SUMMARY OF GEOTECHNICAL CONDITIONS

The following is a summary of the geotechnical conditions and their potential impacts on the construction of the I-5/SR432 Talley Way Interchange project. Due to soft soil conditions across the project site, this project contains ground improvement methods such as stone columns, embankment preloads/surcharges and high strength geosynthetic reinforcement.

Subsurface Conditions

Based on our field explorations, the soil deposits encountered have been grouped into three soil units for geotechnical distinction; fill, alluvium (silty sand and sandy silt) and bedrock. The soil units are grouped primarily on the basis of engineering properties and classification. The units are individually described in the following paragraphs.

The fill was placed during the original roadway construction and Columbia River dredging, and generally consisted of very loose to dense sand and gravel with varying amounts of silt. The fill can be divided into two distinct groups; roadway and dredged. Roadway fill generally consisted of loose to dense gravel with varying amounts of sand and silt. Dredged fill was generally finer grained than roadway fill. It consisted of very loose to dense sand with varying amounts of gravel and silt.

Alluvium was observed in all of the test holes, and generally consists of very soft to hard elastic silt and lean clay with varying amounts of sand and organic matter, and very loose to medium dense silt and sand. It should be noted that a three foot diameter log was encountered on the southern end of the project (see H-1-06), and various organic matter was observed in the soil samples of this unit.

Bedrock is exposed on the east side of the project, however for most of the project it was typically observed below the alluvium to the termination of the test holes. This unit generally consists of 5 to 10 feet of soft to moderately strong sandstone and siltstone underlain by strong to very strong basalt. The boring logs and the geotechnical data report contain further detail concerning the subsurface conditions.

Surface and Groundwater

Surface water is evident across the proposed project site. Major bodies of surface water on the site include: ponds in the southeast and northwest corners of the project, sloughs in the southwest quadrant and the northwest quadrant of the site, the Coweeman River in the north quadrant of the site. Major bodies of surface water adjacent to the site include: the Cowlitz and Columbia Rivers to the west and northwest of the site. Historically, a detailed slough network existed across the site, and between 1966 and 2003 the pond to the southeast of the interchange formed. Portions of the existing slough network are now located beneath existing and proposed roadway embankments. More information pertaining to estimated locations of the historic slough network can be found in the Geotechnical Data Report.

To obtain more accurate groundwater elevations and seasonal variations, 13 open standpipe piezometers were monitored across the site, and three test pits were excavated. Groundwater was encountered in the test pits at elevations between 14 feet and 15 feet. The table below presents the boring and the highest/lowest groundwater elevations

recorded for each piezometer. All of the recorded piezometer readings are summarized in the Geotechnical Data Report for this project.

Summary of Piezometer Data

Boring No.	Lowest Observed Water Elevation (ft)/Date	Highest Observed Water Elevation (ft)/Date
SP-1P-08	14.2/September 12, 2008	17.3/December 12, 2008
SP-2P-08	12.9/October 10, 2008	20.0/December 12, 2008
SP-3P-08	11.8/October 10, 2008	18.8/December 12, 2008
SP-4P-08	12.6/October 10, 2008	15.9/January 13, 2009
SP-5P-08	13.3/October 10, 2008	16.5/January 13, 2009
H-8-06	11.6/October 18, 2006	14.7/January 29, 2007
H-9-06	8.4/October 18, 2006	13.1/June 2, 2008
H-13-06	7.6/ October 18, 2006	15.0/June 2, 2008
H-16-07	31.1/August 14, 2007	38.3/February 20, 2007
H-17-07	16.0/August 14, 2007	20.2/February 19, 2008
H-20P-08	13.3/October 10, 2008	15.4/January 13, 2009
H-33P-08	16.0/June 2, 2008*	16.0/June 2, 2008*
H-46P-08	14.0/October 10, 2008	17.0/June 5, 2008

*Only one reading recorded.

