these routes are expected to be addressed through quick repairs or temporary detours. We will use the funding to address those bridges and potentially unstable slopes that are higher risk or where a feasible detour does not exist.

Right of way funding is available for coastal maintenance stations at Seal Rock and Coos Bay. We are considering an additional facility in Astoria, but it is not currently funded. Each station will be supplied with seismic response kits. The purpose of the kits is to stockpile key materials and supplies that can assist local communities in the early days following a seismic event. The kits will include culvert pipes of various sizes, construction materials, solar powered 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.

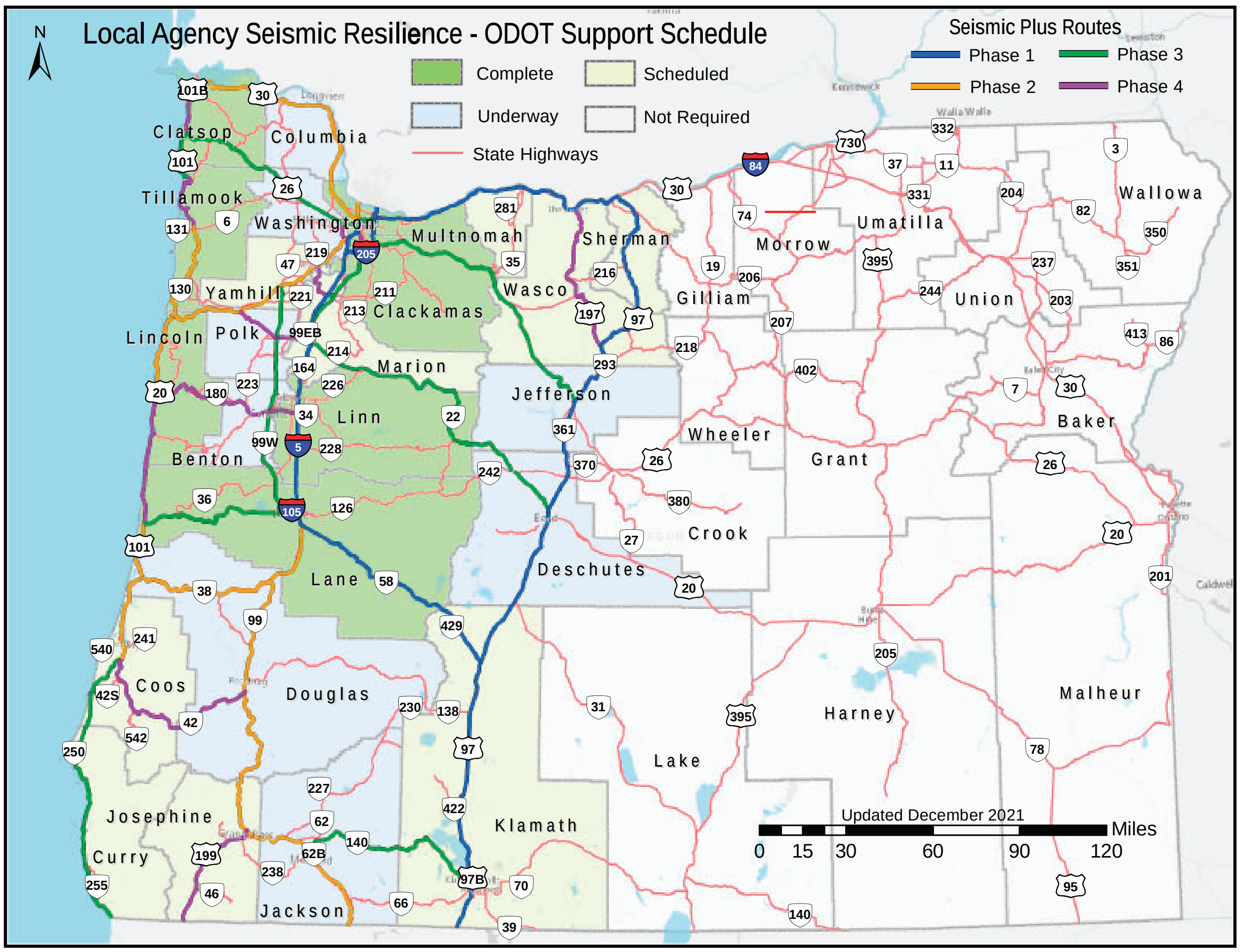
Local Agency Seismic Resilience Support

The Bridge seismic standards engineer and other leaders at ODOT are 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, we can also compare it 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.

