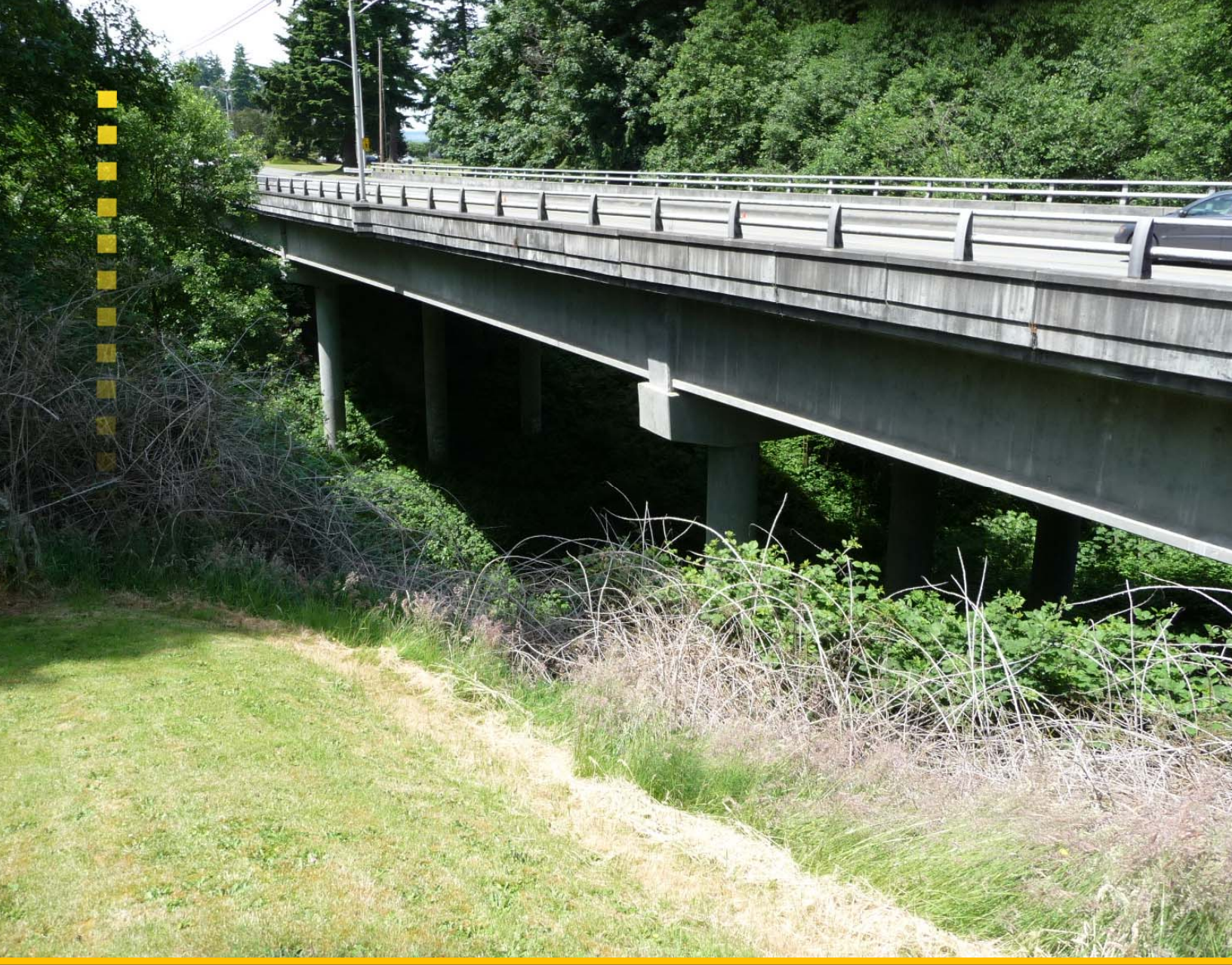

Prepared for: The City of Everett Public Works

08.18.17

Maple Heights Bridge Structural Memo

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EXECUTIVE SUMMARY

The Maple Heights Bridge is a 303-foot long three-span (two 95-foot spans on each end of a 110-foot center span) 40-foot wide concrete bridge built in 1979. The bridge's substructure consists of concrete columns founded on concrete spread footings.

The City of Everett's has tasked TranTech Engineering with conducting a seismic structural vulnerability study on the Maple Heights Bridge. The resulting analysis shows two failure mechanisms. A displacement demand bridge seat deficiency of the east abutment and the lack of shear keys at both abutments. A geotechnical study was not performed but is included in the proposed seismic retrofit project.

Please see the Appendix for a cost estimate of the revised proposed seismic retrofit project.

