Learning From the Past, 1997 Flood Event

During the 1997 flood event that slope aspect and slope greatly influenced landslide behavior. Roads undoubtedly have the greatest effects on slope stability. Rock pits, waste areas and timber landings behave similar to roads and involve the same types of features on the landscape (fills, cuts, and surface drainage features). However, they are often much larger. As a result, they can have significant effects on flood processes. The Klamath National Forest failed to adequately consider peak flows, floods, and floodplains throughout the Westside project area.

The steep and unstable watersheds in the project area have seen multiple severe weather events. It would be wise for the KNF to learn from the past.

Quoted below (emphasis added) is the KNF Flood of 1997 Phase 1 Final Report by Juan De La Fuente and Don Elder:

> Page 13, "Flood effects were greatest in their headwaters of **Walker, Deep**, Ukonom, **Tompkins, Grider, Kelsey, Middle, Portuguese, and Elk Creeks**. These all experienced many landslides in headwaters, and debris flows in many of the tributary channels. Similar, but less severe effects occurred in the headwaters of **Beaver, Thompson,** and Indian Creeks."
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> Page 10, "Estimated recurrence intervals for these peaks ranged from 16 years at Indian Creek (near Happy Camp), to 37 years at Salmon River. The recurrence interval for the 1997 Flood was 14 years on Scott River, 32 years on the Shasta River, 15 years on the Klamath River at Seiad, and 18 years on the Klamath River at Orleans."
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> Page 25, "Nonetheless, the concentration of road damage and flood altered channels in localized areas such as around **Lake Mountain** and **upper Elk** and Ukonorn Creeks suggests that intense storm cells or variations in snowmelt did in fact occur. The **Lake Mountain** area experienced the most severe flood effects on the Klamath Forest (Map 10). This area is drained by **Kelsey, Deep, Middle, and Tompkins** Creeks, (tributaries to the Scott River), and **Grider, and Walker** Creeks (tributaries to the Klamath River above the Seiad). The peak flow in the Scott River had a 14 year recurrence interval, and the peak in the Klamath River below Seiad had a 15 year recurrence interval (Map 5). By contrast, the Salmon River experienced a peak flow with a much higher recurrence interval (37 years), but landsliding, channel alteration, and road damage there was much less severe than in the Lake Mountain Area."
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> Page 18, "The flood of 1997 involved the movement of soil, rock, and organic debris from hillslopes to stream channels at a scale not experienced since 1974 (the most recent landslide episode) on the Klamath National Forest. Approximately 1100 landslides were identified in Phase I. Air photo inventory identified about 446 miles of stream channels which were altered (scour, deposition, or removal of riparian vegetation) by the flood."
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> Page 18, "Field observations revealed that landsliding was the dominant hillslope process associated with the flood. However, evidence of surface erosion was observed locally, primarily on poorly vegetated sites and on road cuts and fills. Scour and deposition are evident in many ephemeral channels which lacked these features prior to the flood. Large

(about 20 acres) slumps and earthflows occurred in the **Walker, Tompkins, Kelsey, and Thompson Creek watersheds**." The largest of these originated on the toe zones of reactivated slumps and earthflows high in the watersheds. **One on Road 46N6 1 in Walker Creek (Photos 4a & 4b) mobilized more than 300,000 cubic yards of material**."

Page 19, "With the exception of **Deep and Walker Creeks**, most streams retained the majority of their 30 year old (post-1964 flood) alder stands growing within andjadjacent to channels. These stands served to trap sediment and large logs. Streams such as **Grider, Walker, Kelsey, Deep, Middle, Tompkins**, and Ukonom Creeks delivered large volumes of sediment to the Klamath River, where remnants are still visible for a considerable distance downstream of their moliths."

Page 21 and 22, "Most of the field observations and temperature data presented here were provided by Jon Grunbaum. A total of 446 miles of altered channel were identified by air photo inventory within the air photo study area. In addition roughly **90 miles of the Klamath, Scott, and Salmon Rivers were altered** within the photo area. **Channel alterations were most severe in Walker and Deep Creeks**, where major debris flows traversed the entire channel length. In these streams, the floodplain was significantly altered and most of the riparian vegetation removed. **The alluvial fan at the mouth of Walker Creek was built up considerably**. Effects were less pronounced at Tompkins, Grider, Kelsey, and Indian Creeks."

Page 22, "Based on observations of fisheries personnel, there appeared to be considerable reduction in size, volume, and depth of pools in **Elk,** Indian, **Beaver, Grider, Tompkins**, South Fork Salmon, and **Walker Creeks,** and there is a larger proportion of fine sediment in the substrate. Alluvial reaches were made shallower and wider due to sedimentation."

Page 25 and 26, "To date, no definitive correlations have been identified which link variations in precipitation intensity, snowpack, or peak flows to variation in severity of flood effects. Nonetheless, the concentration of road damage and flood altered channels in localized areas such as around **Lake Mountain and upper Elk** and Ukonom Creeks suggests that intense storm cells or variations in snowmelt did in fact occur. **The Lake Mountain area experienced the most severe flood effects on the Klamath Forest** (Map 10). This area is drained by **Kelsey, Deep, Middle, and Tompkins Creeks**, (tributaries to the Scott River), and **Grider, and Walker Creeks** (tributaries to the Klamath River above the Seiad). The peak flow in the Scott River had a 14 year recurrence interval, and the peak in the Klamath River below Seiad had a 15 year recurrence interval (Map 5). By contrast, the Salmon River experienced a peak flow with a much higher recurrence interval (37 years), but landsliding, channel alteration, and road damage there was much less severe than in the Lake Mountain Area."