The status of the local agency work is provided below.

Complete	Underway	Scheduled
Clackamas	Benton	Coos
Clatsop	Columbia	Curry
Lane	Deschutes	Hood River
Lincoln	Douglas	Josephine
Linn	Jackson	Klamath
Multnomah	Jefferson	Marion
Tillamook	Polk	Sherman
	Washington	Wasco
		Yamhill



Local Agency Seismic Resilience - ODOT Support Schedule.

4 Bridge Load Rating

An early delivery truck with two axles.


An early freight truck with just three axles.

Trucks continue to evolve to improve the efficiency of freight movement and emergency response. The result is modern trucks travelling over older bridges designed for much smaller loads. To ensure bridges can safely support the trucks, ODOT evaluates each bridge to determine the safe load capacity based on a load rating.

ODOT is currently including the specialized hauling vehicles (SHVs), and emergency vehicles (EVs) in all new load ratings. Due to the concentrated loading, we expect that there will be a need in the near future to strengthen or place load restrictions on many state and local agency bridges.

Load Rating History

In an effort to keep up with transportation demand, national design loads for bridges were increased in 1944, 1980, and 1993. Over half of the bridge population was designed before 1970 using existing design loads; yet the economy demands more efficient delivery services, so trucks continue to get bigger and heavier.

Bridge Load Rating Basics

The load rating analysis determines the capability of a bridge to carry loads. The analysis calculates rating factors at many points to determine the bridge's weakest member. A rating factor is simply the ratio of the load the bridge can carry to the load produced by the vehicle considered.

The load capacity of a bridge takes into account the following factors:

- The weight of the bridge since the bridge must hold itself up.
- The bridge configuration like length of the bridge spans.
- The strength of the concrete, steel, or timber that was used to construct the bridge.
- The bridge condition – are steel members corroded or damaged? Is the concrete cracked? Are portions of the timber decayed?

Using the bridge related factors identified above, we evaluate different truck loading configurations. The analysis is based on the national bridge formula established in 1975 to limit the weight-to-length ratio of a vehicle. There are four categories of loads evaluated that cover different truck configurations.

Legal Loads

(includes SHVs)

Common semi-trucks, construction and waste management trucks with short wheel bases.

≤80,000 lbs GVW

Continuous Trip Permits

Log trucks, milk tank trucks, chip trucks, gasoline tanker trucks, and other semi-trucks that are heavier than legal loads.

≤105,500 lbs GVW

Single Trip Permit Loads

Non-divisible loads like vehicles hauling windmill components; self-propelled cranes.

Variable weights

Emergency Vehicle Loads

Fire trucks and other vehicles equipped to mitigate hazardous situations.

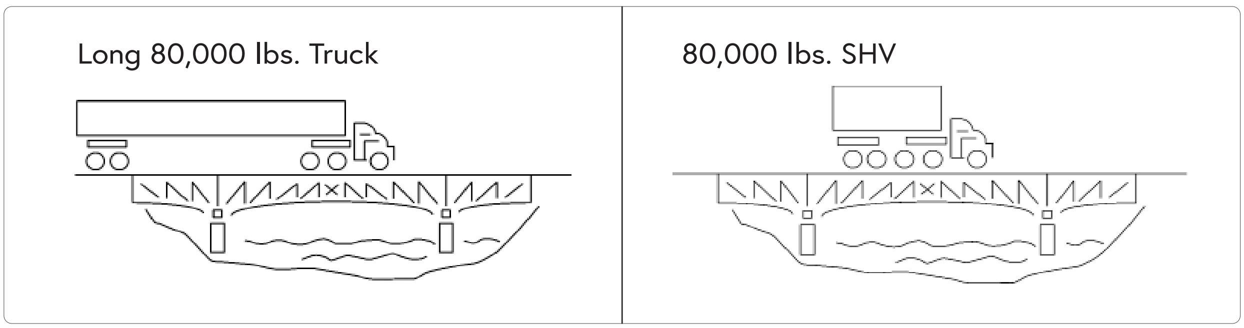
Up to 86,000 lbs GVW with short wheelbases that create highly concentrated loads.

