AN ASSESSMENT OF ROAD REMOVAL AND EROSION CONTROL TREATMENT EFFECTIVENESS: A COMPARISON OF 1997 STORM EROSION RESPONSE BETWEEN TREATED AND UNTREATED ROADS IN REDWOOD CREEK BASIN, NORTHWESTERN, CALIFORNIA

by

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A Thesis

Presented to

The Faculty of Humboldt State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

In Environmental Systems: Geology

August, 1998

AN ASSESSMENT OF ROAD REMOVAL AND

EROSION CONTROL TREATMENT EFFECTIVENESS:

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Abstract

Since rehabilitation of deforested watersheds has begun in the Pacific Northwest, published large scale evaluations of road removal and respective erosion control techniques have been brief and scarce. In 1997, a 12 year recurrence interval storm provided an opportunity to assess the effectiveness of watershed rehabilitation efforts in Redwood National Park, Northwestern California. This study compares 1997 storm erosion and resulting sediment delivery to streams between 91 miles of untreated roads and 21 miles of treated roads in the Redwood Creek basin. The treated roads yielded significantly less 1997 storm erosion and sediment delivery to streams than untreated roads. This comparison also indicated that more intensive erosion control treatments resulted in less overall 1997 storm erosion than minimal treatments; however, the difference in sediment yielded to streams is not pronounced. On stable hillslopes, minimal treatments seem effective and may be a cost effective alternative for reducing sediment input into streams. Among the more extensive erosion control treatments, export outsloping experienced significantly more erosion and resulting sediment delivery to streams than outsloping. Further investigation is recommended for more effective treatment of these road reaches where excess water is present. Fill sites experienced minor erosion resulting from post-treatment adjustments. Most of the erosion occurring on treated roads may be attributed to their location in the Bridge Creek Lineament, a zone marked by excessively sheared schist. Locations with excess water, such as a spring, produced more erosion than the other treated road segments.

Acknowledgments

I would like to give a special thanks to Mary Ann Madej for contributing her time, expert guidance and faith in this project. More special thanks go to Andre Lehre and Mike Furniss for their time and energy in reviewing this report and their expert guidance. This project would not have been possible without financial support from the Biological Resources Division of the United States Geological Survey and Redwood National and State Parks. I give many thanks to Greg Gibbs for his efforts in the field, and for his extraordinary comic relief. Additional thanks go to Deadra Knox, Brian Barr and all of the people who volunteered their time to go out in the field with me. Greg Bundros, Vicki Ozaki and Terry Spreiter provided valuable input, and Paula Bryant was instrumental in creating the GIS maps. Additionally, I want to thank Joel Flynn who provided a wealth of emotional support throughout this project.

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Introduction

Within the last century and a half, logging of coniferous forests in the Pacific Northwest has had a large impact on their ecosystem, hydro-geomorphology and cultural resources. In the Redwood Creek drainage basin, the increased sediment yield associated with timber harvest and road construction, in addition to an already naturally unstable terrain, has been adversely affecting anadromous fish populations. By 1987, 81% of coniferous forests in the Redwood Creek drainage basin had been logged by private timber companies. Much of this logging occurred before the advent of Forest Practice Rules. In 1968, 91 square miles of lower Redwood Creek basin were acquired as Redwood National and State Parks land to preserve the virgin redwood forest (Public Law 90-545). Shortly after the park territory was established, conservationists and government agencies developed an interest in the impact of the upstream and upslope logging activities on the park land. In 1973, regulations were enacted to enforce lower impact methods of logging in the lower basin. Logging in the lower basin was later brought to a halt in 1978 when Congress expanded Redwood National and State Parks to 206 square miles of the lower basin of Redwood Creek (Public Law 95-250). In addition, a Park Protection Zone requires that the upstream 39 square miles of private land above the park be subject to park review for all timber harvest operations (Nolan et al., 1995).

Prior to the 1978 land acquisition, most of the area included in this study had undergone clear-cut timber harvest and dense road construction. This study focuses on Bridge Creek, a watershed having a drastic decline of anadromous fish populations and the most extensive rehabilitation effort in the park (Madej, 1995).

The 1978 park expansion authorized $33 million for the Secretary of the Interior to implement a program to rehabilitate areas in and upstream of the park in order to minimize the impact of the sedimentation on Redwood Creek, preserve riparian and aquatic environments and encourage revegetation (RNSP Draft, 1997). As of 1996, $12 million of the initially appropriated $33 million budget for rehabilitation efforts had been spent. These costs cover heavy equipment, personnel and materials required to complete work. The rehabilitation program at Redwood National and State Parks is still in full operation and currently growing due to approximately $8 million received from the Emergency Supplemental Appropriations Act for 1997 storm road damage (Short, *personal communication*, 1997).

Priorities of rehabilitation are changing with time. Newly listed endangered species are being classified, and previously stable roads are becoming less stable with time (RNSP Draft, 1997). This results in an increased need for erosion control treatments. As of 1987, the focus of erosion control was on tractor logged hillslopes and nearby stream channels, areas of landsliding, gullying in prairie land, and on logging roads. Logging roads comprise the largest quantity of preventable potential erosion and are receiving a proportional amount of attention (Weaver et al., 1987). These logging haul roads and skid trails continue to be the primary cause of extensive erosional activity in Redwood National and State Park. In addition to other supporting studies, a study conducted by Best, Kelsey, Hagans and Alpert determined that logging roads are by far the dominant cause of fluvial erosion resulting from logging activity (Best et al., 1995). Also, mass movement is often prompted by logging roads, especially on steep slopes. The sediment contributed to the stream from fluvial erosion and mass movement still continues to have an adverse effect on the quality of the water and habitat in Redwood Creek and its tributaries (Weaver et al., 1987).

Since rehabilitation of deforested watersheds has begun in the Pacific Northwest, there have been many evaluations of revegetation and surface erosion control techniques; however, published large scale evaluations of more elaborate techniques, such as total stream crossing excavations and sidecast road fill removal, have been brief and scarce.

In attempt to assess the effectiveness of these treatments, this study compares 1997 storm erosion response between 91 miles of untreated roads and 21 miles of treated roads. This analysis addresses the following questions:
-Are erosion control and road removal treatments effective in reducing sediment input to streams?
-Are erosion control and road removal treatments effective in reducing the volume and occurrence of erosion?
-Are more intensive erosion control treatments more effective than minimal treatments?
-Is there a relationship between road reach erosion volumes and occurrences and hillslope position?
-Is there a relationship between stream crossing erosion rates and drainage area or stream power?

The treated roads yielded significantly less 1997 storm erosion and subsequent sediment to channels than untreated roads. This comparison also indicated that more intensive erosion control treatments resulted in less 1997 storm erosion than minimal treatments; however, the difference in sediment yielded to streams is not pronounced. Among the more extensive erosion control treatments, export outsloping experienced significantly more erosion and subsequent sediment delivery to streams since treatment than outsloping. Fill sites only experienced minor erosion resulting from post-treatment adjustment.

Previous Work

The rehabilitation program at Redwood National and State Parks began in 1978 and treatments implemented in 1978 and 1979 were largely experimental. Shortly after beginning this program, the park conducted evaluations of several erosion control and revegetation treatments, as well as investigations of small stream hydrology, deep-seated landslides and debris flow mechanisms.

Madej, Kelsey and Weaver (1980) assessed the effectiveness of secondary erosion control treatments implemented in 1978, the first year of watershed rehabilitation in Redwood National and State Parks. Post-treatment site conditions were observed before and after the following winter. They found that erosion control treatments were effective in reducing erosion during the first winter; although, heavy equipment should have been used less conservatively.

Weaver and Seltenrich (1980) also emphasized the importance of the suitability of treatment prescriptions, based on an assessment of the effectiveness and cost-effectiveness of labor intensive erosion control and revegetation treatments implemented in Redwood National and State Parks in 1978 and 1979.

Kveton and others (1982) assessed the effectiveness of surface erosion control treatments on bare soil slopes between 40 and 55%. Sediment troughs positioned on the outboard edge of the road or on stream crossing sideslopes were used to compare surface erosion occurring on plots with different mulching and vegetation treatments. Sites were monitored for at least two rainy seasons. Primary erosion control treatment effectiveness was not investigated. Treated plots were found to yield 60 to 95% less sediment to channels.

Weaver and others (1987) compared conditions immediately after treatment in 1979 to subsequent years. Most post-rehabilitation erosion resulted from channel adjustments and landsliding, as opposed to rilling and sheet erosion. Inspections included yearly photographic documentation and erosion measurements at established sediment troughs or erosion pin monitoring stations. Additionally, this study focused on cost-effectiveness and assessment of heavy equipment utilization. They found the amount of scour at excavated stream crossings to be controlled by: 1) the amount of woody debris and rock exposed by channel downcutting; 2) stream power; and 3) amount of excavated fill removed from crossing. They concluded that it is much more effective to completely excavate stream crossings, rather than using secondary treatments to armor a partially excavated channel. Weaver and others concluded that effectiveness is largely based on the suitability of treatment prescription, the type of equipment used and the skill of the equipment operator.

Sonnevil (1991) conducted a study of seven different untreated road segments in Redwood National and State Parks. He investigated changes in the factor of safety with progressive sidecast fill removal. He found the factor of safety to increase by 10% when all sidecast fill was removed from the site; however, adjustments in the water table were not taken into consideration.

In 1991, Best (1991) completed a progress report of monitoring and evaluation of watershed rehabilitation of logged lands, which occurred between 1977 and 1991 in Redwood National and State Parks. He compiled all the pre-1991 assessment efforts and discussed the evolution of these programs. He observed that the majority of stream crossing channel adjustments occur within two years after treatment.

No large scale comparisons of erosion occurring on primary erosion control treated roads and untreated roads have been conducted in Redwood National and State Parks; however, several large scale studies have been conducted elsewhere in the Pacific Northwest.

A large scale comparison between treated and untreated roads was conducted by Harr and Nichols (1993) at Canyon Creek watershed, a tributary to the North Fork of the Nooksack River in Washington. The treated roads yielded less sediment to streams during the 1989/1990 rain-on-snow event, a 50-year flood, when compared to pre-treatment yields during rain-on-snow runoff events with recurrence intervals ranging from 2 to 5 years.

Cloyd and Musser conducted a large scale assessment of the response of over 800 miles of erosion controlled roads that had been treated since 1992 in the Siuslaw National Forest, Oregon. Approximately 750 miles of these roads were minimally treated according to the classification in this study, the remaining 70 miles were fully treated. Cloyd and Musser analyzed a random sample of roads, which were compared to a nearby segment of untreated road of similar hillslope position and length. Failures were assigned a severity rating of 0 through 3, 3 being the most severe. They found that the untreated roads had a slightly greater number of failures, which tended to be larger in size and have a greater impact on streams than the failures on treated roads. The largest amount of sediment delivered to channels was associated with mid-slope stream crossings (Plumley, 1997).

In order to evaluate erosion control treatments, it is necessary for the treatments to stand the test of a sizable storm, such as the 12 year recurrence interval, 1997 storm in the Redwood Creek basin. Time and subsequent rainy seasons will most likely provide additional opportunities for future evaluations of watershed rehabilitation.

Location

The study area is located in the lower one-third of the 280 mi^2 Redwood Creek drainage basin, located in the coast ranges of northwestern California (see Figure 1). The study area encompasses the basins of 7 tributaries to Redwood Creek, all located on its west side. From north to south, the following basins are included in the field area: McArthur, Elam, Bond, Forty-four, Tom McDonald, Bridge and Devils (see Table 1).

Figure 1. Location map of Redwood Creek drainage basin, taken from Nolan and Janda (1995).

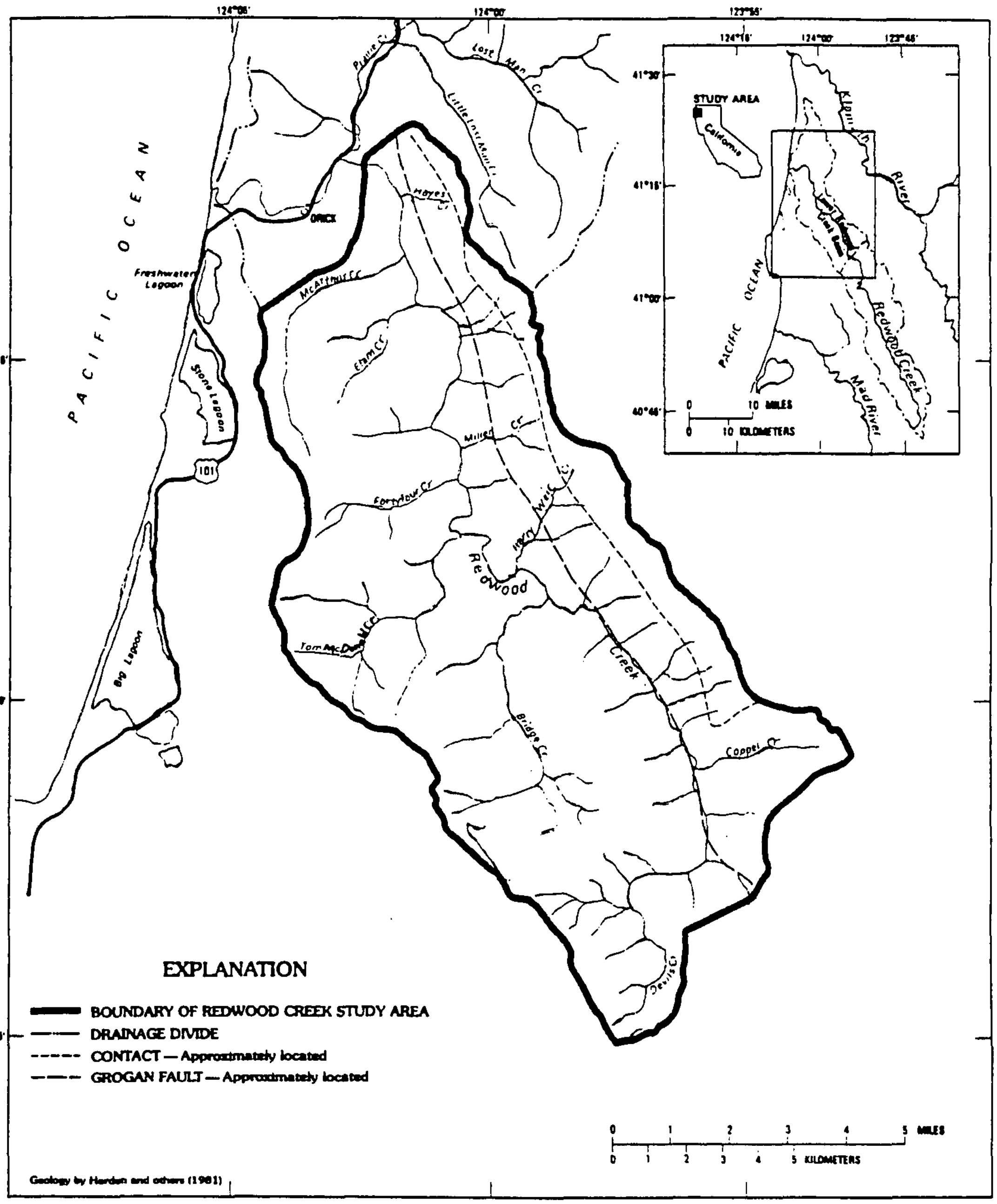

Table 1. Drainage areas of basins within the study area. Drainage area values are taken from Pitlick (1982)

Tributary Basin to Redwood Creek	Drainage Area (mi^2)
McArthur Creek	3.8
Elam Creek	2.5
Bond Creek	1.4
Forty-four Creek	3.1
Tom McDonald Creek	6.9
Bridge Creek	11.3
Devil's Creek	6.9

35.9 = 22,976

Climate/Rainfall

The Redwood Creek drainage basin has a Mediterranean climate and an average annual rainfall of 80 inches. The annual precipitation varies throughout the basin from approximately 60 inches per year near the mouth, to 100 inches per year at th (Iwatsubo et al., 1975). These variations are mostly due to the rainfall occurs from November through April. Snowfall i watershed, but is common in the headwater region of Redwo

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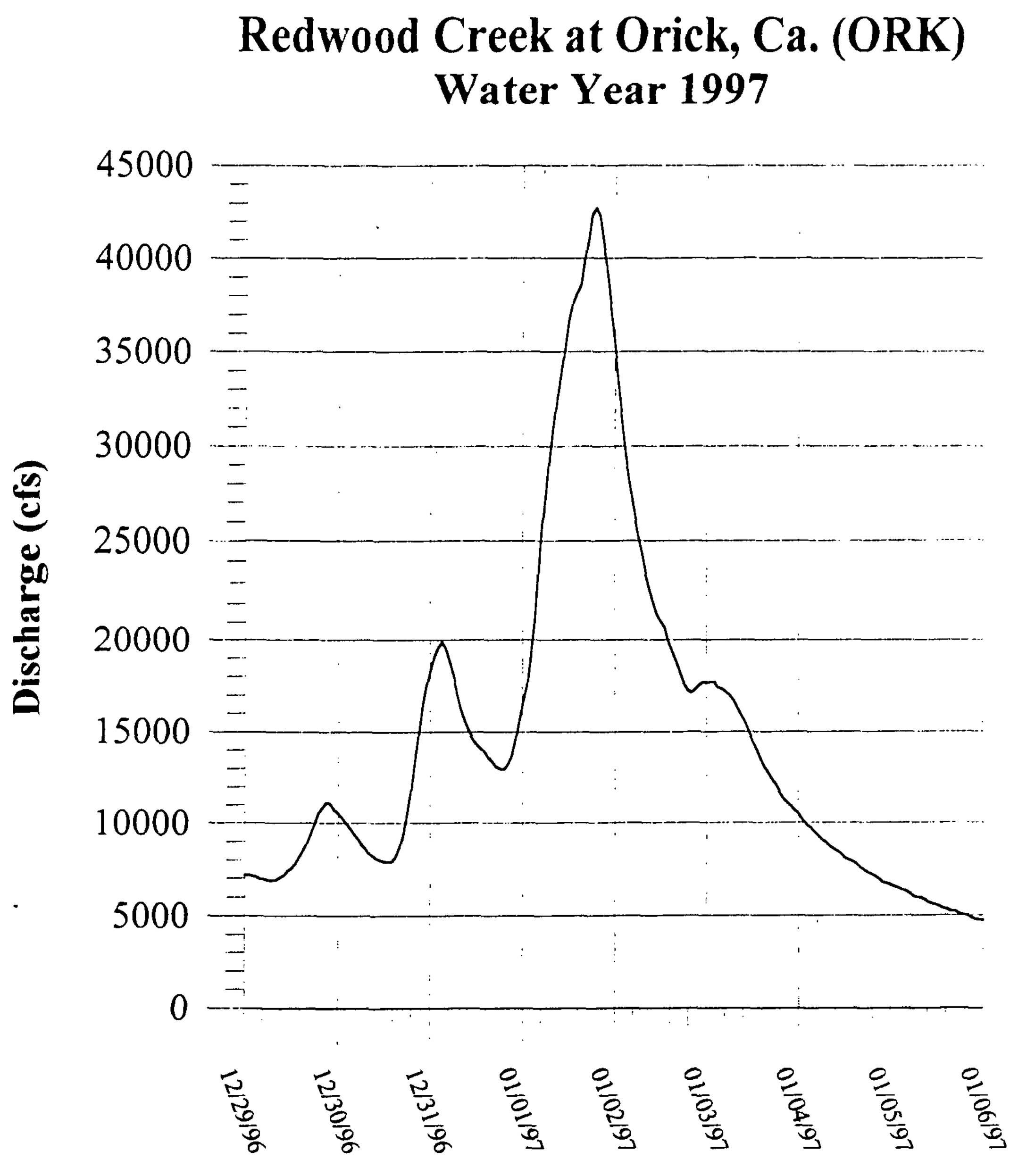
Between December 31, 1996 and January 1, 1997, Bridge Creek experienced its largest storm since 1975. The Elk Camp rain gage, located directly across from the Forty-four Creek, a tributary to Redwood Creek, recorded precipitation amounts of 7.6 inches in 24 hours, and 2.54 inches in 6 hours (Redwood National and State Parks, in house records, 1997). Isopluvial maps for the region indicate that these events have recurrence intervals of Tr = 18 years and Tr = 3 years, respectively (Miller et al., 1973). Peak discharges measured on Redwood Creek at Orick had Tr = 12 years (Redwood National and State Parks, in house records, 1997). These differences in recurrence intervals suggest that this storm was a long duration event, rather than a high intensity event. Long storm duration is also demonstrated by the elongated flood peak on the flood hydrograph for Orick, which is near the mouth of Redwood Creek (see Figure 2). Additionally, previous storms in the region resulted in wet antecedent conditions prior to this 1996-1997 storm event.

Figure 2. 1997 Storm flood hydrograph, created by Tom Marquette from data collected by Redwood National and State Parks.



Between 1954 and 1997, seven major storm events occurred in the Redwood Creek basin (see Table 2). The recurrence intervals for the resulting floods on Redwood Creek ranged from approximately 10 to 50-years (see Figure 3). The 1997 storm is most similar to the January, 1972 storm, but it was substantially smaller than the other flood producing storms. The largest storm, a 45-50-year event, occurred in 1964. Its flood producing effects were compounded by warm rain falling on previously fallen snow (Redwood National and State Parks, in house records, 1997). The 1997 flood event was pronounced throughout the northern half of California. A 60-year recurrence interval was calculated for the Klamath River, and river flows exceeded all records in some Sierra basins (USFS, Watershed Analysis Center, 1997).

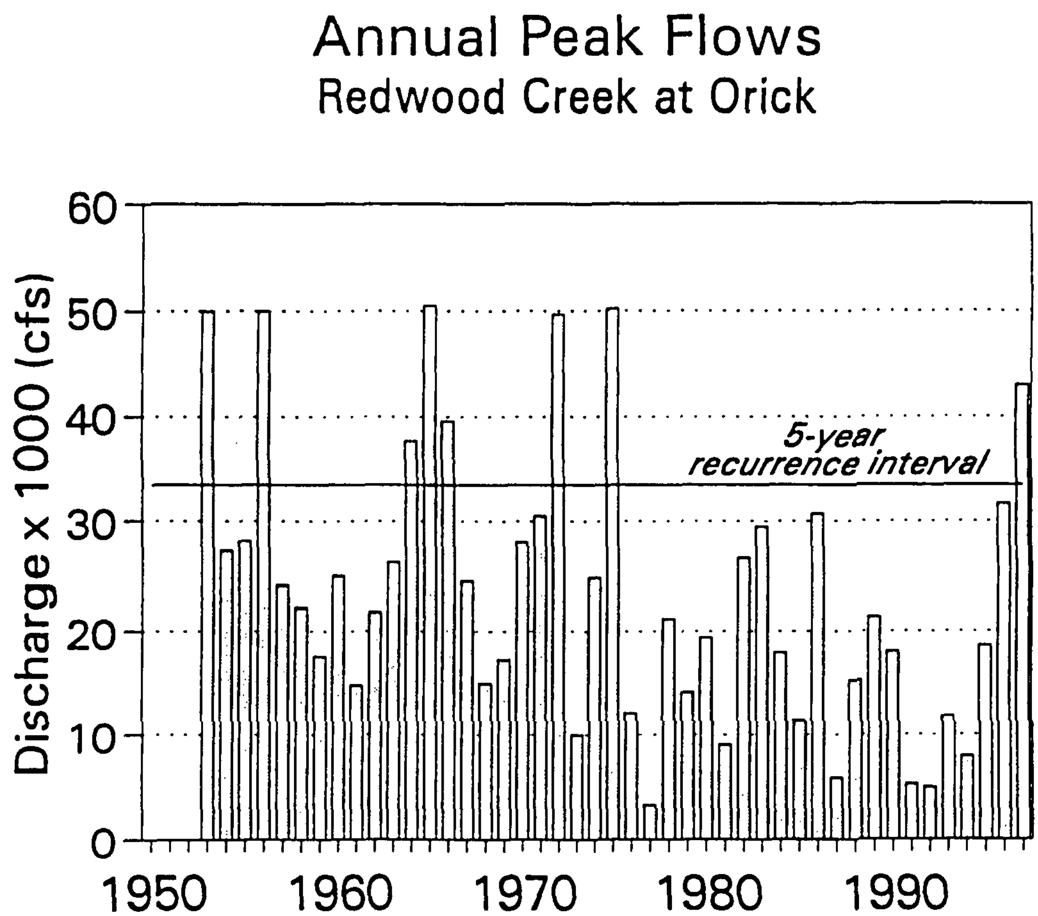
Erosional activity is well documented for all of these storms. The 1964 storm resulted in the greatest amount of erosion. Slope destabilization from previous storms, extensive timber harvesting and road building may have created a unique opportunity for the extensive erosion experienced in the 1964 storm (Harden, 1995). Landslide activity from the 1997 storm was documented and quite visible throughout Humboldt County and some surrounding regions.

Many of the logging roads and skid trail networks in Bridge Creek were constructed in the mid-to late-70's, after the large storms. Although the watershed rehabilitation efforts were completed after all of these storms, they did experience a mild storm with Tr = 3-5 years in 1986.

Table 2. Comparison of flood producing storms in Redwood Creek from 1953 to 1997. (modified from Harden and others, (1978) and Harden (1995))

Year	Peak Discharge at Redwood Creek, Orick (cfs)	Recurrence Interval	API (inches)
1953	50,000	25-30	8.9
1955	50,000	25-30	6.7
1964	50,500	45-50	6.9
1/1972	45,300	15-20	4.5
3/1972	49,700	25-28	8.6
1975	50,200	30-40	4.9
1985	30,700	3-5	7.2
1996-7	43,000	12	7.4

Figure 3. Annual Peak Flows for Redwood Creek at Orick, created by Vicki Ozaki from Redwood National Park data.



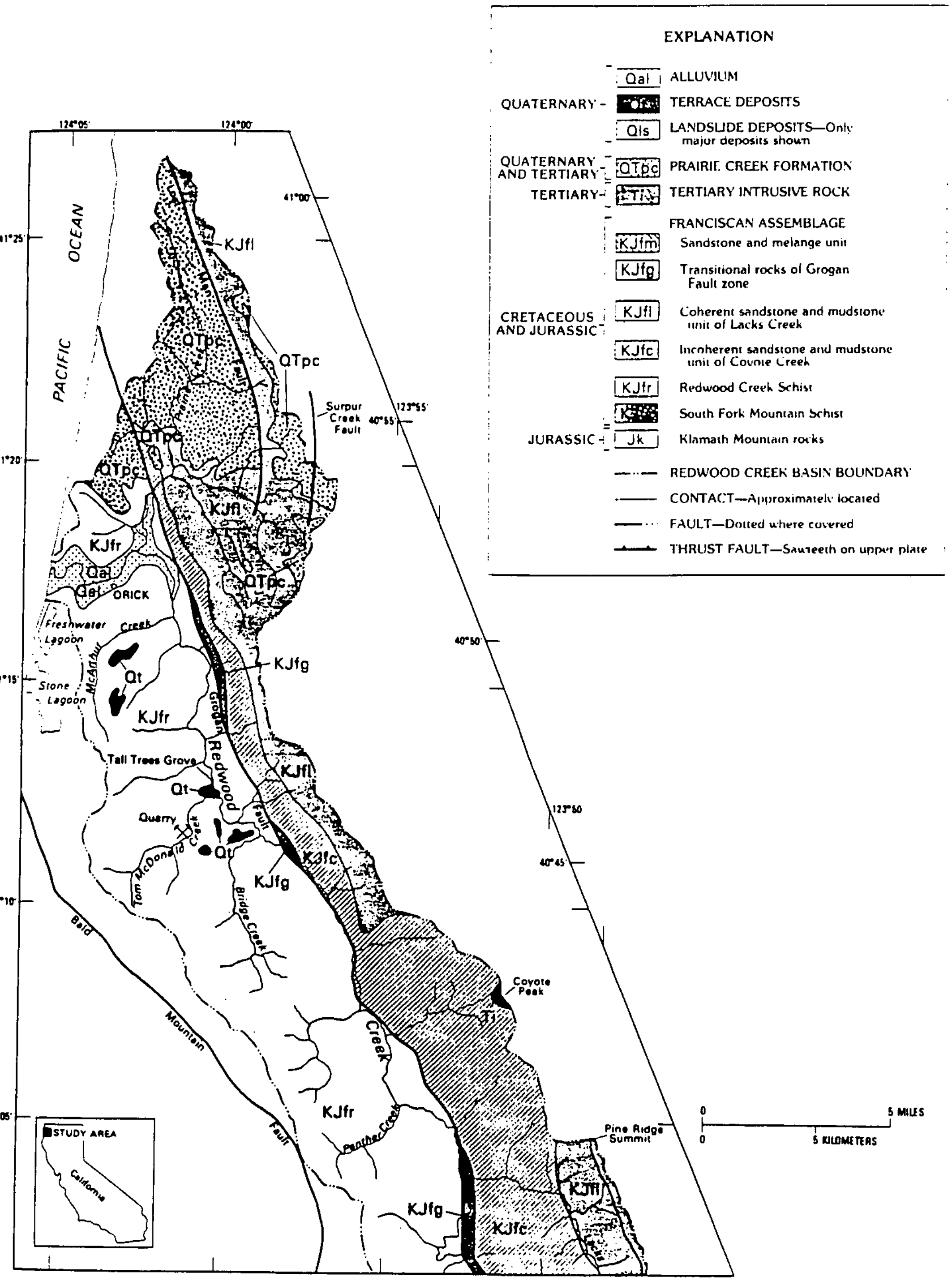
Geology

Lithology

The Redwood Creek basin, is underlain by coherent sandstone and interbedded sandstone and mudstone sequences in Lacks Creek, incoherent sandstone and melange in Coyote Creek, a sequence of transitional rocks, a minor amount of meta-volcanic rock, and South Fork Mountain and Redwood Creek schists (see Figure 4) (Harden, et al., 1982). The study area in the western half of the Redwood Creek basin is underlain by Redwood Creek schist. In some locations the schist is covered by late Pleistocene and Holocene stream terrace deposits (Harden, et al., 1982). The Redwood Creek schist, previously called "Kerr Ranch Schist" and "Redwood Mountain Outlier of the South Fork Mountain Schist," is located within the Redwood Creek basin, but it has been correlated with the South Fork Mountain schist of the Redwood Creek basin and the Colebrooke schist of southwestern Oregon (Cashman, et al., 1986).

The Redwood Creek schist comprises compositionally and texturally variable, clastic meta-sedimentary rocks, sparsely interbedded with basaltic metavolcanic rocks. The meta-sedimentary rocks are dominantly fissile, light-green to charcoal-gray, fine-grained mica schist of the lawsonite-albite-chlorite facies. The typical mineral assemblage includes quartz, chlorite, white mica, albite, graphitic material, lawsonite, sphene and calcite or aragonite. The protolith is believed to be an organic rich mudstone with less frequent interbeds of sandstone (Cashman, et al., 1986).

Figure 4. Generalized bedrock geology of the Redwood Creek basin (modified from Cashman, et al., 1995).



Intense shearing is apparent in outcrops. Due to dense vegetation, colluvium, saprolite and thick soil cover, bedrock outcrops within the study area are rare, but are locally apparent at road cuts. Layers of quartzofeldspathic minerals alternating with platy metamorphic minerals, micas and/or carbonaceous materials are obvious in the schist hand sample. The foliation occasionally expresses crenulation cleavage, cross-cut or parallel quartz veins, or dikes, and is usually disharmonically folded.

Meta-volcanic rocks make up approximately one percent of the Redwood Creek schist unit. These rocks include massive to finely laminated and foliated greenstones, which are basaltic in composition. The typical mineral assemblage includes quartz, chlorite, albite, actinolite, epidote or lawsonite, pumpellyite, white mica and calcite or aragonite (Cashman, et al., 1986).

Unusually thick Quaternary stream terrace deposits and coastal plain sediments are located in the study area (Cashman, et al., 1995). The stream terrace deposits consist of weakly or unconsolidated materials and are located on the ridge tops between Bond and McArthur Creeks (Harden, et al., 1982).

Structure

The Redwood Creek basin is underlain by early Tertiary to Jurassic units of the Franciscan Complex, part of an accretionary prism along the western boundary of the North American plate. Throughout the Mesozoic, the sense of motion along this plate boundary was transform or subductive. This sense of plate motion has been accommodated by east-northeast thrusting and right lateral movement in north-northwest trending faults in Redwood Creek basin and northwestern California. The date of assemblage of the Franciscan units is still undetermined (Cashman, et al., 1995).

The Redwood Creek schist, interpreted as a klippe, is juxtaposed by the Grogan fault against South Fork Mountain schist and Lacks Creek and Coyote Creek units to the east. The course of Redwood Creek is largely controlled by the Grogan fault. This fault strikes northwest and dips 65 degrees to the east and west, it presents evidence of dip-slip, and possibly strike slip movement (Cashman, et al., 1995). This fault, inferred as Mesozoic, has experienced Quaternary displacement. The Redwood Creek schist unit, approximately 70 km long and 10 km wide, is bounded to the west by the Bald Mountain fault. This fault's sense of motion is in dispute, but there is agreement that it has been modified by high angle faulting. Many other faults have been located in the Redwood Creek basin, but pervasiveness and sense of motion is undetermined due to lack of exposure. Relationships between these faults, apparent folds and foliations suggest three major episodes of penetrative deformation (Cashman, et al., 1986).

The Bridge Creek Lineament has been identified as the largest lineament in the Redwood Creek basin (see Map 1) (Harden, et al., 1982). Excessively sheared schist, hillslope failures, and a distinct topographic pattern are used to identify it. The lineament appears to extend from the Panther Creek watershed, along the anomalously oriented segment of Bridge Creek to Tom McDonald Creek, and possibly on to McArthur Creek. According to Cashman and others, crenulation cleavage and fracture cleavage display a stronger development in this zone. Also, tectonic blocks and small thrust faults are slightly more concentrated. The Bridge Creek Lineament cannot be confirmed as a fault due to poor exposure; however, the previously mentioned evidence strongly suggests a shear zone (Cashman, et al., 1986).

Geomorphology

The lithologic and structural qualities of the Redwood Creek schist, the high, 0.003 feet/year tectonic uplift rate, and the high precipitation result in hillslope instability. The highly fractured and foliated schist provides many avenues for chemical weathering of its micaceous component to clay and oxidation of its iron components (Cashman, et al., 1995). On hilltops, resulting regolith depths can range from 1.5 to 7 feet, with the exception of Roger's Peak, where regolith reaches depths of 15 feet. On middle and lower hillslopes regolith can range from 1.5 to 49 feet (Popenoe, personal communication, 1998).

