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Subject: **GEOTECHNICAL REVIEW  
STATE OF WASHINGTON DEPARTMENT OF NATURAL RESOURCES (DNR)  
FOREST PRACTICES APPLICATION (FPA) NO. 2617912  
"PARCHED" TIMBER SALE  
CLALLAM COUNTY, WASHINGTON**

Dear Dr. Copass and others concerned,

Thank you for requesting me to assist you with geotechnical services related to the subject FPA. The following review summarizes my research and analysis regarding the proposed timber sale and is intended for you to use in your comments to the DNR. The terminology herein and comments are intended to be consistent with Section 16 of the DNR Forest Practices Board Manual, dated 5/2016. I am not a DNR Qualified Expert (QE) for forest practices ([https://www.dnr.wa.gov/publications/fr\\_geo\\_experts.pdf](https://www.dnr.wa.gov/publications/fr_geo_experts.pdf)). However, I am a State of Washington Licensed Engineering Geologist (LEG), which is the same license required for QEs, and I have 15+years of engineering geology experience particularly focused on slope stability and geomorphology. I am performing this review as a professional with similar credentials but am intentionally independent from the DNR Forest Practices system. In addition to my comments comparing the subject FPAs to the Board Manual, I have also included comments critical of the Board Manual and/or its typical interpretation and policies with respect to the subject FPA. The focus of my review is the DNR "Geologic Memorandum for the Parched Timber Harvest, Clallam County, Washington," (GMPTH), dated March 22, 2023, which I reviewed digitally. I visited portions of the units in the field on May 4<sup>th</sup> and 9<sup>th</sup>, 2023.

### **I. SUMMARY AND CONCLUSIONS**

The DNR does not appear to have adequately completed geologic office and field review related to the deep-seated landslides (DSLs) and active faults relevant to this timber sale in its analysis of the area based on my review. There is a very large active DSL mapped in the GMPTH below Unit 1 that does not include the required topographic groundwater recharge area (TGRA). The risk to natural resources, and private and public resources / infrastructure appears to be major for this timber sale and has not been addressed in this GMPTH. See section IV below for a list of requested clarifications / changes.

**II. ANALYSIS**

Because this timber sale is a type III, the DNR slope stability reporting does not need to be as rigorous as for a type IV special, but needs to be rigorous / thorough enough to cover any potential Rule-Identified Landforms (RILs). However, when looking at the GMPH, I noticed that the report and its figures did not appear to adequately address several relevant features.

**A. Unit 1**

In Unit 1 there are several relevant features which I have indicated with red numbers corresponding to the following feature numbers.

1. Feature 1 (Red Number 1). I was only able to see this feature from Little River Road due to private property access restrictions. It is mapped as a Quaternary landslide (Qls, with relatively-high certainty due to lack of a question mark). This feature is consistent with a DSL, which is considered a RIL per the DNR Forest Practices. The GMPH discusses it on pages 2-4 and in Image 1. The GMPH concludes that less than roughly 20% of the feature from the geologic map is an active glacial DSL, and delineated a topographic groundwater recharge area (TGRA) which does not extend to Unit 1. The GMPH does not mention that the alluvial fan (Qa<sub>f</sub>) feature on the uphill / scarp side of the Qls contains a residential development which is associated with the recent (certainly since the time of timber harvest) road grades and land modifications (buildings are gray boxes). Active fault traces are mapped on the geologic map along the south edge of figure-1 and also roughly parallel to Little River Road (just west of the left edge of the image, but recent studies have extended east through the entire image as I show in my figure-4).

