OREGON DEPARTMENT OF TRANSPORTATION

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SPR Quarterly Progress Report
October 1, 2016 through December 31, 2016

Date January 17, 2017

TO: Technical Advisory Committee Members:
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Russ Frost, ODOT
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1. Project

Title: Enhancing Landslide Inventorying, LiDAR Hazard Assessment and Asset Management
SPR # 786

2. Project Investigator

Name: Ben A. Leshchinsky, Michael J. Olsen (Co-PI), and William Burns (Co-PI)
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3. Project Coordinator

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4. Key Dates

Project start date: December 23, 2015
Project completion date: December 29, 2017

First Fiscal Year: 2016
Final Fiscal Year: 2018
[List revised dates and corresponding amendment numbers]

5. Project Status

Task 1: Perform comprehensive literature review in consideration of Oregon landslide issues. Arrange and host a workshop involving the TAC to highlight major regional needs and potential obstacles for landslide hazard mapping.

Task 1 Deliverable: Literature Review and Workshop [January 2016]

Percent completed reported in last quarterly report: 100%

Task 2: Modify CCM algorithm to account for existing lithological maps, soil maps, and existing statistical databases to refine semi-automated landslide mapping technique for DOT use.

Task 2 Deliverable: Refined CCM [December 2016]
Percent completed reported in last quarterly report: 70%
Percent completed after this quarter: 75% (estimated for end of quarter)

Key Progress-To-Date

- The algorithm is currently being modified to account for the use of headscarp polylines as an input for inventorying landslides. Focus is being placed on using topographic indicators to identify polylines.
- We have a running beta version of the modified CCM code.
- A probabilistic approach for eliminating falsely identified landslides has been developed and is being tested.

Specific Progress This Quarter

- Machine learning-based approaches are being explored improve headscarp identification using the available topographic data.
- A probabilistic approach for eliminating falsely identified landslides has been developed and is being tested.

Problems

- Differing geologies and modes of slope failure are currently preventing an overarching identification strategy that applies to all highway corridors. Each geomorphologic regime, which may or may not encompass an entire corridor, must currently be mapped individually.

Work Planned for Next Quarter

- Selection and formal documentation of best approach to headscarp identification and removal of falsely identified landslides.

Task 3: Work with DOGAMI and ODOT personnel to select regions of manually inventoried landslides representative of regional unstable geologies around Oregon, and calibrate algorithm to match inventories and slide classifications. Initial analysis will be done for State Highway 36, State Highway 42 and select portion of Highway 101. Validation will be performed on select sections of these highways that do not currently have landslide inventories.

Task 3 Deliverable: Validation of refined CCM [April 2017]
Percent completed reported in last quarterly report: 40%
Percent completed after this quarter: 45% (estimated for end of quarter)

Key Progress-To-Date

- Lidar data has been obtained for all three highway corridors and for nearby inventories produced by DOGAMI.
- Relevant ODOT highway asset geospatial data has been obtained for all three highway corridors.
- DOGAMI inventories having similar geologies to the three highway corridors have been identified.

Specific Progress This Quarter

- Relevant DOGAMI landslide inventories have been selected.

Problems

- None.

Work Planned for Next Quarter

- DOGAMI inventories will be used to calibrate the headscarp identification and falsely identified landslide removal techniques of Task 2.

Task 4: Work with personnel from ODOT to assign significance factors to landslide type/age, proximity to important infrastructure (e.g. highways, bridges, retaining structures), public safety, and emergency access (e.g. "Tier 1 Lifeline" Routes) to enable a prioritization scheme informed by refined landslide mapping and classification algorithm scheme. Use calibrated landslide inventorying scheme and ODOT prioritization metrics to create hazard and risk maps for pilot study of three selected Oregon highways.

Task 4 Deliverable: Risk Maps [September 2017]
Percent completed reported in last quarterly report: 30%
Percent completed after this quarter: 40%

Key Progress-To-Date

- Met with ODOT Senior Transportation Economist, Becky Knudson, to discuss strategy for assigning value to highway closures caused by landslides. Use of the Oregon Statewide Integrated Model for each highway corridor is being planned.