The average hillslope gradient in the Redwood Creek schist is 25 percent (Cashman, et al., 1995), although the approximate average hillslope gradient in the watersheds included in this study is closer to 40 percent. Hillslopes are dominantly convex (see Map 1 and Map 2). Steep hillslope gradients and unstable bedrock result in high erosion rates in this schist unit. In studies conducted from 1974 to 1978, Swanston and others (1995) found hillslope creep of variable depths to be the dominant erosion process in the schist. This hillslope creep has rates ranging from 0.003 to 0.008 feet per year.

Soils

Haul road and skid trail cutbanks provide an opportunity to inventory soils in Redwood Creek basin. According to mapping completed by Popenoe and Martin (1980-1985), there are nine different soil series (see Table 3), which are dominantly derived from meta-sedimentary or meta-volcanic schist within the study area. For taxonomical classification of soils see Appendix I. Marron and Popenoe (1986) found that soil characteristics correlated with drainage basin position and slope characteristics in the Bond Creek watershed. These controls, in addition to variations in climate, organisms, topography and time, may explain distribution of soil units (Marron, 1982). In the study area, Popenoe has found the degree of soil development to be most strongly correlated with hillslope position and age of parent material. The oldest, red soil surfaces located on various ridges represents remnants of a peneplain (Popenoe, *personal communication*, 1997). Plate 1 is a map of soil locations and associated erosion processes. For the corresponding list of soils in each erosion process, see Appendix II.

In the Bridge Creek watershed, there is a north-northwest pattern in soil instability. This pattern is parallel to the Bridge Creek lineament. There are also spots of different soils derived from metavolcanic blocks, some of which occur in these lineaments. The soils along the Bridge Creek lineament (Devilscreek and Elfcreek) were derived from a sheared black schist and have a very disrupted and weakly developed C horizon. Along the lineament, these soils are poorly drained due to a perched water table resulting from the well sheared, low permeability schist (Popenoe, *personal communication*, 1997).

Table 3. Characteristics and settings of principal soils throughout study area. [Modified from Popenoe (1987) and Popenoe and Martin (1980-1985)]

Soil Series	Slope Gradient (%)	Typical Location	Depth to Bedrock (cm)	% Clay Content by Horizon A	B	% Gravel Content by Horizon A	B	Drainage	Permeability
Ahpah	15-75	Ridges, convex slopes, near streams	50-100	20-30	25-35	10-20	5-25	Well	Moderate
Coppercreek	15-75	Moderate to steep slopes	100-150	20-30	27-35	1-35	10-35	Well	Moderate
Devilscreek	30-75	Steep, uniform to concave slopes	>150	25-32	27-35	15-35	5-35	Moderately well, to somewhat poor	Moderate
Elfcreek	15-90	Hollows	>150	15-25	15-25	20-50	15-65	Well or moderate	Moderately rapid
Fortyfour	10-50	Convex and steep slopes	50-100	27-35	40-50	10-25	5-20	Well	Moderately slow
Lackscreek	15-75	Narrow spur ridges and well incised drainages	50-100	20-30	25-35	15-45	35-75	Well	Moderate
Slidecreek	30-75	Sideslopes in highly dissected terrain	>100	20-30	25-35	15-90	35-80	Well	Moderate
Tectah	9-50	Broad ridges and upper sideslopes	>100	25-30	35-50	3-30	2-25	Well	Moderately slow
Trailhead	10-50	Broad ridges and upper sideslopes	>150	28-36	40-60	1-25	1-15	Well	Moderately slow

Erosion Control and Road Removal Procedure

Logging haul road removal and associated erosion control treatments were implemented in order to restore natural runoff patterns, remove potential sediment sources to streams and reduce the volume of future sidecast fill failures. In order to prioritize erosion control projects, the Redwood National and State Parks rehabilitation team conducts air photo analyses and field reconnaissance of erosion hazard. Then, detailed geomorphic maps are created to prescribe erosion control and road removal treatments. Highest priority areas are those with large volumes of sediment that are likely to be released into high quality, intact ecosystem areas. Prescription treatments are based on: 1) evidence of past and present erosional activity; 2) prediction of future activity; 3) soil type; 4) slope and channel gradient; 5) location and quantity of emergent groundwater; 6) amount of surface runoff and in-board ditch flow; 7) establishment of vegetation with stabilizing root systems, and 8) geology. Once site specific treatment areas are identified, erosion control work is designed, roads are surveyed, and contracts or rental agreements are prepared (Spreiter, 1992).

Roads inventoried in this study were treated between 1980 and 1990. Primary erosion control treatments are: 1) road outsloping; 2) cross road drain construction; 3) road decompaction; 4) stream crossing excavation and 5) endhauling fill material away from the worksite. Since the early 1980's various types of heavy equipment were used; size and type of equipment depends on project needs, such as size and type of worksite and distance of material to be moved. The degree of outsloping varied depending on perceived stability of sidecast fill and downslope resources at risk.

The following are brief definitions of primary treatment procedures. For a more elaborate description of these and current procedures in Redwood National and State Parks, see

Watershed Restoration Manual, Redwood National and State Parks, 1992. For a schematic of some of these treatments, see Figure 5.

- Road Outsloping : Fill is removed from the outboard edge of the road with an excavator or bulldozer, placed on the inboard side of the road reaches, and shaped to mimic the original hillslope gradient (see Figure 6). This is completed by an excavator or a bulldozer. This procedure prevents concentration and diversion of surface runoff, reduces failure rate of sidecast fill material and attempts to create a more natural hillslope contour. When outsloping, project managers tried to avoid burying large quantities of organic debris in one spot (Spreiter, *personal communication*, 1997). When springs are present along the cutbank, an inboard ditch may not be available to relieve groundwater runoff, in which case a cross-road drain may also be constructed or fill material may be hauled away (Weaver, *personal communication*, 1997). When the fill material is hauled away, this method is referred to as "export outsloping."

- Cross Road Drain Construction: A drain is constructed across the road by bulldozers or excavators; in the early 1980's backhoes and rippers were also used. These drains are constructed at necessary intervals in order to relieve road runoff, drain excessively wet areas and re-route inboard ditch drainage.

- Road Decompaction: The road surface is ripped with large bulldozers with rear mounted 24 to 36 inch ripper teeth, which are spaced no more that 24 inches apart. Road surfaces were decompacted to an average depth of 24 inches. Road surface ripping is employed in order to increase infiltration and achieve a permeability more similar to the fill, which will overlie the road surface if it is to be outsloped. This may

Figure 5. Schematic of primary erosion control treatments (taken from RNP Restoration Manual, 1992).

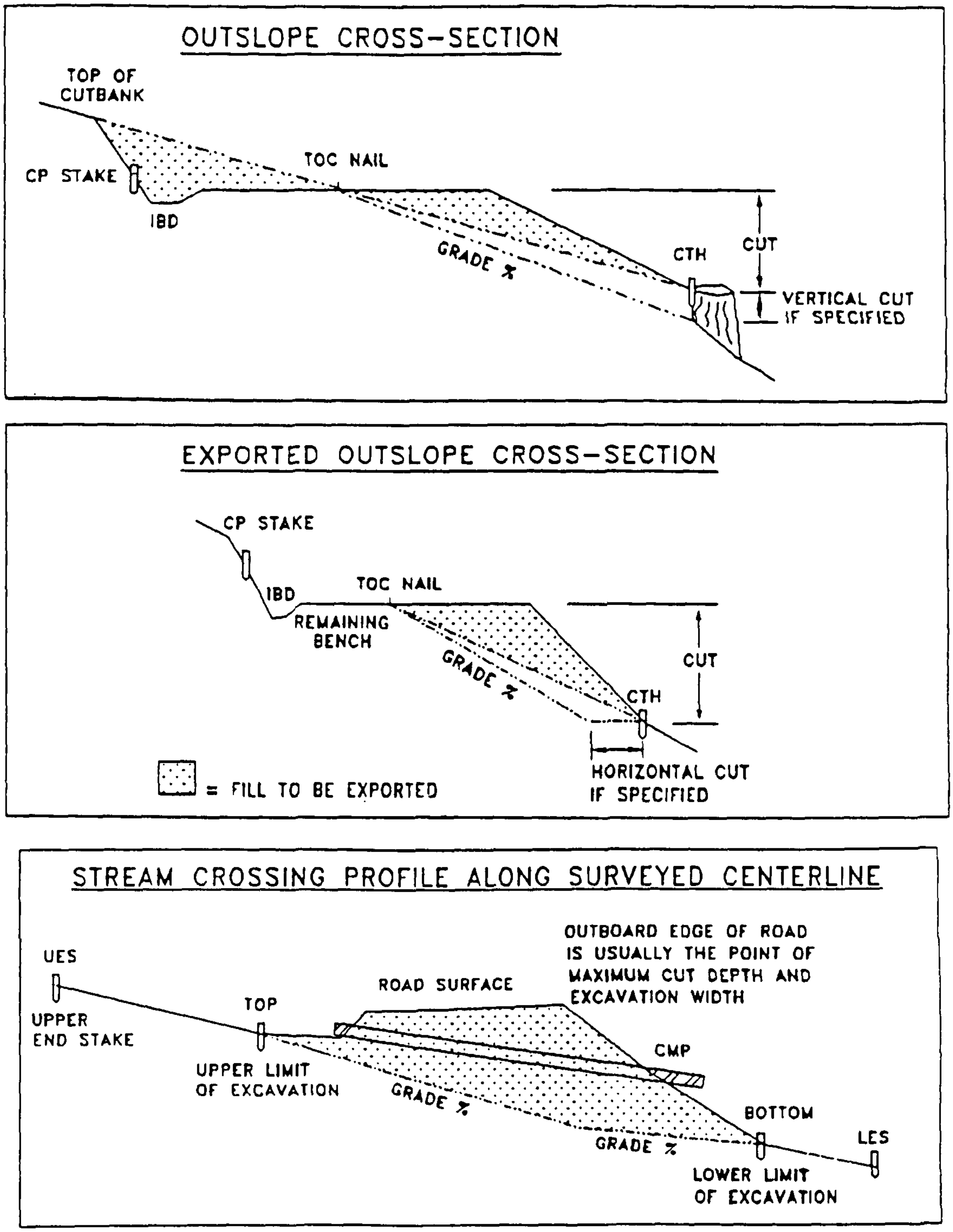
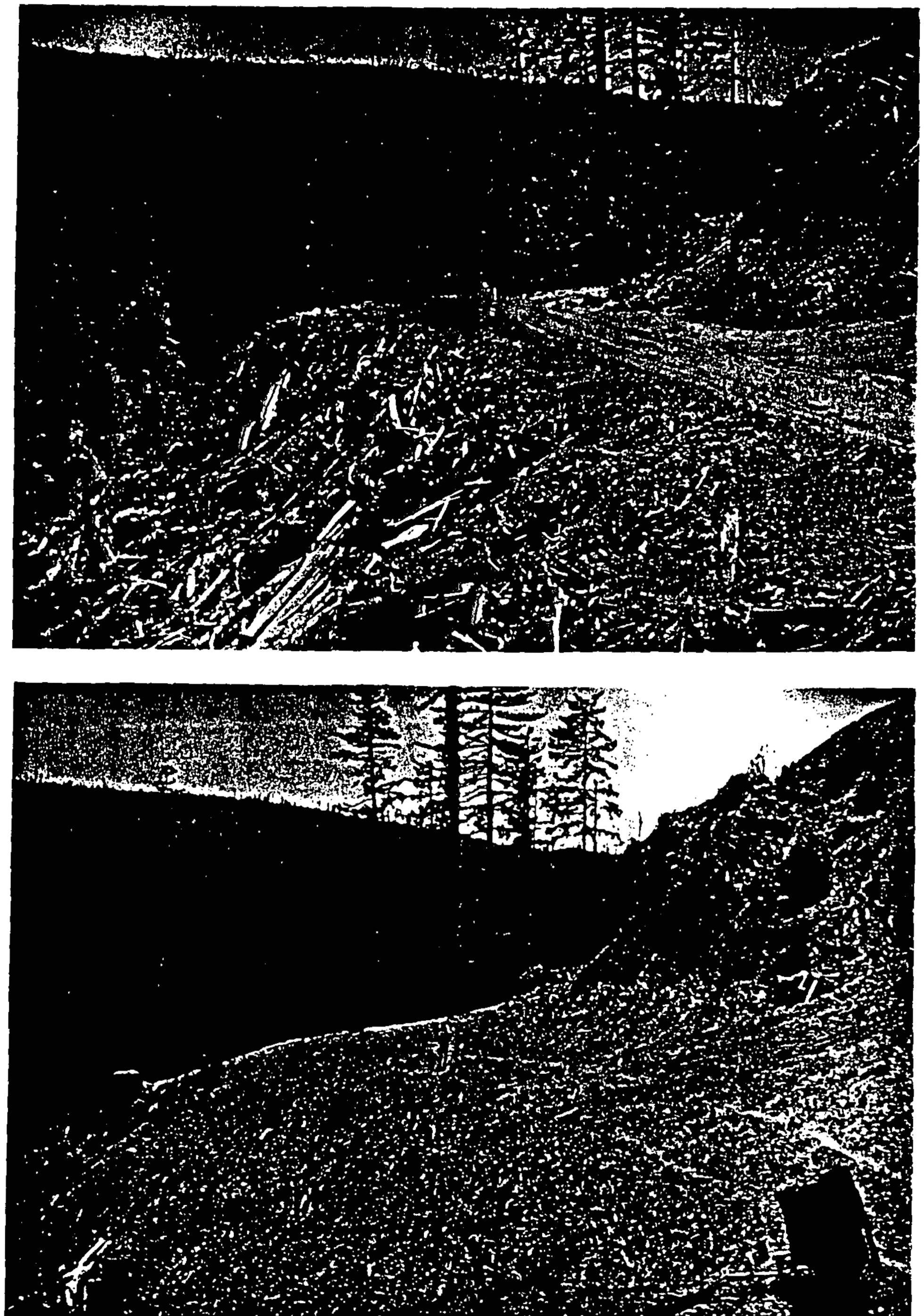


Figure 6. Before and after photographs of an outsloped road segment on the M-7-5-1 Road in the Bridge Creek watershed. Photos were taken on June, 1979 and June, 1981.



possibly prevent a slip plane developing where the old road surface underlies the fill. Additionally, ripping aids in revegetation.

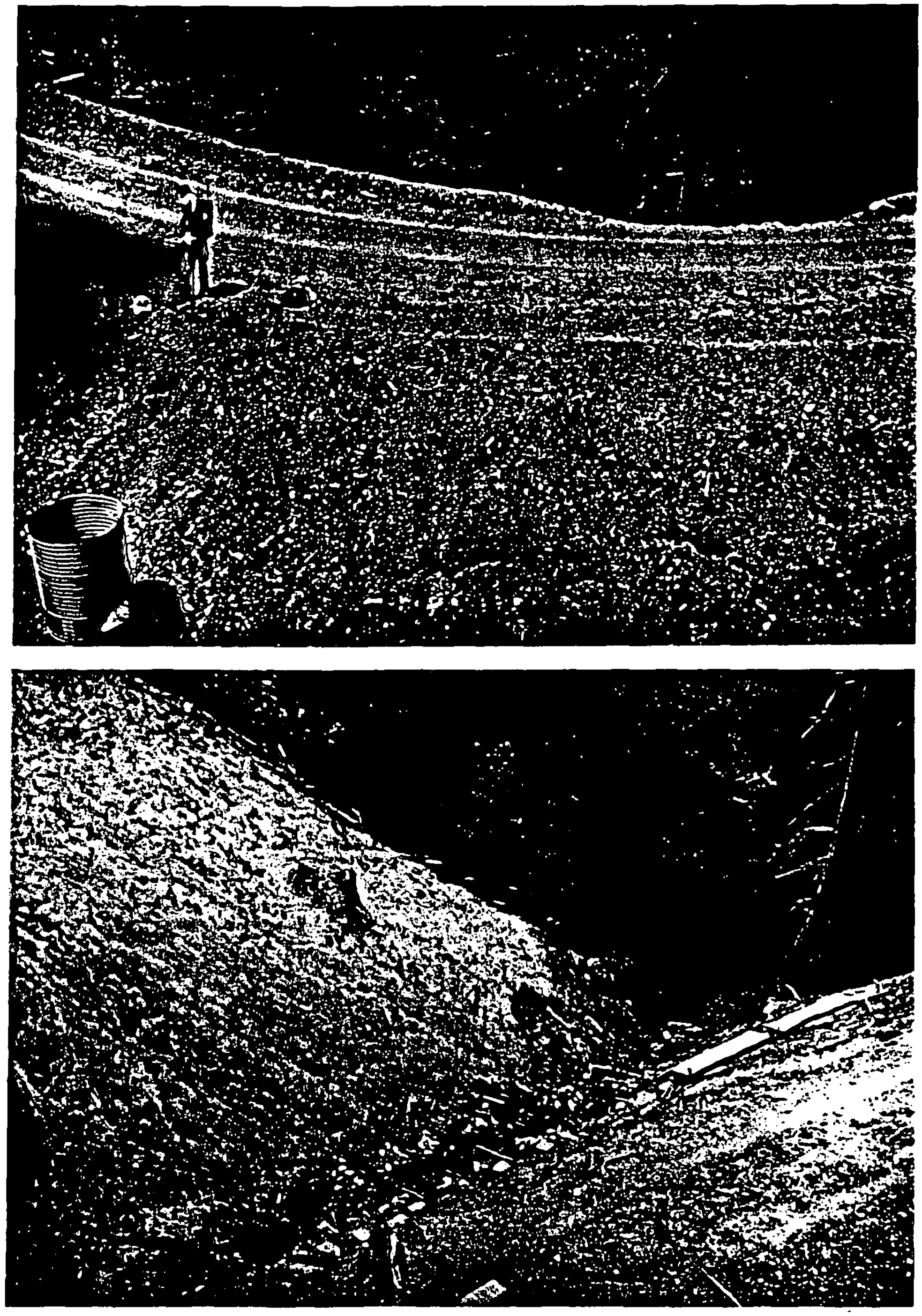
- Stream Crossing Excavation: Prior to excavation, any existing flow is diverted until completion of excavation. Generally, a bulldozer removes much of fill material which is then pushed to a nearby stable site. This is continued until the ground is too steep or wet to continue. An excavator may take over to remove the final fill and any Humboldt crossing logs and culverts until the original channel is located by finding original channel armor or woody debris (see Figure 7). Where the original channel armor was not found, some locations were armored with rock. Stream crossing excavation was employed to prevent stream diversions and erosion of fill.

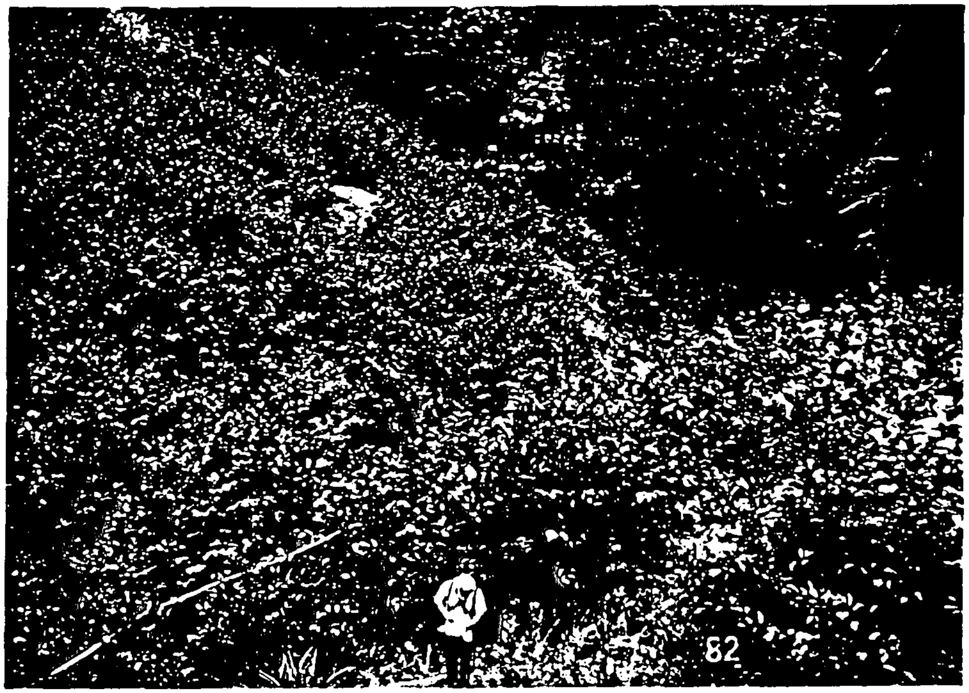
- Endhauling Fill Material: Fill material is occasionally removed from unstable outsloped road reaches and stream crossings and placed at a more stable location. A bulldozer is used to push material to close fill sites. A loader or excavator is used to load the material onto a dump truck, which transports the fill material to more distant fill sites. Fill sites are usually outsloped (Spreiter, 1992).

In addition to the above primary treatments, straw mulch, a secondary treatment was commonly placed over the fresh soil in order to prevent surface erosion in the Bridge Creek basin. Stream channels were occasionally armored. Also, various types of vegetation treatments were commonly implemented. In the early 1980's, Alder trees were planted at crossings as an easy growing, stabilizing force for the hillside and conifer seedlings were commonly planted in effort to re-establish the original vegetation type.

Throughout the 1980's erosion control techniques and prescription criteria evolved to a more objective standard process. Additionally, techniques changed from more labor intensive secondary treatments to an emphasis on primarily heavy equipment. Secondary treatments were used in order to dissipate channel flow energy and armor channels from erosional threats resulting from restoration activity; however, most secondary treatments were not cost effective and were eliminated by the beginning of 1980's. For elaboration on late 1970 and early 1980 erosion control treatments and evaluations, see The Evolution of Approaches and Techniques to Control Erosion on Logged Lands in Redwood National Park, 1977-1981, in Watershed Rehabilitation in Redwood National and State Parks and other Pacific Coast Areas, 1981(Sonnevil and Weaver, 1981).

Figure 7. Before and after photographs of a stream crossing excavation on the M-7-5-1 Road in the Bridge Creek watershed. Photos were taken June, 1979, January, 1980 and July, 1982.

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Field Methods

Site Selection

The main focus of this study is an inventory of treated roads which are located within the Bridge Creek watershed. The Bridge Creek watershed was chosen because it is the most intensely rehabilitated tributary of Redwood Creek. Additionally, Bridge Creek is an anadromous fish-bearing stream, and abundant background data are available. Due to time constraints and access problems, only two-thirds of the roads in the Bridge Creek watershed were inventoried. Road field inventories were conducted on the majority of treated roads located in the headwaters region and on the entire western half of the watershed. These regions were chosen because they provided the largest variety of hillslope positions and road ages (Madej, *personal communication*, 1997).

In order to get a large enough sample size of untreated road segments, it was necessary to include roads in watersheds adjacent to Bridge Creek. Field inventories were conducted on untreated roads in McArthur, Elam, Bond, Forty-four, Tom McDonald, Bridge, and Devils Creeks. These adjacent watersheds were chosen based on similarities in geology, elevation, hillslope gradient, and proximity to Bridge Creek.

Data Collection

Field data were collected from treated roads in Bridge Creek during Summer, 1996 and Spring, 1997. The Summer, 1996 inventory (see Appendices III and IV for inventory form and field definitions) included: 1) quantification of the volumes of fluvial erosion and mass movement since rehabilitation treatment; 2) estimation of erosion potential in a 50-year storm event; 3) sketches or notation of various erosional features; 4) description of vegetation coverage; 5) channel characteristics; and 6) hillslope position and form. The 1997 inventory consisted of a quantification of fluvial erosion and mass movement which had taken place since summer, 1996, presumably due to the January, 1997 storm. These data were appended to the 1996 inventory forms.

Field data were collected from untreated roads in Bridge Creek and adjacent watersheds by the rehabilitation crew as part of a 1997 storm damage assessment (see Appendix V for inventory form). "Untreated" roads include abandoned and lightly maintained administrative use roads. The administrative use roads receive ditch brushing and grading every other year (Mayle, D., *personal communication*, 1997). These field data were collected during the several months following the storm . Erosion volumes inventoried prior to 1997 were subtracted in attempt to constrain erosion to the 1997 storm event; however, the large majority of erosion sites did not experience significant erosion prior to the 1997 storm. These inventory volumes of erosional features on the untreated roads are based mostly on visual estimates, rather than tape measurements. In order to make a more equivalent comparison with treated road measurements, most sites estimated to be more than 500 cubic yards in volume were re-inventoried using field measurements. In order to calculate volumes, road failures were visually broken into geometric figures, such as trapezoids and rectangles. The maximum length of an estimated geometric segment was 50 feet.

Analytical Methods

Analyses are based on field measurements of road related, hillslope failures greater than 3 cubic yards unless otherwise specified. All data were compiled in Microsoft Excel and analyzed in Excel or Statmost.

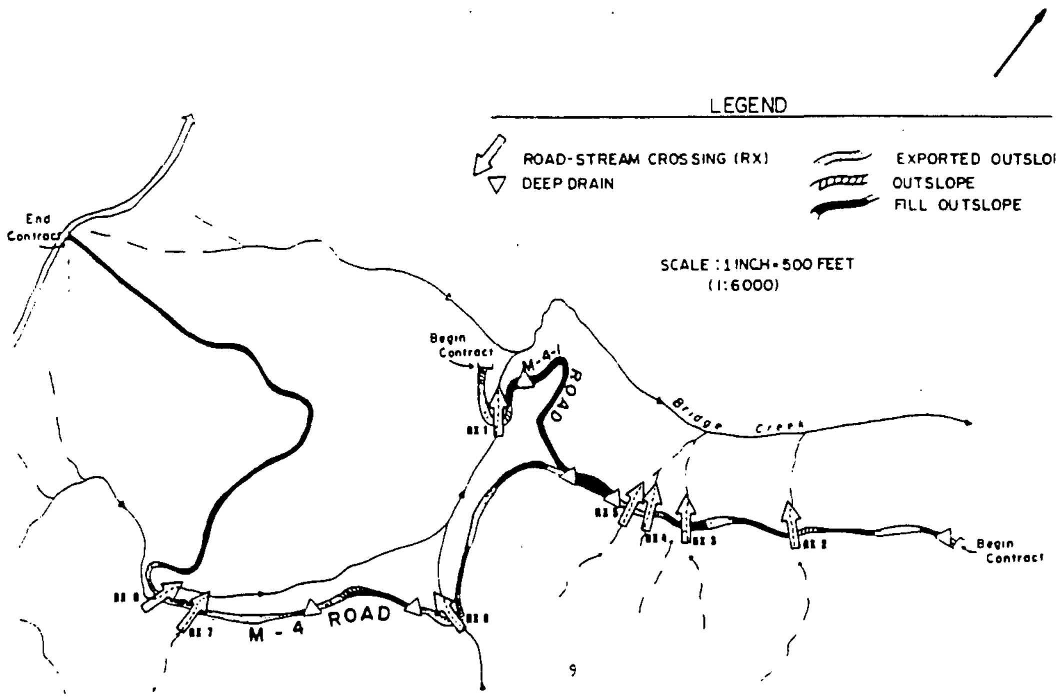
The analysis and discussion sections are split into two parts based on whether a site is a road reach or a road stream crossing (see Figure 8 for an example of a treatment map). Road reaches are stretches of road between stream crossing excavation sites. Stream crossing sites are confined to the excavated stream crossing.

It is important to recognize the classification of treated vs. minimally treated road segments. Treatments on "treated roads" are limited to export outsloping, outsloping and fill sites, and they may be referred to as more "extensive treatments." Minimal treatments are limited to ripping or draining. For a further explanation, see Erosion Control and Road Removal Techniques section of this study.

Data are sorted into "on-site" and "off-site." "On-site" refers to either the untreated road prism and cut bank, or the boundary of the treatment site, as defined by the rehabilitation project manager. Analyses were based on mass movement and fluvial erosion, measured on-site and off-site, unless otherwise stated.

It is important to realize that all analyses (except hillslope position) *only* include erosion which is "road related." If erosion occurred due to the road presence, then it is "road related." The hillslope position analysis is the only section that includes non-road related erosion. An example of non-road related erosion is a debris flow that is initiated at

Figure 8. Erosion control treatment map. (taken from Bundros, 1989. Summary Report. M-4 and M-4-1 Roads. Bridge Creek Watershed Rehabilitation Project 88-3)



a skid trail 100 feet above the inventoried road segment, yet it runs out below the road being inventoried.

The stream crossing analysis of fluvial erosion, stream power, and drainage area includes the following methods. Fluvial erosion volumes are based on field measurements of road related channel incision, bank erosion, gullies and rilling which occur "on site" at excavated stream crossings. Drainage area for each stream crossing site was measured on a 1:12,000 topographic map. Stream power, a measure of the driving forces of stream flow, is calculated for each stream crossing site. It is defined by the equation $W=\alpha QS$, where W=stream power, α=unit weight of water (62.4 lb/ft^3), Q=peak discharge (Q, ft^3/sec), S=upslope channel gradient (field measurement) (Dingman, 1984). The estimated peak discharge value was calculated for 6 hour (Tr=5) and 24 hour (Tr=15) rainfall to capture any relationships which may result from rainfall intensity. Peak discharge is determined by the Rational Method for drainage areas less than 80 acres (Dunne and Leopold, 1978). Peak discharges for basins greater than 80 acres are determined by the regression equations $Q_5=(5.04)(A^{0.89})(P^{0.91})(H^{-0.35})$ and $Q_{18}=(6.93)(A^{0.875})(P^{0.935})(H^{-0.22})$, where $Q_{\#}$=peak discharge, and # is the corresponding recurrence interval, A=drainage area, P=inches of precipitation and H=halfway elevation point between 10% and 85% of the watershed elevation from the discharge site (Waananen and Crippen, 1977). See Appendix IX and XI for data.

Analysis

Untreated and erosion control treated logging haul road response to the 1997 storm was compared. Approximately 110 miles of roads were inventoried in 1996 and 1997 on the west side of Redwood Creek drainage basin. Within the study area, 107,060 cy of 1997 storm erosion originated at road reaches, 90,650 cy of which was delivered to the channel, and 4090 cy of 1997 storm erosion originated at stream crossings. The majority of all 1997 storm erosion occurred as debris flows or rotational or translational debris slides originating on road reaches. The predominance of road reach, rather than stream crossing, erosion is attributed to the duration of the 1997 storm.

It is often unclear whether erosion originating at stream crossings is a result of the road presence or channel adjustment resulting from up or down-stream disturbance. Major upstream channel disturbance, such as abundant slash or skid trail activity was often apparent in the field. Also, a high intensity storm is necessary to provide a large enough discharge to test the stability of stream crossings. Because of these limitations on stream crossing assessment, the focus on erosion originating at stream crossings will be minimal.

Bar charts and box-whisker diagram are used in this section to make visual comparisons. The horizontal lines on the top and bottom of the box-whisker figures represent the maximum and minimum values in each population. The horizontal lines in between the maximum and minimum represent the 10th, 25th, 50th, 75th and 90th percentile points within the population.

Road Reach Analysis

Hillslope Position Analysis

The lower one-third of hillslopes are more susceptible to erosion. The increased pore pressure and surface erosion resulting from ground and surface water are compounded on lower hillslopes. Also, steep gradient inner gorge topography is apparent on a topographic map in some lower hillslope positions (see Map 1). Nolan and others (1976) found 80% of mass movement in the Redwood Creek basin occurring on slopes steeper than 50%. The relation between hillslope position and hillslope erosion was investigated in order to determine if it is necessary to stratify road failure erosion volumes by hillslope position.

All road related and unrelated mass movement and fluvial erosion occurring on treated and untreated road reaches were included in this analysis. Erosion measured on treated roads occurred after treatment and before March, 1997, and erosion measured on untreated roads occurred during Winter, 1997, presumably from the January, 1997 storm.

Sixty-seven road failure sites were identified along 52 miles of the 110 miles of inventoried roads. No failures greater than 3 cubic yards were identified on the remaining roads which total 58 miles in length .

Summary of Statistical Findings

Sixty-seven road failure sites resulted in approximately 133,770 cubic yards of post-treatment and 1997 storm erosion. T-tests and Kolgomorov-Smirnoff statistical analyses were conducted at a 95% confidence level in order to compare population means and distributions, respectively. When broken into respective hillslope positions, the lower hillslope road failure volume population is not different than middle and upper hillslope road failure volume populations based on their distributions (Kolmogorov-Smirnov test, K-S value = .339 and .263, probability = .151 and .417, respectively) (see Figure 9). Population means indicate that lower hillslope data have the same population means as middle and upper hillslope data (two-tailed, unpaired t-test on logarithmic values, p-value = .052 and .238 respectively).

The middle and upper hillslope road failure volume populations are from the same data population based on their distributions and means (Kolmogorov-Smirnov test, K-S value = .188, probability = .941) (two-tailed, unpaired t-test, p-value = .512). This relationship is moderately apparent in the box whisker diagram in Figure 8. The subtle sample difference between these and the lower hillslope road failure volumes, as displayed in Figure 10, is not statistically significantly different.

Scope of Inference

According to respective means and medians (see Table 4), failure site volumes on lower hillslopes were slightly smaller than failures on upper and middle hillslopes (see Figure 10). However, lower hillslopes experience a greater frequency and overall volume of erosion per mile, than middle or upper hillslopes (see Table 4 and Figures 11 and 12). The smaller failure volumes may be attributed to the limited distance for a debris flow to run its course. For example, if a failure originates 50 feet above Bridge Creek, the break in hillslope at the creek will serve as a buttress. The greater number of failures may be attributed to the compounded influence of ground and surface water in the lower slope region.

It is visually (see Figures 11 and 12) and statistically apparent that the lower hillslope road failure data population is substantially different from middle and upper hillslope data

Figure 9. Probability Distribution of Logarithmic Values of Road Reach Failure Site Volumes (cubic yards).

