Research Project Status Report

January 1, 2011 – March 31, 2011

Project Title		Agmt./Task No.	Item No.	Agency Bgt. No.	
Subsurface Drainage for Landslide and Slope Stabilization		GCA6381			
Research Agency		Start Date	Estimated Completion	Revised Completion	
WSU/Desert Research Institute (DRI)		3/2007	12/2010	12/2011	
Principal Investigator(s)		Technical Contact			
Balasingam Muhunthan (WSU) and Greg Pohll (DRI)		Tom Badger 360.709.5461			
WSDOT Program Manager		FHWA or Other Technical Contact			
Kim Willoughby 360.705.7978		Mike Adams			
Funding Source		Schedule Status			
CA, MD, MS, MT, NH, OH, PA, TX, WA, WY		☐ On schedule ☐ Ahead of schedule ☐ Behind schedule			
Research Area					
Bridges & Structures Operations & Materials	☐ Environment ☐ Traffic & Intelligent Transportation Sys	Highway Design & Safety Mobility & Intermodal Planning tems Evaluation			
Original Estimated Cost	Revised Cost	% Funds Expen	ded %	% Work Completed	
\$ 300,000		45%		50%	
Objective					
(1) Provide best practices and guidance for subsurface drainage applications for slope stabilization, including subsurface investigation and testing, groundwater-flow characterization, analysis, drain configurations and design, installation methods,					
monitoring, and maintenance. (2) Evaluate new applications of existing materials and technologies, such as trenchless					
technologies (horizontal directional drilling, micro tunneling, guided boring, etc.) and other innovative technologies and materials,					
for stabilizing slopes using subsurface drainage.					

Project Progress:

Tasks to date include the following:

- Data acquisition (geotechnical reports, observed water levels, drain geometries and flows, precipitation) from WSDOT for the two WA sites (US 101 MP 69.8 and US 101 MP321)
- Data acquisition from DNR websites (e.g. 10 m DEM, soil, road, river and geology).
- Development of a one-layer steady state model for MP69.8 in which average water levels prior to any drain installment were matched by calibrating hydraulic conductivity in both the disruptive Lincoln Creek claystone as well as the disruptive Lincoln Creek claystone passive zone and GHB conductance. Average recharge was initially estimated using a curve number (CN) approach on 2 hour data from the Raymond NOAA gage. This was done because site specific data was not yet acquired at time of steady state model development. Recharge estimated at approximately 25% annual precipitation (or 0.00356 ft/day = 15.6 inch/year). Sensitivity analysis shows recharge most significant to model output. Root mean squared error (rmse) equal to 0.96 ft, or 1%.
- Transient models for MP69.8 were developed for the following scenarios: pre-drain winter water levels (calibrated to H1A-05 December 2005). rmse = 1.2 ft (1% error); pre-drain summer water levels (calibrated to H1A-05 6/8/2005 to 9/29/2005). rmse = 0.047 (3% error). CN set to 70 to reflect soil type and vegetation. One day of no precipitation assumed to separate storms. A single calibration of both winter and summer events is proving difficult. Work is ongoing to develop a solution.
- A steady state model for MP321 was developed using three layers to reflect site geology. Zone and pilot point approaches to hydraulic conductivity fields were tested. Later, the three layer model was converted into a one layer model to improve model stability given numeric instability occurs in steep, thin, perched systems. rmse = 6.3 (4.9% error). Ongoing work will improve calibration.

Page 1 6/23/2011

Research Project Status Report

January 1, 2011 – March 31, 2011

• A transient model of MP321 was developed in three layers, then one layer, spanning 5/6/2009 to 5/10/2010 with drains modeled. Observed data matched includes H-3A-95 and H-1A-95. rmse = 3.9 ft. Ongoing work will improve calibration and water balance.

New Period Proposed Activity:

We will finalize the model development for the selected sites and begin writing the design manual.

Page 2 6/23/2011