AGENCY OF TRANSPORTATION **OFFICE MEMORANDUM**

To: Kristin Higgins, P.E., Structures Project Manager

CEE CCB

From: Callie Ewald, P.E., Senior Geotechnical Engineer, via Christopher Benda, P.E., Soils & Foundations Engineer

Date: April 7th, 2014

Subject: Pittsfield ER BRF 022-1(23) Wave Equation Analysis Review

The following summarizes our review of the wave equation analysis conducted for the piles proposed for the Pittsfield ER BRF 022-1(23) project. We received a copy of the wave equation analysis provided to Chad Contaldi of Cold River Bridges, LLC that was conducted by Michael Deery of GZA GeoEnvironmental, Inc. (GZA) and Pile Driving & Equipment form prepared by the contractor. Mr. Deery performed wave equation analyses for the pile and hammer proposed for use at both abutments. The APE D19-42 single-acting diesel hammer was requested for analysis with a maximum rated energy of 47,335 ft-lbs. This hammer was evaluated for the pile-soil system for the Pittsfield ER BRF 022-1(23) site only.

The characteristics of the proposed pile as well as the hammer and hammer cushion data were reviewed in the WEAP analysis to ensure the analysis was conducted per the contractors' submitted pile and driving equipment data form. The pile and driving equipment data form included a 6 inch steel striker plate. This was verified in the manufacturers hammer specs and appears to have been included in Mr. Deery's analysis. It is unclear whether GRLWeap includes this striker plate as part of the hammer, therefore a few different analyses were run to make certain the stresses and driving criteria meet specifications.

GZA modeled both a variable capacity analysis which develops a driving resistance based on the most efficient hammer stroke for all four fuel settings, as well as a constant capacity analysis or Inspector's Chart which develops a driving resistance based on a varied hammer stroke for the open fuel setting. Both the variable and constant capacity analyses were run with two resistance profiles. The friction profile assumed a triangular distribution of 50% skin friction along the pile and 50% end-bearing. The end-bearing profile assumed 10% skin friction triangularly distributed along the pile and 90% capacity to be developed in end-bearing. We are comfortable with the chosen analysis with respect to the subsurface information presented in the boring logs and previous geotechnical reports.

Based on a review of the material submitted, we agree with the recommendations put forth by GZA in their report dated April 2nd, 2014, which recommends a driving criterion of 6 blows per inch for three consecutive inches and a stroke of 8.5 feet. At these blow counts, the stresses in the pile are expected to remain below 45 ksi per GZA's analysis. <u>A saximeter is required to be on site to monitor the driving process at each substructure.</u> We recommend using a refusal criterion as 10 blows per half inch with a minimum 9.0 foot ram stroke.

The 2011 VTrans Standard Specifications for Construction, Section 504.02(b), states the pile driving equipment must be capable of driving the pile to the required ultimate capacity at blow counts between 3 and 15 BPI. **Based upon this information and the WEAP analysis, the Ape D19-42 hammer should be able to drive the steel HP 12x84 piles to the desired resistance and stay within the specifications.**

The serial number of the hammer should be recorded and kept in the pile driving records. Also, it is important to note that the thickness and condition of the prescribed blue nylon cushion should be inspected prior to driving any piles. **If the thickness of the hammer cushion has decreased by 25%, then the cushion should be replaced, per Agency Specifications.** Generally, the best time to inspect the hammer cushion is when the hammer first arrives on the job, and is placed in the leads.

cc: CCB/Project File

G:\Soils and Foundations\Projects\Pittsfield ER BRF 022-1(23)\ Pittsfield ER BRF 022-1(23) WEAP Review.docx