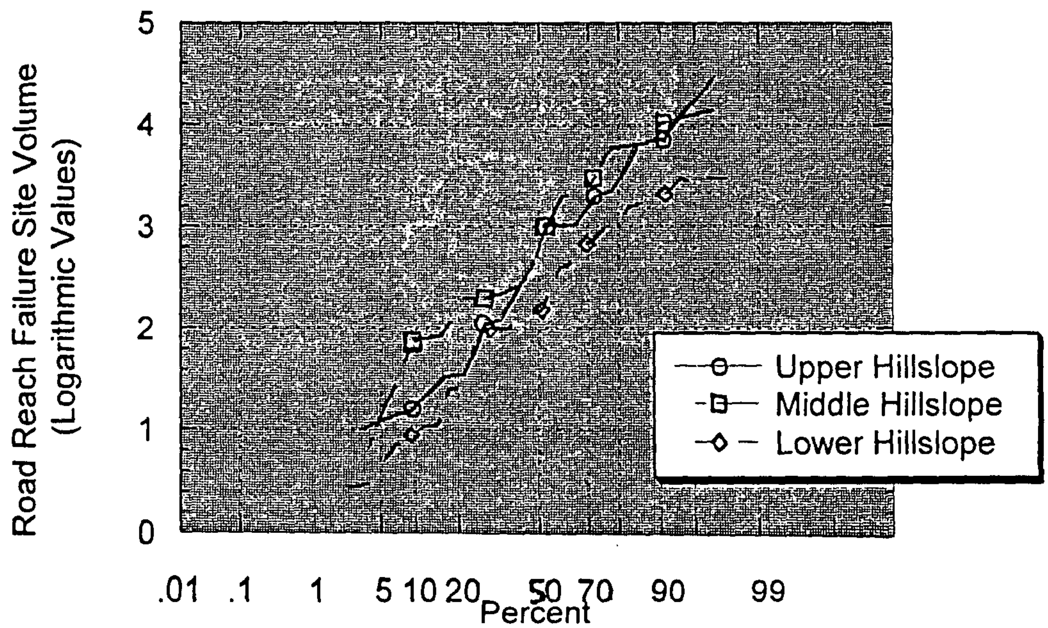


Figure 10. Post-treatment and 1997 storm road failure site volumes.

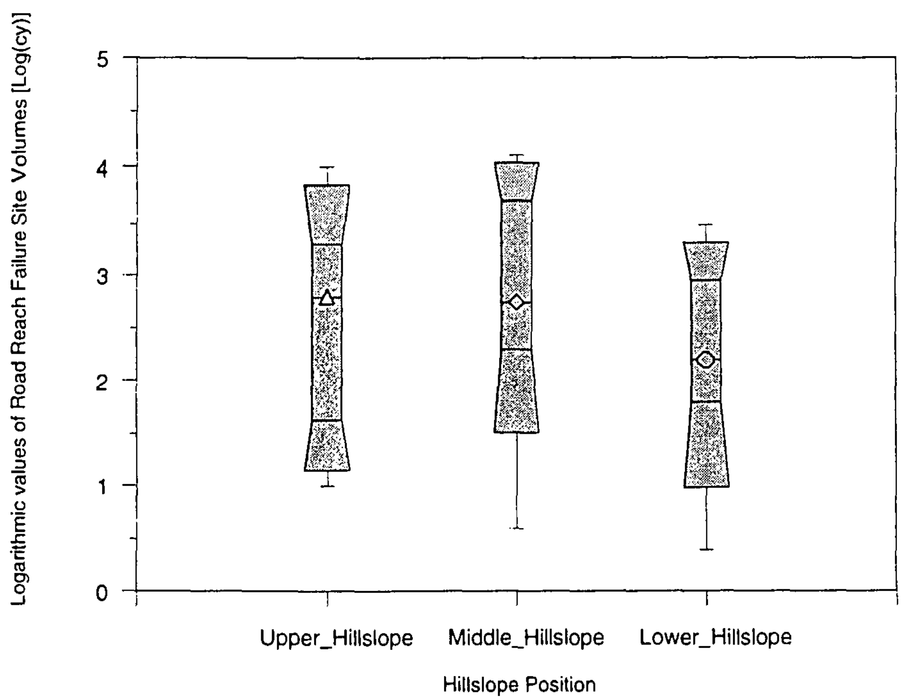


Table 4. Treated and untreated road reach pre and post-1997 storm data.
(excludes stream crossing data)

	Upper Hillslope	**Middle Hillslope**	**Lower Hillslope**	Total
a) Miles of Road Surveyed	34	40	36	110
b) *Treated Miles of Surveyed Road	9.1	2.0	7.4	18.5
c) Number of Road Failure Sites	16	16	38	70
d) Failure Sites per Miles of Surveyed Road [c/a]	0.47	0.40	1.06	
e) Total Volume Failed (cy)	31,608	46,424	24,813	122,845
f) Total Volume per Mile (cy/mi)	930	1161	3412	1117
g) Mean Failure Volume (cy)	1,976	2,902	653	
h) Median Failure Volume (cy)	700	665	146	
i) Maximum Failure Volume (cy)	10,000	13,900	3,085	
j) Minimum Failure Volume (cy)	10	4	3	

*Includes minimally treated

Figure 11. Number of road reach failure sites per mile.

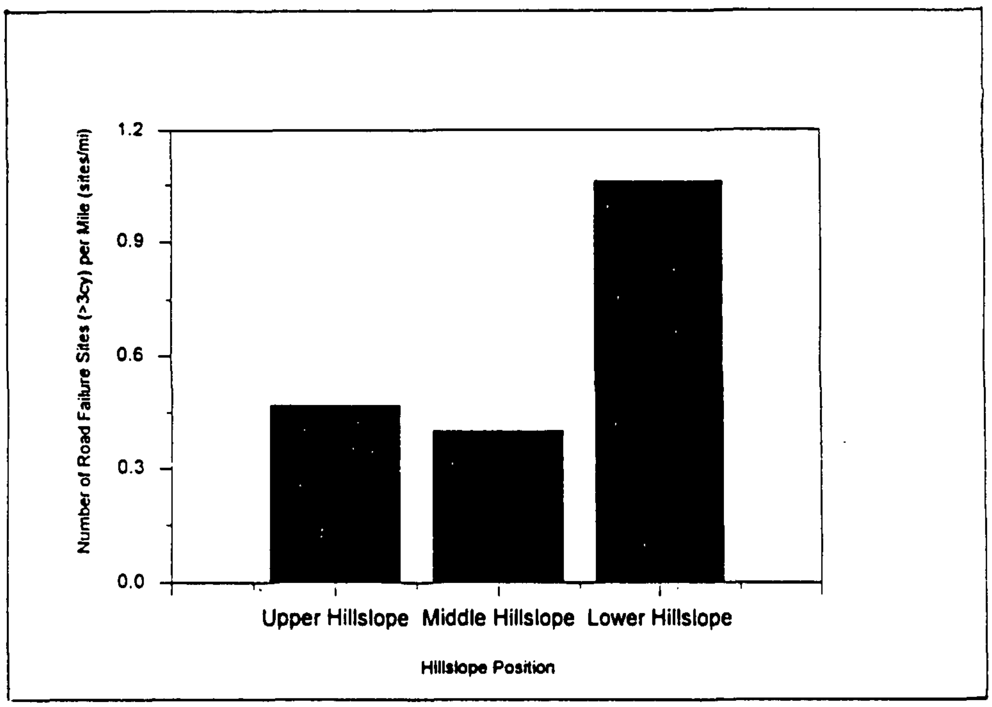
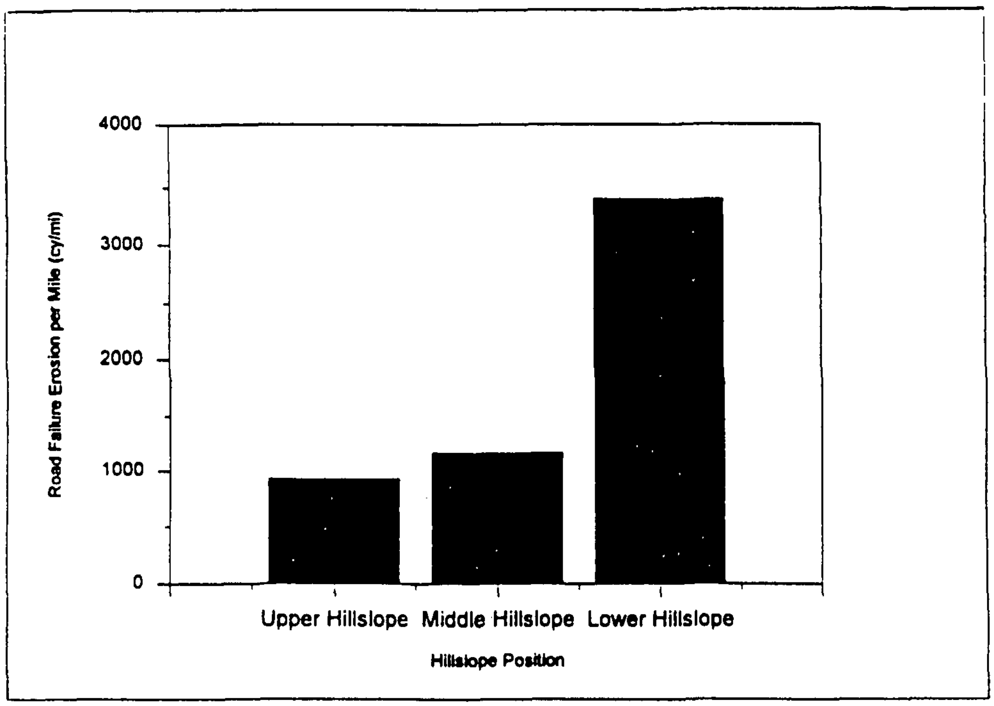


Figure 12. Total volume of road failures per mile on treated and untreated roads.



populations. For this reason, data will be split into lower vs. middle and upper hillslope positions for the 1997 storm erosion comparison in the following section.

Comparison of 1997 Storm Erosion on Treated vs. Minimally Treated vs. Untreated Roads

"Minimal" treatment includes ripping and/or draining only. "Treatment" includes roads that were outsloped, export outsloped or converted into a fill site. Since these inventoried erosion control treatments were implemented, 61% of all erosion originating on treated roads and 41% of the resulting sediment delivered to channels was a result of the 1997 storm (see data in Appendix VI.).

Results

On the inventoried upper and middle hillslope roads, the untreated roads contributed 27 times more sediment per mile to streams than treated roads, and 59 times more sediment per mile to streams than minimally treated roads (see Table 5 and Figure 13) (for data, see Appendix VI). The lower hillslope untreated roads contributed 1.5 times more sediment per mile of road to streams than treated roads, and 1.1 times more sediment per mile of road to streams than minimally treated roads.

The 1997 storm resulted in fewer, but larger volume road failures on untreated roads, when compared to minimally treated and treated roads (see Figure 14 and Figure 15). On the upper and middle hillslopes, more than 4 times as many road failures were initiated on treated roads than minimally treated or untreated roads. On the lower hillslopes, minimally treated roads initiated 2 times as many road failures as the treated roads and over 5 times as many as the untreated roads.

There was more erosion generated by this storm than expected. Treated and minimally treated road reaches yielded an average of 550 cy/mile of 1997 storm erosion. This value is 229% of a 50-year recurrence interval storm erosion potential (240 cy/mile), which is

Table 5. Descriptive statistics of 1997 storm road reach failures.

	Upper/Middle Hillslope			Lower Hillslope			
	treated	minimally treated	untreated	treated	minimally treated	untreated	
Number of Failure Sites (n)	4	2	16	3	13	17	
Mean Failure Size (cy)	93	1139	3714	323	526	1010	
Median Failure Size (cy)	75	1139	2000	255	90	400	
Standard Deviation (cy)	96	1453	903	121	852	1725	
Minimum Failure Size (cy)	4	111	10	251	7	50	
Maximum Failure Size (cy)	217	2166	10000	462	3085	7000	
Total Erosion for Category (cy)	371	2277	59426	968	6843	17175	87,060
Miles of Road Inventoried (mi)	4	8	64	2	5	29	
Normalized Total Erosion Volume (cy/mi)	**103**	**290**	**929**	**457**	**1484**	**601**	70,654
Total Sediment Delivered to Channel (cy)	109	106	52384	718	2232	15105	
Miles of Road Inventoried (mi)	4	8	64	2	5	29	
Normalized Volume of Sediment Delivered to Channel (cy/mi)	**30**	**14**	**819**	**342**	**484**	**528**	
Number of Failure Sites per Mile	*1.1*	*0.3*	*0.3*	*1.4*	*2.8*	*0.5*	
Delivery ratio	.29	.05	.88	.74	.33	.88	

Figure 13. Total volume of road reach erosion per mile.

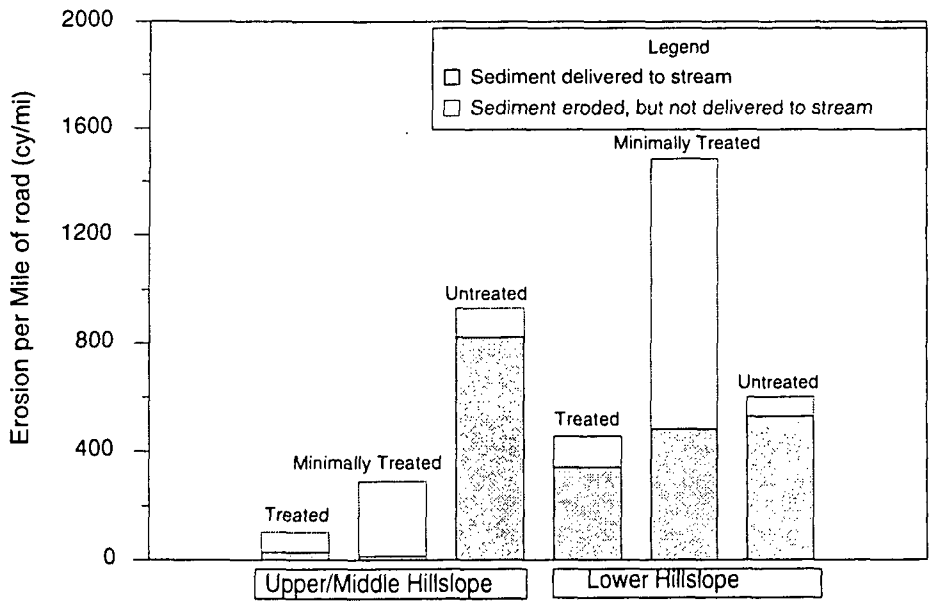


Figure 14. Box/whisker plot of road reach failure site volumes (1997 storm erosion).

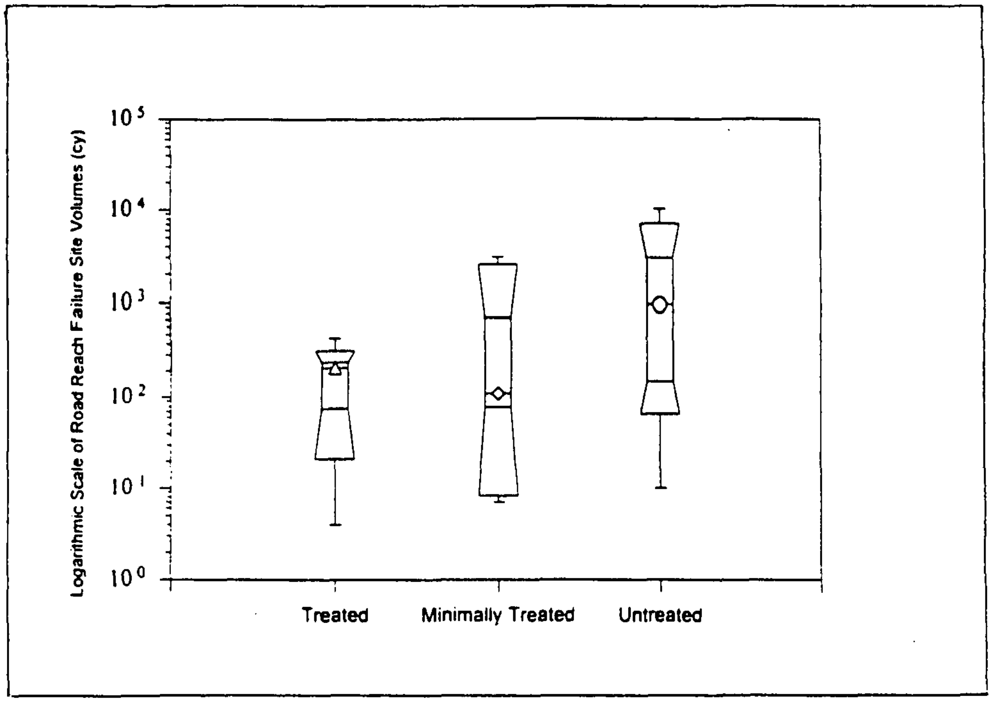
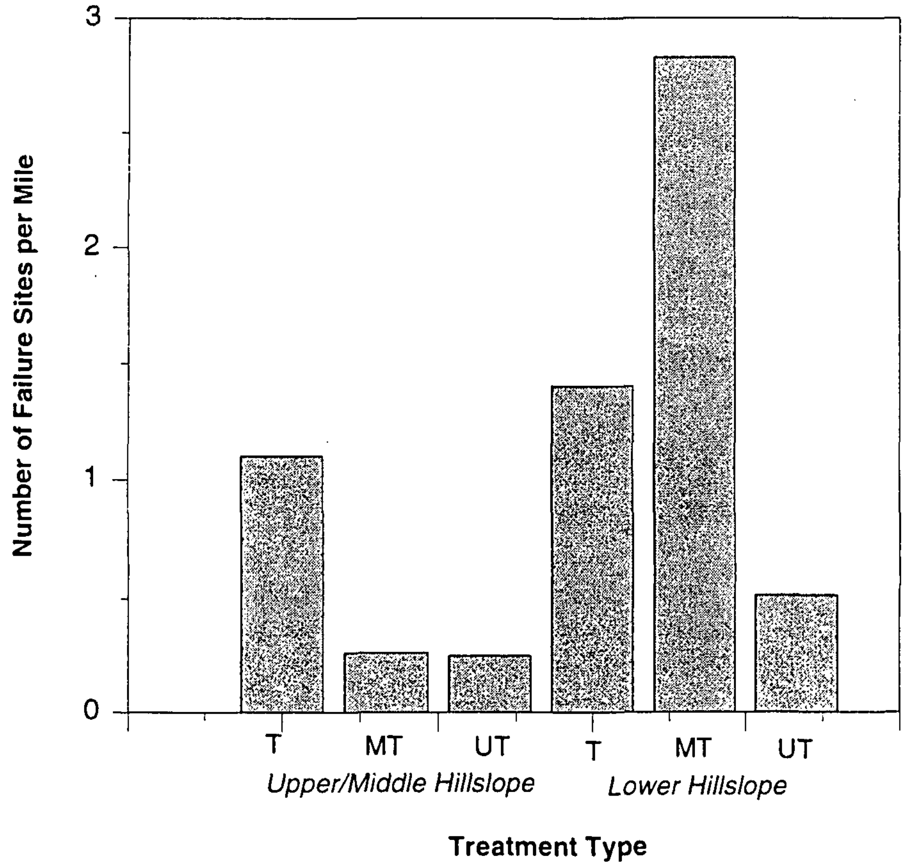


Figure 15. Number of 1997 storm failure sites per mile.



based on field estimates I gathered in 1996 road inventory in the Bridge Creek basin (see Appendix IV for definition of erosion potential). This volume includes erosion on treated roads which was prompted by erosion initiated at untreated roads, such as a debris torrent. Untreated road reaches yielded an average of 824 cy/mile of 1997 storm erosion, which is 122% of an estimated erosion potential (674 cy/site per (RNSP, 1996)) for a 50-year recurrence interval intensity storm event.

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Discussion

Upper/Middle Hillslope

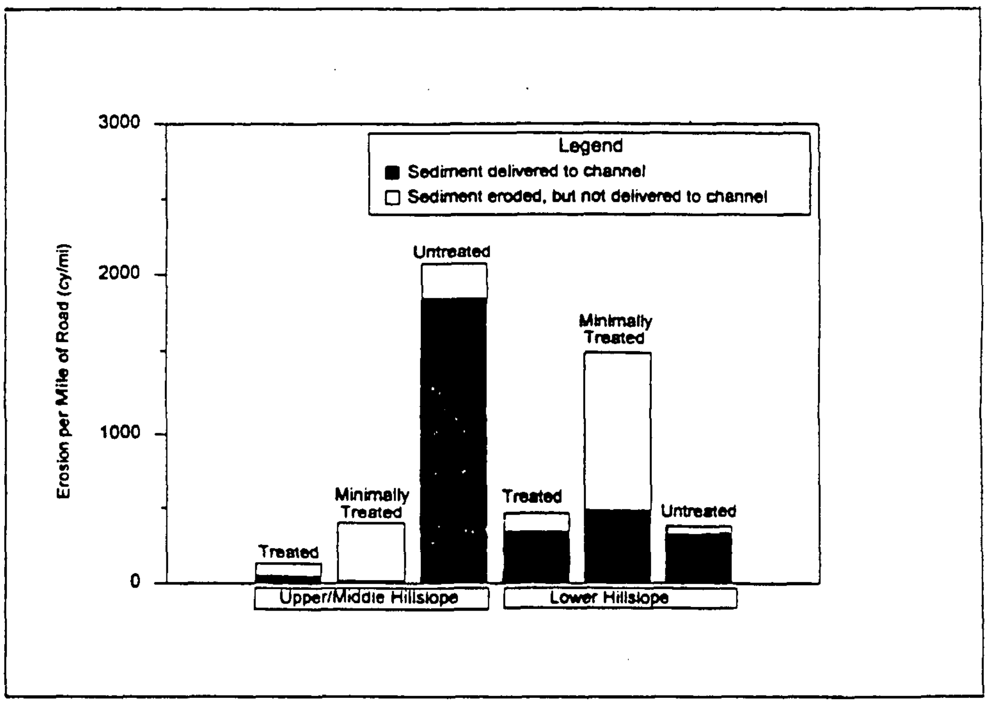
In the upper and middle hillslope locations, both minimal and full road erosion control treatments appear effective in reducing erosion and subsequent sediment delivery to streams. Also, 4 times as many road failures are initiated at treated roads than minimally and untreated roads on upper/middle hillslopes; however, these failures and subsequent sediment delivery to streams are relatively small in size. This may imply that ground disturbance resulting from extensive treatment produces a minor amount of instability, and results in a greater frequency of road reach failures. This instability may result from removing stabilizing vegetation and inadequate restoration of the prior soil compaction. Additionally, some of these failures may be attributed to their proximity to the Bridge Creek Lineament shear zone and location in headwater swales (see Map 1). The headwater swale region is already prone to failure due to steep hillslope gradients and converging groundwater flow. LaHusen (1984) found 57.5% of debris flows in the lower Redwood Creek basin occurred in headwater swales, which he defines as minor swales at the heads of ephemeral drainages.

It is worth noting that the failure volumes and occurrences within the untreated road population are most likely diluted by an excessive proportion of low priority roads. This is because most roads which have been treated are medium to high priority. One of the dominant criteria for assigning road priority for treatment is the potential for erosion and resulting sediment delivery to streams (Redwood National and State Parks, 1981). When low priority roads are removed from the untreated road population, the untreated roads yield 78 times more sediment to streams than treated roads, and 157 times more sediment to streams than minimally treated roads on upper/middle hillslopes (see Figure 16 and Appendix XII. for data summary).

Lower Hillslope

When compared to untreated roads, lower hillslope erosion volumes, minimal (minimally treated) and more extensive (treated) erosion control treatments appear effective in preventing sediment input to streams by a small margin. More extensive erosion control treatments appear to also be effective in preventing road failure erosion by a small margin; however, minimal treatments yielded more erosion than roads with no treatments and appear counterproductive. It is likely that erosion rates on minimally treated roads are inflated due to already unstable hillslope conditions and rehabilitation project manager inexperience in implementing erosion control treatments. Additionally, treated road erosion rates may also be inflated due to unstable hillslope conditions and aggravation of pre-existing hillslope instability resulting from the Roger's Creek debris torrent, which originated at an untreated road. Seventy-six percent of all lower hillslope treated road failure erosion (731 cubic yards) occurred on 2 sites located on segments of the M-7 Road which are adjacent (within approximately 50 feet) to Roger's Creek, a large tributary to Bridge Creek (see Map 1 for failure sites and Map 3 for road location). These 2 failure sites exhibited cracks and sagging prior to the 1997 storm; however, bank undercutting from the Roger's Creek debris torrent may have served as a catalyst of failures, which may not have otherwise occurred.

Figure 16. Total volume of road reach erosion per mile (cubic yards/mile) for medium to high priority roads. (1997 storm erosion)



Unstable hillslope conditions are a result of the Bridge Creek Lineament shear zone, the most prominent shear zone in the study area (see Map 1 and Figure 4). This zone is marked by highly sheared, low permeability schist and poorly drained, incoherent soil (Popenoe, personal communication, 1997). While doing a comparative road failure study in various rock types in north-western California, McCashion and Rice (1983) found roads in areas of heavily fractured rock were 2.7 times as erodible as those in lightly fractured zones. On inventoried lower hillslope roads, 100% of treated road 1997 storm failures originated on the M-7 road, and 100% of the minimally treated road 1997 storm failures originated on the M-6-1 and M-6-2 roads. Most of these road segments are located in the Bridge Creek Lineament shear zone.

It is crucial to acknowledge that the lower hillslope treated and minimally treated road erosion was increased by shear zone destabilization and the Roger's Creek debris torrent disturbance. If these factors were not affecting hillslope stabilization on these treated and minimally treated roads, the lower hillslope results may have portrayed both minimal and extensive erosion control treatments to be effective means of reducing erosion and subsequent sediment delivery to the streams.

Additionally, 92% of the 1997 storm erosion sites (99 % of total volume of erosion) on minimally treated road segments is concentrated on segments of the M-6-1 and M-6-2 which received treatments in 1980 (see Appendix XIII), when the rehabilitation program was new and techniques were unrefined. In retrospect, these road segments should have received more extensive treatments due to the unstable nature of this shear zone. According to the rehabilitation project manager (Bundros, personal communication, 1997), erosion along these reaches should be partially attributed to inexperience, and may have been prevented with more extensive treatment. Forty-six percent of these minimally treated road failures are 1997 storm related.

Comparison of Erosion Control Techniques

In an attempt to determine which erosion control treatments are the most effective, post-treatment erosion was compared among treatment types according to volume per mile, number of sites per mile and size of failure. Fifty-five mass movement or fluvial erosion sites were identified during the summer, 1996 or spring, 1997 inventory of 19 miles of treated and minimally treated roads within the Bridge Creek watershed.

All of the treatments discussed in this section are referred to as "treated" in all other sections. Minimally treated road failure erosion volumes are included in diagrams in order to make visual comparisons; however, they are not discussed in this section. For a discussion of treatment versus minimal treatment, see previous section. See Appendix XIV for data. For treatment descriptions see Erosion Control and Road Removal Procedure section of this document.

Results

Fill Sites

Table 6 and Figures 17, 18 and 19 show that fill sites experienced low erosion rates and relatively few failures, which also tend to be small in size. This suggests that fill sites are an effective means of sediment storage. Fill sites are strategically placed on the most stable road segments, so these results are not surprising. Additionally, although fill sites are not primarily prescribed as an erosion control treatment, they aid in distributing runoff. One-hundred percent of the fill site erosion occurred prior to the 1997 storm. This may imply that the small amount of erosion present at fill sites is a result of disturbance from treatment, and that after short-term adjustments, no further erosion occurred.

Table 6. Road reach failure sites (erosion since treatment).

Type of Treatment:	*Outslope*	*Export Outslope*	*Fill Site***	*Minimally Treated**	
Mean Failure Size (cy)	208	158	23	437	
Median Failure Size (cy)	35	155	4	83	
Standard Deviation	374	128	39	814	
Minimum Failure Size (cy)	4	6	3	3	
Maximum Failure Size (cy)	1040	462	92	3085	
Total Volume of Erosion (cy)	1459	1900	113	13546	17,018
Miles of Road Inventoried (mi)	4	2	5	8	19
Volume of Erosion per Mile of Road Inventoried (cy/mi)	***404***	***892***	***23***	***1792***	896
Total Volume of Sediment Delivered to Channel (cy)	133	1356	62	6172	7723
Volume of Sediment Delivered to Channel per Mile of Road Inventoried (cy/mi)	**37**	**636**	**13**	**816**	406
# of Failure Sites	7	12	5	31	
# of Failure Sites per Mile	2	6	4	1	
% of Erosion that is Mass Movement	98	75	100	100	
* Minimal treatment includes ripping and/or draining with no outslope.					
** Fill Sites may also be outsloped, ripped and/or drained.					

T.6 TOTAL ROAD EROSION = 17,018

APP XVII (p.150) TOTAL LINING EROSION = 8678

25,696 ÷ 19 MILES = 1352 CY/MI

Figure 17. Comparison of erosion control treatment techniques.

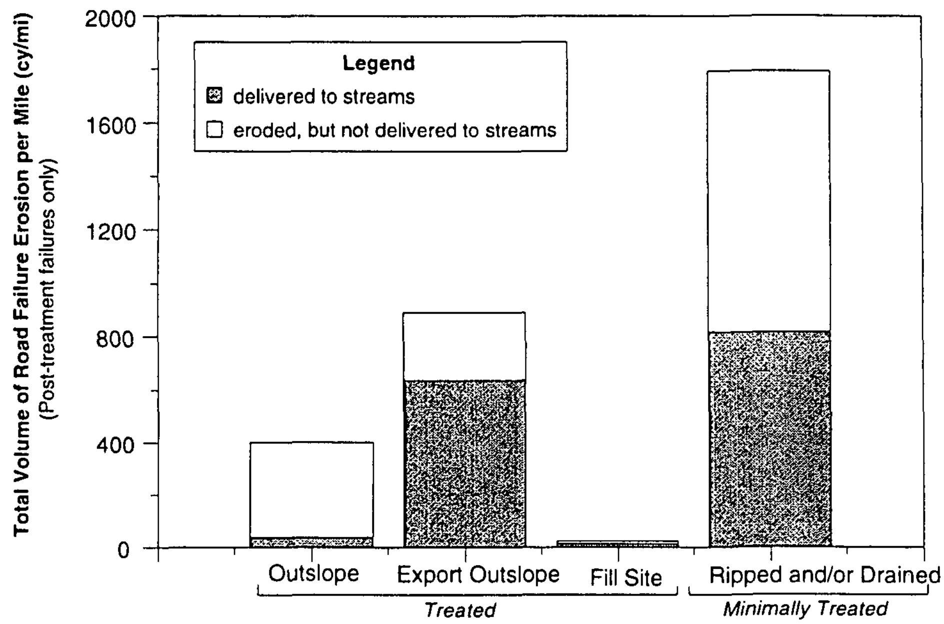


Figure 18. Number of post-treatment road failure sites per mile.

(erosion sites >3 cubic yards).

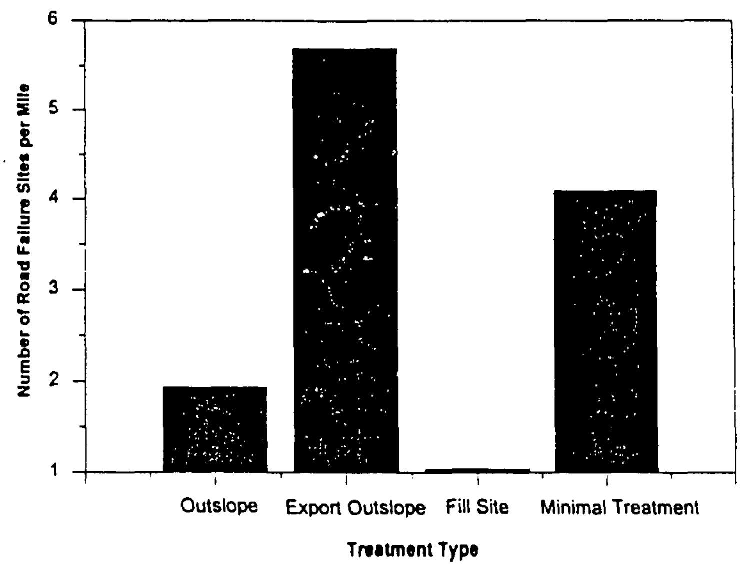
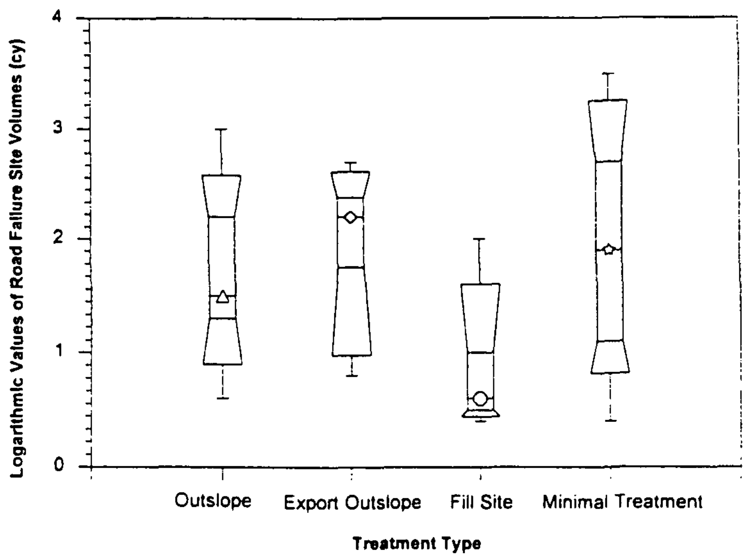


Figure 19. Box-whisker diagram of treated road failure sites.



Outsloping

Outsloping was effective in preventing erosion during the 1997 storm, and in preventing sediment delivery to streams after treatment and during the 1997 storm (see Table 6 and Figures 17, 18 and 19). Eighty-nine percent of this erosion occurred before the 1997 storm, and may be a result of hillslope adjustments to treatment disturbance.

Additionally, 88% of outsloped road failure sites are located in the Bridge Creek Lineament shear zone, as compared to 67% of export outslope road failure sites. This initially less stable terrain may inflate outslope failure rates compared to export outslope failure rates.

Export Outslope

Export outsloping was not effective in preventing erosion or sediment delivery to streams during the 1997 storm (see Table 6 and Figures 17, 18 and 19). Export outsloped road segments yielded 15 times more sediment to streams than outsloped segments during the 1997 storm. This 1997 storm prompted 79% of all export outslope erosion.

