Memorandum 1.12.2a

I-5 MEDFORD VIADUCT PLANNING & ENVIRONMENTAL STUDY

To: Lisa Cornutt

CC: Marc Butorac, PE, PTOE, PMP

From: Bob Goodrich, PE & Michael McNulty, PE

Date: August 21, 2018

Subject: Task 1.12.2a Geotechnical Seismic Hazard Evaluation Impacts

The purpose of this memorandum and the other early anchoring activity memorandums in Phase 1A of the project is to inform the Draft Problem Statement and guide further development of the project.

The purpose of this memorandum is to summarize the cost implications associated with the geotechnical findings presented by Shannon and Wilson Inc. (S&W) in their *Geotechnical Seismic Hazard Evaluation Report I-5 Medford Viaduct Planning and Environmental Study*. A brief discussion of the findings, their impact on seismic modeling, and the anticipated cost implications are presented.

Background

In 2017, OBEC completed planning-level seismic retrofit analysis for the three options listed below:

- Existing (Non-Widening) Design Option – No Widening and Seismic Retrofit
- Design Option 1B – One-Sided 28-Foot Widening and Seismic Retrofit to the East
- Design Option 1C – Two-Sided 14-Foot Widening and Seismic Retrofit

The analysis was based on readily available geotechnical data from previous borings and as-constructed plans. Findings from the analysis were used to preliminary evaluate Design Option 1A – One-Sided 28-Foot Widening and Seismic Retrofit to the East, without performing seismic modeling.

Since the completion of this work, S&W performed a preliminary geotechnical investigation.

Geotechnical Findings

Based on the preliminary investigation, S&W determined the bridge is a soil site class D. Previously, the project team assumed soil site class C. The soil site class parameter is used to develop the “Life Safety” and “Operational” response spectra acceleration (RSA) curves. The RSA curves determine the magnitude of the seismic loading. Additionally, the soil site class and RSA curves are used to define the Seismic Design Category (SDC) per the ODOT Bridge Design Manual (BDM).

Based on soil site class D, the site meets SDC C design requirements, whereas previously the project team used SDC B. SDC classification determines the minimum capacity-protected member connection forces. SDC C requires higher design forces at the column-footing and column-crossbeam connections.

The overall result of using site class D soils is increased seismic loading and higher connection design forces.

Seismic Modeling Impacts

The effects due to the increased seismic loading cannot be quantified without additional seismic modeling. However, the higher connection design forces, which are more readily quantified, provide an upper bound for column, footing, and crossbeam design.

Findings from applying these higher connection forces to the initial retrofitted elements include:

- All tops and bottoms of column “fixed” connections require FRP wrapping
- Retrofitted spread footings need to be 6 to 12 inches longer and wider
- Retrofitted crossbeams require additional steel reinforcement

Based on these findings, the current seismic retrofit strategy still appears viable for the increased seismic loading. The next phase of the project will need to complete additional analysis to verify the validity of this strategy.

Cost Impacts

Using these findings, OBEC re-evaluated the planning-level cost estimates. It is recommended to increase the base construction costs for each Option as shown below. The recommended bridge cost is the sum of the original bridge cost and the three additional costs for the affected retrofitted elements.

Design Option	Original Bridge Cost	Columns Add’l Cost	Footings Add’l Cost	Crossbeam Add’l Cost	Recommended Bridge Cost
Existing (Non-Widening)	$32.8M	$0.3M	$1.0M	$0.4M	$34.5M
1A – One-Sided Widening to the West	$56.6M	$0.4M	$1.8M	$0.7M	$59.5M
1B - One-Sided Widening to the East	$51.8M	$0.5M	$1.6M	$0.6M	$54.5M