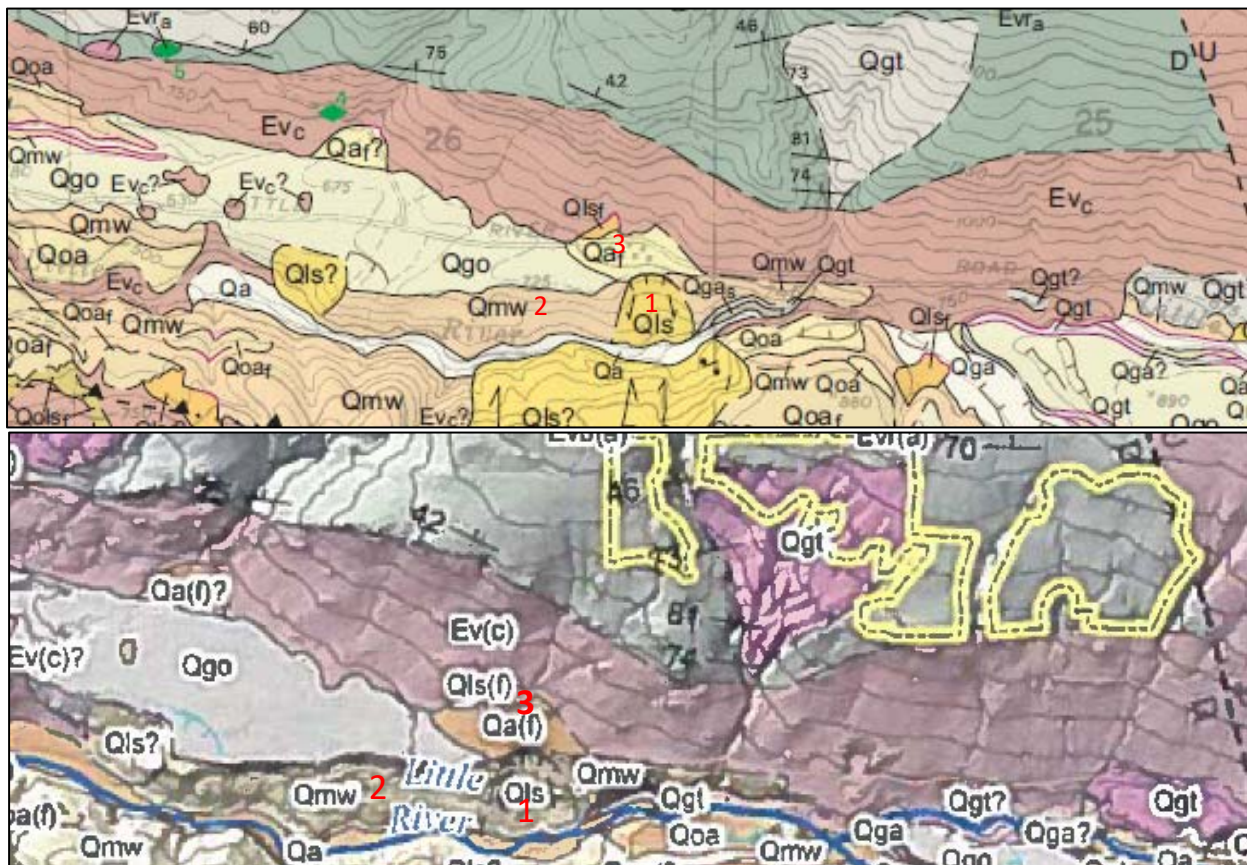


Figure-1: Geologic Maps with My Red Feature Numbers; Upper is Original and Lower is Fig. 1 of GMPH with Unit 1

The limits of the Qls / DSL with my red number 1 for feature 1 is much easier to see on the upper image in figure-1 compared to the lower image in figure-1. In my figure-2 below (Fig. 3 of the GMPH), the DNR shows what they consider to be active glacial DSLs as light-yellow areas, with a blue dotted region as the corresponding TGRA for their reduced size (roughly 20%) of feature 1 / Qls / DSL. The larger orange outline area is my feature 1 / Qls / DSL on the geologic map with my very approximate TGRA outlined in light blue. The area northwest of the larger orange area and south of Little River Road is the residentially-developed area that also includes the private road which the DNR finds is responsible for the “deep-seated slump.” This road grade ascends the steep river bluff from the “slump” area near the river up to the northwest edge of the Qls / DSL / orange area. It appears to me that there are other DSLs in this bluff slope in the area of the private road. The DNR determination that the rest of the Qls / DSL / orange area is entirely “intact terrace” does not appear to me to be adequately supported by evidence and appears otherwise in light distancing and ranging (LiDAR) imagery. I discuss feature 2 and my very approximated TGRA (an official TGRA was not included in the GMPH) below my figure-3.

In my opinion it dramatically under-represents DSLs to map them the way that is typical of the State Lands DNR geologists: they map the DSL and delineate the TGRA for the deposit only, and do not include the scarp area. This is particularly problematic in marine and fluvial environments where the slide deposit is actively being removed, such as for these glacial DSLs in the Little River bluffs. This results in dramatically-undersized DSLs and TGRAs, and frequent omission of landslide areas in DNR reports.