Prior to the 1997 storm, export outsloped road segments were more successful in controlling erosion, because they experienced 1.4 times less erosion than outsloped segments. Because fill is removed from the export outslope site, it should experience less post treatment adjustment than the outsloped sites.

Seventy-five percent of erosion on export outslope sites was due to mass movement versus fluvial erosion. In contrast, 97% of erosion on outslope, minimal treatment and fill sites was due to mass movement. Export outsloping removes unstable fill from unstable terrain, but it leaves an unnatural break in slope and inboard ditch to concentrate runoff and possibly intercept ground water. Also, wet hillslope conditions, which warranted the exporting of fill, contribute to fluvial erosion activity.

Discussion

Many of these road failures may be attributed to prior unstable hillslope conditions or adjustment resulting from ground disturbance due to treatment activity. Also, it is apparent that the treatments (excluding minimal treatments) that were prescribed for the most unstable terrain experienced the most erosion per mile. Every treated and minimally treated road failure in Bridge Creek is located in lower hillslope or headwater swale areas. The majority of these zones also fall within the Bridge Creek Lineament shear zone. These are the most unstable regions of the Bridge Creek watershed.

Before 1997 there were no large storms in the period after treatment (1980-1996). Most of the erosion occurring in this time period may be attributed to disturbances resulting from treatment. For example, removal of vegetation will eliminate established root systems which may act as a stabilizing agent, preventing surface erosion, and in some cases, mass movement. Also, when the road surface is disrupted to complete an outslope or export outslope, the fill may not re-establish its prior compaction, and the piezometric surface may shift. It seems reasonable to assume that these changes will result in changes in the properties of the material and the resulting hillslope mechanics.

Outsloping and fill sites appear to be more effective than export outsloping; however, it should be acknowledged that export outsloping is prescribed to areas that are more prone to erosion. Sonnevil (1991) performed a slope stability analysis to assess how progressive removal of sidecast fill reduced the factor of safety. The factor of safety decreased by only 10%, when removing all the sidecast fill, which is approximately equivalent to export outslope treatment; however, any changes which may occur in the piezometric surface were not included in the factor of safety calculations.

Limitations

1. These roads may require a larger magnitude storm, such as a 50 or 100 year recurrence interval event, in order to reach a state of ground saturation which may exceed the threshold for failure. These roads did not experience a storm greater than 12 year recurrence interval (based on a 24 hour period of precipitation); therefore, they may not have reached their failure thresholds.

2. Variations in analysis resulting from the following variability in data populations and their sizes may result in error:

-Roads classified as untreated did not all receive the same level of maintenance.

-Mileage of outsloped, export outsloped, fill sites and minimally treated roads are different (4, 2, 5, 8 miles respectively).

-Mileage of treated, minimally treated and untreated roads are 5.7 miles to 12.4 miles to 92.1 miles, respectively.

3. Relationships between erosion control treatments and the erosion and resulting sediment delivery to streams they experience may be obscured by the following things:

-Variation in the amount of woody debris remaining in the fill.

-Factors affecting hillslope stability, such as level of ground saturation, soil thickness and clay content, hillslope gradient, topographic position, vegetation and aspect.

-Factors affecting channel stability, such as drainage area, rainfall amounts and stream gradient.

-Off site disturbances, such as a landslide, which may have been caused by bank erosion.

-Variation in heavy equipment and equipment operator for treatment.

-Variation in rehabilitation project manager.

-Variation in time since road construction and erosion control treatments represent variations in storm exposure, road compaction, vegetation re-establishment, etc..

-Initial road conditions, such as width of the road, amount of fill removed in construction and cutbank height (Garner, 1979)

Recommendations

-This study suggests that more extensive treatments are necessary in more unstable terrain. The road failure sites in the Bridge Creek Lineament zone are clustered along the minimally treated road segments, and are sparse along the more extensively treated road segments (See Map 1).

-Further investigation is recommended for road reaches where excess water is present. More extensive treatments, such as export outsloping, may negate the stabilizing forces of compaction and vegetation. Equipment disturbances and a suspected shift in the piezometric surface may also result in destabilization. This recommendation is based on the large occurrence of 1997 storm erosion sites on export outsloped road segments.

-Minimal treatments may be effective in stable situations. The minimally treated road segments located in upper hillslope positions, such as the B-5-1 and B-5-1-1 roads did not experience significant 1997 storm erosion.

-Outsloping seems effective in *dry*, unstable situations, because the outsloped road segments experienced low failure rates.

A large scale comparison based on site by site analysis to monitor the variables controlling hillslope stability is recommended to further assess effectiveness of erosion control treatments. Monitoring ground water on roads before and after treatment (Fiori, personal communication 1997), and throughout the following rainy seasons, in conjunction with a hillslope stability analysis may provide further insight into the role of the water table and subsequent pore pressure response to road treatments.

Stream Crossing Analysis

Factors such as the following have substantial control on the amount of fluvial erosion taking place at a stream crossing: 1) stream power and drainage area (this may be significant; however, a strong relationship was not apparent in statistical analysis); 2) magnitude of stream crossing excavation and the volume of fill in the channel; 3) amount of organic debris in channel; 4) bed particle size in channel; 5) soil type; 6) upstream and downstream disturbances, such as skid trail and road failures or excess organic debris in channel; and 7) storm intensity and antecedent moisture conditions.

<u>Stream Power and Drainage Area Analysis</u>

In order to determine whether stream crossing fluvial erosion volumes should be normalized by drainage area and stream power, the following analysis was completed. A logarithmic linear regression was conducted to determine a relationship between the dependent variable, fluvial erosion, and each of the independent variables, stream power and drainage area. Volumes are based on pre and post-1997 storm fluvial erosion sites greater than 2 cubic yards, which occurred on-site at excavated stream crossings. (See Methods section for additional details.)

Summary of Statistical Findings and Scope of Inference

No significant relationship between fluvial erosion and stream power (6 hour or 24 hour duration) or drainage area was apparent (r-squared values 0.32, 0.33 and 0.27, respectively); however, a weak relationship is apparent when these values are graphed (see Appendix XV, XVI and XVII). Fluvial erosion volumes will therefore not be normalized to stream power or drainage area for the following comparison.

Comparison of 1997 Storm Mass Movement and Fluvial Erosion Volumes on Treated versus Untreated Stream Crossings

Results

On middle and upper hillslopes, untreated stream crossings yielded over twice as much erosion (per stream crossing inventoried) as treated stream crossings (see Figure 20 and Table 7). The same percentage of inventoried stream crossings failed in each category; however, the maximum failure size of untreated crossings is 600 cy and treated crossings is 143 cy (see Table 7).

On lower hillslopes, untreated stream crossings yielded half the number of failures and half the volume of erosion (per stream crossings inventoried) as treated stream crossings (see Figure 20). The maximum failure size of untreated crossings is 200 cy and treated crossings is 146 cy.

According to data collected by the rehabilitation team of Redwood National and State Parks, 64% of the untreated stream crossing failures resulted from plugged culverts, most of which resulted in wash outs, and 36% were a result of fill failure, some of which were prompted by rotting organic matter. Of the treated stream crossing failures, lower hillslope crossings experienced both post-treatment channel incision and bank erosion, but upper and middle hillslope crossings did not experience post-treatment erosion.

Discussion

It is apparent that upper and middle hillslope stream crossing treatments were effective in preventing erosion and resulting sediment yield to streams; however, lower hillslope treatments appear to have been ineffective due to high erosion rates. However, the lower

Figure 20. Comparison of 1997 storm erosion at treated vs. untreated stream crossings.

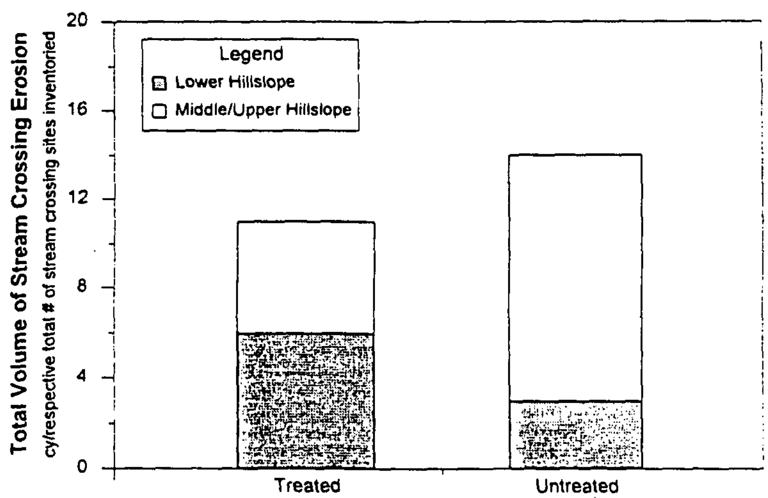


Table 7. Stream crossing failure data and numeric summary (1997 storm erosion).

	Upper/Middle Hillslope		*Lower Hillslope*	
	treated	*untreated*	*treated*	*untreated*
Data (stream crossing road failure sites >49cy):	143	50	146	200
	63	50	108	100
		367		150
		340		
		50		
		500		
		240		
		400		
		75		
		600		
		70		
		100		
Total Erosion for Category (cy)	206	2842	254	450
# of Stream Crossings Inventoried (including non-failures)*	40	267	46	157
Normalized Total Volume of Road Failure Erosion				
(cy/# of Stream Crossings)	5	11	6	3
# of Failure Sites (>49 cy)	2	12	2	3
% of Stream Crossings which Failed	5	5	4	2
**based on Bridge Creek watershed stream crossing density,*				
upper/middle hillslope = 4.2 xing/mi. lower hillslope = 5.5 xing/mi				

P.44 SAYS 4090 CY TOTAL EROSION
FROM ALL XINGS
PAGE 150 SAYS 8678 CY FROM TREATED X-INGS

P.67 Σ TOTAL EROSION FOR CAT. = 3752

Σ UNTREATED EROSION = 2842 + 450 = 3292
Σ TREATED = 206 + 254 = 460

MILES TREATED = 18 MILES
MILES UNTREATED = 92 MILES } PAGE 73

1997 CROSSING
FAILURE EROSION
RATES:

TREATED = 26 CY/MI.
UNTREATED = 36 CY/MI.

hillslope erosion was generated off of only 2 failure sites, which are both located in the Bridge Creek Lineament shear zone, which may be related to this instability. It is difficult to make a conclusion due to these factors.

It is important to recognize that the volume of material excavated from a stream crossing represents potential sediment which may erode during a 50+ year recurrence interval intensity storm. None of these treated stream crossings have stood the test of a storm event which could provoke significant reaction. According to Best and others (1995), the amount of material which can fail at an untreated crossing is directly correlated with the amount of fill in a stream crossing. In the Bridge Creek basin, a total of 117,500 cubic yards of fill was excavated from 86 stream crossings, an average of 1361 cubic yards per stream crossing. Excavated stream crossings in Bridge Creek yielded an average of 5 cubic yards of erosion per site in 1997, which is 8% of a 50-year erosion potential (61 cy/site) for a 50-year recurrence interval intensity storm event. This erosion potential value is based on field estimates (see Appendix IX). Untreated stream crossings yielded an average of 8 cubic yards of erosion per site in 1997, which is 3 % of an estimated erosion potential (232 cy/site per (RNSP, 1996)) for a 50-year recurrence interval intensity storm event.

Recently treated stream crossings may actually be more vulnerable to a small scale storm than untreated crossings. Once treated, a channel may incise as an adjustment towards a new equilibrium. Because a stream crossing site is part of a larger system, upstream and downstream disturbances may prompt channel incision adjustments, particularly during moderate to high intensity storm events. Also, bank erosion may be prompted by channel incision or adjacent hillslope creep, and surface erosion may occur until vegetation is re-established. The success of re-establishing the original channel will also influence the amount of post-treatment adjustment. Error in re-establishing the original channel often occurs due to unexpected sinuosity and variation in gradient of the original channel. The new channel will continue to adjust itself until a natural gradient is met (Klein, 1987).

Klein (draft, 1997) estimates that lower hillslope stream crossings on the west side of Redwood Creek will yield 11 cy/site of post-treatment adjustment channel incision and subsequent bank erosion. The treated stream crossings in Bridge Creek have experienced an average of 113 cy/site of post-treatment channel incision and bank erosion. This high rate of post-treatment adjustment may be attributed to the location in the unstable zone of the Bridge Creek Lineament, in addition to the factors mentioned above.

Stream crossing failures under 50 cubic yards were not considered for this particular comparison, because small scale erosion, particularly under 50 cy, may have been overlooked during the less detailed inventory of untreated roads. This may mask some of the post-treatment adjustment among the treated stream crossings

<u>Partial vs. Total Stream Crossing Excavations</u>

When the original channel bed was not reached during excavation, the treatment is classified as a "partial" excavation, as opposed to a "total" excavation. In order to determine which erosion control technique was more effective in preventing sediment yield to channels, erosion occurring at partially and totally excavated stream crossings was compared.

Results

Partially and fully excavated sites yielded very similar average total volumes of fluvial erosion and mass movement since treatment, 115 cy/site and 112 cy/site, respectively (see

CHECKS W/ TABLE ON P. 150

Figure 21. Comparison of stream crossing erosion by treatment type.

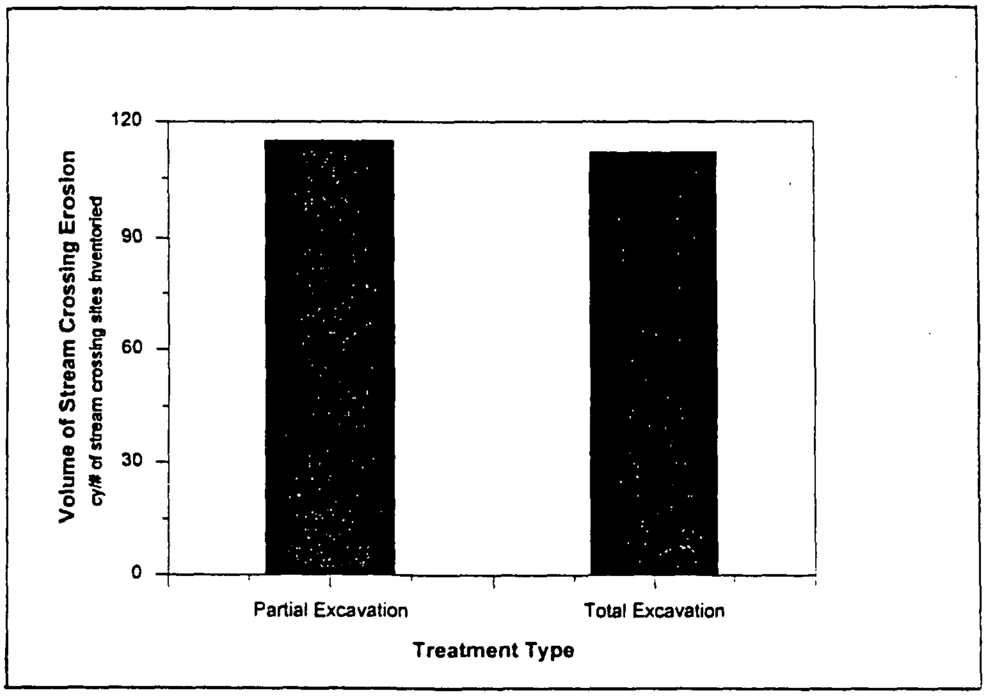


Figure 21). The individual partially excavated and totally excavated failure site volumes are similar in mean (121 cy and 130 cy, respectively), yet different in median volume (110 cy and 59 cy, respectively) (see Figure 22). Ninety-five percent of partially excavated sites experienced failures since treatment, whereas, 86 percent of the totally excavated sites experienced failures. Over 99% of this stream crossing erosion is fluvial, rather than mass movement. For additional statistical information and data, refer to Appendix IX.

Discussion

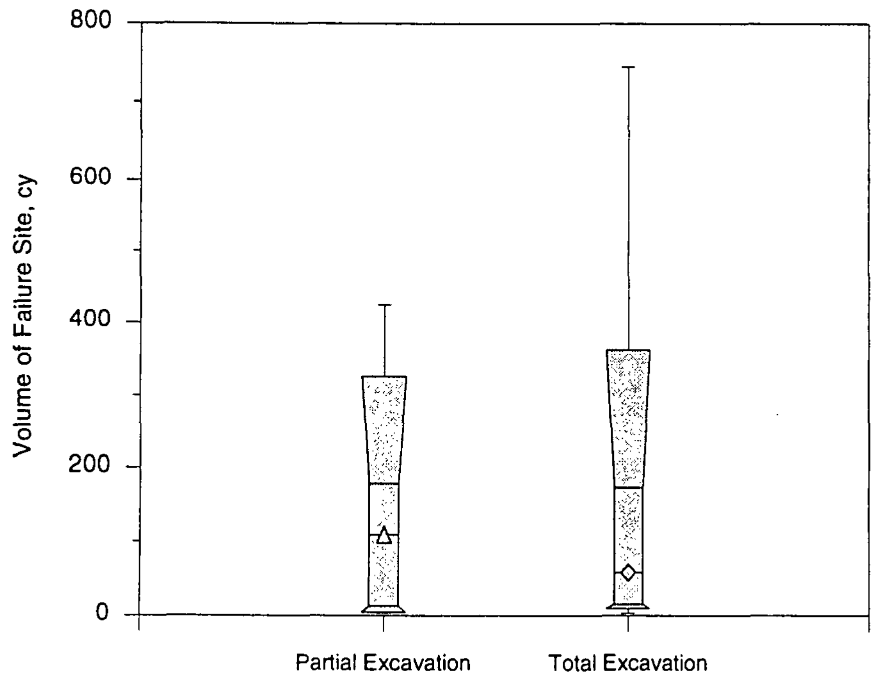
The similar partial and total excavation post-treatment sediment yields may be attributed to either of the following: 1) Partial and total excavations are equally effective in preventing sediment yield to channels, or 2) Stream crossing treatment techniques were prescribed effectively; therefore, most of the 1997 storm erosion resulted from post-treatment adjustment. If all the 1997 storm erosion resulted from post-treatment adjustment, partial and total excavations would both experience this adjustment, and therefore, have similar sediment yields. These treatment techniques are based on estimated erosion potential and sediment delivery to Bridge Creek, so low risk stream crossings were more often partially excavated. Diversion potential, soil type, stream power, and erosion history are major determinants of erosion potential.

Limitations

Stream crossings have not experienced a storm of the intensity necessary to cause significant erosion.

Relationships between erosion control treatment and sediment yielded from erosion may be obscured by the following factors:

Figure 22. Box-whisker diagram of treated stream crossing failure site erosion volumes.



-Treated versus untreated road sample sizes are 18 miles and 92 miles, respectively.

-Factors, such as groundwater, soil thickness and clay content, hillslope gradient, vegetation cover and aspect can affect channel and bank stability; yet, it is difficult to account for their influences due to their variability from site to site.

-Additional factors affecting channel stability, such as stream gradient and amount of channel armor, including woody debris and rock will also influence the driving and resisting forces of stability.

-Off site disturbance can affect stream crossing erosion volumes.

-The project manager, equipment operator and heavy equipment used in treatment was variable for many sites and projects. These differences can produce different levels of excavation precision.

-Also, the untreated stream crossings have received variable degrees of maintenance.

-Variation in time since road construction and erosion control treatments represent variations in storm exposure, road compaction, vegetation re-establishment, etc.

Additionally, stream gradient measurements may lack precision due to inconsistencies in measuring gradient upstream and downstream.

Recommendations

The above analysis is not a sufficient basis for recommendations, because the stream crossings have not been through the test of a sizable storm.

Conclusion

The long duration of the 1997 storm is well captured in the resulting erosion witnessed throughout this study. Over 95% of the 1997 storm erosion consisted of mass movement, rather than fluvial erosion. Over 96% of all storm erosion occurred on road reaches, rather than stream crossings.

During the 1997 storm, upper and middle hillslope untreated road reaches yielded over 27 times more sediment to channels than treated roads, and over 58 times more sediment to channels than minimally treated roads. Additionally, these untreated road reaches experienced 9 times more erosion than treated roads, and over 3 times more erosion than minimally treated roads. All treated road failures occurred in the Bridge Creek headwater swale region.

On lower hillslopes, untreated road reaches yielded over 1.5 times more sediment to channels than treated roads, and approximately 1.1 times more sediment to channels than minimally treated roads. Additionally, these untreated roads experienced 1.3 times more erosion than treated roads, but 2.5 times less erosion than minimally treated roads. Almost all failures occurring on treated and minimally treated roads were located in the Bridge Creek Lineament, a highly fractured and unstable shear zone.

Treated road reaches experienced more failures, but the mean volume of these failures is 1/3 that of untreated road reach failures. The greater frequency may be due to destabilizing adjustments resulting from treatments; however, post-treatment erosion is minimal in comparison with the amount of prevented sediment delivery to streams in the 1997 storm and future higher intensity storms. Thirty-eight percent of all road reach erosion occurring in Bridge Creek occurred before the 1997 storm, and is a likely result of previous slope instabilities and post-treatment adjustments.

The less extensive, "minimal" treatments, which consist of ripping or draining appear ineffective in unstable terrain, yet effective in highly stable terrain. This is evident by the erosion rates and failure site locations. However, road surface ripping is destabilizing when used as an isolated treatment and is not recommended.

Of the more extensive treatment techniques, outsloping and fill sites are effective in reducing sediment delivery to streams. However, export outsloping experienced the greatest erosion rate, 892 cy/mile, of which 636 was delivered to streams since treatment. Over 89% of outslope and fillsite road segment erosion occurred prior to the 1997 storm, where as, only 21% of export outslope erosion occurred prior to 1997. This is a good indication that export outslope road segments were more vulnerable to the 1997 storm. Export outsloping is prescribed to sites which have excess water, such as seeps and springs, and are therefore, more prone to erosion. A more intensive assessment of export outsloping treatments is highly recommended prior to further use.

Untreated stream crossings experienced 1.5 times more 1997 storm erosion than treated stream crossings. Most untreated crossing 1997 storm erosion occurred on upper and middle hillslopes, where as, most treated stream crossing erosion occurred on lower hillslopes, which are located in the shear zone. On treated stream crossings, 1997 storm erosion accounted for only 5.3% of all the erosion which has taken place since treatment (1980-1990). When comparing partially and totally excavated stream crossing erosion, there was no apparent difference in erosion rates. This study is not sufficient in order to assess effectiveness of stream crossing erosion control treatments, because they have not been through the test of a high intensity storm.

The factors affecting hillslope stability, variations in rainfall and time since treatment influence the volumes of erosion and are essential considerations; yet, they are not controlled in this study. Hillslope position and drainage area and stream power were tested for significance; however, other variables were not included in this study. Road reaches on lower hillslopes experienced 3 times more 1997 storm erosion than road reaches on upper and middle hillslopes. Lower hillslope road reaches also experienced twice as many failures; however, their mean failure size is 1/3 the volume of upper and middle hillslope road reach failures. Also, no relationship is apparent between stream crossing erosion and drainage area or stream power.

Overall, minimally and more extensively treated roads experienced 550 cy/mi of road reach erosion, 167 cy/mi of which was delivered to streams in the 1997 storm. This sediment input from approximately 70% of the watershed, resulted in 450 tons/mi^2 or 5,100 tons (English) of suspended sediment plus bedload in Bridge Creek in 1997. Untreated roads experienced 824 cy/mi of road reach erosion, 726 cy/mi of which was delivered to streams in the 1997 storms. In comparison with other regions, these values exceed the 395 cy/mi of erosion present on untreated road reaches in the Coast and Klamath Ranges of northwestern California during the 1976 inventory (McCashion and Rice, 1983). In the Canyon Creek watershed in northwestern Washington, untreated road reaches experienced 4147 cy/mi of sediment delivery to streams resulting from several 2 to 5 year recurrence interval storms; however, after treatment, these same roads experienced no erosion during a 50-year recurrence interval rain-on-snow storm (Harr and Nichols, 1993).

When converted to a per drainage basin value, 1880 cy/mi^2 of sediment from untreated roads was delivered to streams in McArthur Creek to Devil's Creek watersheds during the 1997 storm. This value greatly exceeds the 68 cy/mi^2 of sediment delivery originating at untreated roads and skid trails scattered throughout Redwood National and State Parks during a 3 year recurrence interval storm with over 15 inches of rain in the 38 preceding days (LaHusen, 1984).

Redwood National and State Parks rehabilitation road removal and erosion control efforts appear highly effective in reducing erosion along road reaches and resulting sediment input into streams. However, further investigation is recommended for more effective treatment of road reaches in wet areas, where springs and seeps are present. Locations with excess water produced more erosion than the other treated road segments. Additionally, minimal treatments seem effective in stable situations, and may be a cost effective alternative to reducing sediment input into streams.

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Appendix I. Taxonomical classification for soils identified in study area taken from Popenoe, 1987.

Soil Series	Classification
Ahpah	Fine-loamy, mixed, isomesic Typic Humitropepts
Coppercreek	Fine-loamy, mixed, isomesic Typic Haplohumults
Devilscreek	Fine-loamy, mixed, isomesic Typic Humitropepts
Elfcreek	Loamy-skeletal, mixed, isomesic Typic Eutropepts
Fortyfour	Clayey, oxidic, isomesic Typic Hapludults
Lackscreek	Loamy-skeletal, mixed, isomesic Typic Haplohumults
Slidecreek	Loamy-skeletal, mixed, isomesic Typic Humitropepts
Tectah	Clayey, mixed, isomesic Typic Palehumults
Trailhead	Clayey, oxidic, isomesic Orthoxic Palehumults

Appendix II. Corresponding soil types to erosion process classifications on erosion site map (Map 1 and Map 2).

Erosion Process	**Soil Types**
Earthflows	Atwell-Coppercreek complex, Atwell-Ladybird
Earthflows in Prarie Oak	Aquultic Haploxeralfs-Ultic Haploxeralfs complex
Block/Debris Slides	Devilscreek-Elfcreek-Coppercreek complex
Slow Earthflows	Ultic Haploxeralfs-Pachic Xerumbrepts complex
Fluvial	Coppercreek-Ahpah-Lackscreek complex, Pachic Xerumbrepts-Typic Xerumbrepts complex, Coppercreek-Slidecreek- Lackscreek complex, Ahpah Variant-Coppercreek complex, Coppercreek-Ahpah-Tectah complex, Coppercreek-Tectah-Lackscreek complex
Stable	Techtah-Coppercreek-Trailhead complex, Trailhead clay loam, Trailhead-Fortyfour complex
Marine Terrace	Typic Haplohumults sandy loam-loam
Stream Terraces	Coppercreek-Slidecreek complex, Coppercreek loam
Modern Alluvium	Riverwash, Fluvents, Arlynda silt loam, Fluventic Haplumbrepts, Bigriver fine sand loam, Aquic Humitropepts

Appendix III. Summer 1996 field inventory form (created by Mary Ann Madej).

REDWOOD NATIONAL PARK - INVENTORY OF ROADS ON PAST WATERSHED REHABILITATION SITES 7/11/96

SITE INFORMATION AND SUMMARY

1. Rehab Project #________ 2. Worksite #________ 3. Rehab Project Leader ____
4. Date Mapped:________ 5. Mapped By: ________
6. Watershed:________ 7. Quad ID:________
8. Site type: (1)Crossing, (2)Landing, (3) Road Reach, (4) Ditch/Road Relief, (5) Skid trail (6) Other
9. Erosion Process: (1)Fluvial (Sec.I) (2)Mass movement (Sec. II) (3) Both (4) None

ROAD INFORMATION

10. Road Name:________
11. Year of Construction________ 12. Year of Rehab.________

CONDITION OF FILL:

13. (1)Intact, (2)Sag, (3)Ponded H_2O, (4)Cracks, (5)Scarps, (6)Holes, (7)Gully/Rills (8) Seeps
14. Fill Failure Potential? (1)Yes, (0)No

REHABILITATION INFO.

15. Primary Treatment (1)Total Outslope, (2)Partial Outslope, (3)Export Outslope (4) Total Excavation (5)Partial Excavation (6)Ripped (7) Drained, (8)Fillslope (9)None (10)Other
16. Secondary Treatment (0) None (1) Rocked Channel (2) Straw Mulch (3) Wattles (4) Check dams (5) Contour Trench (6) Other
17. Top Soil Restored? (1)Yes, (0)No (2) Unknown

Vegetation:

18. Revegetation Treatment: (1) Conifer seedlings, (2)Grass Seed, (3)Willow (4) Alder seed (5)Alder seedlings (6) Other

Existing Vegetation:	Avg. Ht.	Avg. Stem Spacing	RANK
Redwood	19____ ft.		20 ____
Douglas Fir	21 ____ ft.		22 ____
Alder	23 ____ ft.	24____ ft.	25 ____
Tanoak	26____ ft.		27____
Madrone	28____ ft.		29____
Shrubs	30 ____ ft.		31____
Herbaceous-Mesic/Xeric	32 ____ % cover		33 ____
Herbaceous-Hydrophytic	34____ % cover		35____

36. Exotics present: (1) Foxglove (2) Pampas Grass (3) Scotch Broom (4)Tansy Ragwort (5)Other

SOIL CHARACTERISTICS

37. Bedrk: (1)Schist (2) Sandstone (3) Other 38. Soil Code (see list) ________
39. Soil Depth: (1)< 50cm, (2)50-100cm, (3)> 100cm

SECTION I: FLUVIAL EROSION SITE

EXISTING FEATURE:

40. (1)Gully, (2)Bank Erosion, (3)Channel Incision (4)Rilling/Surface Erosion, (5)Spring

CHANNEL DESCRIPTION

41. Grade of crossing____% 42. Grade: Upstr.____% 43. Downstr.____%
44. Channel Width: at crossing ____ ft. 45. Upstr.____ ft. 46. Downstr.____ ft.
47. Length of excavated crossing ____ ft. 48. Total Drop ____ ft.
49. Drop due to wood: ____ ft. 50. Drop due to rock: ____ ft.
51. Number of wood steps ____ 52. Number of rock steps ____
53. Dominant Bed Material: (1)Sand, (2)P/C, (3)Bldrs, (4)BedRk, (5)SmOD, (6)LrgOD (7)Fill
54. Bedload Transport (1)High, (2)Moderate (3) Low

SITE DESCRIPTION

55. Diversion Potential? (1)Yes, (0)No 56. Now Diverted? (1)Yes, (0)No
57. Comments:

SECTION II: MASS MOVEMENT SITE

FEATURE TYPE:

58. (1)Earthflow, (2)Shallow debris slide, (3)Rotational Slump (4)Debris Torrent, (5)Cutbank Failure, (6)Fill Failure (7) Failure of Excavated Fill

SLOPE POSITION AND FORM

59. Hillslope: (1) Upper, (2) Middle, (3) Lower, (4) Inner Gorge
60. Topographic: (1) Concave, (2) Planar, (3) Convex
61. BIS? (1)Yes, (0)No 62. Slope Above____ % 63. Slope Below____ %
64. Distance to stream ____ ft.

FEATURE DESCRIPTION

65. Level of Activity: (1)Active, (2)Waiting, (3)Totally Evacuated
66. Average Scarp height:____ ft. 67. Range of scarp heights:____ ft.
68. Features Present: (1)Cracks, (2)Scarps, (3)Ponded Water, (4)Sagging, (5)Holes, (6)Leaning Trees, (7)Spring, (8)Stream Channel Undercutting, (9)Excess H_2O Diverted onto Feature (10) Buried Wood Exposed
69. Comments:

SECTION III: TOTAL EROSION VOLUMES

EROSION VOLUMES	Eroded Before Rehab.	Excavated in Rehab.	Erosion Since Rehab.	Erosion Potential (in 50-yr fld)
I. FLUVIAL EROSION ONSITE - Road Fill at Crossing:	70____ yd^3	71____ yd^3	72____ yd^3	73____ yd^3
OFFSITE i.e., from a diversion, or upstream or downstream impacts of crossing failure.				
Offsite	74____ yd^3		75____ yd^3	76____ yd^3
II. MASS MOVEMENT Total Volume-Onsite	77____ yd^3	78____ yd^3	79____ yd^3	80____ yd^3
-Offsite	81____ yd^3		82____ yd^3	83____ yd^3
TOTAL VOLUME: Total Volume Moved:	84____ yd^3 (70 + 74 + 77 + 81)	85____ yd^3 (71 + 78)	86____ yd^3 (72 + 75 + 79 + 82)	87____ yd^3 (73 + 76 + 80 + 83)
Percent Delivery to Channel	88____ %		89____ %	90____ %
Total Yield to Channel	91____ yd^3 (% x 84)		92____ yd^3 (% x 86)	93____ yd^3 (% x 87)

94. Road Type: (1) Cut and Fill (2) Full Bench

Comments: (For example, provide comments on Extreme Erosion: Nature & Likelihood)

Appendix IV. Definitions of road inventory data fields (modified from Spreiter, 1992, Watershed Restoration Manual, Redwood National and State Parks).

SITE INFORMATION AND SUMMARY

ROAD INFORMATION

1. Rehabilitation Site #: This is an assigned project identification number from rehabilitation reports, which is usually a 3-digit number with year of rehabilitation listed first: (Example: 80-3)
2. Worksite #: This is an assigned treatment site identification, also listed on rehabilitation maps. Usually, it will be a stream crossing (i.e., Rx 4), road reach (R1) or a landing (L2).
3. Rehabilitation Project Leader
4. Date mapped: The date of field inventory.
5. Mapped by: The initials (first, middle, last) of those who did the field mapping for this particular site (i.e., MAM)
6. Watershed: This refers to the major tributary to Redwood Creek in which the inventory site is located (i.e, Bridge Creek).
7. Quad ID: This represents initials for the appropriate topographic quad:
   BH= Bald Hills, RP = Rogers Peak.
8. Site type: Crossing: Locations where a road crossed an ephemeral, intermittent or perennial stream.
   Landing: Locations where logs were stored and loaded onto trucks.
   Road reach: A length of road that was treated (outsloped, ripped or drained) but without major crossings.
   Ditch/Road relief: Locations where a culvert used to drain the inboard ditch, or where waterbars and deep ditches presently drain the old road surface.
   Skid trail: sometimes work was done off the main haul road on smaller skid trails.
   Other: miscellaneous sites such as rock pits.
9. Erosion Process: Is the erosion at the site caused by running water (fluvial) or a type of landslide (mass movement) or are both types of processes active?
10. Road name - as given by the timber company, such as the M-7-1 Rd.
11: Year of construction: Year(s) the road was constructed.
12. Year of rehabilitation
13. Condition of fill: These characteristics or features that are present describe the condition of the road fill at the site.
   Intact: Fill is in good shape.
   Sag =sagging. Has the edge of the road sagged, but no scarps or cracks are visible? Sagging may mean that scarps or cracks were graded away in the past.
   Pond H20 = ponded water. Are there indications of standing or ponded water at the site?
   Cracks: Are there cracks in the road, suggesting initial stage of road fill failure?
   Scarps. Are there scarps in the road with distinct displacement?