Concentrated Loading from SHVs and EVs

As trucks grew heavier in the 1950s and 1960s, ODOT had to do something to protect bridges. The solution was to link allowable weights to the number and spacing of axles and use the bridge formula to establish limitations. Limiting the weight-to-length ratio of a vehicle crossing a bridge is accomplished by either spreading the weight over additional axles or by increasing the distance between axles. One unintended consequence of the bridge formula is a new class of trucks that are called specialized hauling vehicles (SHVs.) These trucks are a single unit with many axles spaced closely together to comply with the requirements of the bridge formula.

Specialized Hauling Vehicle. (SHV)

As shown in a FHWA publication on the bridge formula (excerpt shown below), the loading on bridges can be considerably more for an 80,000 pound specialized hauling vehicle than for an 80,000 pound semi-truck.



This illustration shows how a short vehicle with closely spaced axles can produce higher load effects on bridges compared to a longer vehicle of the same weight that has the axles farther apart.

Because of national concern with SHVs there is now a requirement to update all load ratings to include these vehicles. Specialized hauling vehicles emerged at the same time as new, heavier emergency vehicles were beginning to use roadways.

The current federal highway bill, Fixing America's Surface Transportation (FAST) Act, made it legal for emergency vehicles that have heavier than legal axle weights to travel on the interstate system to respond to wildland fires and other natural disasters. As a result, FHWA has mandated all states to load rate, and if necessary, load post bridges on interstate routes, or with reasonable access (one road mile) of an interstate, for FAST Act emergency vehicles.

The FHWA mandate requires that lower risk bridges on an interstate or within one road mile, referred to as Group 1 bridges, be rated for emergency vehicles when a normal re-rating is warranted. All other bridges that are on an interstate or within one road mile are identified as Group 2 bridges and are required to be rated for emergency vehicles by Dec. 31, 2022, which we completed.

Keep in mind that these posting signs do not affect all emergency vehicles, only those that have heavier than legal axle weights. Emergency vehicles that meet legal axle weights only have to adhere to load postings for legal vehicles.

Firetruck. (Emergency Vehicle)

The truck shown on this page is an example of the EVs legalized by the FAST Act. These EVs can have a tandem axle weighing nearly double that of the traditional legal tandem. The weight on the two rear axles of this firetruck is equal to the weight that a five-axle dump truck can carry, while the dump truck spreads the load out over its 22-foot wheelbase. Not only is this load much more concentrated than the SHVs, but it is also almost twice the concentrated load that was used to design the interstate era bridges built in the 1950s and 1960s.

Oregon is planning to expand these same criteria to all public roadways instead of just on or near an interstate. The FHWA mandate requires that if a state law allows or exempts emergency vehicles to operate as legal loads without restriction off the interstate system, then bridges must be load rated and posted, if necessary, for these vehicles.

It will take several years to get all of the bridges within Oregon load rated for the FAST Act emergency vehicles. ODOT decided to load post all state owned bridges that have been load rated for emergency vehicles and do not have the capacity to support them safely. As a result, ODOT crews have already load posted 390 state owned bridges and will continue to do so.

It Gets More Complicated

The majority of Oregon bridges need updated load ratings using the current method for analysis and to account for the new types of heavier vehicles.

The engineering aspect of an analysis can be complicated. In some cases, the plans for older bridges are not available. Instead of being archived, they may have been placed in an unknown location, or inadvertently discarded as office locations and personnel changed. The challenge is that bridge details like the location of reinforcing steel is not known so a load rating is assigned based on the condition and length of the bridge spans.