Construction Considerations for Various Project Elements

Ground Improvement

Due to the soft ground conditions, site access will be difficult. Therefore, we anticipate that the construction of the stone columns will likely require the use of temporary roads, crane mats and/or the construction of a large-area working platform. The contractor will be responsible for design of any required temporary roads, working platforms, etc. The fine grained soils will lose strength and may liquefy during column installations. Densification between columns is not likely to occur in the silty soils. Because of the near surface groundwater, the stone column construction process may bring soil and water to the ground surface. Because of this, the drainage blanket must not be constructed prior to completion of the stone columns in order to prevent its contamination and potential clogging by fines excavated during placement of the stone columns.

Embankments

The soft ground conditions will also make it difficult to meet embankment compaction requirements for the first couple of lifts of the embankment. The contractor shall establish a solid compacting surface for the proposed embankment prior to placing the first lift of embankment. The compacting surface could be achieved by over excavating untreated areas below the embankment and replacing with a separation geosynthetic and quarry spalls, or through the use of geogrids and/or geosynthetic for soil stabilization.

Bridge and Wall Foundation Excavations

The bottom elevations of the bridge footings and abutment walls are near the observed groundwater elevation. It may be necessary to construct an acceptable bearing surface by

over excavating the soft wet soils and replacing these soils with compacted borrow. It should be understood that the cut slopes for the overexcavation could be unstable due to the soft soil conditions and groundwater. Dewatering the overexcavation may be very difficult, and could add to the instability of the excavation.

Wet Weather Considerations

It should be noted that the fine grained soils (alluvium) will be prone to erosion when exposed, and precipitation will be slow to infiltrate these soils.

Luminaires

Luminaire foundations will be drilled shaft type foundations. It should be expected that ground water will be encountered in all excavations that extend below an elevation of 15 feet. Shaft stability may be a problem for excavations extending below ground water. The contractor should plan on full depth temporary casing. In addition, rock may be encountered in the foundation excavation for luminaire number 59 (AL 125+88, 53 feet left). The contractor should have appropriate equipment to complete the foundation excavation.

Site Access

Site access during the wet season could be difficult due to the soft nature of the surface soil (Unit 2-alluvium). When exposed silts become wet, they will become very slippery, soft, and prone to rutting. Quarry spalls, geogrids and/or geosynthetic for soil stabilization may be needed to maintain site access for haul roads and staging areas.

Available Geotechnical Reports

The following memorandums and reports contain design and construction information relevant to the project and are available at the Project Engineer's Office:

Tony Allen and Andrew Fiske, *Geotechnical Memorandum*, I-5/SR432/Talley Way Interchanges: Geotechnical Recommendations for P-line Bridge, Cowlitz County, Washington, March, 2009.

Tony Allen and Andrew Fiske, *Geotechnical Memorandum*, I-5/SR432/Talley Way Interchanges: Geotechnical Recommendations for P-line Bridge-Shallow Foundation Alternative, Cowlitz County, Washington, June, 2009.

Tony Allen and Andrew Fiske, *Geotechnical Memorandum*, I-5/SR432/Talley Way Interchanges: Geotechnical Recommendations for Borrow Suitability, Cowlitz County, Washington, June, 2009.

Tony Allen and Andrew Fiske, *Geotechnical Memorandum*, I-5/SR432/Talley Way Interchanges: Geotechnical Recommendations for R-line Bridge, Cowlitz County, Washington, July, 2009.

Tony Allen and Andrew Fiske, *Geotechnical Memorandum*, I-5/SR432/Talley Way Interchanges: Luminaire Foundation Recommendations, Cowlitz County, Washington, September, 2009.

Tony Allen and Andrew Fiske, *Geotechnical Memorandum*, I-5/SR432/Talley Way Interchanges: Geotechnical Recommendations for P-line Walls and P-line/M-Line/N-Line Embankments, Cowlitz County, Washington, September, 2009.

Tony Allen and Andrew Fiske, *Geotechnical Memorandum*, I-5/SR432/Talley Way Interchanges: Geotechnical Recommendations for R-line Walls and R-line Embankments, Cowlitz County, Washington, September, 2009.

Tony Allen and Andrew Fiske, *Geotechnical Data Report*, I-5/SR432/Talley Way Interchanges, Cowlitz County, Washington, September, 2009.

SEPT. 17, 2009

Prepared By: Andrew J. Fiske
Foundation Engineer

D. Todd Mooney

Reviewed By: D. Todd Mooney
Senior Foundation Engineer