Specific Progress This Quarter

- Meeting with Becky Knudson.

- Obtained bridge replacement cost estimates for all three corridors and examples of previous ODOT cost estimates associated with highway closures.

Problems
- None.

Work Planned for Next Quarter
- The Statewide Integrated Model results may be ready by the end of next quarter.
- Determination of a protocol for what proportion of estimated costs should be assigned based on the size, type, and location of landslides.

Task 5: Establish a guideline for application of CCM in context of the current DOGAMI landslide mapping framework, delivered as a publically-available special publication.

Task 5 Deliverable: DOGAMI Special Publication [September 2017]
Percent completed reported in last quarterly report: 5%
Percent completed after this quarter: 10%

Key Progress-To-Date
- Met with DOGAMI to refine CCM and start on outline for special publication (September 2016)

Specific Progress This Quarter
- Probabilistic approaches for identifying headscarps and removing falsely identified landslides are designed to assign confidence to landslides according to existing DOGAMI methodologies.

Problems
- None.

Work Planned for Next Quarter
- Meet again with DOGAMI to begin documentation for application of CCM within context of their program.

Task 6: Deliver technical report and pilot hazard/risk maps for ODOT use based on landslide activity and proximity to important infrastructure.

Task 6 Deliverable: Final Report [October 2017]
Percent completed reported in last quarterly report: 20%
Percent completed after this quarter: 20%

Key Progress-To-Date
- Draft of literature review is complete.
- Implemented feedback from TAC within literature review.

Specific Progress This Quarter
- None.

Problems

- None.

Work Planned for Next Quarter

- Production of formal documentation of refined CCM methodology.

6. <u>Project Coordinator's Comments</u> (Completed by ODOT)

Project is successfully proceeding as described in the original work plan. The December brainstorming session with ODOT Senior Economist Becky Knudson and Curran Mohney to improve Task 4 deliverables was a success, and Becky will be providing corridor information to the OSU team around April 2017. A TAC Demo Meeting is planned for early summer 2017, and communication with OSRAA billing is in progress.

7. <u>Finances</u> (Completed by ODOT)

SPR Project Summary

VENDOR	FY'16	FY'17	FY'18	FY'19	TOTALS
ORIGINAL BUDGET	**$ -**	$ -	$ -	$ -	$ -
WORK PLAN BUDGET	$ 56,000	$ 167,000	$ 27,000	$ -	$ 250,000
REVISED BUDGET	**$ 56,000**	**$ 167,000**	**$ 27,000**	**$ -**	**$ 250,000**
EXPENDITURES - VENDOR	$ 48,217	$ -	$ -	$ -	$ 48,217
BALANCE	$ 7,783	$ 167,000	$ 27,000	$ -	$ 201,783
ODOT	FY'16	FY'17	FY'18	FY'19	TOTALS
ORIGINAL BUDGET	$ 83,000	$ 138,000	$ 55,000	$ -	$ 276,000
REVISED BUDGET	**$ 8,674**	**$ 7,000**	**$ 8,000**	**$ -**	**$ 23,674**
EXPENDITURES - ODOT	$ 8,698	$ 2,461	$ -	$ -	$ 11,159
BALANCE	$ (24)	$ 4,539	$ 8,000	$ -	$ 12,515
PROJECT	FY'16	FY'17	FY'18	FY'19	TOTALS
ORIGINAL BUDGET	$ 83,000	$ 138,000	$ 55,000	$ -	$ 276,000
REVISED BUDGET	**$ 64,674**	**$ 174,000**	**$ 35,000**	**$ -**	**$ 273,674**
EXPENDITURES - PROJECT	$ 56,915	$ 2,461	$ -	$ -	$ 59,376
BALANCE	$ 7,759	$ 171,539	$ 35,000	$ -	$ 214,298