Holes. Holes indicate that fill is falling through the crossing or they commonly suggest the presence of decaying logs within the fill.

Gully/rills. Are gullies (greater than 1 ft x 1 ft) or rills (less than 1 ft x 1 ft) present on the road surface or on the fill slope?

14. Fill Failure potential: Yes or no. Does this site have the potential for fill to erode during a large storm (say a 20-year storm?). This requires a subjective answer.

Rehabilitation Information: (May circle more than one item).

15. Primary Treatment: (For a detailed description of these treatments, see Erosion Control and Road Removal Procedure section of this document.)

Total outslope is where the road is recontoured to mimic the natural hillslope.

Partial outslope is a situation where some road bench remains, and a break in slope between the hillslope and old road surface is obvious.

Total or partial excavation (usually refers to crossings)-- a total excavation removed fill material down to the original channel, and a partial excavation dished out the crossing but did not go as deep.

Ripped: when the road was decompacted by rippers mounted on bulldozers. It helps increase infiltration on abandoned logging roads.

Drained: Large waterbars or cross road drains were constructed to drain water across the old road surface.

None: Sometimes a segment of road was not treated if it looked stable at the time of rehabilitation.

16. Secondary Treatment: Labor intensive treatments which didn't involve heavy equipment. For a detailed description of these, see *The Evolution of Approaches and Techniques to Control Erosion on Logged Lands in Redwood National and State Parks, 1977-1981, in Watershed Rehabilitation in Redwood National and State Parks and other Pacific Coast Areas, 1981.*

17. Top soil restored? During total outsloping, the original topsoil that was removed from the road surface during construction is commonly found and replaced on the road surface. If you can tell by the texture and color of the soil that topsoil was replaced, circle Yes. If the surface material still looks like road fill, answer No. If you can't tell, circle Unknown.

18. Revegetation Treatment

18-31: For the existing vegetation, an estimated average height and spacing for the given species is noted. Vegetation types are ranked according to dominance with '1' as most common, '2' the next most common, and so on.

32-35. Herbaceous: Basically includes everything that isn't a tree or a shrub.

Mesic/Xeric includes grasses, forbs, ferns, etc.

Hydrophytic includes species associated with wet areas and seeps, such as reeds, cattails, horsetails, etc.

This is an estimate of percent cover for herbaceous species: percentage listed in order to distinguish between heavy cover with almost no soil showing and sparse, with lots of bare soil.

36. Exotics present.

37. Bedrock type.
38. Soil code: Soil type present at site is approximated by soil maps created by Popenoe and Martin, 1980-1985 in Watershed rehabilitation soil inventory, in house report: Redwood National and State Parks. For elaboration on soils, see soils section of this document.

Soil Code Legend

Soil Name	**Code**
Red (5yr or 2.5yr), well drained soils with clay Bt horizons	
Trailhead (Otr-c-Cr3&4)	1
Trailhead variant (Otr-csk-4)	2
Trailhead with water-rounded clasts	3
Trailhead with seep	4
Fortyfour variant (Owr-lsk-Cr2)	5
Fortyfour (Otr-c-Cr2)	6
Brown (10yr or 7.5yr), loamy, well drained soils	
Tectah (Ot-c-Cr4)	7
Tectah (Ot-c-3&4)	8
Coppercreek (Ot-fl-Cr3 & 4)	9
Coppercreek, stream terrace	10
Coppercreek, stream terrace with hardpan	11
Coppercreek, wet substratum	12
Coppercreek-like, weakly developed (Ow-fl-Cr3 &4)	13
Coppercreek-like overlying debris flow	14
coppercreek-like overlying silty fluvial sediments	15
Coppercreek-like overlying mottled silty sediments	16
Coppercreek-like overlying stratified sediments	17
Coppercreek, weakly developed	18
Slidecreek (Ow-lsk-3 &4)	19
Slidecreek, reddish (Owr-lsk-3&4)	20
Slidecreek, stream terrace	21
Ahpah (Ow-fl-Cr2)	22
Ahpah, talc schist phase	23
Ahpah, reddish (Owr-fl-Cr2)	24
Ahpah, shallow (Ow-fl-Cr1)	25
Ahpah overlying mottled silty fluvial sediments	26
Ahpah, wet (Owg-fl-Cr2)	27
Ahpah, wet substratum	28
Thin, gray gravelly loam (Oe-fl-Cr1)	29
Ahpah variant (Ow-fl-R2)	30
Lackscreek (Ow-fl-R2)	31
Lackscreek (Ow-lsk-Rx2)	32
Lackscreek Variant (Ow-lsk-Cr2)	33

Lackscreek, wet (Owg-lsk-Rx2)	34
Lackscreek, wet substratum	35
Shallow, brown, very gravelly loam (Ow-lsk-R1)	36
Gray gravelly loams and very gravelly sandy loams	
Elfcreek (Oe-lsk-3&4)	37
Elfcreek very gravelly loam (Oe-lsk-4)	38
Elfcreek very cobbly loam (Oe-lsk-4)	39
Shallow, gray, gravelly loam (Oe-fl-Crl)	40
Fine-grained (silt or sand size) terrace and ash deposits	41
Soils with imperfect drainage	
Devilscreek, moderately well drained (Owg-fl-3&4)	42
Devilscreek, moderately well drained, reddish (Owg-fl-3&4)	43
Devilscreek, somewhat poorly drained (Owg-fl-3&4)	44
Devilscreek, somewhat poorly drained, cobbly stream terrace	45
Devilscreek variant, moderately well drained (Owg-lsk-3&4)	46
Devilscreek variant, somewhat poorly drained (Owg-lsk-3&4)	47
Deep, wet colluvium or stripped Devilscreek soils (Oeg-lsk-3&4)	48
Water-saturated colluvium or stripped Devilscreek soils (Oeg-lsk-3&4)	49
Moderately deep, wet, gray soils (Oeg-fl-Cr2)	50
Fine-grained (silt or sand size) terrace and ash deposits	51

39. Soil depth: Soil depth for this category is assigned from soil depths given in Popenoe and Martin, 1980-1985 in Watershed rehabilitation soil inventory, in house report: Redwood National and State Parks

FLUVIAL EROSION SITE

40. Existing erosion feature:

Gully: The site contains a gully as one of the major erosional features. Gullies are new channels that have a cross-sectional area greater than one square foot. Anything smaller is considered a rill and is lumped with surface erosion processes.

Streambank erosion: The site shows signs of channel widening through erosion of its banks.

Stream incision: The stream has eroded deeper in recent years, usually marked by a distinct break in slope and narrower, incised small channel within a larger channel.

Surface erosion and rilling: This includes rills, sheet erosion, raveling, soil pedestals, formation of a coarse lag layer on the old road fill surface.

Spring: The crossing area or excavation site drains a spring or seep, which is causing erosion downslope.

Channel Description:

41. Grade of crossing: The longitudinal gradient of excavated crossing is measured with a clinometer.

42,43. This is the same for the natural channel upstream and downstream of the excavated area.

44. Channel width at crossing: This is the estimated width at high flow in the excavated crossing.

45,46, This is the average channel width upstream and downstream of the excavated crossing.

47. Length of excavated crossing: The length from upslope side to downslope side of excavation is measured with a 165 or 300 foot measuring tape.

48. Total drop: This is the elevation difference between the downslope side of the excavation and the upslope side. This was calculated from the length and gradient.

49. Drop due to wood: Frequently logs or other woody debris cause a small waterfall in the channel. These are sites where much energy is dissipated. This is the total elevation drop for all the wood-based steps in the excavated channels. For example, two log steps, both 2 ft. high, would yield a total "drop due to wood" of 4 ft.

50. Drop due to rocks. Similar to 45, but in this case the channel 'steps' are due to boulders or bedrock in the channel bed, causing plunge pools.

51, 52. Number of wood or rock steps: See explanation for field 49.

53. Dominant bed material: This describes the bed material in the channel bottom.

Sand is less than 2 mm.

P/C = pebbles and cobbles, between 2 mm and 256 mm,

Boulders are particles greater than 10 inches median diameter (256 mm). SmOD is small organic debris (< 6 inches in diameter)

LrgOD is large organic debris (> 6 inches in diameter).

54. Bedload Transport: This is a subjective assessment if a lot of sand, pebbles and cobbles have been transported through this channel. If there's a lot of moss growing on boulders, it's probably an indication that not much bedload has been transported recently.

55. Diversion Potential. Does the site have the potential for flow to be diverted from its natural flow course as a result of conditions at this site? The most probable conditions for diversion potential are when the channel is not well incised and the old road grade is steep.

56. Is the stream currently diverted from its natural flow course at this site?

SECTION II - MASS MOVEMENT SITE

58. Feature type: Circle those that apply:

Earthflow: An earthflow is a slow moving, deep seated landslide with an irregular and hummocky surface.

Shallow debris slide: A debris slide moves translationally along planar or gently undulating surfaces. The head scarp is near vertical, and cracks parallel to the slope are usually present in the crown region. Blocks break up into smaller and smaller parts as the slide moves toward the toe. Movement is relatively slow as compared to a debris torrent, but fast in comparison to an earthflow. If forested, trees will appear jack-strawed or have curved trunks.

Rotational slump: This feature involves movement of a block, or series of blocks, such that displacement is along a concave upward surface. These features are characterized by steep head scarps, and contain flanks with scarps which decrease in height from the head region to the toe. The upper surface of the blocks are either flat or tilted back into the hillslope, and may contain trees leaning upslope. Often the movement grades into a more translational nature toward the lower portion of the slump which may contain a zone of uplift, and trees leaning downslope.

Debris torrent. This is an extremely rapid downslope movement of material due to complete saturation. A failed surface contains a serrate of V-shaped scarp, and irregular flanks often with levees in the lower portions. Displacement occurs along a planar surface, and the surface scar is long and narrow. Debris torrents typically follow drainage routes, scouring the channel valley to bedrock and mobilizing soil and trees. They typically build up sufficient energy during failure such that the liquefied material accumulates only at sharp breaks in stream valley slope or orientation.

Cutbank failure: This feature is a failed or slumped cut bank on an old road.

Fill failure: Feature involves perched fill from a road or landing that is failing or has failed downslope.

Failure of excavated fill: This is the case where the road fill material that was excavated, moved, and set on the slope (outsloped or put on a fillsite) has subsequently failed since the rehabilitation project was completed.

SLOPE POSITION AND FORM

59. Hillslope: This defines the site's local position on the hillslope, not its position relative to the entire basin.

Upper hillslope area: The site is within the upper one-third of the slope.

Middle hillslope area. The site is within the middle one-third of the slope.

Lower hillslope area. The site is within the lower one-third of the slope.

Inner Gorge: The site is located within the steep side slopes of an inner gorge of a stream channel. (Usually > 70% slope).

60. Topographic Form: The general shape of the affected hillslope is best described as:

Concave: Convergent (spoon shaped, or a hollow)

Planar: Straight

Convex: Divergent, such as the nose of a ridge, watershed divide or interfluve.

61. BIS. Break in Slope: Is the site located at or immediately above a distinct change in hillslope gradient (BIS) which leads from either: moderate slopes above the feature to steeper slopes below, or steeper above and gentler below?

62. Slope Above (%). The average hillslope gradient immediately upslope of the site. This figure was calculated in the field with a clinometer or from a topographic map.

63. Slope Below (%). The average gradient immediately downslope of the site. This figure was calculated in the field with a clinometer or from a topographic map.
64. Distance to stream (ft): Indicates the approximate distance to the nearest stream from the toe of the feature.

FEATURE DESCRIPTION

65. Level of Activity: Circle best answer.

Active: Is the site active (movement within the last several years?) "Active" means the erosion is still occurring, though not necessarily at the original rate. Gullies will have near vertical, raw banks and/or active headcuts. Landslides will show recent, mostly bare scarps, recently titled trees and perched blocks which have just started to move.

Waiting: Features assigned this classification are thought to be currently inactive (no signs of movement in the last several years), but the scarps and other indicators suggest that during an especially large storm the instability could become active and fail or move downslope. This feature type also includes sites which show subtle indicators of future mass movement, but which have not yet moved significantly.

Totally Evacuated: Has the material associated with the site been completely removed?

66. Average scarp Height: This is the average scarp height in feet.
67. Range of scarp heights: This is the range of scarp heights in feet.
68. Features present: CIRCLE ALL THAT APPLY.

Cracks: Are there cracks in the road or ground, suggesting slope movement?

Scarps: Are there scarps in the road or ground with distinct displacement?

Ponded Water: Are there indications of standing or ponded water at the site, if not now, during the wet season?

Sagging: Has the edge of the road sagged, but no scarps or cracks are visible. Sagging may mean that scarps or cracks were graded away in the past.

Holes: Holes indicate that fill is falling through the crossing, often suggesting the presence of decaying logs within the fill.

Leaning trees: Does the site have leaning or bowed trees resulting from hillslope movement?

Spring: Is the mass movement feature a result of emergent ground water?

Stream channel undercutting: Is the site destabilized (or has the potential for being destabilized) by stream channel undercutting?

Excess water diverted onto feature: Excess water diverted onto a site can initiate failure and /or accelerate erosion. Is upslope water diverted to this site? Is water ponded (in an inboard ditch or poorly drained surface) on the site, causing saturation, which may lead to failure?

Buried Wood Exposed: Is buried wood exposed on the surface or at scarps?

SECTION III - TOTAL EROSION VOLUMES

70 - 93. There are four time periods to consider here.

One is how much erosion occurred before the rehabilitation work was done. This figure would have to be researched from park materials.

Excavated in rehabilitation: This is the volume of material excavated from a stream crossing or removed from a landslide during the actual rehabilitation work. This figure is taken from park rehabilitation reports.

Erosion since rehabilitation: This is the amount measured in the field based on what you think the ground configuration was after rehabilitation and what has eroded since (in gullies, slumps, incised channels, etc.). These volumes are based on calculations of field measurements of geometric figures.

Erosion potential: This is an estimate, based on field observations, of how much material will eroded during the next 50-years, assuming a large (50-year storm) occurring during this period. Perched fill, cracks in the fill, undercut or oversteepened banks, are some indicators of potential erosion. Consideration of all site conditions and past erosion processes evident within the basin in similar geomorphic, hydrologic, and soil settings are considered when deciding the potential.

Total volume moved: (eroded or excavated) This is the sum of fluvial-onsite, fluvial-off-site and mass movement features.

Percent delivery to channel: This is an estimate of the percent of eroded material that entered in the past and will enter in the future to the nearest stream.

Total yield to channel: This is the total volume moved multiplied by the delivery percentage. This is the amount of sediment you think will actually make it to a stream channel in the time periods defined above.

94. Road Type: This is the type of road originally cut into the hillside.

Appendix V. 1997 Storm damage assessment inventory form.

REDWOOD NATIONAL AND STATE PARKS STORM DAMAGE ROAD INVENTORY UPDATE (form date 1/11/97)

Road:________________________________ Date: / / 97

Field Location:________________________________ Evaluated by:________________________

Air Photo Year & Number:________________________ Site Number:________________________

Photos taken? Y / N Roll #_____ Frames #__________________

Has site been modified? Y / N Has this limited evaluation of site? Y / N If yes, how?

Primary type of erosion:
Fluvial Mass movement Other__________

Was this site identified in road inventory? Y / N
Site number of, or between :______________

Type of Location:
Stream crossing Headwater swale Broad bowl Not in swale/drainage Landing Ditch Relief Bridge

Slope position and shape:
Upper Middle Lower Inner gorge Aspect________ Slope gradient:___________

Planar Convex Concave Break in slope Broad swale Ridge ??? Other__________________

Bedrock: Sheared Grey Schist Black Schist Shale Sandstone Gold Bluffs Other____________________
Depth to bedrock?________ Springs at bedrock/soil contact? Y / N Soil type:____________________

Cause(s) of failure: (circle all that apply, x thru primary. if order of events can be determined, number causes)

Fill failure Cutbank failure Hillslope failure Debris torrent Humboldt No drainage structure

Rotten orgs Buried springs Road(s) above Road(s) below. Undercut toe Other__________________

Plugged Undersized Crushed Rotten Bottom Band Separation Shotgun Further investigation needed

Stream diver Spring diver Plugged ditch Ponded Waterbar Roll dip Fallen trees Nothing obvious

Culvert diameter:____ Headwall height:____ Overwhelmed? Y / N / ? Plugged? Y / N / ? Trash rack? Y / N
If no culv, would a culv have reduced erosion? Y / N / ? If no TR, would TR have reduced erosion? Y / N / ?
Comments:

Rolling dip or waterbar? Y / N If Y, did it help reduce erosion? Y / N / ?
If N, would one have reduced erosion? Y / N / ? How much sed would have been saved?___________
Comments:

Inboard ditch at site? Y / N Functional? Y / N If Y, did it help reduce erosion at this site? Y / N / ?
If N, would func. IBD have reduced erosion here? Y / N / ? How much sed would have been saved?________
Comments:

Volume of failure in cy: (1st cy circled is road fill; if a 2nd cy is circled, it is the total vol. involved in failure)
Volume estimate in cy: <50 50-100 100-500 500-1000 1000-3000 3000-10,000 >10,000 ???

Total volume that entered channel in cy:
Volume estimate in cy: <50 50-100 100-500 500-1000 1000-3000 3000-10,000 >10,000 ???

Does failure involve movement / erosion of "original" bedrock / soil? Y / N / ? Comments:
Volume estimate in cy: <50 50-100 100-500 500-1000 1000-3000 3000-10,000 >10,000 ???

Future erosion potential: (1st circle is this winter, 2nd number is long term)
Volume estimate in cy: <50 50-100 100-500 500-1000 1000-3000 3000-10,000 >10,000 ???

Volume of pre-storm / now remaining fill to excavate at this site: (circle which)
Volume estimate in cy: <50 50-100 100-500 500-1000 1000-3000 3000-10,000 >10,000 ???

FEMA site? Y / N FEMA site form w/ sketch done: Y / N Sketch on back? Y / N
Comments:

REDWOOD NATIONAL PARK STORM DAMAGE ASSESSMENT [illegible]

Road:________________________________ Date: /   / 97
Field Location:____________________________ Name:____________________
Air Photo Year & Number:_________________ Site Number:_______________
Is this site currently driveable? Y / N   Photo taken? Y / N Roll #___ Shot(s) #________

Sketch and Briefly Describe Problem: (dimensions were estimated / measured)
(include original road width and length of road involved with problem and its repair)

Describe Cause: (further / off road investigation of cause: needed / done / not needed)

Predictions for rest of winter:

Ultimate Fix: (include estimate of type and amount of materials needed)

Short Term Fixes: (include any equipment needs)
What can be done to prevent more damage? (flagged: yes / no)

Can it easily be made driveable with park equipmemt? Y / N

REDWOOD NATIONAL PARK STORM DAMAGE ASSESSMENT [illegible]

Road:_________________________________ Date: /   / 97
Field Location:___________________________ Name:____________________
Air Photo Year & Number:____________________ Site Number:________________
Is this site currently driveable? Y / N   Photo taken? Y / N Roll #___ Shot(s) #________

Sketch and Briefly Describe Problem: (dimensions were estimated / measured)
(include original road width and length of road involved with problem and its repair)

Describe Cause: (further / off road investigation of cause: needed / done / not needed)

Predictions for rest of winter:

Ultimate Fix: (include estimate of type and amount of materials needed)

Short Term Fixes: (include any equipment needs)
What can be done to prevent more damage? (flagged: yes / no)

Can it easily be made driveable with park equipmemt? Y / N

Appendix VI. Road reach failure erosion data. SEE p. 44

		1997 STORM EROSION (Volumes additional to 96 vol.)									
		On Site		Off Site		On Site		Off Site		Percent	Cause of
Rehab	Worksite	ROAD RELATED				NOT ROAD RELATED				Delivery	Failure
Project #	#	Mass Wast.	Fluv Eros	Mass Wast.	Fluv Eros.	Mass Wast.	Fluv Eros.	Mass Wast.	Fluv. Eros.		
1	2										
83-2	R10	111								95	
88-1	R-4										
88-1	R-3A										
88-1	R-1										
88-1	*UNTREATED										
88-3	R12										
88-3	R13										
88-3	R5										
88-3	R6										
88-3	R9										
88-3	R6										
88-3	R14										
88-3	R8										
88-3	R10										
88-4	R1-2										
88-4	R3-4										
88-4	R4-5										
88-4	R5-6										
88-4	R2-3		82							100	
88-5	0+00-9+38										
88-5	66+00-67+61										
88-5	64+09-66+00										
88-5	47+00-50+53										
88-5	42+00-44+47										
88-5	39+68-42+00										
88-5	37+00-39+68										
88-5	31+38-37+00										
88-5	14+39-21+41										
88-5	67+61-77+00										
88-5	6761-XRD										
88-5	62+45-64+09										
88-5	55+00-62+45	2166								0	
88-5	50+53-55+00										
88-5	44+47-47+00										
88-5	21+41-31+38										
88-5	9+38-14+39										
87-3	R1					407				0	
87-3	R1										
87-3	R2										
87-3	R3										
87-3	R4										
87-3	R5										
87-3	R6										
87-3	R8										

		1997 STORM EROSION (Volumes additional to 96 vol.)									
		On Site		Off Site		On Site		Off Site		Percent	Cause of
Rehab	Worksite	ROAD RELATED				NOT ROAD RELATED				Delivery	Failure
Project #	#	Mass Wast.	Fluv Eros	Mass Wast.	Fluv Eros.	Mass Wast.	Fluv Eros.	Mass Wast.	Fluv. Eros.		
1	2										
80-3	R0-SX1-1										
80-3	RSX1-1-L1S1										
80-3	RL1S1-C5										
80-3	RC5-C6										
80-3	RC6-SX3-1									0	
80-3	DF-1										
80-3	L7										
80-3	RC6-SX3-1-A	1180								0	
80-3	RC6-SX3-1-B	9								0	
80-3	RC6-SX3-1-C	3085								0	
80-3	RSX3-1-C8-A	7								0	
80-3	RSX3-1-C8-B	19								0	
80-3	C8-SX4-1										
80-3	SX4-1-C9										
80-3	C9-L6	740								90	
80-3	C12-SX2-2-A	83								90	
80-3	C12-SX2-2-B	246								90	
80-3	C12-SX2-2-C	667								90	
80-3	RSX2-2-L7	78								0	
80-3	RL7-FA	558								90	
80-3	RFA-FB	90								95	
80-3	RFB-SX1-2										
80-3	RF1										
80-3	RF2										
80-3	END-SX3-2										
80-3	SX3-2-RF3-A										
80-3	SX3-2-RF3-B										
80-3	RF3-A										
80-3	RF3-B										
83-2	R1										
83-2	R2										
83-2	R3										
83-2	R4										
83-2	R5-A	4								0	
83-2	R5-B	33								0	
83-2	R5-C	117								0	
83-2	R6										
83-2	R7										
83-2	R8										
83-2	R9										
		9193	82	0	0	407	0	0	0		

		FLUVIAL EROSION (PRE-1997 STORM)							MASS MOVEMENT (PRE-1997 STORM)						
		Onsite				Offsite			Onsite				Offsite		
Rehab Project #	Worksite #	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential
1	2	70	71	72	73	74	75	76	77	78	79	80	81	82	83
87-3	R9			0	0		0	0			0	0		0	0
87-3	R10			0	0		0	0			0	0		0	0
87-3	R13			0	0		0	0			0	0		0	0
87-3	R14			0	0		0	0			0	0		0	0
87-3	R15			0	0		0	0			0	0		0	0
87-3	R1			5	8		0	0			0	0		0	0
87-3	R11			0	0		0	0			0	0		0	0
87-3	R12			0	0		0	0			0	0		0	0
87-5	R1			0	0		0	0			0	0		0	0
87-5	R2			0	0		0	0			0	0		0	0
87-5	R3			0	0		0	0			0	0		0	0
87-5	R4			0	0		0	0			0	0		0	0
87-5	R5			0	0		0	0			0	0		0	0
87-5	R6			0	0		0	0			0	0		0	0
87-5	R7			0	0		0	0			0	0		0	0
87-5	R8		1410	0	0		0	0			218	558		0	0
87-5	R9			0	0		0	0			0	0		0	0
88-3	R2-A			0	0		0	0			0	0		0	30
88-3	R2-B			0	0		0	0			0	0		0	0
88-3	R3			0	52		0	0			0	52		0	0
88-3	R4-A			0	0		0	0			0	0		0	0
88-3	R4-B			0	0		0	0			0	0		0	0
88-3	R6-1			3	4		0	0			0	0		0	0
88-3	R6-3			0	0		0	0			0	0		0	0
88-3	R6-4			0	0		0	0			0	0		0	0
88-3	R7-0			4	5		0	0			0	0		0	0
88-3	R7-1			0	0		0	0			0	0		0	0
88-3	R7-2			0	0		0	0			0	0		0	0
88-3	R7-3			0	0		0	0			0	1750		0	0
88-3	R-8			83	211		0	0			0	0		0	0
88-3	R9-1			0	0		0	0			0	0		0	0
88-3	R9-2			0	0		0	0			0	0		0	0
88-3	R9-3			74	82		0	0			0	0		0	0
88-3	R0			0	0		0	0			0	0		0	0
88-3	R1			0	0		0	0			0	0		0	0
88-3	R6-2			14	21		0	0			0	0		0	0
88-5	R5			0	0		0	0			0	0		0	0
88-5	R8			0	0		0	0			0	0		0	0
88-5	R1			0	0		0	0			0	0		0	0
88-5	R2			0	0		0	0			0	0		0	0
88-5	R3			0	0		0	0			0	0		0	0
88-5	R4			0	0		0	0			0	0		0	0
88-5	R6			0	0		0	0			0	0		0	0
88-5	R7			0	0		0	0			0	0		0	0

		FLUVIAL EROSION (PRE-1997 STORM)							MASS MOVEMENT (PRE-1997 STORM)							
		Onsite				Offsite			Onsite				Offsite			
Rehab Project #	Worksite #	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	
1	2	70	71	72	73	74	75	76	77	78	79	80	81	82	83	
83-2	R10															
86-1	R-4			0	0		0	0			0	0		0	0	
86-1	R-3A			0	0		0	0			0	0		0	0	
86-1	R-1			0	0		0	0			0	0		0	0	
86-1	*UNTREATED			0	0		0	0			0	0		0	0	
86-3	R12			0	0		0	0			0	0		0	0	
86-3	R13			0	0		0	0			0	0		0	0	
86-3	R5			0	0		0	0			0	0		0	0	
86-3	R6			0	0		0	0			0	0		0	0	
86-3	R9			0	0		0	0			0	0		0	0	
86-3	R6			0	0		0	0			0	0		0	0	
86-3	R14			0	0		0	0			0	0		0	0	
86-3	R8			0	0		0	0			0	250		0	0	
86-3	R10			0	0		0	0			0	0		0	0	
86-4	R1-2			0	0		0	0			0	0		0	0	
86-4	R3-4			0	0		0	0			0	0		0	0	
86-4	R4-5			0	0		0	0			0	0		0	0	
86-4	R5-6			0	0		0	0			0	0		0	0	
86-4	R2-3			0	0		50	21			0	0		0	0	
86-5	0+00-9+38			0	0		0	0			0	0		0	0	
86-5	66+00-67+61			0	0		0	0			0	0		0	0	
86-5	64+09-66+00			0	0		0	0			0	0		0	0	
86-5	47+00-50+53			0	0		0	0			0	0		0	0	
86-5	42+00-44+47			0	0		0	0			0	0		0	0	
86-5	39+68-42+00			0	0		0	0			0	0		0	0	
86-5	37+00-39+68			0	0		0	0			0	0		0	0	
86-5	31+36-37+00			0	0		0	0			0	0		0	0	
86-5	14+39-21+41			0	0		0	0			0	0		0	0	
86-5	67+61-77+00			0	0		0	0			0	0		0	0	
86-5	6761-XRD			1	1		7	8			0	0		0	0	
86-5	62+45-64+09			0	0		0	0			0	0		0	0	
86-5	55+00-62+45			0	0		3	5			0	0		0	0	
86-5	50+53-55+00			0	0		0	0			0	0		0	0	
86-5	44+47-47+00			0	0		0	0			0	0		0	0	
86-5	21+41-31+36			0	0		0	0			0	0		0	0	
86-5	9+38-14+39			0	0		0	0			0	0		0	0	
87-3	R1			0	0		0	0			0	0		0	0	
87-3	R1			0	0		0	0			0	0		0	0	
87-3	R2			0	0		0	0			0	0		0	0	
87-3	R3			0	0		0	0			0	0		0	0	
87-3	R4			0	0		0	0			0	0		0	0	
87-3	R5			0	0		0	0			0	0		0	0	
87-3	R6			0	0		0	0			0	0		0	0	
87-3	R8			0	0		0	0			0	0		0	0	

Rehab Project #	Worksite #	FLUVIAL EROSION (PRE-1997 STORM) Onsite Eroded Pre-Rehab	Onsite Exc. in Rehab	Onsite Post-Rehab	Onsite Erosion Potential	Offsite Eroded Pre-Rehab	Offsite Post-Rehab	Offsite Erosion Potential	MASS MOVEMENT (PRE-1997 STORM) Onsite Eroded Pre-Rehab	Onsite Exc. in Rehab	Onsite Post-Rehab	Onsite Erosion Potential	Offsite Eroded Pre-Rehab	Offsite Post-Rehab	Offsite Erosion Potential
1	2	70	71	72	73	74	75	76	77	78	79	80	81	82	83
87-3	R9			0	0		0	0			0	0		0	0
87-3	R10			0	0		0	0			0	0		0	0
87-3	R13			0	0		0	0			0	0		0	0
87-3	R14			0	0		0	0			0	0		0	0
87-3	R15			0	0		0	0			0	0		0	0
87-3	R1			5	8		0	0			0	0		0	0
87-3	R11			0	0		0	0			0	0		0	0
87-3	R12			0	0		0	0			0	0		0	0
87-5	R1			0	0		0	0			0	0		0	0
87-5	R2			0	0		0	0			0	0		0	0
87-5	R3			0	0		0	0			0	0		0	0
87-5	R4			0	0		0	0			0	0		0	0
87-5	R5			0	0		0	0			0	0		0	0
87-5	R6			0	0		0	0			0	0		0	0
87-5	R7			0	0		0	0			0	0		0	0
87-5	R8		1410	0	0		0	0			218	556		0	0
87-5	R9			0	0		0	0			0	0		0	0
88-3	R2-A			0	0		0	0			0	0		0	30
88-3	R2-B			0	0		0	0			0	0		0	0
88-3	R3			0	52		0	0			0	52		0	0
88-3	R4-A			0	0		0	0			0	0		0	0
88-3	R4-B			0	0		0	0			0	0		0	0
88-3	R6-1			3	4		0	0			0	0		0	0
88-3	R6-3			0	0		0	0			0	0		0	0
88-3	R6-4			0	0		0	0			0	0		0	0
88-3	R7-0			4	5		0	0			0	0		0	0
88-3	R7-1			0	0		0	0			0	0		0	0
88-3	R7-2			0	0		0	0			0	0		0	0
88-3	R7-3			0	0		0	0			0	1750		0	0
88-3	R-8			83	211		0	0			0	0		0	0
88-3	R9-1			0	0		0	0			0	0		0	0
88-3	R9-2			0	0		0	0			0	0		0	0
88-3	R9-3			74	82		0	0			0	0		0	0
88-3	R0			0	0		0	0			0	0		0	0
88-3	R1			0	0		0	0			0	0		0	0
88-3	R6-2			14	21		0	0			0	0		0	0
88-5	R5			0	0		0	0			0	0		0	0
88-5	R8			0	0		0	0			0	0		0	0
88-5	R1			0	0		0	0			0	0		0	0
88-5	R2			0	0		0	0			0	0		0	0
88-5	R3			0	0		0	0			0	0		0	0
88-5	R4			0	0		0	0			0	0		0	0
88-5	R6			0	0		0	0			0	0		0	0
88-5	R7			0	0		0	0			0	0		0	0

		FLUVIAL EROSION (PRE-1997 STORM)							MASS MOVEMENT (PRE-1997 STORM)						
		Onsite				Offsite			Onsite				Offsite		
Rehab Project #	Worksite #	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential
1	2	70	71	72	73	74	75	76	77	78	79	80	81	82	83
88-5	R9			0	0		0	0			0	0		0	0
88-8	R4			0	0		0	0			0	0		0	0
88-8	R6			0	0		0	0			0	0		0	0
88-8	R1			0	0		0	0			0	0		0	0
88-8	R2			0	0		0	0			0	0		0	0
88-8	R3			0	0		0	0			0	0		0	0
88-8	R5			0	0		0	0			0	0		0	0
88-9	A			0	0		0	0			0	0		0	0
88-9	B			110	111		45	30			0	0		0	0
90-3	R30-25			0	0		0	0			0	0		50	141
90-3	R20-15A			0	0		0	0			0	0		0	0
90-3	R20-15B			0	0		0	0			0	0		0	0
90-3	R25-20			0	0		0	0			0	0		0	0
90-3	L25-20			0	0		0	0			0	0		0	0
90-3	R5-0			0	0		0	0			0	0		0	0
90-3	R12-5-A			0	0		0	0							
90-3	R12-5-B			0	0		0	0			167	132		0	0
	4010-1														
	4020-1														
	11010-2														
	11015-1														
	11040-2														
	2030-1														
	2040-1														
	2040-11														
	2040-12														
	6010-1														
	6010-2														
	6010-3														
	1030-1														
	5010-1														
	5010-3/4														
	5010-5														
	5011-1														
	5020-2														
	5020-3														
	5040-3														
	5061-1														
	5061-2														
	5070-2														
	5080-1														
	5080-2														
	8020-2														
	8020-3														

		FLUVIAL EROSION (PRE-1997 STORM)							MASS MOVEMENT (PRE-1997 STORM)							
		Onsite				Offsite			Onsite				Offsite			
Rehab Project #	Worksite #	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	
1	2	70	71	72	73	74	75	76	77	78	79	80	81	82	83	
	8035-1															
	8035-2															
	8035-3															
	8050-1															
	8050-2															
	8050-3															
	10010-1															
	10010-4															
	10030-1															
	10030-3															
	10030-4															

