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MEMORANDUM

To: **MARK THOMAS & CO., INC.**
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February 5, 2013
Job No.: 2009-130-GDR

Attn.: Mr. Matt Brogan

From: Frank Y. Wang, G.E.

Sub: Estimation of Seepage Rate
I-80/680/12 ICP Project, Solano County, California

This memorandum is prepared to summarize the estimated groundwater seepage flow rate expected during the footing excavations for this project, including the following three bridge structures:

- Green Valley Road OC, Br. No. 23-0246
- Green Valley Road OC – Over SB 680 On-Ramp, Br. No. 23-0247
- WB 80 to WB 12 Separation – Over WB 80 On-Ramp, Bridge, Br. No. 23-0248

Based on the boring data, the groundwater was encountered at about 10 to 15 feet below existing grade. Based on the plans provided, the footings are generally above the groundwater. The seepage rate is considered relatively small. However, Bent 3 of the WB 80 to WB12 and Bent 2 of the Green Valley Road OC are quite close to the groundwater level and we have assumed groundwater table at 2 feet above the bottom of the excavation.

The flow of groundwater through porous media, such as soil, is dependent upon many variables. The most important parameters that control the flow of water in soil are the permeability of the soil and the head differential. The permeability of the soil can be determined from laboratory test results or a site pump test. In the absence of laboratory tests or pump test data, an estimate of the permeability can be made based on standard correlations published in geotechnical literature. Head differential can be determined based on the elevation of the measured phreatic surface and the anticipated drawdown needed to keep the ground surface dry and workable.

The permeability of soil is generally very difficult to estimate accurately from laboratory tests and correlations. This is because the permeability of the soil is dependent on numerous factors such as the soil density, the void ratio, the presence of sand or silt lenses, the soil saturation, sample disturbance, etc. It is virtually impossible to account for all these factors accurately in the laboratory or when correlating with published values. Consequently, permeability based on laboratory tests and/or correlations can be off by orders of magnitude. For this project, we estimated the seepage using soil description and published soil data correlations in literature.

At the planned location of Bent 3 of WB 80 to WB 12 Separation structure, the site is underlain by predominantly clayey materials. At the planned location of Bent 2 of Green Valley Road OC,

the site is underlain by about 10 feet of lean clay overlying a layer of clayey sand. We have assumed a typical permeability of 10^{-6} cm/s for the clayey materials and 10^{-4} cm/s for the clayey sand.

We have used the computer program SEEP/W (by Geoslope) for estimating the seepage rate. The seepage rate is estimated on the order of 0.003 gallon-per-minute (gpm) for Bent 3 of WB 80 to WB 12 and 0.05 gpm for Bent 2 of Green Valley Road OC.

Please be advised that we are performing a professional service and that our conclusions and professional opinions only. All work done and all recommendations made are in accordance with generally accepted geotechnical engineering principles and practices. No warranty, expressed or implied, of merchantability or fitness, is made or intended in connection with our work.