SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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June 27, 2012

AECOM
701 Fifth Avenue, Suite 1100
Seattle, WA 98104

Attn: Mr. Aaron Silver

RE: STATE ROUTE (SR) 202 SAMMAMISH RIVER BRIDGE PROJECT, POTENTIAL GEOTECHNICAL EFFECTS OF PROPOSED ROADWAY BRIDGE CONSTRUCTION ON EXISTING RAILROAD BRIDGE AND FILL

This letter is in response to AECOM's request of June 20, 2012, that Shannon & Wilson, Inc. address questions raised by the Port of Seattle regarding the potential effects of the proposed roadway bridge on the existing railroad bridge and fill.

The City of Woodinville proposes to construct a new roadway bridge immediately south of the existing (1963) SR 202 bridge over the Sammamish River. The proposed bridge, shown in AECOM's 60 Percent Design submittal, will include new wedge approach fills at its east and west abutments, and will be supported by two piers founded on approximately 4-foot-diameter drilled shafts. An existing railroad bridge is located south of the proposed roadway bridge and is oriented on a skew such that the two structures would be closest near the new roadway bridge east abutment (Pier 2). The two structures diverge rapidly to the west. Therefore, the area of interest regarding effects on the existing railroad bridge is at and around the east abutment.

EAST APPROACH FILL SETTLEMENT EFFECTS

Based on information received from AECOM, the new east approach fill would be within about 10 feet of the existing railroad bridge. The existing topography slopes downward to the river at this location such that the new approach fill would be approximately wedge shaped, with a maximum thickness of about 5 feet immediately behind the abutment wall. Based on the plans for the 1963 Sammamish River Bridge, the new roadway bridge will be located at approximately the location of an older timber bridge that was removed during construction of the 1963 bridge. The approach fills for this older timber bridge will largely form the approaches of the new roadway bridge. Because relatively little new fill is being placed for the new approach, and

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because a large fill has been in place at this location for at least 50 years, we anticipate that the settlement induced by the new east approach fill will be small. Because the new fill would be at least 10 feet away from the existing railroad bridge, it is unlikely to cause significant settlement of the railroad bridge.

DRILLED SHAFT CONSTRUCTION EFFECTS

The nearest proposed drilled shaft supporting Pier 2 would be at least 16 feet from the existing railroad bridge. This is further than the industry-recognized minimum distance (4 diameters) for interaction effects of adjacent drilled shaft foundations. To further reduce the potential for disturbance of the existing railroad bridge, the drilled shaft construction technique could be tailored to reduce potential ground losses, caving, and vibration.

In general, there are three typical methods of constructing drilled shafts: the dry, casing, and wet methods. These methods are generally described in our August 2007 Draft Geotechnical Report for the project. We anticipate that a combination of the casing and wet methods will be used for the following reasons:

- Without a casing, soft/loose soil overlying the dense to very dense/hard glacially consolidated soil could cave or squeeze into the shaft excavation.
- A casing is needed to prevent seepage from shallow groundwater levels.
- When the proposed foundations are located near exiting SR 202 bridge or railroad bridge foundations, the casing would provide lateral support to reduce the risk of ground loss during drilled shaft construction.

This could be accomplished, for example, by using an oscillator- or rotator-type installation method.

Since the distance from the nearest shaft to the existing railroad bridge exceeds 4 diameters, we anticipate settlements due to drilled shaft installation to be insignificant.

VIBRATION AND SETTLEMENT MONITORING DURING CONSTRUCTION

There is a potential for damage to the existing SR 202 and railroad bridges and nearby utilities due to vibrations and resulting settlements caused by drilled shaft installation, and due to settlement caused by the proposed east approach fill. Although settlements are not anticipated, monitoring of the railroad bridge will be performed. If any movements are detected the drilling will be stopped until corrective measures are implemented to prevent further movement.

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We recommend developing and implementing vibration and settlement monitoring criteria for the existing railroad bridge.

Vibration Monitoring

The vibration criteria should consider the type and frequency of the vibrations, the structural design, and the existing condition of the bridge structure. The criterion for possible damage resulting from vibrations is expressed in terms of a maximum peak particle velocity (ppv).

Based on our review of various standards for vibration monitoring, the maximum tolerable ppv could vary from 0.5 inch per second (ips) to 2.0 ips. The 0.5 ips criterion is applicable to sensitive structures and utilities such as brick masonry buildings and old water pipelines with lead joints. The 2.0 ips criterion may be appropriate for reinforced concrete structures that do not have significant amounts of cracking or spalling. Particle velocities can be measured during construction using a vibration monitor (seismograph) located as close as possible to the structure or utility being monitored.

We recommend that the first drilled shafts be installed farthest from the existing railroad bridge so that the vibrations can be measured. The monitoring program could consist of measuring the vibrations at a location as close as possible to the existing structure. If possible, vibration monitors should be installed directly on the existing railroad bridge and its pile foundations for the duration of construction activities. If measured vibrations are at or above a level that could potentially cause damage, mitigation measures, such as jacking or oscillating, or use of a larger, variable-moment, vibratory hammer(s) for casing installation should be implemented.

We recommend that an existing condition survey be performed for the existing railroad bridge and other nearby facilities that may be affected by the new bridge construction activities. Documentation should include photographs, videos, sketches, and/or written comments. This information will be invaluable in assessing the need for mitigation measures, as well as resolving potential disputes.

Settlement Monitoring

We recommend that optical survey points (monuments) be provided on the exposed corners of pile caps or abutments of the existing railroad bridge, and that measurements in three orthogonal directions be taken weekly beginning prior to placement of any new fill at the east approach site or excavation of any drilled shaft. Construction activities at and in the vicinity of the bridge along with the state of construction of the bridge (e.g., fill heights, shafts installed, etc.) should

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be recorded with each measurement. The location and elevation of each survey point should be surveyed when installed to establish an initial condition or baseline. Optical survey point measurements should be performed using survey techniques accurate to within 0.1 inch or better. When optical survey points are damaged, the Contractor should stop embankment or shaft construction at that section until the survey point has been repaired and new baseline measurements made. Survey point baseline measurements and all subsequent readings should be provided to the geotechnical engineer who will review the data weekly.

We appreciate the opportunity to be of service. If you have any questions about this information, please call me at (206) 695-6850.

Sincerely,

SHANNON & WILSON, INC.

MICHAEL D. HARNEY
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6/27/12

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