Rehab Project #	Worksite #	Total Eroded Pre-Rehab	Volume Exc. in Rehab	Moved Post-Rehab	Erosion Potential	Percent Eroded Pre-Rehab	Delivery Post-Rehab	to Channel Erosion Potential	Total Eroded Pre-Rehab	Yield to Post-Rehab	Channel Erosion Potential	Pre-1997 Storm Erosion Features Activity Level	Avg. Scarp Ht.	Range Scarp Ht.	Features Present
		TOTAL VOLUME OF POST-TREATMENT/PRE-1997 STORM EROSION													
1	2	84	85	86	87	88	89	90	91	92	93	65	66	67	68
80-3	R0-SX1-1			0	0					0	0				
80-3	RSX1-1-L1S1			92	1359		50	50		48	680	2	15		1,4,5
80-3	RL1S1-C5			11	14		90	90		10	13				
80-3	RC5-C6		2500	26	34		100	90		26	31				
80-3	RC6-SX3-1			3	4		90	90		3	4				
80-3	DF-1			1040	154		2	50		19	77	1	10	35200	2,6
80-3	L7			0	0					0	0				
80-3	RC6-SX3-1-A														
80-3	RC6-SX3-1-B														
80-3	RC6-SX3-1-C														
80-3	RSX3-1-C8-A														
80-3	RSX3-1-C8-B			12	11		100	100		12	11				
80-3	C8-SX4-1			0	0					0	0				
80-3	SX4-1-C9			0	0					0	0				
80-3	C9-L6			0	0					0	0				
80-3	C12-SX2-2-A			65	65		0	0		0	0	3	3	3	1,2,6
80-3	C12-SX2-2-B			11	11		0	0		0	0	3	3	3	1,2,6
80-3	C12-SX2-2-C											3	3	3	1,2,6
80-3	RSX2-2-L7			0	0					0	0				
80-3	RL7-FA			311	83		90	75		280	62	3	8	8	1,2,6
80-3	RFA-FB			2863	281		95	75		2720	211	1	5	0,10	1,2,6
80-3	RFB-SX1-2			678	330		100	90		678	297	1	5	4,6	1,2,6,10
80-3	RF1		300	26	0		0			0	0	1	2	2	1,2,4,6
80-3	RF2		1190	0	0					0	0				
80-3	END-SX3-2			0	0					0	0				
80-3	SX3-2-RF3-A			100	0		20			20	0	1	6	4,8	1,2,6
80-3	SX3-2-RF3-B			127	0		20			25	0	1	6	4,8	1,2,6
80-3	RF3-A			143	0		19			27	0	1	3	2,5	1,2,4,6,9
80-3	RF3-B			11	0		19			2	0	1	3	2,5	1,2,4,6,9
83-2	R1		1020	0	0					0	0				
83-2	R2		1395	0	0					0	0				
83-2	R3		6160	35	36		100	100		35	36				
83-2	R4		2099	0	0					0	0				
83-2	R5-A		1582	12	0		100	90		12	10				
83-2	R5-B														
83-2	R5-C														
83-2	R6		2109	0	0					0	0				
83-2	R7			0	0					0	0				
83-2	R8		1535	0	0					0	0				
83-2	R9			0	0					0	0				

Rehab Project #	Worksite #	TOTAL VOLUME OF POST-TREATMENT/PRE-1997 STORM EROSION: Total Volume Moved: Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Percent Delivery to Channel: Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Total Yield to Channel: Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Pre-1997 Storm Erosion Features: Activity Level	Avg. Scarp Ht.	Range Scarp Ht.	Features Present
1	2	84	85	86	87	88	89	90	91	92	93	65	66	67	68
83-2	R10														
86-1	R-4			0	0					0	0				
86-1	R-3A			0	0					0	0				
86-1	R-1			0	0					0	0				
86-1	*UNTREATED			0	0					0	0				
86-3	R12			0	0					0	0				
86-3	R13			0	0					0	0				
86-3	R5			0	0					0	0				
86-3	R6			0	0					0	0				
86-3	R9			0	0					0	0				
86-3	R6			0	0					0	0				
86-3	R14			0	0					0	0				
86-3	R8			0	250			40		0	100	1	1	0,1	1,2,4,6
86-3	R10			0	0					0	0				
86-4	R1-2			0	0					0	0				
86-4	R3-4			0	0					0	0				
86-4	R4-5			0	0					0	0				
86-4	R5-6			0	0					0	0				
86-4	R2-3			50	21		100	100		50	21				
86-5	0+00-9+38			0	0					0	0				
86-5	66+00-67+61			0	0					0	0				
86-5	64+09-66+00			0	0					0	0				
86-5	47+00-50+53			0	0					0	0				
86-5	42+00-44+47			0	0					0	0				
86-5	39+68-42+00			0	0					0	0				
86-5	37+00-39+68			0	0					0	0				
86-5	31+38-37+00			0	0					0	0				
86-5	14+39-21+41			0	0					0	0				
86-5	67+61-77+00			0	0					0	0				
86-5	6761-XRD			7	9		5	20		0	2				
86-5	62+45-64+09			0	0					0	0				
86-5	55+00-62+45			3	0		80	50		2	3				
86-5	50+53-55+00			0	0					0	0				
86-5	44+47-47+00			0	0					0	0				
86-5	21+41-31+38			0	0					0	0				
86-5	9+38-14+39			0	0					0	0				
87-3	R1			0	0					0	0				
87-3	R1			0	0					0	0				
87-3	R2			0	0					0	0				
87-3	R3			0	0					0	0				
87-3	R4			0	0					0	0				
87-3	R5			0	0					0	0				
87-3	R6			0	0					0	0				
87-3	R8			0	0					0	0				

		TOTAL VOLUME OF POST-TREATMENT/PRE-1997 STORM EROSION													
		Total	***Volume***	***Moved***		***Percent***	***Delivery***	***to Channel***	***Total***	***Yield to***	***Channel***	***Pre-1997 Storm Erosion Features***			
Rehab Project #	Worksite #	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Activity Level	Avg. Scarp Ht.	Range Scarp Ht.	Features Present
1	2	84	85	86	87	88	89	90	91	92	93	65	66	67	68
87-3	R9			0	0					0	0				
87-3	R10			0	0					0	0				
87-3	R13			0	0					0	0				
87-3	R14			0	0					0	0				
87-3	R15			0	0					0	0				
87-3	R1			5	8		90	80		5	8				
87-3	R11			0	0					0	0				
87-3	R12			0	0					0	0				
87-5	R1			0	0					0	0				
87-5	R2			0	0					0	0				
87-5	R3			0	0					0	0				
87-5	R4			0	0					0	0				
87-5	R5			0	0					0	0				
87-5	R6			0	0					0	0				
87-5	R7			0	0					0	0				
87-5	R8		1410	218	556		30	60		65	334	2	20	20	3,6,,7,,9
87-5	R9			0	0					0	0				
88-3	R2-A			0	30			20		0	6	2	4	7	2,3
88-3	R2-B			0	0					0	0				
88-3	R3			0	52			20		0	10	1	3	1,3	1,7
88-3	R4-A			0	0					0	0				
88-3	R4-B			0	0					0	0				
88-3	R6-1			3	4		95	95		2	3				
88-3	R6-3			0	0					0	0				
88-3	R6-4			0	0					0	0				
88-3	R7-0			4	5		30	30		1	2				
88-3	R7-1			0	0					0	0				
88-3	R7-2			0	0					0	0				
88-3	R7-3			0	1750			25		0	438	1	4	1,8	1,2,3,4,6
88-3	R-8			83	211		100	100		83	211				
88-3	R9-1			0	0					0	0				
88-3	R9-2			0	0					0	0				
88-3	R9-3			74	82		100	100	74	82	0				
88-3	R0			0	0					0	0				
88-3	R1			0	0					0	0				
88-3	R6-2			14	21		95	95		13	20				
88-5	R5			0	0					0	0				
88-5	R6			0	0					0	0				
88-5	R1			0	0					0	0				
88-5	R2			0	0					0	0				
88-5	R3			0	0					0	0				
88-5	R4			0	0					0	0				
88-5	R6			0	0					0	0				
88-5	R7			0	0					0	0				

		TOTAL VOLUME OF POST-TREATMENT/PRE-1997 STORM EROSION													
		Total Volume Moved				Percent Delivery to Channel			Total Yield to Channel			Pre-1997 Storm Erosion Features			
Rehab Project #	Worksite #	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Activity Level	Avg. Scarp Ht.	Range Scarp Ht.	Features Present
1	2	84	85	86	87	88	89	90	91	92	93	65	66	67	68
88-5	R9			0	0					0	0				
88-8	R4			0	0					0	0				
88-8	R6			0	0					0	0				
88-8	R1			0	0					0	0				
88-8	R2			0	0					0	0				
88-8	R3			0	0					0	0				
88-8	R5			0	0					0	0				
88-9	A			0	0					0	0				
88-9	B			155	141		90	90		140	127				
90-3	R30-25			50	0		85	100		43	141	1	2	2,3	2,6,7,9
90-3	R20-15A			0	0					0	0				
90-3	R20-15B			0	0					0	0				
90-3	R25-20			0	0					0	0				
90-3	L25-20			0	0					0	0				
90-3	R5-0			0	0					0	0				
90-3	R12-5-A											1	6	4,10	8
90-3	R12-5-B			167	132		80	75		134	99	1	6	4,10	8
	4010-1														
	4020-1														
	11010-2														
	11015-1														
	11040-2														
	2030-1														
	2040-1														
	2040-11														
	2040-12														
	6010-1														
	6010-2														
	6010-3														
	1030-1														
	5010-1														
	5010-3/4														
	5010-5														
	5011-1														
	5020-2														
	5020-3														
	5040-3														
	5061-1														
	5061-2														
	5070-2														
	5080-1														
	5080-2														
	8020-2														
	8020-3														

		TOTAL VOLUME OF POST-TREATMENT/PRE-1997 STORM EROSION													
		Total	Volume	Moved		Percent	Delivery	to Channel	Total	Yield to	Channel	Pre-1997 Storm Erosion Features			
Rehab Project #	Worksite #	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Activity Level	Avg. Scarp Ht.	Range Scarp Ht.	Features Present
1	2	84	85	86	87	88	89	90	91	92	93	65	66	67	68
	8035-1														
	8035-2														
	8035-3														
	8050-1														
	8050-2														
	8050-3														
	10010-1														
	10010-4														
	10030-1														
	10030-3														
	10030-4														

		1997 STORM EROSION (Volumes additional to 96 vol.)									
		On Site		Off Site		On Site		Off Site		Percent	Cause of
Rehab	Worksite	ROAD RELATED				NOT ROAD RELATED				Delivery	Failure
Project #	#	Mass Wast.	Fluv Eros	Mass Wast.	Fluv Eros.	Mass Wast.	Fluv Eros.	Mass Wast.	Fluv. Eros.		
1	2										
87-3	R9										
87-3	R10										
87-3	R13										
87-3	R14										
87-3	R15										
87-3	R1										
87-3	R11										
87-3	R12										
87-5	R1										
87-5	R2										
87-5	R3										
87-5	R4										
87-5	R5										
87-5	R6										
87-5	R7										
87-5	R8										
87-5	R9										
88-3	R2-A										
88-3	R2-B										
88-3	R3										
88-3	R4-A										
88-3	R4-B										
88-3	R6-1										
88-3	R6-3										
88-3	R6-4										
88-3	R7-0										
88-3	R7-1										
88-3	R7-2										
88-3	R7-3	217								50	
88-3	R-8										
88-3	R9-1										
88-3	R9-2										
88-3	R9-3										
88-3	R0										
88-3	R1										
88-3	R6-2										
88-5	R5										
88-5	R8										
88-5	R1										
88-5	R2										
88-5	R3										
88-5	R4										
88-5	R6										
88-5	R7										

Rehab Project #	Worksite #	1997 STORM EROSION (Volumes additional to 96 vol.) ROAD RELATED On Site Mass Wast.	ROAD RELATED On Site Fluv Eros	ROAD RELATED Off Site Mass Wast.	ROAD RELATED Off Site Fluv Eros.	NOT ROAD RELATED On Site Mass Wast.	NOT ROAD RELATED On Site Fluv Eros.	NOT ROAD RELATED Off Site Mass Wast.	NOT ROAD RELATED Off Site Fluv. Eros.	Percent Delivery	Cause of Failure
1	2										
88-5	R9										
88-8	R4										
88-8	R6										
88-8	R1										
88-8	R2										
88-8	R3										
88-8	R5										
88-9	A										
88-9	B						238			100	
90-3	R30-25	255								30	
90-3	R20-15A										
90-3	R20-15B										
90-3	R25-20										
90-3	L25-20										
90-3	R5-0										
90-3	R12-5-A	462								90	
90-3	R12-5-B	251								90	
	4010-1	440								100	1,6,8,11
	4020-1	10								100	8,2,11
	11010-2	3000								70	1
	11015-1	3000								100	6,12,13
	11040-2	200								0	11
	2030-1					330				0	3
	2040-1	268								90	10
	2040-11					200				40	2,5,3,12
	2040-12	6250								90	2
	6010-1	7400						6500		90	3,4,6,7,13
	6010-2							1000		10	3
	6010-3							1000		10	3
	1030-1	1000								90	13
	5010-1	100								50	8
	5010-3/4	50								80	8,5
	5010-5	1000								90	8,1
	5011-1	2000								50	8
	5020-2	1000								100	1,2
	5020-3	2000								50	10
	5040-3	500								90	
	5061-1					1500				85	3,2
	5061-2					2000				80	3
	5070-2	1000								100	1,2,5
	5080-1	400								90	14
	5080-2	1200								90	
	8020-2	100								95	1,5
	8020-3	1650								50	1,5

		1997 STORM EROSION (Volumes additional to 96 vol.)									
		On Site		Off Site		On Site		Off Site		Percent	Cause of
Rehab	Worksite	ROAD RELATED				NOT ROAD RELATED				Delivery	Failure
Project #	#	Mass Wast.	Fluv Eros	Mass Wast.	Fluv Eros.	Mass Wast.	Fluv Eros.	Mass Wast.	Fluv. Eros.		
1	2										
	8035-1	30000								100	15,11,1,2
	8035-2	7000								100	1,15
	8035-3	6500								90	1,2,15
	8050-1	10400								85	11,1,2
	8050-2					6500				0	1,2,3
	8050-3	2000								90	1,2,14
	10010-1	7000								90	
	10010-4	60								95	11,1,2,5
	10030-1	75								50	1,15
	10030-3	100								80	1,2,5
	10030-4			100						90	1,14,15

Appendix VII. Road reach re-vegetation data.

Data Collected Summer, 1998

English units (ft or yd3)

Rehab Project	Worksite #	Top Soil Restored	Reveg. Treat.	Redwood Height	Rank	DougFir Height	Rank	Alder Height	Avg. Stem Spacing	Rank	Tanoak Height	Rank	Madrone Height	Rank	Shrubs Height	Rank	Herb. Dry % Cover	Rank	Herb-Wet % Cover	Rank	Exotics Present
1	2	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
80-3	R0-SX1-1	2	5	6	5	10	4	20	2	2					3	3	60	1			
80-3	RSX1-1-L1S1	2	5	4	4	9	3	35	10	2							65	1			
80-3	RL1S1-C5	2	5	8	3	12	4	30	4	1							65	2			
80-3	RC5-C6	2	5	5	3			30	10	1							60	2			
80-3	RC6-SX3-1	2	5	4	4	10	3	35	4	1							70	2	5	5	
80-3	DF-1	2	5																		
80-3	L7	2	5	4	3	3	4	40	20	2							20	1			
80-3	RC6-SX3-1-A	2	5	4	4	10	3	35	4	1							70	2	5	5	
80-3	RC6-SX3-1-B	2	5	4	4	10	3	35	4	1							70	2	5	5	
80-3	RC6-SX3-1-C	2	5	4	4	10	3	35	4	1							70	2	5	5	
80-3	RSX3-1-C8-A	2	5	5	3	6	4	30	10	2							75	1			
80-3	RSX3-1-C8-B	2	5	5	3	6	4	30	10	2							75	1			
80-3	C8-SX4-1	2	5			5	3	30	10	2							80	1			
80-3	SX4-1-C9	2	5					20	10	2							90	1			
80-3	C9-L6	2	5	6	4	5	3	30	7	2							65	1			
80-3	C12-SX2-2-A	2	5					40	50	2							40	1			
80-3	C12-SX2-2-B	2	5					40	50	2							40	1			
80-3	C12-SX2-2-C	2	5					40	50	2							40	1			
80-3	RSX2-2-L7	2	5	4	3	3	4	40	20	2							20	1			
80-3	RL7-FA	2	5	3	3			30	10	4					3	2	40	1			
80-3	RFA-FB	2	5	3	4	4	3		7						3	2	50	1			
80-3	RFB-SX1-2	2	5			4	4	50	8	1					5	2	45	3			
80-3	RF1	2	5	4	3	3	4	40	20	2							20	1			
80-3	RF2	2	5					35	8	2					3	3	30	1			
80-3	END-SX3-2	2	5	3	5	3	4	30	12	1					4	2	30	3			
80-3	SX3-2-RF3-A	2	5	4	4	4	3	20	5	1	3	5			1	6	25	2			
80-3	SX3-2-RF3-B	2	5	4	4	4	3	20	5	1	3	5			1	6	25	2			
80-3	RF3-A	2	5					35	8	2					3	3	30	1			

Rehab	Worksite	Top Soil	Reveg.	Redwood		DougFir		Alder	Avg. Stem		Tanoak		Madrone		Shrubs		Herb. Dry		Herb-Wet		Exotics
Project	#	Restored	Treat.	Height	Rank	Height	Rank	Height	Spacing	Rank	Height	Rank	Height	Rank	Height	Rank	% Cover	Rank	% Cover	Rank	Present
80-3	RF3-B	2	5					35	8	2					3	3	30	1			
83-2	R1	2	1	2	4	2	3	30	5	1					1	5	40	2			
83-2	R2	2	1	2	4	2	2	30	6	1					1	3	2	5			
83-2	R3	2	1	1	4	2	3	28	5	1							5	2			
83-2	R4	2	1			20	2	30	4	1							15	3			
83-2	R5-A	2	1	2	4	3	3	27	6	1							5	2			
83-2	R5-B	2	1	2	4	3	3	27	6	1							5	2			
83-2	R5-C	2	1	2	4	3	3	27	6	1							5	2			
83-2	R6	2	1	20	2			30	2	1							5	3	3	4	
83-2	R7	2	1	5	3	6	2	25	4	1							5	4			
83-2	R8	2	1	4	4	5	3	30	8	1							40	2			
83-2	R9	2	1	3	2			35	2	1							10	3	3	4	
83-2	R10																				
86-1	R-4	2	1	4	4			15	10	2					3	3	40	1			
86-1	R-3A	2	1					20	4	1					3	3	65	2	3	4	
86-1	R-1	2	1					22	3	1					3	3	65	2			
86-1	*UNTREATED	2	1					18	4	1					3	3	65	2			
86-3	R12	2				2	3	20	2	1							20	2			
86-3	R13	0		3	2				3								20	1			
86-3	R5	2		4	3			28	2	1							20	2			
86-3	R6	2		2	3	1	4	15	1	2							50	1			
86-3	R9	2		2	3	2	4	15	2	1							25	2			
86-3	R6	2						20	2	1					2	2	75	3			
86-3	R14	0				3	2		70								35	1			
86-3	R8	0		4	2	3	4	15	30	3							30	1	1	5	
86-3	R10	0		5	3										3	2	80	1			
86-4	R1-2	2	3	3	3			14	10	1							40	2			
86-4	R3-4	0	3	5	3			18	3	1							60	2			
86-4	R4-5	0	3	5	3			20	15	2							50	1			
86-4	R5-6	0	3	3	4			20	3	1					3	3	30	2			
86-4	R2-3	0	3	2	4			15	3	1					3	2	50	3			
86-5	0+00-9+38	2	1	5	3	2	5	20	15	2	6	4			5	1					2
86-5	66+00-67+61	2	1			2	3	25	3	1							5	2			

Rehab Project	Worksite #	Top Soil Restored	Reveg. Treat.	Redwood Height	Rank	DougFir Height	Rank	Alder Height	Avg. Stem Spacing	Rank	Tanoak Height	Rank	Madrone Height	Rank	Shrubs Height	Rank	Herb. Dry % Cover	Rank	Herb-Wet % Cover	Rank	Exotics Present
86-5	64+09-66+00	2	1			3	2	17	2	1							2	3			
86-5	47+00-50+53	2	1	3	4	2	5	18	5	1					2	2	3	3			
86-5	42+00-44+47	2	1			1	3	23	1	1	3	4			2	2					
86-5	39+68-42+00	2	1			1	3	20	4	1	3	4			2	2					
86-5	37+00-39+68	2	1			2	3	15	10	2	4	4			12	1					
86-5	31+36-37+00	2	1	2	4	2	3		1		6	2			10	1					2
86-5	14+39-21+41	2	1	2	5	3	3	18	12	1	4	4			5	2					2
86-5	67+61-77+00	2	1			3	3	25	3	1							10	2			
86-5	6761-XRD	2	1					25	4	1							10	2			
86-5	62+45-64+09	2	1			3	2	18	1	1							2	3			
86-5	55+00-62+45	2	1			2	3	25	2	1	1	4			6	2					
86-5	50+53-55+00	2	1			3	2	21	6	1											
86-5	44+47-47+00	2	1	3	3	3	4	21	2	1							5	2	1	5	
86-5	21+41-31+36	2	1			1	1	20	25	3	3	4			2	2					
86-5	9+38-14+39	2	1	2	4	4	3	22	10	1					4	2					
87-3	R1	2	1	3	4	2	5	12	5	1	2	6			4	2	35	3			
87-3	R1	2	1	3	4	2	5	12	5	1	2	6			4	2	35	3			
87-3	R2	2	1	3	4			20	2	1					3	2	35	3			
87-3	R3	2	1	5	3	2	4	25	3	1					4	5	30	2			
87-3	R4	2	1					25	3	1					3	3	30	2			
87-3	R5	2	1	2	3			25	2	1					3	4	25	2			
87-3	R6	2	1					20	4	1							25	2			
87-3	R8	2	1	3	4			20	2	1					4	3	40	2			
87-3	R9	2	1					14	3	1					4	3	45	2			
87-3	R10	2	1	3	4			17	2	1					4	3	60	2			
87-3	R13	2	1	3	3			12	2	1							62	2			
87-3	R14	2	1	3	3			15	1	1					2	4	35	2			
87-3	R15	2	1					22	3	1							45	2			
87-3	R1	2	1	3	4	2	5	12	5	1	2	6			4	2	35	3			
87-3	R11	2	1	4	4			15	2	1					5	2	20	3			
87-3	R12	2	1	2	4	4	3	20	3	1							50	2			
87-5	R1	2	1	6	2	5	3	20	2	1											
87-5	R2	2	1					25	2	1							10	2			

Rehab	Worksite	Top Soil	Reveg.	Redwood		DougFir		Alder	Avg. Stem		Tanoak		Madrone		Shrubs		Herb. Dry		Herb-Wet		Exotics
Project	#	Restored	Treat.	Height	Rank	Height	Rank	Height	Spacing	Rank	Height	Rank	Height	Rank	Height	Rank	% Cover	Rank	% Cover	Rank	Present
87-6	R3	2	1	4	3	6	2	25	2	1							25	4			
87-6	R4	2	1	2	2			30	3	1							20	3			2
87-5	R5	2	1	5	3	4	4	30	3	1							25	2			
87-5	R6	2	1	5	4	5	3	30	3	1							30	2			
87-5	R7	2	1	4	2	4	3	25	3	1							5	4			
87-5	R8	2	1	3	4			20	2	1							20	3	30	2	
87-5	R9	2	1	4	4	4	5	20	2	1					3	2	20	3			
88-3	R2-A	2		6	3	4	4	22	4	2					4	5	75	1			
88-3	R2-B	2		6	3	4	4	22	4	2					4	5	75	1			
88-3	R3	2		3	4			20	2	1					3	2	10	3			
88-3	R4-A	2		4	3	3	4	15	2	2							70	1			
88-3	R4-B	2		4	3	3	4	15	2	2							60	1			
88-3	R6-1	2		4	3	3	4	20	2	1					3	5	60	2	2	6	
88-3	R6-3	2		4	3	2	4	15	3	1							20	5	70	2	
88-3	R6-4	2		8	4	3	5	15	3	1					3	6	5	3	30	2	
88-3	R7-0	2		4	4			20	10	1							20	3	60	2	
88-3	R7-1	2		12	1	4	4	2	7	5							20	2	60	3	
88-3	R7-2	2		4	3	4	4	18	3	1							50	2			
88-3	R7-3	2		4	3	4	4	18	3	1							50	2			
88-3	R-8	2		4	3			20	2	1							20	2			
88-3	R9-1	0		2	3			20	2	1							50	2			
88-3	R9-2	2		2	3			20	2	1					1	4	30	2			
88-3	R9-3	2						20	2	1					3	3	30	2			
88-3	R0	2		3	3	3	4	15	2	1							50	2			
88-3	R1	2		4	3			20	2	1							30	2			
88-3	R6-2	2		2	3	2	4	25	2	1							60	2			
88-5	R5	2		5	3	5	2	20	1	1							20	4			
88-5	R6	2		6	5	6	1	8	3	3	3	4			4	2	8	6			
88-5	R1	2		2	3	4	2		5						2	1					
88-5	R2	2		2	3	3	2	12	1	1	2	4			2	5	2	6			
88-5	R3	2		3	2	4	1								3	3	3	4			
88-5	R4	2		4	2	6	1	15	15	3	2	5					40	4			
88-6	R6	2		6	2	5	3	20	2	1									4	4	

Rehab Project	Worksite #	Top Soil Restored	Reveg. Treat.	Redwood Height	Rank	DougFir Height	Rank	Alder Height	Avg. Stem Spacing	Rank	Tanoak Height	Rank	Madrone Height	Rank	Shrubs Height	Rank	Herb. Dry % Cover	Rank	Herb-Wet % Cover	Rank	Exotics Present
88-5	R7	2		3	3				7		2	1			2	2	1	4			
88-5	R9	2		5	1				8		2	3	1	4	2	2					
88-8	R4	2		4	2	4	1		15						2	3	2	4			
88-8	R6	0		1	2	3	1		4						1	3					
88-8	R1	0				2	1		20						3	2					
88-8	R2	0				4	1		30						1	2					
88-8	R3	2		4	2	4	1		20						2	3	1	4			
88-8	R5	0		3	2	4	1		25						2	3					
88-9	A	2	1	4	3	3	4	20	4	1							50	2			
88-9	B	2	1	4	3	3	4	20	4	1							50	2			
90-3	R30-25	2		5	3	4	4	20	3	1							60	2			
90-3	R20-15A	2	1	5	3	4	4	20	2	1					4	5	65	2			
90-3	R20-15B	2	1	4	4	3	5	12	6	1							70	2	10	3	1
90-3	R25-20	2		8	3	8	4	15	2	1							50	2	5	5	1.2
90-3	L25-20	0		5	5	5	4	12	4	1					4	6	15	2	20	3	
90-3	R5-0	2		9	4			20	1	1					3	3	80	2			
90-3	R12-5-A	2		7	3	6	2	17	2	1					5	2	50	4	10	5	
90-3	R12-5-B	2		7	3	6	2	17	2	1					5	2	50	4	10	5	

Appendix VIII. Road reach site characteristics.

		Data Collected Summer, 1996 English units (ft or yd3)															
Rehab Project #	Worksite #	Rehab Leader	Date Mapped	Mapped By	Watershed	Quad ID	Site Type	Erosion Process	Road Name	Year of Construct	Year of Rehab	Condition of Fill	Fill Failure Potential	Primary Treatment	2ndry Treat	Bdrx	Soil Code
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	37	38
80-3	R0-SX1-1	GJB&TH	6/18/96	GWG,DJK,ALB	BRIDGE	BH	3	4	M-6-1	1969-70	1980	1	0	6	0	1	9,22
80-3	RSX1-1-L1S1	GJB&TH	6/18/96	GWG,DJK,ALB	BRIDGE	BH	3	2	M-6-1	1969-70	1980	2,3,4,6	1	6,7,8	2	1	9,22
80-3	RL1S1-C5	GJB&TH	6/18/96	GWG,DJK,ALB	BRIDGE	BH	3	1	M-6-1	1969-70	1980	2,3,4,5,6	1	7,6,8	2	1	9,22
80-3	RC5-C6	GJB&TH	6/19/96	GWG,DJK,ALB	BRIDGE	BH	3	1	M-6-1	1969-70	1980	2,4,7	1	2,6,7	2	1	9,22
80-3	RC6-SX3-1	GJB&TH	6/19/96	GWG,DJK,ALB	BRIDGE	BH	3	4	M-6-1	1969-70	1980	2,3,4,5,6,8	0	6,7,8	2	1	9,22
80-3	DF-1	GJB&TH	6/19/96	GWG,DJK,ALB	BRIDGE	BH	6	2	M-6-1	1969-70	1980	5	0	2	2	1	9,22
80-3	L7	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	2	4	M-6-2	1971	1980	1	0	2	0	1	53
80-3	RC6-SX3-1-A	GJB&TH	6/19/96	GWG,DJK,ALB	BRIDGE	BH	3	4	M-6-1	1969-70	1980	2,3,4,5,6,8	0	6,7	2	1	9,22
80-3	RC6-SX3-1-B	GJB&TH	6/19/96	GWG,DJK,ALB	BRIDGE	BH	3	4	M-6-1	1969-70	1980	2,3,4,5,6,8	0	6,7	2	1	9,22
80-3	RC6-SX3-1-C	GJB&TH	6/19/96	GWG,DJK,ALB	BRIDGE	BH	3	4	M-6-1	1969-70	1980	2,3,4,5,6,8	0	6,7	2	1	9,22
80-3	RSX3-1-C8-A	GJB&TH	6/19/96	GWG,DJK,ALB	BRIDGE	BH	3	4	M-6-1	1969-70	1980	3,6	0	6,7	2	1	9,22
80-3	RSX3-1-C8-B	GJB&TH	6/19/96	GWG,DJK,ALB	BRIDGE	BH	3	4	M-6-1	1969-70	1980	3,6	0	6,7	2	1	9,22
80-3	C8-SX4-1	GJB&TH	7/2/96	GWG,DJK,ALB	BRIDGE	BH	3	4	M-6-1	1969-70	1980	3,6	0	6,7	2	1	9,22
80-3	SX4-1-C9	GJB&TH	7/2/96	GWG,DJK,ALB	BRIDGE	BH	3	4	M-6-1	1969-70	1980	1	0	6,7	2	1	9,22
80-3	C9-L6	GJB&TH	7/2/96	GWG,DJK,ALB	BRIDGE	BH	3	4	M-6-1	1969-70	1980	2,6,7	0	6,7	2	1	9,22
80-3	C12-SX2-2-A	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	3	2	M-6-2	1971	1980	2,4,5	0	7	0	1	53
80-3	C12-SX2-2-B	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	3	2	M-6-2	1971	1980	2,4,5	0	7	0	1	53
80-3	C12-SX2-2-C	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	3	2	M-6-2	1971	1980	2,4,5	0	7	0	1	53
80-3	RSX2-2-L7	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	3	2	M-6-2	1971	1980	4,5	1	7	0	1	53
80-3	RL7-FA	GB,TH	9/3/96	ALB,GWG	BRIDGE	BH	3	2	M-6-2	1971	1980	4,5	1	7	0		53
80-3	RFA-FB	GB,TH	9/6/96	ALB,GWG	BRIDGE	BH	3	2	M-6-2	1971	1980	4,5	1	7	0	1	53
80-3	RFB-SX1-2	GB,TH	9/10/96	ALB,GWG,MAM	BRIDGE	BH	3	2	M-6-2	1971	1980	2,4,5	1	7	0	1	53
80-3	RF1	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	6	2	M-6-2	1971	1980	4,5	1	7	0	1	53
80-3	RF2	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	3	4	M-6-2	1971	1980	1	0	6	0	1	53
80-3	END-SX3-2	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	3	4	M-6-2	1971	1980	1	0	7	0	1	53
80-3	SX3-2-RF3-A	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	3	2	M-6-2	1971	1980	5	1	7,9	0	1	53
80-3	SX3-2-RF3-B	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	3	2	M-6-2	1971	1980	5	1	7,9	0	1	53
80-3	RF3-A	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	3	2	M-6-2	1971	1980	4,5	1	6	0	1	53