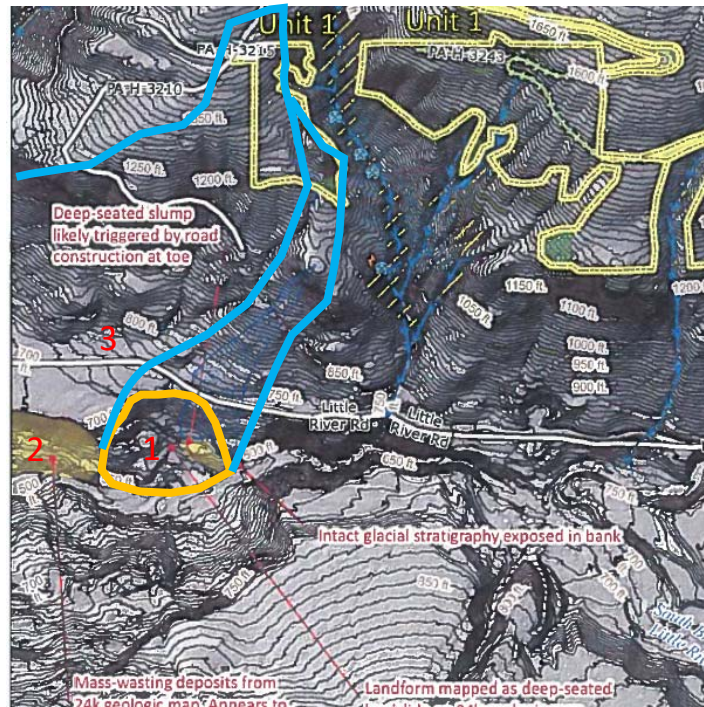
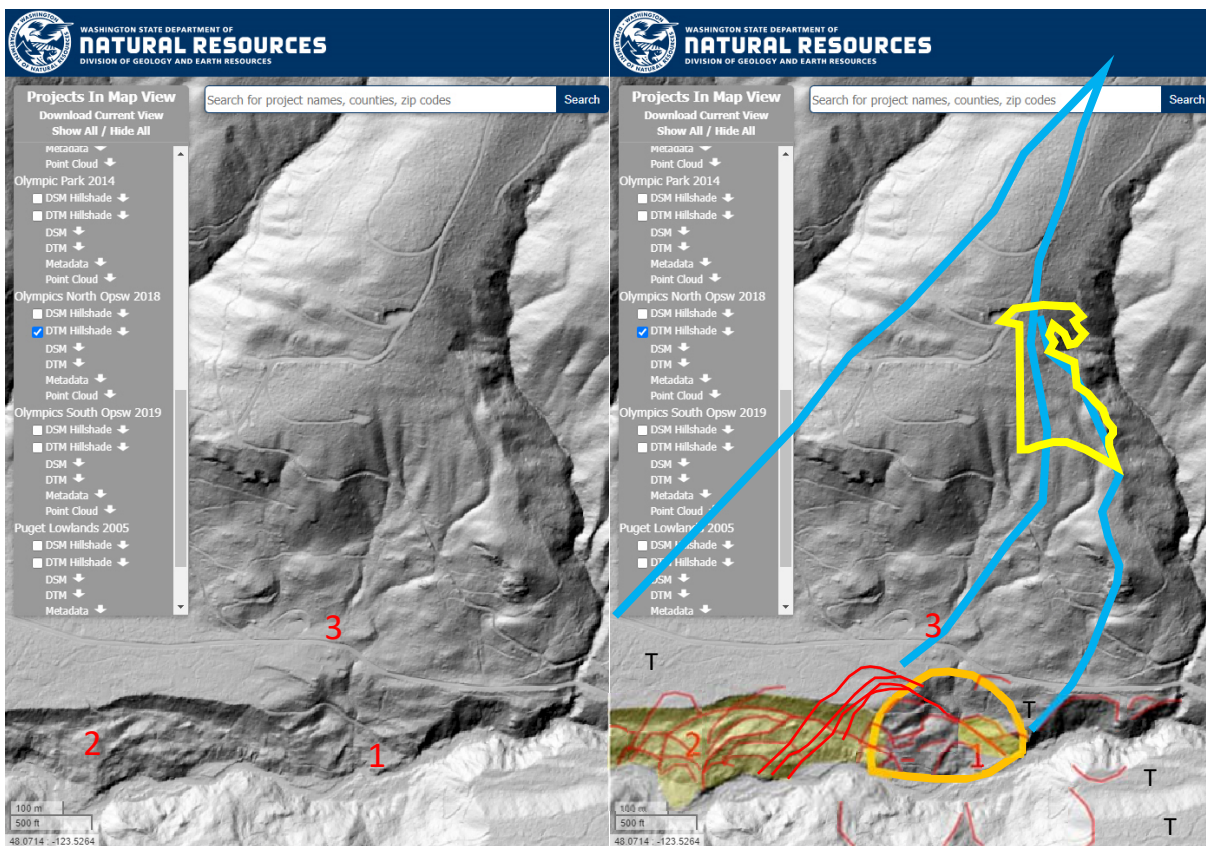