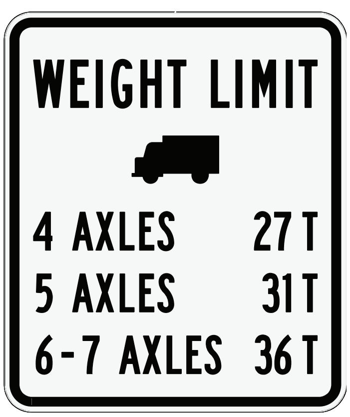
Another complication can be that a basic analysis may show the need for load posting or strengthening when the bridge shows no signs of distress. For these situations, ODOT performs a load rating using a more advanced analysis to determine the strength of the bridge. If the load rating for a bridge in good condition still shows the need for load posting or strengthening, ODOT may test the materials or perform an on-site load test to determine the strength of the bridge.

What Happens When a Bridge Can't Carry the Truck Load?

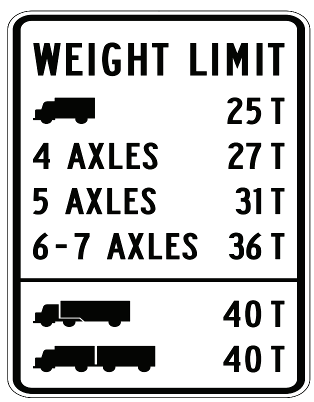
Oregon's economy depends on moving goods efficiently and communities depend on emergency vehicles having ready access to all bridges. Therefore, we make every effort to ensure bridges are safe and reliable. If a load rating indicates that one or more loads exceed the bridge capacity, ODOT uses the under capacity resolution process to address the load rating.

Actions include:

- Coordinating with local agencies, the freight industry and interested parties, including FHWA.
- Monitoring by the region bridge inspector (if not already begun.)
- Reviewing impacts of a load restriction and alternate routes.
- Assembling a response team by ODOT Maintenance to generate an action plan.
- Mobilizing a bridge crew to complete repairs if a bridge cannot be restricted or preparing a contract to either repair or replace the bridge, depending on timing and overall needs.



An example of a load posting sign for when only SHVs need to be restricted.



An example of a load posting sign for when all legal vehicles, including SHVs, need to be restricted.

According to FHWA, If there is no readily available means to address the load rating, the bridge owner must post load restrictions as soon as possible but no later than 30 days after a load rating identifies the need for posting.

When load postings for a bridge get down to 15 tons or less, we will use a sign that has a single weight posting for all vehicles, showing the maximum tons allowed on the bridge.

Why a recent increase in the number of load posted/ restricted bridges?

Per FHWA memorandum HIBT-10, every U.S. state and other jurisdiction had until Dec. 31, 2022, to have every NBI bridge re-load rated to include the specialized hauling vehicles. ODOT met this federal deadline by working with our consultant engineering firms to complete the load ratings. As a result of completing so many load ratings in a relatively short time, there has been a slight increase in the number of bridges that have rated out low for legal or permit vehicles and thus required either a load posting for legal vehicles or a restriction for permit loads.

Some of the bridges that needed to be re-load rated ended up with much lower rating factors. This was due to differences in current load rating methods versus previous practices. The main difference is that previous load rating methods only analyzed the maximum force locations of each member, or bridge component, that were required to be load rated within a bridge. Current load rating procedures not only analyze these same maximum force locations, but also look at every change in structural details (changes in reinforcing, material properties, and member geometries) that will have an effect on the member capacity through the entire bridge. Since our current load rating procedures are now looking at every detail that can change a member's capacity throughout the entire bridge, we often find locations on a bridge that now control the load rating that were never looked at or considered in the older load rating methods since they are not at maximum force locations. This is the reason why some bridges that had previously passed a load rating analysis are now rating out low and requiring a load posting/restriction. Having a relatively large number of bridges re-load rated in a short time has resulted in an increase in load postings/restrictions when compared to previous years.

2023 TUNNEL DATA

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.

