RECOGNITION OF NON-RULE IDENTIFIED HIGH HAZARD LANDFORMS IDENTIFIED DURING LANDSLIDE HAZARD ZONATION PROJECT MAPPING IN WASHINGTON STATE

Rule Identified Potentially Unstable Landforms:

- Inner gorges have steep, straight or concave side-walls that contain a distinctive break in slope. Landslides occur along side-walls.
- Bedrock hollows have concave profiles and straight to concave shaped areas with consistent topography. Hollows can be partially filled with colluvial soils when recently excavated hollows contain seeps or springs. Slopes >70% are generally unstable, but failures can occur with varying steepness.
- Groundwater recharge areas deliver groundwater directly over very steep bedrock slopes, typically >70%.
- Outer edges of meander bends where undercutting occurs by streams, and mudflows, or where meanders are 'trapped' by other structures, hazardous conditions exist.
- Terraces with slopes >65% have great potential for delivering to streams when being undercut by streams. Secondary terraces occur and are susceptible to hydrologic changes.

Non-Rule Identified High Hazard Landforms:

- Steep headwalls (>70%) are usually >70% and are often parallel to convergent slopes. These are located in drainages that may have been formerly lake or reservoirs. These headwalls are often found between bedrock hollows and inner gorges. Mud Mountain, Ranches, Mason, and Chehalis Slough WAUs are illustrated below.
- Inner gorges have steep, straight or concave profiles along dammed reservoirs have high slope failure rates due to repeated fluctuations in water level every year. Repeat massive failures of internal gorges can occur at any time, especially during storms. The Mud Mountain WAU Coastal Bluffs Landform is shown below as a thin red strip along the shoreline. This shoreline is shown below as a thin red strip along the shoreline. Active landslides are observable in the upper left corner of the illustration.
- Groundwater recharge areas deliver groundwater directly over very steep bedrock slopes, typically >70%.
- Outer edges of meander bends where undercutting occurs by streams, and mudflows, or where meanders are 'trapped' by other structures, hazardous conditions exist. The Skamokawa, and Gray’s Bay WAUs are illustrated below.

Active Deep-Seated Landslides: Including Earth Flows have high potential for secondary failure and taking delivery to streams which access flow through bodies of deep-seated landslides. Additionally, this landform includes landslides which exhibit recent movement (fresh headscars, oversteepened toe, tension cracks, pullout preferential crack, and shallow water pressure, leading to unstable conditions along the terrace faces. Mud Mtn. and Spada Lake WAUs are illustrated below.

Reservoir Influenced Terrace Faces along dammed reservoirs have high slope failure rates due to repeated fluctuations in water level every year. Repeat massive failures of internal gorges can occur at any time, especially during storms. The Skamokawa, and Gray’s Bay WAUs are illustrated below.

Recommendations: Consistent landslide mapping of non-rule identified landforms requires team members to work together in identifying specific criteria for each landform. This will lead to more regional landform classification based on similar characteristics such as washouts, stone sheets, and terraces. More consistent parameters defining a landform will lead to better hazard mapping and prevention of delivering sediment to streams.