Background Brief on …

Bridges

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Approximately 6,800 bridges connect Oregon's 59,000 mile road and highway system. The road system is vital to the movement of citizens, visitors and freight. Bridges are points where the road system is especially susceptible to interruption. When officials must limit the weight of loads allowed on bridges that may not have been built to handle today's traffic and loads or are beginning to show signs of deterioration, commerce can be seriously disrupted by requiring long detours for heavy trucks on alternate routes. Freight bottlenecks are also caused when bridges lack sufficient vertical or horizontal clearances.

The Oregon Department of Transportation **(ODOT)** owns and maintains 2,700 bridges on the state highway system. Most of the rest are under the control of local governments throughout the state.

ODOT inspects most bridges every two years; those that are beginning to show signs of significant wear are inspected more frequently. Funding for bridge inspection, including inspection of local bridges is part of ODOT's Bridge Program. Maintenance and minor repairs for state highway bridges fall to ODOT maintenance crews and are covered in the maintenance portion of ODOT's budget. Bridge structural repair, rehabilitation and replacement are part of the Bridge Program in the Statewide Transportation Improvement Program (**STIP**).

Aging Bridges

Most of Oregon's bridges are nearing the end of their "design life." Over time, in each successive construction era, bridge design life has increased: from 30 years in the 1930s to 50 years in the 1950s, to 75 years in the mid-1990s to 100 years or even 150 years with contemporary design and construction. The life of a bridge, though long, is not infinite. No series of continued repairs, regardless of how well timed, can continue to extend the life of a bridge forever. Eventually, all bridges will need to be replaced.

The service life of a bridge is an estimate of the number of years a bridge may remain in service. The expected service life can vary depending on the quality of the construction materials and methods, the quality and timing of maintenance activities, environmental factors, and usage.

ODOT analyzes bridge service life using three categories of bridges, based on the period of construction and importance to the highway network. The categories are: 1) high value coastal, historic and major river crossings, and border structures; 2) bridges built during the 1950s and 1960s; and 3) all others.

As of 2011, the median age of ODOT bridges is 45 years and the most frequently occurring bridge age is 53. Approximately 13 percent of the ODOT inventory is currently 70 years or older. The passage of time, traffic, effects of the elements, and the structural weight of the bridges themselves have taken their toll on older bridges that were designed for lower vehicle weights, slower traffic speeds, and less traffic volume than are typical on Oregon's roads today.

Modern trucks are heavier than those in use when many of the state's bridges were designed and built. The number of miles traveled annually by trucks exceeding 70,000 pounds has increased from roughly 100,000 in 1965 to over 1.5 million today. In some cases, the trucks exceed what older bridges were designed to carry. Enforcement of an 80,000 pound weight limit on a large number of Oregon's bridges would impose a number of costs on motor carriers, including the need to purchase additional trucks, hire additional drivers, and pay higher weight-mile taxes. Those costs, when passed on to producers, would also have a negative effect on many business sectors, particularly manufacturing. The movement of large non-divisible loads, single items such as transformers and construction equipment weighing 150,000 pounds, 200,000 pounds or more, would be seriously impacted by bridges restricted to 80,000 pounds.

Oregon Transportation Investment Act (OTIA)

In recognition of the importance to the Oregon economy of unimpeded freight mobility in important transportation corridors, the 2003 Legislative Assembly enacted OTIA III, the third Oregon Transportation Investment Act, authorizing ODOT to issue additional revenue bonds for highway improvement projects, including bridge repair and modernization. The measure increased vehicle registration and title transaction fees to help repay the bonds. The amount dedicated to bridge projects was divided between state bridges ($1.3 billion) and city and county bridges ($300 million). Projects were selected by the Oregon Transportation Commission with input from technical rating committees, the Oregon Freight Advisory Committee, Area Commissions on Transportation, and stakeholders.

The 10-year OTIA III State Bridge Delivery Program is currently moving toward conclusion. The program will have replaced or repaired hundreds of ODOT bridges statewide, making it the largest bridge construction effort in Oregon since the interstate highway era. As of February 2012, only two bridges have yet to begin construction; 12 are under construction and 257 are open to traffic.

By its completion, the bridge program will have replaced 149 bridges, resulting in the lowest forecast levels of overall bridge deficiency in Oregon in nearly two decades. OTIA III has not, however, overcome the anticipated rate of deterioration. As OTIA III projects are completed, more aging bridges will fall into the categories of needing repair or replacement and new bridges will begin to age.

Transition to Bridge Preservation

The OTIA III bridge program was funded through bonding a portion of the State Bridge Program revenues. As a result, the money available for bridge repair, refurbishment and replacement for the next few decades will be lower than in the past. In addition, the primary revenue sources for state highways, the motor fuel tax and weight-mile tax, are experiencing

long-term decline as motorists change their driving habits and more fuel-efficient vehicles enter the marketplace. As a result of these factors, ODOT has adopted new strategies to preserve the investment in roads and bridges. Due to conditions and policies which led to OTIA, the agency has transitioned from a "worst first" approach to project selection to a focus on bridges that are on the "cusp" between good and poor condition, in concert with consideration of conditions and the importance of the transportation corridors on which the bridges are located. It is generally held that the investment needed to preserve the inventory in good condition is more cost-effective than paying for the more extensive and expensive repairs and replacements that are needed once the asset conditions have declined to poor condition.

Increased emphasis on maintenance is expected to extend the service life of most of ODOT's bridge inventory, except for those constructed in the 1950s and 1960s. Many of those bridges were designed for loads weighing much less than allowed by state law since the mid-1980s, meaning it is not cost effective to preserve those bridges because of their weaker elements. Based on current bridge conditions and increased maintenance, the average remaining service life of ODOT bridges is 35-40 years, with the estimated total service life in the 80-85 year range. The 1950s and 1960s bridges are the largest group in the state's inventory (1,043 bridges). While it is not cost effective to preserve them, there is currently no funding to begin the process of replacing them, which creates the potential for widespread freight restrictions in 20-30 years.