ODOT manages nine state-owned vehicular tunnels and is responsible for all inspection, maintenance, and major rehabilitation of the structures. ODOT also inspects two pedestrian tunnels that were formerly vehicular tunnels and since 2017, we inspect five vehicular tunnels owned by other road agencies. This includes a portion of the Capitol Mall parking structure which meets the federal definition of being a tunnel. We inspect six vehicular tunnels owned by other agencies.

ODOT has performed inspections on tunnels for more than 20 years. Until 2017 there were no FHWA requirements to inspect or report tunnels. The inspections were done under the authority of the State of Oregon and the inspection program/procedures were devised by the state of Oregon, although they were based on the National Bridge Inspection Standards (NBIS.) Under the ODOT program, tunnels were inspected on a two-year regular inspection cycle, with in-depth inspections on a 10-year cycle. ODOT district maintenance crews perform drainage inspections each year.

National Tunnel Inspection Standards (NTIS) Implementation

In 2017, FHWA instituted a requirement that tunnels be inspected. Now, the National Tunnel Inspection Standards (NTIS) for the inventory, inspection and load rating of tunnels is available to the public. States are now required to report the results of these inspections yearly to FHWA, similarly to the way they are required to report bridge inspection information for the National Bridge Inventory (NBI.)

While there are parallels between the data reported for the NBI and NTI, there is one striking difference. The NTI condition data is only element data (the condition of the individual parts of a tunnel, such as the liner, portal, electrical system, etc.) The NBI condition data includes element data as well as ratings of the major components of a bridge such as the deck, superstructure, substructure and culvert. The NTI has no equivalent to major components, only elements.

The major component ratings allowed FHWA to create a bridge condition rating for the entire structure. However, there is no major component rating for tunnels. Oregon wanted to be able to determine the overall tunnel condition (good, fair or poor.) Putting the element condition information together to determine the overall tunnel condition provided a challenge as there is no established national standard.

To classify the tunnel condition with the updated NTI 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 2023 tunnel condition information that is reported is based on the updated HI method calibrated with a general assessment of the tunnel conditions and engineering judgement.

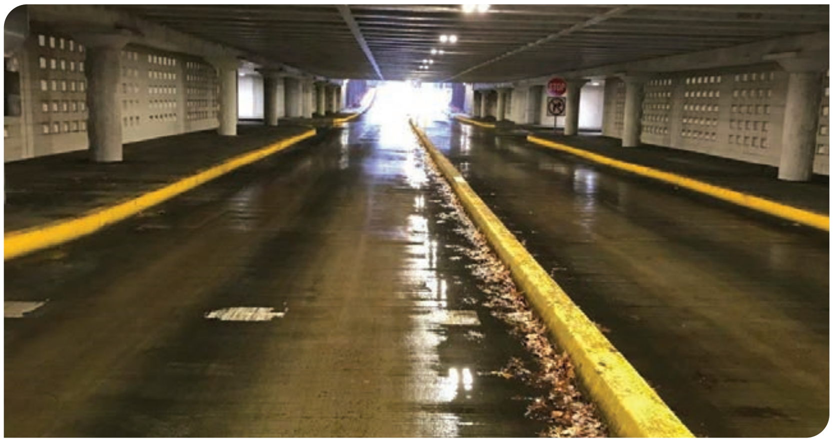
Capitol Mall Tunnel

There is an underground parking structure located in the Capitol Mall in Salem. Chemeketa Street ramps down from the west, passes through the structure, and ramps up again on the east to match street level. The portion of Chemeketa Street that is below street level is enclosed by walls and a roof. This portion of the underground parking structure is considered the "Capitol Mall Tunnel." Above the tunnel and the parking structure is a grassy, parklike area.

There are openings on the north and south sides of the tunnel wall that provide access to the parking area. Although most of the traffic in the tunnel is the result of vehicles entering/leaving the parking structure, it is possible to travel through the structure using Chemeketa Street without entering the parking structure.

Roadway inside the tunnel accessing the parking area.

ODOT did not consider this parking structure a tunnel, as the roadway's primary purpose is to provide access to the parking structure. However, due to the design of this underground parking structure, the portion of Chemeketa Street that is covered meets the federal definition of a tunnel.



Interior view of the tunnel, showing parking area entrances.