Figure-2: GMPH Fig. 3 with My Added Orange Outline of Geologic Map DSL / Qls and Light Blue Outline of Very Rough Estimate of TGRAs for Features 1 and 2

My Figure-3 below is a comparison of “bare-earth” LiDAR from the DNR LiDAR Portal with my annotations. I find that these images from the DNR website provide a third look at this area in comparison to the two images on page 3 of the GMPTH, although the digital quality of the FPA PDF document is low and many features are difficult to see clearly. **Rather than finding the topography dominated by intact terraces as the GMPTH did, I find the terrain to be dominated by DSL activity** related to river scour and channel migration, and apparent groundwater-driven landslides in glacial or post-glacial sediments. I have included a black letter T in areas that appear to me to be intact terraces. In Figure-3 I have also approximated the locations of Unit 1, the DNR-identified glacial DSLs, landslide scarps, and TGRAs. The very dark shaded area east of feature 1 appears to be actively scoured by the River and appears to have potential to expand into the road. This feature appears as though the proposed timber sale would increase runoff and groundwater here, which would decrease stability. Instability here directly and adversely affects residences, Little River Road, and Little River.



**Figure-3: LiDAR Imagery with Light Yellow DNR DSLs, Rough Yellow Unit 1 Outline, My Feature Numbers, My Landslide Scarps in Red, Orange Geologic Map DSL / Qs, Black Ts for Terraces, and Light Blue Outline of Very Rough Estimate of TGRAs**

2. Feature 2 (Red Number 2). I was not able to review this feature in the field due to private property access. This feature is visible as delineated by the DNR in my Figure-2 above (Fig. 3 from the GMPTH) and my rough approximation of the DNR’s delineation is shown above in my Figure-3. The GMPTH text does not mention this feature, but in its Fig. 3 is called out as: “Mass-wasting deposits from 24k geologic map. Appears to be deep-seated landslide in LiDAR.” The materials in this area appear to be glacial based on the geologic map, the GMPTH, and appear to be “active.” **As such, feature 2 is likely an active glacial DSL, which is a RIL, with a TGRA that is also a RIL. A TGRA for feature 2, which appears that it would include Unit 1 and at least one residential property, was omitted from the GMPTH.**

It appears to me that several scarps associated with this feature extend up onto the terrace and show significant displacement of the glacial terrace, implying that the area the DNR shaded yellow on their Fig. 3 should be enlarged significantly.

DSL activity in this area may also be affected by the presence of east-west trending near-vertical fault scarps (from the active Lake Creek – Boundary Creek fault), which are mapped in the vicinity of features 1 and 2 and are particularly susceptible to slope instability, which I discuss below.

**3. Feature 3 (Red Number 3).** I did not review this area in detail in the field. This area is shown as a “landslide debris fan (Qls<sub>r</sub>)” on the geologic map (Figure 1 above) and appears to be the uphill edge of a larger alluvial fan area (Qaf) which extends to feature 1 and nearly to feature 2. The GMPH did not discuss this landslide feature or the alluvial fan feature. This landslide area could also have TGRA impact to Unit 1.

