UTC Project Information	
Project Title	Assessment of Washington State Bridges for Post-Earthquake Mobility and Recovery Planning
University	Washington State University
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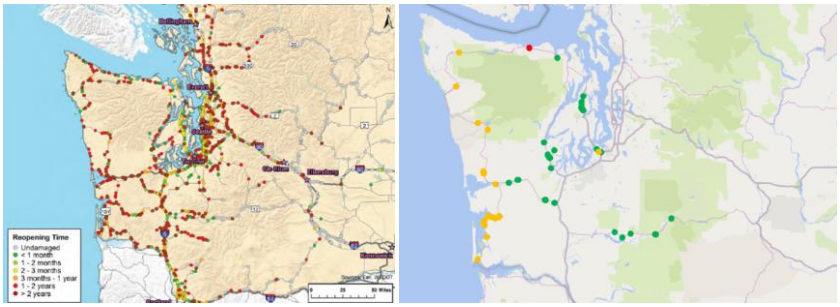
Funding Source(s) and Amounts Provided (by each agency or organization)	University of Washington PacTrans $40,000 Washington State University $40,000
Total Project Cost	$80,000
Agency ID or Contract Number	69A3551747110
Start and End Dates	August 16, 2020 – August 15, 2022
Brief Description of Research Project	A 2019 Department of Homeland Security report assessing the regional resiliency of western Washington State to a Cascadia Subduction Zone earthquake predicted widespread and high levels of bridge damage. Due to this report, the emergency response and recovery plan is heavily reliant on air transportation modes to provide resources to the affected populations. However, surface transportation modes, if available, are better suited for moving large volumes of resources and serving as critical lifelines for impacted regions of the state. The goal of this study was to create an improved prediction of non-functional, partially functional, and functional bridges that will assist in post-earthquake emergency planning. This research project focused on determining the functionality of bridges along the routes that connect to the main WSDOT critical lifeline corridor of I-5/405 and I-90. WSDOT has active research projects that are focusing on the resiliency of the I-5/405/90 lifeline but are not directly assessing the functionality of the routes connecting into it. Without these secondary routes, the post-earthquake mobility of the state will be reduced, emergency management plans will be difficult to enact, and long-term recovery will be impaired. This study used updated bridge models, based on a database of important characteristics of selected bridges across WA state, and 60 synthetic Cascadia Subduction Zone earthquake ground motions to improve predictions of likely loss of functionality for bridges along the secondary state routes (SR) of 101, 12, 16, and 3. Results of these analyses were that very few, if any, bridges are expected to be completed destroyed resulting in no functionality post-earthquake. Bridges inland of the coast and outside of the sedimentary basins of Seattle, Port Angeles, and Tacoma were predicted to remain fully functional post-earthquake. Lastly, bridges located along the coast are likely to sustain damage requiring repair but should be partially

	functional within 3-6 months post-earthquake based on estimates from the WA Bridge Design Manual. These results only considered multi-span bridges supported by piers with reinforced concrete columns. Single span bridges were omitted but are expected to remain functional. Other bridges would need to be evaluated on a case-by-case basis and liquefaction was omitted but could cause significant bridge damage.
Describe Implementation of Research Outcomes (or why not implemented)	The outcomes of this research are being actively communicated to personnel in the WSDOT bridge and structures office. The outcomes of this research are also being used as a representative project for ongoing research in partnership with University of Washington. The ongoing research project will further refine the results from this project by broadening the number of bridges analyzes, including the effects of softer soil profiles, and by incorporating the expected performance of the I-5/I-405/I-90 lifeline.
Place Any Photos Here	The figure below shows the results described analysis on the right compared to the Dept. of Homeland security assessment on the left. Note that the updated predictions from this project show that most of the bridges are green or yellow, indicating either fully serviceable or return to partial service within 3 months, respectively.  Figure 1. Comparison of RRAP report reopening time predictions (Left) to analysis results from this project (Right).
Impacts/Benefits of Implementation (actual, or anticipated)	It is anticipated that the impact of this project will be an updated emergency response plan for western WA. This research, along with ongoing research in collaboration with University of Washington, demonstrates that the likelihood of significant damage and long-term loss of bridge service is low for almost all regions of western WA, except coastal cities within shallow basins, such as Port Angeles. This new data means that ground transportation can likely be used for emergency response and recovery.
Web Links • Reports • Project website	See PacTrans Final Report