Entrance from tunnel to parking area.

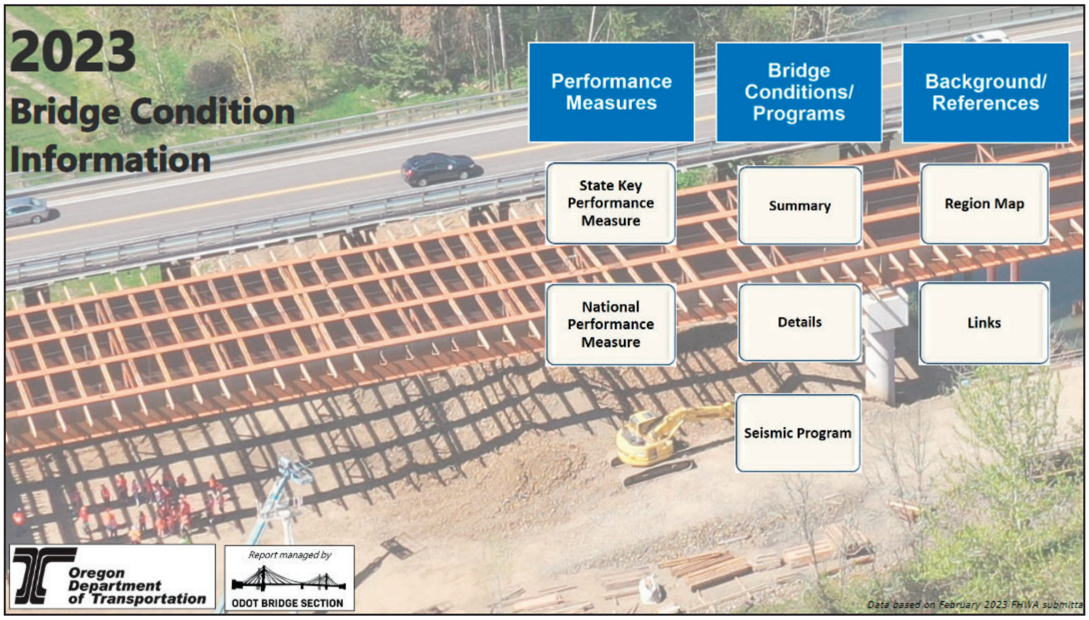
The inventory and inspection of the Capitol Mall Tunnel was a challenge due to several factors. The first factor was using tunnel inspection techniques/elements and applying them to standard building components. Not all building inspection components compare with tunnel inspection components. The second factor that made the inspection a challenge was determining the separation of the tunnel portion from rest of the parking structure. For example, there is one parking level on each side of the tunnel and one parking level is below the tunnel.

Tunnel Conditions

ODOT used the tunnel rating system based on the Oregon NTI element data to capture the data in the following table.

TUNNEL CONDITIONS AS OF FEBRUARY 2023 *(based on 2023 FHWA submittal of NTI data)*

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	Good	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			24126	Capitol Mall Tunnel, Chemeketa St	1990	363	Reinforced Concrete	Good	DAS
			51C26	W Burnside Tunnel	1940	230	Reinforced	Fair	Portland
			51C32	Rocky Butte Tunnel	1939	400	Reinforced Concrete	Good	Portland
			25B125	Cornell Tunnel #1, NW Cornell Rd	1940	497	Reinforced Concrete	Fair	Portland
			25B127	Cornell Tunnel #2, (W), NW Cornell Rd	1941	247	Reinforced Concrete	Fair	Portland
			22476	Owyhee Tunnel, Owyhee Lake Rd	1929	200	Rock	Fair	Malheur County



More information is available online through the 2023 Interactive Bridge Condition Report. https://www.oregon.gov/odot/Bridge/Pages/BCR.aspx

The report includes detailed bridge condition information by region, county, district and route with tables and an interactive map. The front page of the report is shown above.

Oregon Department of Transportation

2023

Bridge Condition Report & Tunnel Data

Delivery & Operations Division | Bridge Section | https://www.oregon.gov/ODOT/Bridge/Pages/BCR.aspx