**4. Active Faults.** The immediately-adjacent “Aldwell” timber sale (FPA 2617563) included an engineering geologic risk assessment (EGRA) report by the same author as the GMPH for the subject FPA, which included significant discussion of active fault traces (activity at 1, 3, 7, 8.5, and 11 thousand years ago with Magnitude 7-7.5 earthquakes) of the “North Olympic fault zone” or “Lake Creek-Boundary Creek fault.” The same 2021 reference from the Aldwell EGRA (*Elizabeth R. Schermer, Colin B. Amos, William Cody Duckworth, Alan R. Nelson, Stephen Angster, Jaime Delano, Brian L. Sherrrod; Postglacial Mw 7.0–7.5 Earthquakes on the North Olympic Fault Zone, Washington. Bulletin of the Seismological Society of America 2020;; 111 (1): 490–513. doi: <https://doi.org/10.1785/0120200176>*), and a 2019 reference (*Duckworth, Cody, "Slip and strain accumulation along the Sadie Creek fault, Olympic Peninsula, Washington" (2019). WWU Graduate School Collection. 896. <https://cedar.wvu.edu/wwuet/896>*) from the 2021 reference show active fault traces crossing my “feature 1” and my “Feature 3” discussed above and trace very close to the top of my “feature 2.” Figure-4 and figure-5 below include images from the 2021 and 2019 documents with my annotations. **The DNR did not discuss active faults in the GMPH and their presence within the discussed active DSLs.**

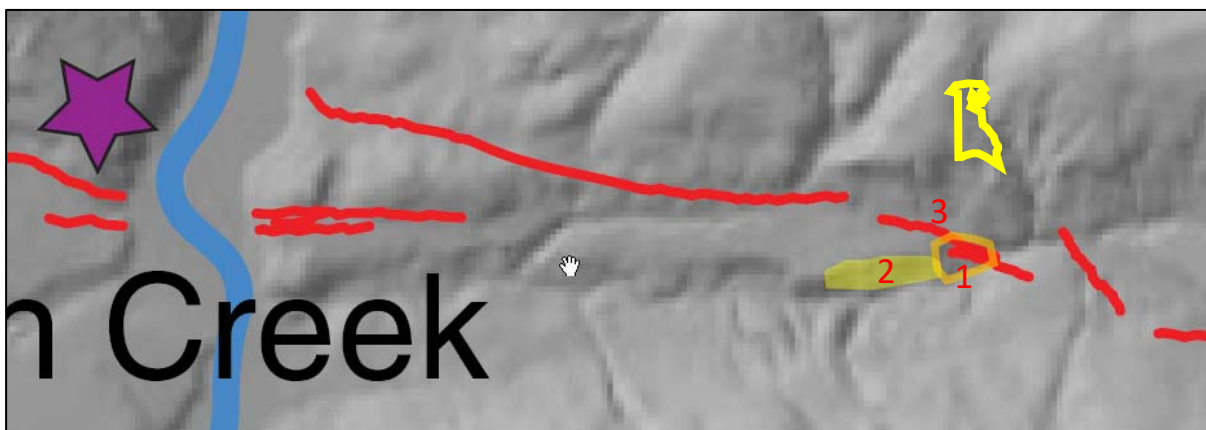


Figure-4: 2021 Fault Study Referenced in Aldwell EGRA with Red Fault Traces, My Hand at Quarry Location discussed in Aldwell FPA, Orange Feature 1, Yellow Shaded Feature 2, Yellow Outlined Unit 1, and Red Numbers for Features 1-3