Protection of High Value Bridges

ODOT is currently managing its historic coastal bridges and some other major bridges as an exception to its estimated service life strategy. The agency believes that with significant cost for rehabilitation and maintenance, the service life of major bridges can be extended to well beyond 100 years at a significant life cycle cost benefit to the state. Preservation of these major historic bridges is important for their cultural value and because the cost of replacement would far exceed revenues available to do so.

Local Bridges

ODOT is responsible for all bridges on state highways. However, state highways make up only 8,000 miles of Oregon's road system, compared to 33,000 miles of county roads and 10,800 miles of city streets. There are 4,000 bridges on county roads and city streets and those bridges must also be inspected, maintained, and periodically replaced. ODOT administers contracts for the inspection of local agency bridges with funding from the local bridge program.

Federal funding for bridges is shared between state and local bridges. This process, and the selection process for local bridge projects, are outlined by formal agreement between ODOT and local agencies. All repair and replacement projects on local bridges funded by OTIA III have been completed.

Columbia River Crossing

The Columbia River Crossing **(CRC)** is a bridge, highway, and transit project that is meant to address transportation and economic challenges on the Interstate 5 **(I-5)** Bridge between Oregon and Washington and its approaches in Portland and Vancouver. With only three lanes in each direction, the existing bridges are strained to capacity to carry the current 125,000 vehicles each day. With the population of the region expected to increase by over one million people during the next 25 years, ODOT and Washington State Department of Transportation are working with local governments to develop solutions for congestion, safety, bicycle and pedestrian access, public transportation needs, seismic vulnerability, and marine navigation and mobility constraints.

In 2005, Oregon and Washington created a 39-member Columbia River Crossing Task Force to represent a broad range of perspectives to advise the project team. That group selected a replacement bridge that incorporates light rail and dedicated bicycle/pedestrian access. A

second entity, the 10-member Project Sponsors Council, helped further refine the project, setting the number of lanes on the bridge at 10 (three through lanes and two interchange connections in each direction) and modifying the scope of interchange modifications.

A number of independent analyses of the project have also helped improve the project. An Independent Review Panel created by Governors Kulongoski and Gregoire issued a report in the summer of 2010 that reasserted the project's importance and provided a series of recommendations to help address key issues. In February 2011, a follow-up Bridge Review Panel made the recommendation to modify the bridge design to a less risky type of structure. In the summer of 2011, the Oregon State Treasurer's Office completed a review of the project's finance plan that was requested by Governor Kitzhaber. The review recommended more conservative financial assumptions and suggested means to help tolling generate additional resources to fill a gap created by the more conservative assumptions.

On December 7, 2011, the CRC project achieved a significant milestone, with federal oversight agencies, the Federal Highway Administration and Federal Transit Administration, issuing a record of decision, concluding the environmental planning phase under the National Environmental Policy Act. The record of decision identifies a replacement bridge with light rail as the alternative that best improves safety, travel reliability, freight mobility, and bridge structural stability and relieves congestion on I-5 between Portland and Vancouver.

The project's cost is estimated at $3.1- $3.5 billion. The bridge is to be funded by a combination of federal funds, state funds and tolling revenues. Construction could begin as early as 2013, depending on the availability of funding, and would continue through 2020.

Seismic Risk

Oregon lies in a region of particularly high seismic activity, due primarily to its proximity to the "Cascadia Subduction Zone" **(CSZ)**, where the Juan de Fuca (tectonic) Plate pushes under the North American Plate. The seismic activity below Western Oregon is capable of generating earthquakes of magnitudes as high as nine on the Richter scale, sufficient to cause catastrophic damage to structures, including bridges. A recent ODOT and Oregon State University study, "Seismic Vulnerability of Oregon State Highway Bridges" (November 2009), concludes that a large CSZ earthquake off the Oregon Coast would result in major widespread damage that would prevent vehicular travel on many segments of I-5, U.S. 101 and all routes between I-5 and the coast.

Prior to 1958, bridge designs did not account for "seismic loading," due to the lack of understanding at that time of the earthquake potential in the Northwest. More sophisticated analysis in the years following the 1989 Loma Prieta earthquake in California has alerted ODOT engineers to the potential for bridge failures during an earthquake, as well as methods for retrofitting most of those bridges to enhance their ability to survive such an event.

ODOT has identified retrofit methods that can help protect bridges from earthquake damage; Phase I "life safety" retrofits strengthen the connection of the bridge superstructure to the substructure, while Phase 2 "serviceability" retrofits strengthen the piers and footings of the bridge. Even with retrofits, however, engineers note that it is impossible to absolutely assure no damage from a high-magnitude earthquake.

ODOT is following up on the recommendations of the "Seismic Vulnerability" report. The Department is updating lifeline route designations to incorporate recent bridge replacements and to ensure that access to critical supplies and facilities is maintained. ODOT is also refining plans for possible mitigation and emergency response when an earthquake occurs. Currently, there is no dedicated funding for the seismic retrofit of bridges.

At this time, ODOT spends about $1 million annually when retrofit is included as part of

other scheduled work on bridges, but these are isolated retrofits that do not significantly improve mobility after a large seismic event. As funds become available, the strategic seismic retrofitting of bridges in high priority corridors can be completed. To date, the agency has partially (phase 1) retrofitted 178 bridges. More than 500 bridges of the 2,700 bridges on the state highway system have been built since 1993 using modern seismic design standards.

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