Rehab Project #	Worksite #	Rehab Leader	Date Mapped	Mapped By	Watershed	Quad ID	Site Type	Erosion Process	Road Name	Year of Construct	Year of Rehab	Condition of Fill	Fill Failure Potential	Primary Treatment	2ndry Treat	Bdrx	Soil Code
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	37	38
80-3	RF3-B	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	3	2	M-6-2	1971	1980	4,5	1	6	0	1	53
83-2	R1	TS,LJ	8/13/96	DJK,ALB	BRIDGE	BH	3	4	M-3-1	1964	1983	1	0	2	0	1	43
83-2	R2	TS,LJ	8/13/96	DJK,ALB	BRIDGE	BH	3	4	M-3-1	1964	1983	1	0	2	0	1	9
83-2	R3	TS,LJ	8/13/96	DJK,ALB	BRIDGE	BH	3	1	M-3-1	1964	1983	5	1	2	0	1	9
83-2	R4	TS,LJ	8/13/96	BEB,GWG	BRIDGE	BH	3	4	M-3-1	1964	1983	1	0	2	0	1	9
83-2	R5-A	TS,LJ	8/13/96	DJK,ALB	BRIDGE	BH	3	1	M-3-1	1964	1983	1	0	1	0	1	43
83-2	R5-B	TS,LJ	8/13/96	DJK,ALB	BRIDGE	BH	3	1	M-3-1	1964	1983	1	0	1	0	1	43
83-2	R5-C	TS,LJ	8/13/96	DJK,ALB	BRIDGE	BH	3	1	M-3-1	1964	1983	1	0	1	0	1	43
83-2	R6	TS,LJ	8/19/96	GWG,BEB	BRIDGE	BH	3	1	M-3-1	1964	1983	2,4,8	0	1	0	1	
83-2	R7	TS,LJ	8/19/96	GWG,BEB	BRIDGE	BH	3	4	M-3-1	1964	1983	1,3	0	8	0	1	
83-2	R8	TS,LJ	8/19/96	GWG,BEB	BRIDGE	BH	3	4	M-3-1	1964	1983	1	0	8	0	1	
83-2	R9	TS,LJ	8/19/96	GWG,BEB	BRIDGE	BH	3	4	M-3-1	1964	1983	1,4	0	2,8	0	1	
83-2	R10	TS,LJ	4/7/97	ALB,GWG	BRIDGE	BH	3	2	M-3-1	1964	1983			6	0	1	
86-1	R-4	MK	7/30/96	ALB,BEB	BRIDGE	BH	3	4	M-7	1962	1986	1	0	3	2	1	19
86-1	R-3A	MK	7/31/96	DJK,GWG	BRIDGE	BH	3	1	M-7	1962	1986	2,3,8	1	3	2	1	22
86-1	R-1	MK	7/31/96	DJK,GWG	BRIDGE	BH	3	1	M-7-4	1962	1986	2,5	1	3	2	1	22
86-1	*UNTREATED	MK	7/31/96	GWG,DJK	BRIDGE	BH	3	1	M-7-4	1962	1986	2,5	1	9	2	1	22
86-3	R12	LEJ	7/10/96	BB, ALB	BRIDGE	RP	3	4	M-4 1/2	1960	1986	1	0	1,3,8	0	1	22
86-3	R13	LEJ	7/10/96	BB, ALB	BRIDGE	RP	3	4	M-4 1/2	1960	1986	2,5	1	3	0	1	22
86-3	R5	LEJ	7/16/96	ALB, DJK	BRIDGE	RP	3	4	M-5	1962	1986	2,3,5,6	1	1,7,8	2	1	9,22
86-3	R6	LEJ	7/16/96	DJK, ALB	BRIDGE	RP	3	4	M-5	1962	1986	3,4,8	1	2		1	32,44
86-3	R9	LEJ	7/16/96	ALB, DJK	BRIDGE	RP	3	4	M-5	1962	1986	2	0	1,6,7,8	2	1	22
86-3	R6	LEJ	7/16/96	BB,GG	BRIDGE	RP	3	4	M-5	1962	1986	2,5,8	1	1	2	1	32,44
86-3	R14	LEJ	7/10/96	BB, ALB	BRIDGE	RP	3	4	M-4 1/2	1960	1986	1	0	7	0	1	22
86-3	R8	LEJ	7/16/96	ALB, DJK	BRIDGE	RP	3	2	M-5	1962	1986	3	1	7	2	1	1,9,22
86-3	R10	LEJ	7/16/96	BB,GG	BRIDGE	RP	3	4	M-5	1962	1986	1	0	7	0	1	9
86-4	R1-2	GJB	6/12/96	GWG,DJK,ALB	BRIDGE	RP	3	4	M-6-1	1969	1986	1	0	2,6,7,8	0	1	9,22
86-4	R3-4	GJB	6/5/96	ALB,GWG	BRIDGE	RP/BH	3	4	M-6-1	1969	1986	1,2	0	2,6,7,8	0	1	9,22
86-4	R4-5	GJB	6/5/96	ALB,GWG	BRIDGE	BH	3	4	M-6-1	1969	1986	1,3	0	2,7	0	1	9,22
86-4	R5-6	GJB	6/4/96	MAM,GWG,ALB	BRIDGE	RP	3	4	M-6-1	1969	1986	1	0	2	0	1	9,22
86-4	R2-3	GJB	6/6/96	MAM,GWG,ALB	BRIDGE	RP	3	4	M-6-1	1969	1986	3,4,6	0	7,3	0	1	9,22
86-5	0+00-9+38	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	1	0	2	2	1	22

Rehab Project #	Worksite #	Rehab Leader	Date Mapped	Mapped By	Watershed	Quad ID	Site Type	Erosion Process	Road Name	Year of Construct	Year of Rehab	Condition of Fill	Fill Failure Potential	Primary Treatment	2ndry Treat	Bdrx	Soil Code
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	37	38
86-5	66+00-67+61	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	1	0	2,7	2	1	23
86-5	64+09-66+00	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	1	0	5,8	2	1	9
86-5	47+00-50+53	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	1	0	5,8	2	1	22
86-5	42+00-44+47	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	1	0	5,8	2	1	22,9
86-5	39+68-42+00	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	1	0	7,3	2	1	42
86-5	37+00-39+68	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	1	0	8	2	1	9
86-5	31+36-37+00	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	1	0	3,7	2	1	22
86-5	14+39-21+41	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	1	0	2	2	1	22
86-5	67+61-77+00	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	3,8	0	5,6,7	2	1	42,44,22
86-5	6761-XRD	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	4	1	M-3-1-2	1967	1986	1	0	5	2	1	42
86-5	62+45-64+09	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	1	0	6,7	2	1	8
86-5	55+00-62+45	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	2,7	0	2,7	2	1	7,42
86-5	50+53-55+00	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	1	0	6,7	2	1	9
86-5	44+47-47+00	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	1	0	6,7	2	1	9,34
86-5	21+41-31+36	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	1	0	6,7	2	1	9
86-5	9+38-14+39	LEJ	8/7/96	DJK,GWG	BRIDGE	BH	3	4	M-3-1-2	1967	1986	3,4,8	0	6,7	2	1	22
87-3	R1	GB	9/10/96	ALB,GWG,MAM	BRIDGE	BH	3	1	M-6-2	1971	1987	1	0	2,6,6,7	2	1	9,27
87-3	R1	GB	9/10/96	ALB,GWG,MAM	BRIDGE	BH	3	4	M-6-2	1971	1987	1	0	3,6,7	2	1	9,27
87-3	R2	GB	9/10/96	ALB,GWG,MAM	BRIDGE	BH	3	4	M-6-2	1971	1987	1	0	2,6,7,8	2	1	22,9
87-3	R3	GB	9/10/96	ALB,GWG,MAM	BRIDGE	BH	3	4	M-6-2	1971	1987	1	0	2,6,8	2	1	9
87-3	R4	GB	9/17/96	ALB,GWG	BRIDGE	BH	3	4	M-6-2	1971	1987	1	0	2,6,8	2	1	9
87-3	R5	GB	9/17/96	ALB,GWG	BRIDGE	BH	3	4	M-6-2	1971	1987	1	0	2,6,8	2	1	9
87-3	R6	GB	9/17/96	ALB,GWG	BRIDGE	BH	3	4	M-6-2	1971	1987	1	0	2,6,8	2	1	9
87-3	R8	GB	9/17/96	ALB,GWG	BRIDGE	BH	3	4	M-6-1	1971	1987	1	0	2,6,8	2	1	22
87-3	R9	GB	9/17/96	ALB,GWG	BRIDGE	BH	3	4	M-6-1	1971	1987	1	0	2,6,7,8	2	1	9
87-3	R10	GB	9/17/96	ALB,GWG	BRIDGE	BH	3	4	M-6-1	1971	1987	1	0	2,6,8	2	1	42
87-3	R13	GB	9/24/96	ALB,GWG	BRIDGE	BH	3	4	M-6-2-1	1971	1987	1	0	3,6	2	1	22
87-3	R14	GB	9/24/96	ALB,GWG	BRIDGE	BH	3	4	M-6-2-1	1971	1987	1	0	3,6	2	1	9
87-3	R15	GB	9/24/96	ALB,GWG	BRIDGE	BH	3	4	M-6-2-1	1971	1987	1	0	3,6	2	1	22,9
87-3	R1	GB	9/10/96	ALB,GWG,MAM	BRIDGE	BH	4	1	M-6 2	1971	1987	1	0	5,6	2	1	9,27
87-3	R11	GB	9/17/96	ALB,GWG	BRIDGE	BH	3	4	M-6-1	1971	1987	1	0	6,7	2	1	9,22
87-3	R12	GB	9/24/96	ALB,GWG	BRIDGE	BH	3	4	M-6-2-1	1971	1987	1	0	6,7	2	1	9,22

Rehab Project #	Worksite #	Rehab Leader	Date Mapped	Mapped By	Watershed	Quad ID	Site Type	Erosion Process	Road Name	Year of Construct	Year of Rehab	Condition of Fill	Fill Failure Potential	Primary Treatment	2ndry Treat	Bdrx	Soil Code
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	37	38
87-5	R1	LEJ	8/20/96	BEB,GWG	BRIDGE	RP	3	4	M-3	1966	1987	1	0	2,6,8	0	1	53
87-5	R2	LEJ	8/20/96	BEB,GWG	BRIDGE	RP	3	4	M-3	1966	1987	1	0	2,6,8	0	1	53
87-5	R3	LEJ	8/20/96	BEB,GWG	BRIDGE	RP	3	4	M-3	1966	1987	1	0	2,6,8	0	1	1,6
87-5	R4	LEJ	8/20/96	BEB,GWG	BRIDGE	RP	2	4	M-3	1966	1987	2	0	6,8	0	1	1
87-5	R5	LEJ	8/20/96	BEB,GWG	BRIDGE	RP	3	4	M-3	1966	1987	1,8	0	1,6,8	0	1	22,42
87-5	R6	LEJ	8/20/96	BEB,GWG	BRIDGE	RP	3	4	M-3	1966	1987	2	0	2,6	0	1	23,32,9
87-5	R7	LEJ	8/20/96	BEB,GWG	BRIDGE	RP	3	4	M-3	1966	1987	1	0	6,7,8	0	1	1,22,9
87-5	R8	LEJ	8/20/96	BEB,GWG	BRIDGE	RP	3	2	M-3	1966	1987	3,7,8	1	1,6	2	1	48
87-5	R9	LEJ	8/20/96	BEB,GWG	BRIDGE	RP	3	4	M-3	1966	1987	3,8	0	2,6,8	0	1	22,48,31
88-3	R2-A	GB	7/17/96	ALB,DJK	BRIDGE	BH	3	2	M-4	1957	1988	3,8	0	3	2	1	9
88-3	R2-B	GB	7/17/96	ALB,DJK	BRIDGE	BH	3	4	M-4	1957	1988	1	0	1,6	2	1	22,7
88-3	R3	GB	7/17/96	GG,BB	BRIDGE	BH	3	2	M-4	1957	1988	4,6,7	1	2,8	2	1	9,42
88-3	R4-A	GB	7/17/96	ALB,DJK	BRIDGE	BH	3	4	M-4	1957	1988	1	0	2,8	2	1	18
88-3	R4-B	GB	7/17/96	ALB,DJK	BRIDGE	BH	3	4	M-4	1957	1988	1	0	3	2	1	18
88-3	R6-1	GB	7/23/96	ALB,DJK,BB	BRIDGE	BH	3	1	M-4	1957	1988	2,3,6	0	2,7,8	2	1	53
88-3	R6-3	GB	7/23/96	ALB,DJK,BB	BRIDGE	BH	3	4	M-4	1957	1988	1,3	0	1,8	2	1	22,9
88-3	R6-4	GB	7/23/96	BB, DJK,ALB	BRIDGE	BH	3	4	M-4	1957	1988	2,8	0	3	2	1	22,31
88-3	R7-0	GB	7/23/96	BB,DJK	BRIDGE	BH	3	4	M-4	1957	1988	2,3,4,8	1	3,6,7	2	1	38
88-3	R7-1	GB	7/23/96	BB,DJK	BRIDGE	BH	3	4	M-4	1957	1988	8	0	2,8	2	1	9,44
88-3	R7-2	GB	7/23/96	ALB	BRIDGE	BH	3	4	M-4	1957	1988	1	0	3	2	1	9,22
88-3	R7-3	GB	7/23/96	ALB	BRIDGE	BH	3	2	M-4	1957	1988	2,3,4,5	1	3	2	1	53
88-3	R-8	GB	7/23/96	MAM,GWG	BRIDGE	BH	3	1	M-4	1957	1988	9	1	3	2	1	53
88-3	R9-1	GB	7/23/96	MAM,GWG	BRIDGE	BH	3	4	M-4	1957	1988	1	0	2,8	2	1	1,9,22,7
88-3	R9-2	GB	7/23/96	MAM,GWG	BRIDGE	BH	3	4	M-4	1957	1988	6	0	2,8	2	1	1,22
88-3	R9-3	GB	7/23/96	MAM,GWG	BRIDGE	BH	3	1	M-4	1957	1988	5	1	3	2	1	31,9,22
88-3	R0	GB	7/23/96	ALB,DJK,BB	BRIDGE	BH	3	4	M-4-1	1972	1988	3,7,8	1	3	2	1	44,47
88-3	R1	GB	7/23/96	BEB,ALB,DJK	BRIDGE	BH	3	4	M-4-1	1972	1988	1	0	2,8	2	1	42,9,21
88-3	R6-2	GB	7/23/96	DJK,ALB,BB	BRIDGE	BH	4	1	M-4	1957	1988	4,5,6	1	7	2	1	44
88-5	R5	MK	9/5/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1	1965	1988	1	0	3,6	2	1	22
88-5	R8	MK	9/5/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1	1965	1988	1	0	3,6	2	1	22
88-5	R1	MK	9/5/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1	1965	1988	1	0	6,7	0	1	9,22
88-5	R2	MK	9/5/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1	1965	1988	1	0	6,7	2	1	9

Rehab Project #	Worksite #	Rehab Leader	Date Mapped	Mapped By	Watershed	Quad ID	Site Type	Erosion Process	Road Name	Year of Construct	Year of Rehab	Condition of Fill	Fill Failure Potential	Primary Treatment	2ndry Treat	Bdrx	Soil Code
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	37	38
88-5	R3	MK	9/5/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1	1965	1988	1	0	6,7	0	1	9
88-5	R4	MK	9/5/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1	1965	1988	1	0	6,7	0	1	9,22,17
88-5	R6	MK	9/5/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1	1965	1988	1	0	6	0	1	9
88-5	R7	MK	9/5/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1	1965	1988	1	0	6,7	0	1	5,22,9
88-5	R9	MK	9/5/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1	1965	1988	1	0	6,7	0	1	31,1
88-8	R4	DS	8/27/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1-1	1965	1988	1	0	2,3,6	2	1	1
88-8	R6	DS	8/27/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1-1	1965	1988	1	0	2	0	1	1,7
88-8	R1	DS	8/27/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1-1	1965	1988	1	0	6,7	0	1	9,22,1,7
88-8	R2	DS	8/27/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1-1	1965	1988	1	0	6,7	0	1	9,22
88-8	R3	DS	8/27/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1-1	1965	1988	1	0	6,7	0	1	22
88-8	R5	DS	8/27/96	ALB,GWG	BRIDGE	RP	3	4	B-5-1-1	1965	1988	1	0	6,7	0	1	9,22
88-9	A	MK	7/30/96	DJK,GWG	BRIDGE	BH	3	4	M-7	1962	1988	1	0	2,8	2	1	42
88-9	B	MK	7/30/96	GWG,DJK	BRIDGE	BH	4	1	M-7	1962	1988	7	1	3	2	1	22
90-3	R30-25	DS	7/30/96	DJK,GWG	BRIDGE	RP	3	2	M-7	1962	1990	2	1	3	2	1	31,22
90-3	R20-15A	DS	7/30/96	DJK,GWG	BRIDGE	RP	3	4	M-7	1962	1990	1	0	1	2	1	22
90-3	R20-15B	DS	7/30/96	DJK,GWG	BRIDGE	RP	3	4	M-7	1962	1990	3,8	0	3	2	1	9,48
90-3	R25-20	DS	7/30/96	BEB,ALB	BRIDGE	RP	3	4	M-7	1962	1990	1	0	1	2	1	9,32
90-3	L25-20	DS	7/30/96	BEB,ALB	BRIDGE	RP	2	4	M-7	1962	1990	1	0	8	2	1	9,20
90-3	R5-0	DS	7/30/96	ALB,BEB	BRIDGE	RP	3	4	M-7	1962	1990	2	1	1	2	1	9,22
90-3	R12-5-A	DS	7/30/96	BEB,ALB	BRIDGE	RP	3	2	M-7	1962	1990	4,5	1	3	2	1	22
90-3	R12-5-B	DS	7/30/96	BEB,ALB	BRIDGE	RP	3	2	M-7	1962	1990	4,5	1	3	2	1	22
	4010-1		1/12/97	TS,JF	DEVILS		3	2	M-2-1					9	0		
	4020-1		1/12/97	TS,JF	DEVILS		3	2	M-2-1-1					9	0		
	11010-2		1/15/97	BAS	TOM MCDONALD		3	2	C-Line					9	0		
	11015-1		1/15/97	TS,JF	TOM MCDONALD		3	2	C-Line					9	0		
	11040-2		1/23/97	BAS	TOM MCDONALD		3	2	B-5					9	0		
	2030-1		1/22/97	JG	BRIDGE		3	2	M-7.5					9	0		
	2040-1		1/18/97	TS/JF	BRIDGE		3	2	M-Line					9	0		
	2040-11		1/18/97	TS/JF	BRIDGE		3	2	M-Line					9	0		
	2040-12		1/18/97	TS/JF	BRIDGE		3	2	M-Line					9	0		
	6010-1		1/11/97	TS/JF	FORTY-FOUR		3	2	A-9					9	0		
	6010-2		1/23/97	MS	FORTY-FOUR		3	2	A-9					9	0		

Rehab Project #	Worksite #	Rehab Leader	Date Mapped	Mapped By	Watershed	Quad ID	Site Type	Erosion Process	Road Name	Year of Construct	Year of Rehab	Condition of Fill	Fill Failure Potential	Primary Treatment	2ndry Treat	Bdnx	Soil Code
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	37	38
	6010-3		1/23/97	MS	FORTY-FOUR		3	2	A-9					9	0		
	1030-1		1/13/97	TS	BOND		3	2	L-1					9	0		
	5010-1		1/14/97	TS	ELAM		3	2	L-Line					9	0		
	5010-3/4		1/14/97	TS	ELAM		3	2	L-Line					9	0		
	5010-5		1/14/97	TS	ELAM		2	3	L-Line					9	0		
	5011-1		1/19/97	JF/NY	ELAM		3	2	L-Spur					9	0		
	5020-2		1/11/97	TS/JF	ELAM		3	2	L-1(West)					9	0		
	5020-3		1/11/97	TS/JF	ELAM		3	2	L-1(West)					9	0		
	5040-3		1/20/97	MS	ELAM		3	2	L-2					9	0		
	5061-1		1/22/97	MS	ELAM		3	2	L-2-3-1					9	0		
	5061-2		1/22/97	MS	ELAM		3	2	L-2-3-1					9	0		
	5070-2		1/14/97	TS	ELAM		3	2	L-4					9	0		
	5080-1		1/21/97	MS/AB	ELAM		3	2	L-5					9	0		
	5080-2		1/21/97	MS/AB	ELAM		3	2	L-5					9	0		
	8020-2		1/13/97	BAS/LA	McARTHUR		3	2	A-9-7-1					9	0		
	8020-3		1/13/97	BAS/LA	McARTHUR		3	2	A-9-7-1					9	0		
	8035-1		1/11/97	TS/JF	McARTHUR		3	2	L-Line					9	0		
	8035-2		1/11/97	TS/JF	McARTHUR		3	2	L-Line					9	0		
	8035-3		1/11/97	TS/JF	McARTHUR		3	2	L-Line					9	0		
	8050-1		1/13/97	BAS/LA	McARTHUR		3	2	L-2-2-1					9	0		
	8050-2		1/22/97	BAS	McARTHUR		3	2	L-2-2-1					9	0		
	8050-3		1/22/97	BAS	McARTHUR		3	2	L-2-2-1					9	0		
	10010-1		1/18/97	TS/JF	REDWOOD		3	2	M-Line					9	0		
	10010-4		1/20/97	TS/JF	REDWOOD		3	2	M-Line					9	0		
	10030-1		1/20/97	TS/JF	REDWOOD		3	2	M-8					9	0		
	10030-3		1/20/97	TS/JF	REDWOOD		3	2	M-8					9	0		
	10030-4		1/20/97	TS/JF	REDWOOD		3	2	M-8					9	0		

Rehab Project #	Worksite #	Soil Depth	Hillslope Position	Topogr. Position	BIS	%Slope Above	%Slope Below	Dist. to Stream	Road Type
1	2	39	59	60	61	62	63	64	94
80-3	R0-SX1-1	2	3						
80-3	RSX1-1-L1S1	2	3	1	1				
80-3	RL1S1-C5	2	3						
80-3	RC5-C6	2	3						
80-3	RC6-SX3-1	2	3						
80-3	DF-1	2	3	1	1	45	55	15	
80-3	L7		3						1
80-3	RC6-SX3-1-A	2	3						
80-3	RC6-SX3-1-B	2	3						
80-3	RC6-SX3-1-C	2	3						
80-3	RSX3-1-C8-A	2	3						
80-3	RSX3-1-C8-B	2	3						
80-3	C8-SX4-1	2	3						
80-3	SX4-1-C9	2	3						
80-3	C9-L6	2	3						
80-3	C12-SX2-2-A		3	2	1	85	85	400	1
80-3	C12-SX2-2-B		3	2	1	65	65	400	1
80-3	C12-SX2-2-C		3	2	1	65	65	400	1
80-3	RSX2-2-L7		3						1
80-3	RL7-FA		3	1	0			0	1
80-3	RFA-FB		3	1	0			0	1
80-3	RFB-SX1-2		3	1	0	82	80	0	
80-3	RF1		3	2	1	50	50	400	1
80-3	RF2		3						1
80-3	END-SX3-2		3						1
80-3	SX3-2-RF3-A		3	1	1	30	57	180	1
80-3	SX3-2-RF3-B		3	1	1	30	57	180	1
80-3	RF3-A		3	1	1	44	50	180	1

Rehab Project #	Worksite #	Soil Depth	Hillslope Position	Topogr. Position	BIS	%Slope Above	%Slope Below	Dist. to Stream	Road Type
1	2	39	59	60	61	62	63	64	94
80-3	RF3-B		3	1	1	44	50	180	1
83-2	R1	3	1						
83-2	R2	3	1						
83-2	R3	3	1						
83-2	R4	3	1						1
83-2	R5-A	3	1						
83-2	R5-B	3	1						
83-2	R5-C	3	1						
83-2	R6		1						
83-2	R7		1						
83-2	R8		1						
83-2	R9		1						
83-2	R10		1						
86-1	R-4	3	3						
86-1	R-3A	2	3						1
86-1	R-1	2	3						1
86-1	*UNTREATED	2	3						1
86-3	R12	2	2						
86-3	R13	2	2						
86-3	R5	2	2						
86-3	R6	2	2						
86-3	R9	2	2						
86-3	R6	2	2						1
86-3	R14	2	2						
86-3	R8	3	2	3	1	45	35	10	
86-3	R10	2	2						1
86-4	R1-2	2	3						
86-4	R3-4	2	3						
86-4	R4-5	2	3						
86-4	R5-6	2	3						
86-4	R2-3	2	3						
86-5	0+00-9+38	2	1						1

Rehab Project #	Worksite #	Soil Depth	Hillslope Position	Topogr. Position	BIS	%Slope Above	%Slope Below	Dist. to Stream	Road Type
1	2	39	59	60	61	62	63	64	94
86-5	66+00-67+61	2	1						1
86-5	64+09-66+00	3	1						1
86-5	47+00-50+53	2	1						1
86-5	42+00-44+47	2	1						1
86-5	39+68-42+00	3	1						1
86-5	37+00-39+68	3	1						1
86-5	31+38-37+00	2	1						1
86-5	14+39-21+41	2	1						1
86-5	67+61-77+00	3	1						1
86-5	6761-XRD	3	1						1
86-5	62+45-64+09	3	1						1
86-5	55+00-62+45	3	1						1
86-5	50+53-55+00	3	1						1
86-5	44+47-47+00	3	1						1
86-5	21+41-31+38	3	1						1
86-5	9+38-14+39	2	1						1
87-3	R1	3	3						
87-3	R1	3	3						
87-3	R2	2	3						
87-3	R3	3	3						
87-3	R4	3	3						
87-3	R5	3	3						
87-3	R6	3	3						
87-3	R8	2	3						
87-3	R9	3	3						
87-3	R10	3	3						
87-3	R13	2	3						
87-3	R14	3	3						
87-3	R15	2	3						
87-3	R1	3	3						
87-3	R11	3	3						
87-3	R12	3	3						

Rehab Project #	Worksite #	Soil Depth	Hillslope Position	Topogr. Position	BIS	%Slope Above	%Slope Below	Dist. to Stream	Road Type
1	2	39	59	60	61	62	63	64	94
87-5	R1		1						
87-5	R2		1						
87-5	R3	3	1						
87-5	R4	3	1						
87-5	R5	2	1						
87-5	R6	2	1						
87-5	R7	3	1						
87-5	R8	3	1	1	1	45	54	300	
87-5	R9	2	1						
88-3	R2-A	3	3	2	1	70	65	700	1
88-3	R2-B	2	3						1
88-3	R3	3	3	2	0			200	1
88-3	R4-A	3	3						
88-3	R4-B	3	3						
88-3	R6-1		3						
88-3	R6-3	2	3						
88-3	R6-4	2	3						
88-3	R7-0	3	2						
88-3	R7-1	3	2						
88-3	R7-2	3	2						1
88-3	R7-3		2	1	0			30	1
88-3	R-8		2						1
88-3	R9-1	3	2						
88-3	R9-2	3	2						
88-3	R9-3	2	2						
88-3	R0	3	3						
88-3	R1	3	3						1
88-3	R6-2	3	3						
88-5	R5	2	1						
88-5	R8	2	1						
88-5	R1	3	1						
88-5	R2	3	1						

Rehab Project #	Worksite #	Soil Depth	Hillslope Position	Topogr. Position	BIS	%Slope Above	%Slope Below	Dist. to Stream	Road Type
1	2	39	59	60	61	62	63	64	94
88-5	R3	3	1						
88-5	R4	3	1						
88-5	R6	3	1						
88-5	R7	2	1						
88-5	R9	2	1						
88-8	R4	3	1						
88-8	R6	3	1						
88-8	R1	3	1						
88-8	R2	3	1						
88-8	R3	2	1						
88-8	R5	3	1						
88-9	A	2	3						
88-9	B	2	3						1
90-3	R30-25	2	3	1	1	42	0	0	1
90-3	R20-15A	2	3						1
90-3	R20-15B	3	3						1
90-3	R25-20	3	3						
90-3	L25-20	3	3						
90-3	R5-0	3	3						
90-3	R12-5-A	2	3	1	1	40	30	0	
90-3	R12-5-B	2	3	1	1	40	30	0	
	4010-1		4	1					
	4020-1		1	1					
	11010-2		2						
	11015-1		3	1					
	11040-2		2						
	2030-1		2	3					
	2040-1		2						
	2040-11		2	1					
	2040-12		2	1					
	6010-1		2	3					
	6010-2		1	1					

Rehab Project #	Worksite #	Soil Depth	Hillslope Position	Topogr. Position	BIS	%Slope Above	%Slope Below	Dist. to Stream	Road Type
1	2	39	69	60	61	62	63	64	94
	6010-3		2	1					
	1030-1		1	1					
	5010-1		4	1					
	5010-3/4		4	3					
	5010-5		4	1					
	5011-1		2						
	5020-2		1	3					
	5020-3		1	1					
	5040-3		4	3					
	5061-1		3	1					
	5061-2		3	1					
	5070-2		4						
	5080-1		1	3					
	5080-2		3	2					
	8020-2		3	2					
	8020-3		3	2					
	8035-1		1	1					
	8035-2		1	1					
	8035-3		1	3					
	8050-1		2	2					
	8050-2		2	2					
	8050-3		2	2					
	10010-1		4	2					
	10010-4		4	2					
	10030-1		4	1					
	10030-3		3	1					
	10030-4		3	2					

Appendix IX. Stream crossing erosion data.

SEE p. 71

English Units (ft or yd3)

		FLUVIAL EROSION (PRE-1997 STORM)							MASS MOVEMENT (PRE-1997 STORM)										
			Onsite				Offsite			Onsite				Offsite		Pre-1997 Storm Erosion Features			
Rehab Project #	Worksite #	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Activity Level	Avg. Scarp Ht.	Range Scarp Ht.	Features Present
1	2	70	71	72	73	74	75	76	77	78	79	80	81	82	83				
88-4	RX1		2100	87	11		3	1			0	10		0	0				26
88-4	RX2		4110	71	39		39	78			0	0		0	0				
88-4	RX3		2471	81	156		52	204			0	0		0	0				
88-4	RX4		560	25	39		21	20			4	66		0	0				
88-4	RX5																		
88-4	RX6		1740	64	43		27	10			2	40		0	0				16
80-3	SX1-1		300	26	13		11	5			0	0		0	0				108
80-3	SX2-1		1110	434	266		115	134			0	48		0	0				
80-3	SX3-1		375	7	9		0	0			0	0		0	0				17
80-3	SX4-1		200	9	18		0	0			0	0		0	0				
88-3	RX12		762	23	15		103	208			0	0		0	0				34
88-3	RX13		132	9	32		2	67			0	0		0	0				
88-3	RX14		255	32	24		7	5			0	0		0	0				
88-3	RX3		3541	29	27		6	4			0	0		0	0				
88-3	RX6		7	63	31		45	31			0	0		0	0				
88-3	RX9		646	45	119		45	125			0	0		0	0				16
88-3	RX1		326	6	12		2	4			0	0		0	0				
88-3	RX2		446	4	67		0	0			0	0		0	0				
88-3	RX4		5115	58	63		18	9			0	0		0	0				
88-3	RX5																		
88-3	RX7		1531	7	53		0	0			3	8		0	0				
88-3	RX8		809	103	34		108	9			0	0		0	0				83
88-3	RX10		330	30	55		0	0			0	0		0	0				4
88-3	RX2		1350	40	34		0	0			0	0		0	0				
88-3	RX3		1380	65	95		33	19			0	0		0	0				5
88-3	RX4		120	8	17		4	6			0	0		0	0				
88-3	RX5		680	21	36		9	4			0	0		0	0				5
88-3	RX6		3485	172	135		139	92			0	0		0	0				14
88-3	RX7		3100	58	29		0	0			0	0		0	0				
88-3	RX8		2400	129	35		0	0			0	0		0	0				
88-3	RX1		6300	237	203		127	18			0	0		0	0				30
90-3	RX20+35		4630	59	65		5	4			0	0		0	0				3
90-3	RX25		5505	113	106		65	123			0	0		0	0				
90-3	RX12+00		0	27	1		27	1			0	0		0	0				
				2142			1013				9			0					

		FLUVIAL EROSION (PRE-1997 STORM)							MASS MOVEMENT (PRE-1997 STORM)							Pre-1997 Storm Erosion Features			
			Onsite				Offsite			Onsite				Offsite					
Rehab Project #	Worksite #	Eroded Pre-Rehab	Exc. in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Exc in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Activity Level	Avg. Scarp Ht.	Range Scarp Ht.	Features Present
1	2	70	71	72	73	74	75	76	77	78	79	80	81	82	83				
83-2	RX-1		540	63	96		13	0		0	0	0		0	0				
83-2	RX-2		1378	5	10		0	0		0	0	0		0	0				
83-2	RX-3		326	30	39		0	0			0	0		0	0				
83-2	RX-4		5320	17	24		1	7			0	0		0	0				
83-2	RX-5		7558	9	9		0	0			0	0		0	0				
83-2	RX-6		575	21	43		9	28			0	0		0	0				
83-2	RX-7		1877	7	5		18	31			0	0		0	0				
83-2	RX-8		440	4	2		0	0			0	0		0	0				
83-2	RX-9		650	24	66		35	20			0	0		0	0				
83-2	RX-10		111	86	95		77	71			0	0		0	0				
80-3	SX2-2		1810	22	31		12	24			0	0		0	0				146
80-3	SX1-2		1810	313	119		0	0			0	0		0	0				
80-3	SX3-2		1220	293	201		67	169			0	0		0	0				
87-5	RXE102+00																		
87-5	RXE100+00		500	2	3		13	63			0	0		0	0				
87-5	RXE95+00		754	5	5		0	0			0	0		0	0				
87-5	RX79+05		991	3	3		0	0			0	0		0	0				
87-5	RXE44+00		1000	4	1		11	1			0	0		0	0				
88-5	RX-9		774	3	4		0	0			0	0		0	0				
88-5	RX-8																		
88-5	RX-7		1712	20	28		1	1			0	0		0	0				
87-3	RX-1		2940	98	116		49	35			0	0		0	0				32
87-3	RX-2		4720	24	30		33	40			0	0		0	0				
87-3	RX-7		6370	65	49		18	0			0	0		0	0				
87-3	RX-8																		
87-3	RX-9		600	7	15		0	0			0	0		0	0				2
87-3	RX-10		595	75	80		156	166			0	0		7	7				48
87-3	RX-6		315	3	3		11	18			0	0		0	0				
87-3	RX-4		1200	245	142		498	65			0	0		0	175				
88-8	RX 134+29																		
88-8	RX 120+50																		
88-8	RX 114+12																		
	4010-2																		25
	11010-1																		50
	11040-1																		50
	11040-3																	367	
	11040-4																		340

1448 1020 0 7

TOT. 3590 2033 9 7

		FLUVIAL EROSION (PRE-1997 STORM)							MASS MOVEMENT (PRE-1997 STORM)							Pre-1997 Storm Erosion Features			
			Onsite				Offsite			Onsite				Offsite					
Rehab Project #	Worksite #	Eroded Pre-Rehab	Exc in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Exc in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Activity Level	Avg. Scarp Ht.	Range Scarp Ht.	Features Present
1	2	70	71	72	73	74	75	76	77	78	79	80	81	82	83				
	2040-4																		50
	2040-5																		
	2040-9																		500
	2040-10																		240
	2050-1																		400
	6030-1																		75
	6040-1																		600
	1010-1																		200
	5010-2																	100	
	5020-1																		70
	5040-1																		
	5040-2																		
	5070-1																		20
	5070-3																	10	
	5080-3																		
	8020-1																		100
	10030-2																		150