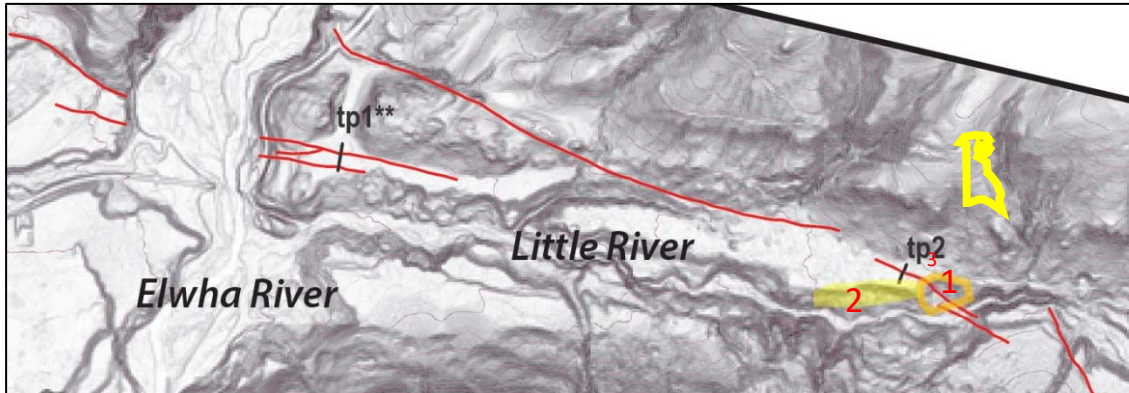


Figure-5: 2019 Fault Study Referenced in 2021 Reference from Aldwell EGRA; Red Fault Traces, Orange Feature 1, Yellow Shaded Feature 2, Yellow Outlined Unit 1, and Red Numbers for Features 1-3, "tp2" and Black Line is a Fault Investigation

**B. Unit 2**

In Unit 2 I reviewed only the northwest and northeast portions in the field, including the Creek bluff slopes and adjacent upland areas. At the northwest corner of the northeast portion of the unit (marked with a red 1), I observed the bedrock DSL discussed on page 2 of the GMPH, including the old timber sale boundary markers on the body of this DSL which have been moved uphill to above the head-scarp. I do not understand the GMPH discussion here. The geologist would have approved harvesting part of the slide body and head-scarp, but the forester excluded it? If it was to be included in the sale, would the sale then be a type IV special? I agree that the head-scarp and upper part of the slide body appear dormant-distinct, but I would anticipate uphill-propagation of the Creek scour at the toe of this slide as category E or a potential for future instability. This DSL appears to have been caused by Creek scour at the toe and groundwater, both of which will be increased by this FPA. The FPA activity map shows a strange overlap of the riparian management zone (RMZ) graphic onto the harvest area that is inconsistent with the GMPH harvest boundary that should be edited.

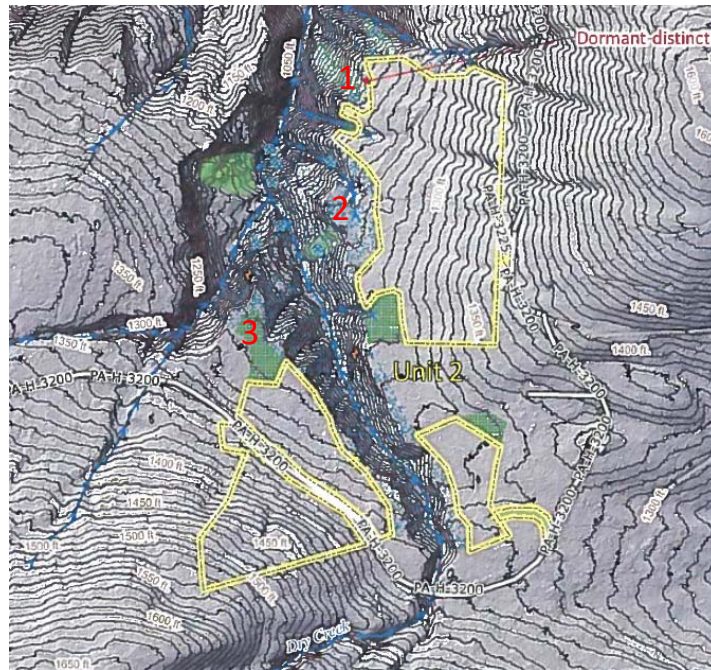


Figure-6: GMPH Fig. 4 with My Annotations

The area of my red number 2 which is a broad wetland with minimal timber appears to also be a large DSL, with the ridge between the wetland / type 4 stream being the slide block. This slide appears to also be a bedrock DSL, which eliminates the delineation of a TGRA and the harvest boundary would remain in its current location. Timber harvest east / uphill of this area will add major additional surface and groundwater to this area, which will certainly increase erosion in the streams and instability of the stream bluffs, but the forest practices rules allow this.

The LTA on the north edge of the northwest portion of Unit 2, where my red 3 is located, appears to avoid harvesting this narrow ridge between very steep and unstable Inner Gorge and shallow landslide slopes. The shallow landslide (lightning symbol) appears to be on the west side of this ridge. I interpret the east-facing slope adjacent to the shallow landslide to be a DSL. The RMZ in this area seems minimal.

