APPENDIX C

BEAVER CREEK CUMULATIVE WATERSHED EFFECTS

Landslide Model

The landslide model results are based on the Salmon Sub-basin Sediment Analysis, completed in 1993 by two geologists from the Klamath National Forest, Juan de la Fuente and Polly Haessig. The sediment study identifies landslides and estimates landslide volumes based on air photo interpretation with some ground verification. Each landslide in the Salmon River sub-basin is identified by location, geomorphic terrane, disturbance history (road, timber harvest, or fire related, or in an undisturbed area), and time period the landslide was activated. Landslide prediction is based on actual landslide production for the photo period 1970 to 1975, a time when several large floods occurred but excludes the exceptionally large 1964 flood. The coefficients, expressed as cubic yards per acre given a series of floods similar to the 1970 to 1975 period, are displayed in table A-1.

Table A-1 Landslide Model Coefficients

Geomorphic Type	Road	Harvest/Fire Related<20 years	Harvest/Fire >20-40 years	Undisturbed
Active Landslides	1000	1257		525
Dormant Slides incl. Toe Zone	225	3.2	3.0	2.8
Granitic Mtn. Slopes >60%	1005	126.5	1.3	
Granitic Mtn. Slopes <60%	361	15.9	0.6	
Non-Granitic Slopes >60%	823	2.5	1.7	
Non-Granitic Slopes <60%	192	1.1	0.3	
Unconsolidated Inner Gorge	376	513	926	
Granitic Inner Gorge	1201	146	77	7.3
Other Inner Gorge	285	19.2	7.2	
Glacial Moraine and Terraces	7.5	6.5	4.9	3.2

To estimate future landslide production, the appropriate coefficient is multiplied by the acres of each geomorphic type by disturbance for each subwatershed. Roads and geomorphic type are Geographic Information System (GIS) layers or derived layers. Road prism widths of 33 feet are assumed for converting road lengths to acreage. The harvest/fire history is partially derived from existing layers but has been supplemented with air photo interpretation specifically for this project. Areas with apparently recent regeneration harvest on 1975 and 1995 air photos have been added to the harvest history layer for this analysis. Through use of GIS, acres of different disturbance histories on different geomorphic types and in different subwatersheds are generated and plugged into sediment modeling equations. The sediment model results are displayed in Step 5.

Equivalent Roaded Area (ERA) Methodology

The ERA methodology is in common use throughout the Forest Service Region 5 (California Region) for assessing Cumulative Watershed Effects (CWE). The basis for this methodology is converting road, harvest, fire, or other disturbance into equivalent roaded area using coefficients. The coefficients used for Beaver Creek are simplified from the Klamath Forest Plan. Roads have a coefficient of 4.1 acres per road mile, 0-20 year old regeneration harvest areas 0.21 acres/acre and 20-40 year old harvest 0.09 acres/acre. The information needed to calculate ERA is in GIS and the percent ERA for each subwatershed are displayed in Step 5.

The percent ERA for each subwatershed is compared with a Threshold of Concern (TOC). The TOC is also calculated based on the channel sensitivity (C), beneficial uses (B), soil erodibility (E), hydrologic response (H), and slope stability (S). The index for each of these factors is plugged into the equation:

Watershed Sensitivity Level (WSL) = 3C + 2B + E + H + S

Watershed Sensitivity is converted to a Threshold of Concern in the equation:

Threshold of Concern (TOC) = (43* - WSL)/2

*The number "43" is used because it best fits a regression of the watershed sensitivity levels and previously determined Thresholds of Concern.

Each watershed sensitivity parameter for all subwatersheds is displayed in Step 3, table 3-4. The explanation and index value for each is discussed in the following paragraphs.

Channel Sensitivity (C) is based on Pfankuch ratings, where available, or professional judgement of conditions in the primary stream and major tributaries through the watershed or subwatershed.

Parameter	Class	Index	Description
Channel Sensitivity	Very High	5	Pfankuch rating >130
	High	4	Pfankuch rating 115-130
	Moderate	3	Pfankuch rating 77-114
	Low	2	Pfankuch rating 39-76
	Very Low	1	Pfankuch rating <39

Beneficial Use (B) is an index of relative contribution to beneficial use streams. Five beneficial use stream classes are defined in the Forest Service Manual. A Class 1A stream is a highly productive anadromous stream or is a municipal or campground water source. Beaver Creek, from the junction of Cow and Grouse Creeks, and West Fork Beaver Creek below Jaynes Canyon are considered Class 1A. The remaining streams in the watershed are Class 1B to Class 4. Class 1B streams are moderately productive anadromous streams and Class 4 have no beneficial uses.

Parameter	Class	Index	Description
Beneficial Use	Very Highly Significant	5	Contains the entire drainage area of a Class 1A stream.
	Highly Significant	4	Contains 25 percent or more of the drainage area of a Class 1A stream or the entire drainage area of a Class 1B stream.
	Moderately Significant	3	Contains 5 percent or more of the drainage area of a Class 1A stream, 25 percent or more of a Class 1B stream, or the entire drainage area of a Class 2 stream.
	Significant	2	Contains one percent or more of the drainage area of a Class 1A stream, 5 percent or more of the drainage area of a Class 1B stream, 25 percent or more of the drainage

area of a Class 2 stream, or the entire drainage area of a Class 3 stream.

Other1Does not meet the criteria of any previous category.

Soil Erodibility (E) is based on the relative proportions of soils with different inherent erosion potentials where:

Erodibility = [6(A + C) + 5(B + D) + 3(E + F + H) + 2(G + I) + J]/Watershed Acres; and:

A = acres of granitic soils
B & D = acres of metamorphic units on steep slopes
C = acres of mica schist
E = acres of dormant landslides
F = acres of shallow soil and rock outcrops
G = acres of very to extremely gravelly surface
H = acres of cobbly surface
I = acres of glacial till
J = acres of all other units

ParameterClassIndexDescription

Soil ErodibilityVery High Sensitivity5Erodibility > 5
Highly Sensitive4Erodibility 4-5
Moderately Sensitive3Erodibility 3-4
Low Sensitivity2Erodibility 1.3-3
Very Low Sensitivity1Erodibility 1-1.3

Hydrologic Response Potential (H) is based on the percent of the watershed in the rain on snow zone, between 3,000 and 4,500 feet elevation.

ParameterClassIndexDescription

Hydrologic ResponseHigh Peak Runoff 4Rain on snow zone > 1/2 of the
Potentialwatershed
Moderate Peak3Rain on snow zone 1/4 to 1/2 of
Runoff Potentialwatershed
Low Peak Runoff2Rain on snow zone < 1/4 of the
Potentialwatershed

Slope Stability (S) is based on the proportion of the watershed in various slope stability catagories where:

Stability Rating = [10A + 6B + 4(C + D) + 3E + F]/Watershed Area

A = acres of active landslide
B = acres of unconsolidated inner gorge
C = acres of consolidated inner gorge

D = acres on toe zones of dormant landslides
E = acres on highly dissected, steep granitics
F = acres of all other terranes

Parameter	Class	Index	Description
Slope Stability	Very High Risk	5	Stability Rating > 1.5
	High Risk	4	Stability Rating 1.3 - 1.5
	Moderate Risk	3	Stability Rating 1.2 - 1.3
	Low Risk	2	Stability Rating 1.1 - 1.2
	Very Low Risk	1	Stability Rating 1.0 - 1.1