Unstable Slopes – Glacial deep-seated landslides and their groundwater recharge areas

Considerations for the CMER Work Plan

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(NOT a CMER or UPSAG consensus product)

A review of the CMER Work Plan Unstable Slopes Program, in light of the recent Oso landslide event, reveals some opportunity to provide more information about the influence of forest practices on that type of landslide – a deep-seated landslide (dsls) in glacial material (gl), and its groundwater recharge area (gwra). The CMER Work Plan already includes some proposed work in this area, but pursuit of that avenue of study was not very fruitful; an alternative is proposed here, as well as additional proposed study for CMER to consider including in the work plan.

Critical Questions – Unstable Slopes – gwra, gl dsls

One critical question can be found in the CMER 2015 Work Plan, page 130 , Table 24, Unstable Slopes Rule Group Critical Questions and Programs:

Does harvesting of the recharge area of a glacial deep-seated landslide promote its instability?

The approach currently in the work plan leads to understanding how the groundwater recharge areas affect unstable slopes. There have been issues with that approach because of the complexity and variation among gl dsls and gwr areas, and the inability to acquire accurate local weather information to run the model that estimates water input to the soil under clearcut conditions vs. forested conditions.

This new proposal does not attempt to understand the underlying water and stability issues, but rather looks for evidence of when/where and under what conditions a gl dsls seems to move in conjunction with forest practices activity on the gl dsls and/or its gwra.

An additional critical question is not in the CMER Work Plan at this time. It could be worded something like this:

Can relative levels of response to forest practices be predicted by key characteristics of gl dsls and/or their gwra's? (characteristics such as landslide type, glacial stratigraphy, and relative sizes of gwr harvest and gl dsls)

Current rule lumps together all landslides over about 10m in depth up to hundreds of meters in depth. These landslides generally range in area from hundreds of square feet to a square mile or more. The landslide types vary and the stratigraphy that they occur in is quite variable. It may be that smaller "gl dsls" behave more like shallow rapid landslides, being quite sensitive to forest practices, while the giant gl dsls may behave more independently from forest practices. A study that examines the historic pattern of movement of the various sizes and types of gl dsls in relation to harvest activities could help us understand the sensitivity of various gl dsls scenarios to forest practices. Weather information will be considered in conjunction with the forest practice activities because dsls motion is often related to long periods of excess precipitation.

Proposed Study Approach

A three-phased approach is described here.

Phase 1 – compile and complete mapping of the gl dsls

Through efforts by Washington Department of Natural Resources (Geology Division), United States Geological Survey, TFW stakeholders conducting Watershed Analysis, CMER's Landslide Hazard Zonation and potentially others, extensive mapping of al dsls has occurred across Washington State. These resources should be gathered together in one electronic layer. Any gaps should be identified and mapping of gl dsls should be done in those areas.

This layer would form the basis for going forward into Phase 2 – we would have the population of gl dsls we needed to start the binning process. One, accessible layer would also be most useful to forest engineers, qualified experts and regulators screening for potential gl dsls and their gwra.

Phase 2 – create some bins of gl dsls with similar features

This phase, fairly similar to the deep-seated landslide classification project already scoped by UPSAG (page 136 of CMER 2015 Work Plan) would bin gl dsls by landslide type (e.g., earthflow, rotational translational), by stratigraphic section (e.g., the stratigraphy section at Oso is fairly constant for some distance up and down valley and there might be other valleys with a similar section), by size of gl dsls and size of gwra (e.g., gl dsls vary from a couple of acres to hundreds of acres in size and gwr areas vary from almost nothing where gl dsls form in a glacial veneer and initiate from a bedrock ridge to those features with gwr from glacial terraces), and by proximity to the channel. These characteristics are likely to have differential responses to changes in gwr. Bins would need to be somewhat generalized – the objective would be to identify several bins into which most of the gl dsls in Washington State could be placed and then subsample these bins for Phase 3.

Phase 3 – examine history of harvest, weather, channel and slope and movement

We would select some sites of each type to examine in detail the historic photos, reports and weather records to determine the relative scale of harvest, the weather conditions of the few years previous to harvest, stream channel actions, and movement of the landslide.

Possible Results

Phase 1 - the results of this phase could be used as a screening tool to inform foresters when they are in the vicinity of a gl dsls, and need to consider gwr, as well as preparing for Phase 2&3

Phase 2 - this phase helps sort the types of gl dsls for further study

Phase 3 – we may be able to determine which kinds and sizes of gl dsls are more or less sensitive to forest practices under which channel and weather scenarios

Completely Speculative Budget & Schedule

Phase 1

1. Putting together existing maps into one layer – shorter term; DNR has the materials and expertise to do this efficiently if they can assign someone to do it

2. Filling gaps with new mapping – longer term, to follow step 1 above; costs & timing depend on how much mapping is needed; should be able to complete within a few months and $100, 000.

Phase 2

Hire a consultant to go over the data and bin it according to UPSAG proposed categories and/or to propose categories/classification for different types of gl dsls. This should be able to be accomplished in a few months, at a cost of $50,000. Landslides to evaluate in Phase 3 would be chosen from these categories. Weather conditions need to be considered as part of the sampling scheme.

Phase 3

Examination of photo, hydro and other records, and field visits for each site to be examined will play into the costs. How many samples will we want evaluated?

Guesstimates below depend on how much original mapping is needed, how many categories, how many samples, availability of DNR to do some of the work, etc.

PHASE	WHAT?	WHO?	HOW LONG?	HOW MUCH?
Phase 1 Step 1	Compile existing info	DNR?	3 mo.	?
Phase 1 Step 2	Fill gaps with original mapping	DNR? Consultant?	Hopefully a few mo., may be able to continue with Phase 2 if gaps are minor	$100K or less
Phase 2	Classify gl dsls	Consultant	6 mo.	$75K
Phase 3	Examine samples Remote & field	Consultant	12 mo.	$200K
TOTAL			About 2 years	Around $400K?