This LTA has experienced major windthrow that appears associated with the recent harvest of the area immediately to the west. The south, east, and west edges of this LTA appeared very wet at the time of my field review, with standing water and saturated, soft soils. There appears to be a north-flowing stream(s) from several culverts in the PA-H-3200 road through a recent harvest area west and south of this LTA through the LTA to these very steep bluff slopes. These conditions appeared similar to wetland conditions and may have contributed to windthrow in this area. The LTA at the northwest corner of the west edge of the unit appears to be covering some very borderline harvest area which appears as though more of it should be bound out of the sale rather than considered an LTA.

### **C. Landslide Repair on PA-H-3100**

On page 5 of the GMPTH the 2021 landslide that caused severe road damage is discussed at length. The area was harvested in 2011, or roughly 10 years before the slide. The older drainage / swale where the slide initiated did not include any category E features or indications of shallow instability. This is not the type of feature that would be bound out of harvest and there is no RIL here. However, a “heavy storm event” ten years after harvest was able to “trigger” this slide because there was an increased “...runoff from immature forest upland.” Typical TGRA calculations assume that harvested areas reach equal stability and hydrologic conditions to unharvested forest within 12 years. Does the DNR find that 2 years of additional growth of these immature trees would have prevented such a landslide? If unharvested, would the same landslide have occurred? This seems like evidence that timber harvest in features such as this does not indicate resiliency to “heavy storm events.” Most climate change predictions include increased “heavy storm events.” I understand that the DNR is including climate change conditions into future timber harvest per the results of recent litigation and this seems like the type of conditions which should be considered for such an updated analysis.



### III. REQUESTED CHANGES / CLARIFICATIONS

#### Unit 1

- Qls / Deep-seated slump / feature 1: explain lack of fault discussion and expand DSL area to include uncertainty of “intact terrace,” particularly due to potential adverse effects on infrastructure, residences, and delivery potential to Little River.
- Active glacial DSL / feature 2 immediately west of feature 1: delineate TGRA for this DSL and consider expanding the DSL area to include scarps extending above terrace.
- “Landslide debris fan (Qls<sub>f</sub>)” / Feature 3: discuss this feature and explain why it was not reviewed, or review it.

#### Unit 2

- Dormant-distinct DSL / feature 1: explain the discussion of this in GMPTH and clarify the timber sale boundary between FPA maps.
- Northwestern LTA / feature 3: review this area for streams and windthrow hazard in very wet soil conditions, consider the narrow area between shallow landslides, wet soil windthrow, DSLs, and RMZs to be bound out rather than LTA.

#### Landslide Repair PA-H-3100

- Is DNR appropriately considering heavy storm events in immature forests for roadway drainage design?
- Are large areas of immature forested slopes a consideration for increased runoff and shallow landslides delivering sediment to streams?
- Do events like this give reason to question the hydrologic assumptions based on frequently-referenced studies such as Pypker, T.G., et al. 2009, and Jassal, R.S., 2009?

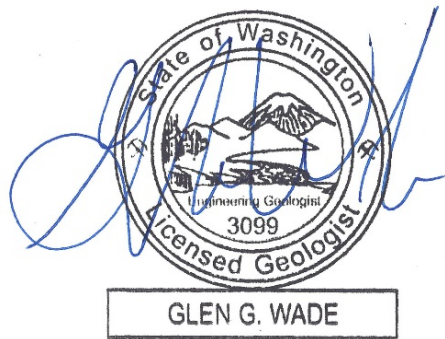
**IV. LIMITATIONS**

The comments in this letter apply only to the subject land and they are not transferable to nearby or adjoining property. These comments are the property of OFCO and may be used by others only with their permission.

These comments were based on a limited review of documents and field observations, with minimal or no subsurface investigation directly related to investigation of this timber sale. The prediction of hazard events is particularly difficult and speculative in nature and the discussion on that subject herein is my informed opinion only. Users who need a high level of reliance on the observations and conclusions of the study may wish to obtain further investigations.

No warranty, neither express, nor implied, is provided herewith. Please call on me if you have questions about the contents or meaning of this report.

Sincerely yours,



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