Page 28, "Due to this combination of factors, landsliding is a common process today, and much of the recent landsliding consists of localized slumps and earthflows (reactivations) and debris slides on the toes of slump and earthflow deposits."

Page 50, "Three primary conclusions are drawn, all of which have direct implications to future management of the Klamath National Forest. These are: (1) **Sensitive Lands-** Certain land types displayed particularly high landslide and debris flow rates under flood conditions; (2) **Roads-** Of the typical forest management practices, roads exhibited the largest directly observable effects on flood processes; (3) **De-vegetation-** Widespread de-vegetation of some watersheds by a combination of wildfire and timber harvest was associated with high rates of landslides and debris flows, particularly when it occurred on sensitive land types."

Page 51, "6. The Effect of Roads on Landslide Rates- Roads obviously had a large effect on flood processes. About **25% of all landslides** identified on air photos (1 82) **occurred in the road corridor**, and the landslide density (landslides per square mile) in road corridors was about 27 times that on undisturbed land."

Page 52, "Rock pits and **waste areas** often involve very large cuts and fills (up to several hundred thousand cubic yards) and have the **potential to destabilize hillslopes and alter drainage patterns**. The large fills associated with landings and waste areas initiated a number of landslides."

Page 52, "Predicting Landslide Sites- Many of the 1997 landslides occurred in areas with well-defined landslide features, such as on toe zones with well-fined slope breaks or on steep swales with clearly defined boundaries which would have identifiable as having a high landslide potential prior to the flood. However, **some occurred in areas where evidence of previous landsliding was subtle**, and poorly-defined, and it would have been difficult to have predicted a landslide of the magnitude which occurred at the site in 1997. Examples of debris slides in poorly defined swales were observed at McCash and **Deep Creeks** where debris slides occurred on 55% slopes. Similarly, subtle slump features were reactivated in **Tompkins and Grider** Creeks."

Page 52, "The Effect of Timber Harvest and Fire on Landslide Rates- De-vegetated areas (logged areas or areas burned at high to moderate intensity) experienced landslides at a rate 6 times that of undisturbed land (exclusive of landslides in road corridors)."

Page 52, "Physical Factors & Interactions Influencing the Flood Effects and Interactions- There is a strong correlation between the distribution of flood effects (landsliding and road damage sites) and physical attributes of the landscape. This was **particularly true with geomorphic terrane**, and elevation, and to a lesser degree with slope, and aspect.

Combinations of Factors- Pre-flood disturbance to the soil and vegetation (**roads, harvest, fire**) exerted considerable influence on flood effects. **Areas of concentrated de-vegetation and roads likely experienced cumulative effects, or the, results of multiple individual effects that accumulated ' over time and space.**

Threshold Conditions- Field observations revealed that **all types of landslides** (shallow debris slides, deep-seated slumps and earthflows and debris slides on road fills) **occurred together** in watersheds like **Walker and Tompkins Creeks.** This suggests that high groundwater conditions were attained at a variety of depths."

Recommendations:
1. **Sensitive Lands-** (a) Identify and delineate sensitive lands (Riparian Reserves) at the watershed (during Watershed Analysis) and site levels (when projects are done). Utilize sound proven tools such as topographic maps, 30 meter digital elevation models DEM), air photos, and field investigations as well as new developments such as high resolution laser-generated DEM's; (b) Develop vegetative and soil objectives for Riparian Reserve lands; (c) **Manage Riparian Reserves toward obtaining the stated objectives.**

2. **Roads-** (a) Repair ERFO sites in accordance with guidelines in Appendix C of this report; (b) Decommission high risk, un-needed roads; (c) Focus road maintenance where most needed to prevent watershed damage, and with attention to repairing road drainage and diversion problems; (d)Avoid unstable lands when new roads are constructed, and utilize state of the art geotechnical techniques in landslide terrane and at streamcrossings; (e) Place special attention on constructing stable fills, whether for ERFO repair, new roads, waste areas, landings, etc.; (f) Initiate a process for inventorying high risk road segments and sites; (g) Prioritize road repair, upgrading, maintenance, 'and decommissioning projects on a watershed basis to maximize the benefit to aquatic resources; (h)Seek funding from multiple sources.

3. **Vegetation Management-** (a) **Assure that timber harvest avoids unstable lands and other Riparian Reserves** by utilizing skilled technical personnel during field layout; (b) In combating wildfire, employ strategies to minimize the amount of high and moderate intensity fire on Riparian Reserves; (c) Design prescribed fire to avoid high and moderate intensity fire on Riparian Reserves.

7. **Map of Peak Flood Levels-** Prepare a simple map and photographs showing maximum water levels which occurred during the 1997 flood on the Klamath River and some major tributaries.

11. **Vegetation Management-** In Riparian Reserves, develop and apply vegetation management **objectives and guidelines for unstable lands** and other types of Riparian Reserve. Outside of Riparian Reserves, apply the following vegetation management guidelines: **Avoid regeneration harvesting and intense site preparation fire on landslide deposits and granitic terrane over large contiguous drainage areas**. This can be accomplished by utilizing skilled earth scientists during layout. Avoid denuding discrete swales, which may be prone to debris slides in granitic terrane. Avoid de-vegetation of large contiguous area of landslide deposits, particularly within the same local hydrologic catchment. Maintain down logs to interact with future debris flows, in balance with desired fuel loading. Review pre-existing timber sales and find whether trees are marked within Riparian Reserves associated with landslides and altered channels associated with the 1997 flood. Use this process to refine Riparian Reserve mapping.

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