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1. INTRODUCTION

The Maple Heights Bridge is a 303-foot long three-span (95':110':95') 40-foot wide concrete bridge built in 1979. The bridge's substructure consists of concrete columns founded on concrete spread footings and its superstructure is composed of concrete pre-stressed girders made composite with a cast-in-place deck. The existing bridge plans are available under the "Records/Plans" tab in the WSDOT Bridge Inspection Software.

The Maple Heights Bridge is a vital link in a chain of three bridges that provide the only access to neighborhoods located along the Mukilteo Boulevard, an NHS route between the cities of Everett and Mukilteo. The other two bridge, Merrill & Ring (SID 08560600) and Edgewater (SID 08559300), are both load posted and both have projects proposed to deal with existing deficiencies. The Mukilteo Boulevard traverses deep ravines and winds along steep hillsides and is the only access to the neighborhoods along its length. It also serves over 6000 vehicles per day in its load restricted condition. If any two of these three bridge were to fail during a seismic event there is no other access to the areas isolated by the bridge failures.

The cities of Everett and Mukilteo have struggled for years with the issues caused by the substandard and deficient bridges serving the Mukilteo Boulevard. As mentioned above, projects are also being proposed for the Merrill & Ring and Edgewater bridges. While the project funding requests are being submitted separately, the City of Everett intends to combine as many of the projects as possible into a Mukilteo Boulevard Bridge Replacement and Repair Program to achieve maximum efficiency and economy as well as to solve long standing capacity and functional problems caused by these bridges.

The bridge is generally in good condition with good seismic details for a bridge of its era. While it is the best of the three bridges mentioned above, it is seismically vulnerability by two failure mechanisms that will be described in the following section.

2. SEISMIC VULNEARABILITY STUDY

The City of Everett has initiated a seismic vulnerability study as part of the request for seismic retrofit funding from the WSDOT administered Local Bridge Program. The details of the seismic vulnerability analysis performed as part of this study are described in further detail below:

A structural model of the bridge was developed based on the existing bridge plans. Next, the bridge was analyzed for seismic vulnerability per guidelines provided by AASHTO's Guide Specifications for Seismic Bridge Design and WSDOT's Bridge Design Manual.

From this investigation, it has been determined that the bridge is at risk of collapse during a large seismic event. The critical locations are the abutments. A nonlinear static pushover analysis was performed and no failure mechanisms were formed from lateral forces exerted to the bridge during a design earthquake event. It was also found that the bridge has adequate superstructure strength and column shear strength.

Please note, that this preliminary seismic study did not include a geotechnical investigation on the potential for any soil-structure interface related possible failure mechanisms that may form at the interior pier spread footings of the bridge.

Per the results obtained from this study, the original construction cost estimate submitted for funding has been reduced to provide the required girder seat length at the east abutment, adding transverse shear keys at both abutments, and investigating possible soil failure mechanisms.

Please see the Appendix for a refined cost estimate of the proposed seismic retrofit improvements.

3. CONCLUDING REMARKS

While the Maple Heights bridge was found to have surprisingly good seismic details for a bridge of its era, it is still vulnerable during a large seismic event to a span collapse mainly due to lack of lateral seating capacity and shear keys at its abutment locations.

Because of the importance of the bridge for emergency services to potentially isolated neighborhoods, a seismic retrofit project is required to protect the bridge to make sure it remains in service after a seismic event.

APPENDIX | Seismic Retrofit Estimate

TRANTECH
Engineering LLC

City of Evertt Maple Heights Seismic Retrofit

Engineer's Preliminary Opinion of Cost

ITEM	UNITS	QUANTITY	UNIT PRICE	AMOUNT
Mobilization	LS	1	$ 45,000	$ 45,000
Structure Surveying	LS	1	$ 20,000	$ 20,000
Project Temporary Traffic Control	LS	1	$ 100,000	$ 100,000
Removal of Structure and Obstruction	LS	1	$ 20,000	$ 20,000
Bridge Seismic Retrofit - Seat Extension and Transverse Stop Blocks	LS	1	$ 250,000	$ 250,000
Soil Improvements	LS	1	$ 200,000	$ 200,000
Slope Restoration	LS	1	$ 50,000	$ 50,000
Repair/Restoration of Public & Private Facilities	LS	1	$ 20,000	$ 20,000

Subtotal:	**$**	**705,000**
Contingency @15% of Subtotal :	**$**	**105,750**
Total Construction Cost:	**$**	**810,750**
PE @ 25% of Total Const. Cost	**$**	**202,687.50**
CM @ 18% of Total Const. Cost	**$**	**145,935.00**
Total Cost	**$**	**1,159,373**
Total 2019 Construction Cost with Inflation @5% / Year	**$**	**1,278,208**

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