Rehab Project #	Worksite #	Total Eroded Pre-Rehab	Volume Exc in Rehab	Moved Post-Rehab	Erosion Potential	%Delivery to Channel: Eroded Pre-Rehab	%Delivery to Channel: Post-Rehab	%Delivery to Channel: Erosion Potential	Total Eroded Pre-Rehab	Yield to Post-Rehab	Channel Erosion Potential
		TOTAL VOLUME OF POST-TREATMENT/PRE-1997 STORM EROSION									
1	2	84	85	86	87	88	89	90	91	92	93
86-4	RX1		2100	90	22		100	100		90	22
86-4	RX2		4110	110	117		100	95		110	111
86-4	RX3		2471	133	360		100	95		133	342
86-4	RX4		560	50	125		100	90		50	113
86-4	RX5										
86-4	RX6		1740	93	93		100	100		93	93
80-3	SX1-1		300	36	17		100	90		36	16
80-3	SX2-1		1110	549	448		100	100		549	448
80-3	SX3-1		375	7	9		100	100		7	9
80-3	SX4-1		200	9	18		100	100		9	18
86-3	RX12		762	126	223		100	90		126	201
86-3	RX13		132	11	99		100	90		11	89
86-3	RX14		255	39	29		100	90		39	26
86-3	RX3		3541	35	31		100	60		35	19
86-3	RX6		7	108	62		100	60		108	37
86-3	RX9		646	90	244		100	90		90	220
86-3	RX1		326	8	16		100	100		8	16
86-3	RX2		446	4	67		100	100		4	67
86-3	RX4		5115	76	73		100	100		78	73
86-3	RX5										
86-3	RX7		1531	10	61		100	100		10	61
88-3	RX8		809	211	43		100	100		211	43
86-3	RX10		330	30	55		100	100		30	55
88-3	RX2		1350	40	34		100	100		40	34
88-3	RX3		1380	98	114		100	100		98	114
88-3	RX4		120	12	23		100	90		12	21
88-3	RX5		680	30	40		100	90		30	36
88-3	RX6		3485	311	227		100	95		311	216
88-3	RX7		3100	0	0		100	100		58	29
88-3	RX8		2400	0	0		100			129	0
88-3	RX1		6300	364	221		100	100		364	221
90-3	RX20+35		4630	64	69		100	95		64	66
90-3	RX25		5505	178	229		100	90		178	206
90-3	RX12+00		0	54	2		100	100		54	2

30 w/vol Σ = 2976

		TOTAL VOLUME OF POST-TREATMENT/PRE-1997 STORM EROSION									
		Total	Volume	Moved		%Delivery to Channel			Total	Yield to	Channel
Rehab Project #	Worksite #	Eroded Pre-Rehab	Exc in Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential	Eroded Pre-Rehab	Post-Rehab	Erosion Potential
1	2	84	85	86	87	88	89	90	91	92	93
83-2	RX-1		540	77	98		80	70		61	67
83-2	RX-2		1378	0	0		20	90		1	9
83-2	RX-3		328	0	0		100	90		30	35
83-2	RX-4		5320	18	31		100	90		18	28
83-2	RX-5		7558	9	9		100	100		9	9
83-2	RX-6		575	30	71		100	100		30	71
83-2	RX-7		1877	25	38		100	100		25	38
83-2	RX-8		440	4	2		100	100		4	2
83-2	RX-9		850	59	86		100	90		59	77
83-2	RX-10		111	183	166		80	90		130	150
80-3	SX2-2		1810	34	55		100	90		34	49
80-3	SX1-2		1810	313	119		100	95		313	113
80-3	SX3-2		1220	359	370		100	80		359	298
87-5	RXE102+00										
87-5	RXE100+00		500	14	66		100	100		14	66
87-5	RXE95+00		754	5	5		100	100	5	5	5
87-5	RX79+05		991	3	3		65	100		2	3
87-5	RXE44+00		1000	14	2		100	100		14	2
88-5	RX-9		774	3	4		100	80		3	3
88-5	RX-8										
88-5	RX-7		1712	21	29		95	80		20	23
87-3	RX-1		2940	147	151		100	95		147	143
87-3	RX-2		4720	57	70		100	95		57	67
87-3	RX-7		8370	81	49		95	90		77	44
87-3	RX-8										
87-3	RX-9		800	7	15		100	90		6	14
87-3	RX-10		595	237	253		100	95		237	240
87-3	RX-6		315	14	21		100	95		14	20
87-3	RX-4		1200	743	382		100	80		743	306
88-8	RX 134+29										
88-8	RX 120+50										
88-8	RX 114+12										
	4010-2										
	11010-1										
	11040-1										
	11040-3										
	11040-4										

24 w/vol Σ: 2437
+ 2976
5413

			TOTAL VOLUME OF POST-TREATMENT/PRE-1997 STORM EROSION								
		Total	Volume	Moved		%Delivery to Channel			Total	Yield to	Channel
Rehab	Worksite	Eroded	Exc in	Post-	Erosion	Eroded	Post-	Erosion	Eroded	Post-	Erosion
Project #	#	Pre-Rehab	Rehab	Rehab	Potential	Pre-Rehab	Rehab	Potential	Pre-Rehab	Rehab	Potential
1	2	84	85	86	87	88	89	90	91	92	93
	2040-4										
	2040-5										
	2040-9										
	2040-10										
	2050-1										
	6030-1										
	6040-1										
	1010-1										
	5010-2										
	5020-1										
	5040-1										
	5040-2										
	5070-1										
	5070-3										
	5080-3										
	8020-1										
	10030-2										

Rehab Project #	Worksite #	1997 STORM EROSION (Volumes additional to 96 vol.) ROAD RELATED On Site Mass Wast.	Fluv Eros	ROAD RELATED Off Site Mass Wast.	Fluv Eros.	NOT ROAD RELATED On Site Mass Wast.	Fluv Eros.	NOT ROAD RELATED Off Site Mass Wast.	Fluv. Eros.	Percent Delivery	Cause of Failure
1	2										
86-4	RX1							100			
86-4	RX2										
86-4	RX3										
86-4	RX4										
86-4	RX5										
86-4	RX6							100			
80-3	SX1-1						110	100			
80-3	SX2-1										
80-3	SX3-1							100			
80-3	SX4-1										
86-3	RX12		109					100			
86-3	RX13										
86-3	RX14										
86-3	RX3										
86-3	RX6										
86-3	RX9							100			
86-3	RX1										
86-3	RX2										
86-3	RX4										
86-3	RX5										
86-3	RX7										
86-3	RX8							100			
86-3	RX10							100			
88-3	RX2										
88-3	RX3		7					100			
88-3	RX4										
88-3	RX5							100			
88-3	RX6		5					100			
88-3	RX7										
88-3	RX8										
88-3	RX1							100			
90-3	RX20+35										
90-3	RX25				1097			100			
90-3	RX12+00										

Rehab Project #	Worksite #	1997 STORM EROSION (Volumes additional to 96 vol.) On Site, ROAD RELATED: Mass Wast.	On Site, ROAD RELATED: Fluv Eros	Off Site, ROAD RELATED: Mass Wast.	Off Site, ROAD RELATED: Fluv Eros.	On Site, NOT ROAD RELATED: Mass Wast.	On Site, NOT ROAD RELATED: Fluv Eros.	Off Site, NOT ROAD RELATED: Mass Wast.	Off Site, NOT ROAD RELATED: Fluv. Eros	Percent Delivery	Cause of Failure
1	2										
83-2	RX-1		37					100			
83-2	RX-2		10					100			
83-2	RX-3										
83-2	RX-4										
83-2	RX-5										
83-2	RX-6										
83-2	RX-7										
83-2	RX-8										
83-2	RX-9										
83-2	RX-10										
80-3	SX2-2							100			
80-3	SX1-2										
80-3	SX3-2										
87-5	RXE102+00										
87-5	RXE100+00										
87-5	RXE95+00										
87-5	RX79+05										
87-5	RXE44+00										
88-5	RX-9										
88-5	RX-8										
88-5	RX-7										
87-3	RX-1							100			
87-3	RX-2										
87-3	RX-7										
87-3	RX-8										
87-3	RX-9							100			
87-3	RX-10							100			
87-3	RX-6										
87-3	RX-4				142		155	100			
88-8	RX 134+29										
88-8	RX 120+50										
88-8	RX 114+12										
	4010-2							100	6,9,11		
	11010-1							100	6		
	11040-1							100	6		
	11040-3							10	6,1		
	11040-4							100	6,7		

Rehab Project #	Worksite #	1997 STORM EROSION (Volumes additional to 96 vol.) — ROAD RELATED — On Site — Mass Wast.	ROAD RELATED — On Site — Fluv Eros	ROAD RELATED — Off Site — Mass Wast.	ROAD RELATED — Off Site — Fluv Eros.	NOT ROAD RELATED — On Site — Mass Wast.	NOT ROAD RELATED — On Site — Fluv Eros.	NOT ROAD RELATED — Off Site — Mass Wast.	NOT ROAD RELATED — Off Site — Fluv. Eros.	Percent Delivery	Cause of Failure
1	2							100	6		
	2040-4						500,1000	95	6,7		
	2040-5							100	6		
	2040-9							10	1,6,7		
	2040-10							100	6,1		
	2050-1							100	6		
	6030-1							100	7,8,1		
	6040-1							10	6		
	1010-1							50	8,11		
	5010-2							85	8		
	5020-1							90	3		
	5040-1				75			85	3		
	5040-2			350				100	6		
	5070-1							20	1,7,8		
	5070-3							90	3,14,7		
	5080-3			250				95	6		
	8020-1							95	11		
	10030-2										

Σ 0 168 600 1314

2082

Appendix X. Stream crossing re-vegetation data.

		Data Collected Summer, 1996				English Units (ft or yd3)															
Rehab Project #	Worksite #	Top Soil Restored	Reveg Treat	Redwood Height	Rank	DougFir Height	Rank	Alder Height	Avg. Stem Spacing	Rank	Tanoak Height	Rank	Madrone Height	Rank	Shrubs Height	Rank	Herb. Dry % Cover	Rank	Herb-Wet % Cover	Rank	Exotics Present
1	2	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
86-4	RX1	2	3	4	3			20	3	1							60	2			
86-4	RX2	2	3	3	3			20	3	2							65	1			
86-4	RX3	0	3	4	3			20	2	2							75	1			
86-4	RX4	0	3	6	3			25	3	1							35	2			
86-4	RX5																				
86-4	RX6	0	3	5	3			25	2	1							50	2			
80-3	SX1-1	2	5					30	6	2					3	3	80	1			
80-3	SX2-1	2	5	5	3			30	2	2							65	1			
80-3	SX3-1	2	5	5	4	7	3	40	6	2							60	1			
80-3	SX4-1	2	6					25	15	2							70	1			
86-3	RX12	2		4	3			15	2	1					3	4	35	2			
86-3	RX13	0		6	4		2	15	8	3							80	1			
86-3	RX14	0		4	3			23	3	1							40	2			
86-3	RX3	2		4	3			30	5	2							15	1			
86-3	RX6	0		5	3	3	4	35	2	1							30	2			
86-3	RX9	2		2	3			30	2	1							10	2			
86-3	RX1	2		7	3			12	10	2					3	1			20	4	
86-3	RX2	2		5	3			25	5	1					3	2	15	4	6	5	
86-3	RX4	0		4	3			30	3	1					2	2			30	4	
86-3	RX5																				
86-3	RX7	0		4	3			25		1			2	2							
86-3	RX8	2		3	3			25	2	1					2	2	15	4			
88-3	RX10	0						25	2	1					3	2					
88-3	RX2	2		2	4			20	2	1					2	2	30	3			
88-3	RX3	2						25	2	1					2	2	5	3			
88-3	RX4	2		3	4	4	3	15	4	2							75	1			
88-3	RX5	2		3	4	4	3	15	2	1					3	6	70	2			
88-3	RX6	0		3	4	2	3	30	3	1							20	2			
88-3	RX7	2		6	3			25	3	1							10	2			

Rehab Project #	Worksite #	Top Soil Restored	Reveg Treat	Redwood Height	Rank	DougFir Height	Rank	Alder Height	Avg. Stem Spacing	Rank	Tanoak Height	Rank	Madrone Height	Rank	Shrubs Height	Rank	Herb. Dry % Cover	Rank	Herb-Wet % Cover	Rank	Exotics Present
1	2	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
88-3	RX8	2						20	2	1					3	3	30	2			
88-3	RX1	2		2	3			18	2	1					2	4	50	2			
90-3	RX20+35	2		3	3	4	4	25	4	1							60	2	5	5	
90-3	RX25	2		3	3			20	2	1					3	4	60	2	2	5	
90-3	RX12+00	2		6	3			20	3	1					3	4	30	2	10	5	
83-2	RX-1	2	1,5	4	6	4	5	30	8	1			4	2			20	4	20	3	
83-2	RX-2	2	1,5					35	8	2					5	3	10	1			
83-2	RX-3	2	1,5					30	8	2							20	1			
83-2	RX-4	2	1,5					35	4	1							30	2	2	3	
83-2	RX-5	2	1,5					31	6	2							25	1			
83-2	RX-6	2	1,5					35	3	1							60	2			
83-2	RX-7	2	1,5	2	3			30	10	1							15	2			
83-2	RX-8	2	1,5	3	2			35	2		1						10	3	3	4	
83-2	RX-9	2	1,5	3	4	6	3	35	5	1							40	2			
83-2	RX-10	2	1,5					40	4	1							65	2			
80-3	SX2-2	2	5					45	10	2							20	1			
80-3	SX1-2	2	5					40	5	1					3	3	10	2			
80-3	SX3-2	2	5					40	15	2					5	3	20	1			
87-5	RXE102+00																				
87-5	RXE100+00	2	1	4	2	6	3	25	2	1							2	1			
87-5	RXE95+00	2	1	4	3			20	2	1							10	2			
87-5	RX79+05	2	1			20	4	30	2	1							30	2	20	3	
87-5	RXE44+00	0	1	3	2			35	3	1									5	3	
88-5	RX-9	2		3	2	2	4	20	2	1							10	3			
88-5	RX-8																				
88-5	RX-7	2		10	3			20	3	1									50	2	
87-3	RX-1	2	1	2	3			22	3	1							30	2			
87-3	RX-2	2	1	4	3	2	5	30	3	1					2	4	20	2			
87-3	RX-7	2	1	4	3			26	2	1							20	2			
87-3	RX-8																				
87-3	RX-9	2	1	3	4			27	2	1					6	3	30	2			
87-3	RX-10	2	1	2	3			17	2	1							20	2			

Rehab	Worksite	Top Soil	Reveg	Redwood		DougFir		Alder	Avg. Stem		Tanoak		Madrone		Shrubs		Herb. Dry		Herb-Wet		Exotics
Project #	#	Restored	Treat	Height	Rank	Height	Rank	Height	Spacing	Rank	Height	Rank	Height	Rank	Height	Rank	% Cover	Rank	% Cover	Rank	Present
1	2	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
87-3	RX-6	2	1					15	2	1							30	2			
87-3	RX-4	2	1	3	3			25	2	1							50	2			
88-8	RX 134+29																				
88-8	RX 120+50																				
88-8	RX 114+12																				

Appendix XI. Stream crossing site characteristics data.

English units (ft or yd3)

Rehab Project #	Worksite #	Rehab Leader	Date Mapped	Mapped By	Watershed	Quad ID	Site Type	Erosion Process	Road Name	Year of Construct	Year of Rehab	Condition of Fill	Fill Failure Potential	Primary Treatment	2ndry Treat	Bdrx	Soil Code	Soil Depth
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	37	38	39
86-4	RX1	GJB	6/12/96	GWG,DJK,ALB	BRIDGE	RP	1	3	M-6-1	1969	1986	1	0	4	0	1	9,22	2
86-4	RX2	GJB	6/12/96	GWG,DJK,ALB	BRIDGE	RP	1	1	M-6-1	1969	1986	6,1	0	4	0	1	9,22	2
86-4	RX3	GJB	6/5/96	ALB,GWG	BRIDGE	RP	1	1	M-6-1	1969	1986	1,5,6	1	5	0	1	9 22	2
86-4	RX4	GJB	6/5/96	ALB,GWG	BRIDGE	BH	1	3	M-6-1	1969	1986	1,2	1	5	1	1	9 22	2
86-4	RX5																	
86-4	RX6	GJB	6/4/96	MAM,GWG,ALB	BRIDGE	RP	1	1	M-6-1	1969	1986	1	0	5	1	1	9,22	2
80-3	SX1-1	GJB&TH	6/18/96	GWG,DJK,ALB	BRIDGE	BH	1	1	M-6-1	1969-70	1980	1,2,6	0	4	1,2	1	9,22	2
80-3	SX2-1	GJB&TH	6/19/96	GWG,DJK,ALB	BRIDGE	BH	1	3	M-6-1	1969-70	1980	2,3,5,7	1	4	1,2	1	9,22	2
80-3	SX3-1	GJB&TH	6/19/96	GWG,DJK,ALB	BRIDGE	BH	1	3	M-6-1	1969-70	1980	2,4,5,6,7	1	4	1,2,4	1	9,22	2
80-3	SX4-1	GJB&TH	7/2/96	GWG,DJK,ALB	BRIDGE	BH	1	1	M-6-1	1969-70	1980	6	0	4	1,2,4	1	9,22	2
86-3	RX12	LEJ	7/10/96	BB, ALB	BRIDGE	RP	1	1	M-4 1/2	1960	1986	1	0	4	2	1	38	3
86-3	RX13	LEJ	7/10/96	BB, ALB	BRIDGE	RP	1	1	M-4 1/2	1960	1986	4,6,7	1	4	2	1	44	3
86-3	RX14	LEJ	7/10/96	BB, ALB	BRIDGE	RP	1	1	M-4 1/2	1960	1986	2,7	1	4	2	1	22	2
86-3	RX3	LEJ	7/16/96	ALB, DJK	BRIDGE	RP	1	1	M-5	1962	1986	2,8	1	4	2	1	32	2
86-3	RX6	LEJ	7/16/96	ALB, DJK	BRIDGE	RP	1	1	M-5	1962	1986	6	0	4	2	1	32,9	2
86-3	RX9	LEJ	7/16/96	DJK, ALB	BRIDGE	RP	1	1	M-5	1962	1986	2,3,4,5,6,7	1	4	2	1	9	2
86-3	RX1	LEJ	7/16/96	BB,GG	BRIDGE	RP	1	1	M-5	1962	1986	8	1	5	2	1	1	3
86-3	RX2	LEJ	7/16/96	BB,GG	BRIDGE	RP	1	1	M-5	1962	1986	8	1	5	2	1	1	3
86-3	RX4	LEJ	7/16/96	BB,GG	BRIDGE	RP	1	1	M-5	1962	1986	8	1	4	2	1	9,22	2
86-3	RX5																	
86-3	RX7	LEJ	7/16/96	BB,GG	BRIDGE	RP	1	3	M 5	1962	1986	2,4,5	1	4	1,2	1	22	2
86-3	RX8	LEJ	7/16/96	BB,GG	BRIDGE	RP	1	1	M-5	1962	1986	4,5	1	5	2	1	9	2
86-3	RX10	LEJ	7/16/96	BB,GG	BRIDGE	RP	1	1	M-5	1962	1986	1	0	5	0	1	22	2
88-3	RX2	GB	7/17/96	GG,BB	BRIDGE	BH	1	1	M-4	1957	1988	4	1	4	1,2	1	37	3
88-3	RX3	GB	7/17/96	GG,BB	BRIDGE	BH	1	1	M-4	1957	1988	7	1	5	2	1	22	2
88-3	RX4	GB	7/17/96	ALB,DJK	BRIDGE	BH	1	1	M-4	1957	1988	2,4	1	4	2	1	18	3
88-3	RX5	GB	7/17/96	ALB,DJK	BRIDGE	BH	1	1	M-4	1957	1988	2,7	1	4	2	1	22	2
88-3	RX6	GB	7/23/96	BB	BRIDGE	BH	1	1	M-4	1957	1988	2	1	4	2	1	9,27	3
88-3	RX7	GB	7/23/96	MAM,GWG	BRIDGE	BH	1	1	M-4	1957	1988	1	0	4	2	1	42	3
88-3	RX8	GB	7/23/96	MAM,GWG	BRIDGE	BH	1	1	M-4	1957	1988	2,5	1	4	2	1	31	2
88-3	RX1	GB	7/23/96	BEB,ALB,DJK	BRIDGE	BH	1	1	M-4-1	1972	1988	2,4	1	4	2	1	53	
90-3	RX20+35	DS	7/30/96	GWG,BEB	BRIDGE	RP	1	1	M-7	1962	1990	5	1	4	2,4	1	22,9	2
90-3	RX25	DS	7/30/96	DJK,GWG	BRIDGE	RP	1	1	M-7	1962	1990	2,4,5	1	4	2	1	9	3
90-3	RX12+00	DS	7/30/96	ALB,BEB	BRIDGE	RP	1	1	M-7	1962	1990	1	0	4	2	1	19	3
83-2	RX-1	TS,LJ	8/13/96	BEB,GWG	BRIDGE	BH	1	1	M-3-1	1964	1983	4,5,7	1	4	0	1	42	3
83-2	RX-2	TS,LJ	8/13/96	ALB,DJK	BRIDGE	BH	1	1	M-3-1	1964	1983	2,7	1	4	1	1	22,43	2
83-2	RX-3	TS,LJ	8/13/96	ALB,DJK	BRIDGE	BH	1	1	M-3-1	1964	1983	2,7,8	1	4	0	1	43	3
83-2	RX-4	TS,LJ	8/13/96	BEB,GWG	BRIDGE	BH	1	1	M-3-1	1964	1983	1,4,8	0	4	0	1	43	3
83-2	RX-5	TS,LJ	8/13/96	DJK,ALB	BRIDGE	BH	1	1	M-3-1	1964	1983	2,8	1	4	0	1	22	2
83-2	RX-6	TS,LJ	8/19/96	GWG,BEB	BRIDGE	BH	1	1	M-3-1	1964	1983	1	0	4	0	1		
83-2	RX-7	TS,LJ	8/19/96	GWG,BEB	BRIDGE	BH	1	1	M-3-1	1964	1983	2,4,7	1	4	1	1		
83-2	RX-8	TS,LJ	8/19/96	GWG,BEB	BRIDGE	BH	1	1	M-3-1	1964	1983	1	0	4	0	1		

Rehab Project #	Worksite #	Rehab Leader	Date Mapped	Mapped By	Watershed	Quad ID	Site Type	Erosion Process	Road Name	Year of Construct	Year of Rehab	Condition of Fill	Fill Failure Potential	Primary Treatment	2ndry Treat	Bdrx	Soil Code	Soil Depth
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	37	38	39
83-2	RX-9	TS,LJ	8/19/96	GWG,BEB	BRIDGE	BH	1	1	M-3-1	1964	1983	2,4	0	4	0	1		
83-2	RX-10	TS,LJ	8/19/96	GWG,BEB	BRIDGE	BH	1	1	M-3-1	1964	1983	4,5,7,8	1	4	0	1		
80-3	SX2-2	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	1	1	M-6-2	1971	1980	2,4,5	1	4	0	1	53	
80-3	SX1-2	GB,TH	9/10/96	ALB,GWG	BRIDGE	BH	1	1	M-6-2	1971	1980	1	0	4	1,2	1	37	3
80-3	SX3-2	GB,TH	8/12/96	ALB,GWG	BRIDGE	BH	1	1	M-6-2	1971	1980	2	1	4	2,6	1	53	
87-5	RXE102+00																	
87-5	RXE100+00	LEJ	8/20/96	BEB,GWG	BRIDGE	RP	1	1	M-3	1966	1987	1	0	1	2	1	53	
87-5	RXE95+00	LEJ	8/20/96	BEB,GWG	BRIDGE	RP	1	1	M-3	1966	1987	1	0	4	2	1	53	
87-5	RX79+05	LEJ	8/20/96	BEB,GWG	BRIDGE	RP	1	1	M-3	1966	1987	7,8	0	4	2	1	9	3
87-5	RXE44+00	LEJ	8/20/96	BEB,GWG	BRIDGE	RP	1	1	M-3	1966	1987	1	0	4	0	1	22	2
88-5	RX-9	MK	9/5/96	ALB,GWG	BRIDGE	RP	1	1	B-5-1	1965	1988	1	0	5	2	1	25	2
88-5	RX-8																	
88-5	RX-7	MK	9/5/96	ALB,GWG	BRIDGE	RP	1	1	B-5-1	1965	1988	2,7	1	5	2	1	22	2
87-3	RX-1	GB	9/10/96	ALB,GWG,MAM	BRIDGE	BH	1	1	M-6-2	1971	1987	4	0	5	2	1	9	3
87-3	RX-2	GB	9/10/96	ALB,GWG,MAM	BRIDGE	BH	1	1	M-6-2	1971	1987	4	0	4	2	1	9	3
87-3	RX-7	GB	9/17/96	ALB,GWG	BRIDGE	BH	1	1	M-6-2	1971	1987	1	0	4	2	1	22	2
87-3	RX-8																	
87-3	RX-9	GB	9/17/96	ALB,GWG	BRIDGE	BH	1	1	M-6-1	1971	1987	8	0	4	2	1	22	2
87-3	RX-10	GB	9/17/96	ALB,GWG	BRIDGE	BH	1	3	M-6-1	1971	1987	2,4,5,6	1	4	2	1	22	2
87-3	RX-6	GB	9/24/96	ALB,GWG	BRIDGE	BH	1	1	M-6-2-1	1971	1987	1	0	4	1,2	1	9	3
87-3	RX-4	GB	9/24/96	ALB,GWG	BRIDGE	BH	1	3	M-6-2-1	1971	1987	2,4,5,6	1	4	2	1	44	3
88-8	RX 134+29																	
88-8	RX 120+50																	
88-8	RX 114+12																	
	4010-2		1/12/97	TS,JF	DEVILS		1	1	M-2-1					9	0			
	11010-1		1/15/97	BAS	TOM MCDONALD		1	1	C-Line					9	0			
	11040-1		1/23/97	BAS	TOM MCDONALD		1	1	B-5					9	0			
	11040-3		1/23/97	BAS	TOM MCDONALD		1	3	B-5					9	0			
	11040-4		1/23/97	BAS	TOM MCDONALD		1	1	B-5					9	0			
	2040-4		1/18/97	TS/JF	BRIDGE		1	1	M-Line					9	0			
	2040-5		1/20/97	TS/JF	BRIDGE		1	1	M-Line					9	0			
	2040-9		1/18/97	TS/JF	BRIDGE		1	1	M-Line					9	0			
	2040-10		1/18/97	TS/JF	BRIDGE		1	3	M-Line					9	0			
	2050-1		1/23/97	BAS	BRIDGE		1	1	B-5					9	0			
	6030-1		1/22/97	DS	FORTY-FOUR		1	1	A-9-6-1					9	0			
	6040-1		1/15/97	BAS	FORTY-FOUR		1	1	A-9-9					9	0			
	1010-1		1/23/97	MS	BOND		1	2	M-11					9	0			
	5010-2		1/14/97	TS	ELAM		1	2	L-Line					9	0			
	5020-1		1/11/97	TS/JF	ELAM		1	1	L-1(West)					9	0			
	5040-1		1/20/97	MS	ELAM		1	1	L-2					9	0			
	5040-2		1/20/97	MS	ELAM		1	2	L-2					9	0			
	5070-1		1/14/97	TS	ELAM		1	1	L-4					9	0			
	5070-3		1/15/97	TS/JF	ELAM		1	3	L-4					9	0			
	5080-3		1/21/97	MS/AB	ELAM		1	3	L-5					9	0			
	8020-1		1/14/97	BAS	McARTHUR		1	1	A-9-7-1					9	0			
	10030-2		1/20/97	TS/JF	REDWOOD		1	1	M-8					9	0			

Rehab Project #	Worksite #	Existing Feature	Crossing Grade (%)	Grade Upstream	Grade Dwnstrm	Crossing Width	Width Upstream	Width Dwnstrm	Length of crossing	Total Drop (ft)	Drop due to Wood	Drop due to Rock	#Wood Steps	#Rock Steps	Dominant Bed Mat.	Bedload Transport	Diversion Potential	Now Diverted
1	2	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
86-4	RX1	2,3	26	18	22	18	10	6	80	21	0	16	0	4	3	1	0	0
86-4	RX2	2,3	41	65	48	5	8	5	100	38	5	9	2	3	3,2	2	0	0
86-4	RX3	2,3	28	19	25	2	3	4	50	13	0	5	0	1	2	3	0	0
86-4	RX4	2,3	34	38	38	6	3	6	38	12	0	5	0	4	2	2	0	0
86-4	RX5																	
86-4	RX6	2,3	20	20	22	6	4	8	93	22	3	16	2	8	2	1	0	0
80-3	SX1-1	2,3	17	6	60	8	7	4	43	7	0	6	0	1	3	2	0	0
80-3	SX2-1	2	35	30	40	20	12	6	60	20	0	0	0	0	6	3	0	0
80-3	SX3-1	2,3,4	35	24	28	3		3	30	10	2	0	1	0	5,6	3	0	0
80-3	SX4-1	2,3	20	25	25	4	4	4	35	7	5	0	1	0	2	3	0	0
86-3	RX12	2	18	47	22	7	10	7	50	9	0	3	0	2	4	1	0	0
86-3	RX13	2,3	51	53	43	3	3	2	42	19	3	0	1	0	2	2	0	0
86-3	RX14	2,3,4	37	53	63	3	3	7	50	17	5	2	2	1	2	1	0	0
86-3	RX3	2,3	25	28	20	5	4	4	77	19	0	2	0	1	2,4,7	2	0	0
86-3	RX6	2,3	20	52	28	12	6	7	47	9	2	2	1	1	2,4	2	0	0
86-3	RX9	1,2,3	32	55	50	5	8	3	53	15	0	0	0	0	2,4	2	0	0
86-3	RX1	3	34	34	36	4	4	3	47	18	3	8	2	4	2	3	0	0
86-3	RX2	3	30	65	45	2	2		60	18	0	0	0	0	2	3	0	0
86-3	RX4	2,3	15	35	18	6	4	6	141	20	13	5	4	3	2	2	0	0
86-3	RX5																	
86-3	RX7	2	13	25	54	5	4	6	80	11	0	10	0	3	1	3	0	0
86-3	RX8	3	31	38	28	4	12	6	64	20	0	24	0	7	2	2	0	0
86-3	RX10	3	20	30	25	4	2	3	88	17	2	0	2	0	2	2	0	0
88-3	RX2	3	30	40	60	7		6	87	25	0	20	0	3	2	2	0	0
88-3	RX3		29	45	50	4	10	2	110	30	0	7	0	3	2	2	0	0
88-3	RX4	2,3,4	35	53	42	2	3	1	60	20	0	0	0	0	2	2	0	0
88-3	RX5	4	45	62	60	4	15	8	50	20		2		1	2	2	0	0
88-3	RX6	2,3	18	18	27	10	15	10	122	21	4	0	1	0	2	1	0	0
88-3	RX7	2,3	33	55		10			120	40	5	14	2	8	2	2	0	0
88-3	RX8	2,3	14	25	12	16	9	20	90	13	2	4	2	3	2	2	0	0
88-3	RX1	3	7	7		18	18	22	91	3	3	0	1	0	2,6	2	0	0
90-3	RX20+35	2,3	11	10	11	6	4	4	190	20	4	3	2	3	2	2	0	0
90-3	RX25	2,3	25	35	15	8	3	10	110	26	9	6	5	3	2	1	0	0
90-3	RX12+00	2	5	5	13	12	10	15	46	7	0	2	0	2	2	2	0	0
83-2	RX-1	1,4	25	50	47	5	4	5	38	9	0	0	0	0	2	2	0	0
83-2	RX-2	1,4	40	35	31	2		3							2,7	2	1	0
83-2	RX-3	2,3	48	48	60	5			50	22					2	3	1	0
83-2	RX-4	3	22	25	25	4	3	4	104	22	2	8	1	5	2	3	0	0
83-2	RX-5	2	43	40	42	4			64	25	3	2	2	1	2	2	0	0
83-2	RX-6	3	29	42	48	3	3	8	63	17	0	0	0	0	2	2	0	0
83-2	RX-7	3	28	30	30	3	2	3	64	18	5	5	2	3	2	2	0	0
83-2	RX-8	3	20	45	45	3	3	3	40	8		1		1	2	2	0	0

Rehab Project #	Worksite #	Existing Feature	Crossing Grade (%)	Grade Upstream	Grade Dwnstrm	Crossing Width	Width Upstream	Width Dwnstrm	Length of crossing	Total Drop (ft)	Drop due to Wood	Drop due to Rock	#Wood Steps	#Rock Steps	Dominant Bed Mat.	Bedload Transport	Diversion Potential	Now Diverted
1	2	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
83-2	RX-9	2,3	20	25	45	6	12	4	70	12	5	5	1	2	2	2	0	0
83-2	RX-10	2,3	43	40	31	10	7	12	64	25	0	0	0	0	6	1	0	0
80-3	SX2-2	2,3	30	47	55	4		4	62	18	0	8	0	5	2	3	0	0
80-3	SX1-2	2	15	10	21	22	26	26	100	16	1	5	1	3	2	1	0	0
80-3	SX3-2	2,3	28	5	6	12	6	6	80	22	12	0	3	0	6	2	0	0
87-5	RXE102+00																	
87-5	RXE100+00	2,3	17	12	43	2	1	4	62	11	0	0	0	0	7	3	0	0
87-5	RXE95+00	3	12	22	32	2			70	9	0	0	0	0	7	3	0	0
87-5	RX79+05	3,4	20	5	15	1			95	18	0	0	0	0	7	3	0	0
87-5	RXE44+00	3	5	5	5	4	8	3	25	1	0	0	0	0	2	2	0	0
88-5	RX-9	3	22	15	40	5	2		35	4	3	0	2	0	2	2	0	0
88-5	RX-8																	
88-5	RX-7	2,3	25	5	18	4	2		90	22	3	0	1	0	2	2	0	0
87-3	RX-1	2,3	26	25	30	3	4	8	142	37	19	8	14	6	2,6	2	0	0
87-3	RX-2	2,3	28	30	60	4	5	3	133	37	11	15	6	10	2	2	0	0
87-3	RX-7	2,3	18	13	30	4	8	5	140	24	1	8	1	5	2	2	0	0
87-3	RX-8																	
87-3	RX-9	3	33	47	12	2	2	2	58	18	8	3	3	2	5	3	0	0
87-3	RX-10	2,3	18	28	40	9	15	10	65	11	1	0	1	0	2	2	0	0
87-3	RX-6	3	12	17	60	2	5	4	39	5	0	3	0	3	2	3	0	0
87-3	RX-4	2,3	23	54	42	20	25	18	79	18	0	2	0	1	6	2	0	0
88-8	RX 134+29																	
88-8	RX 120+50																	
88-8	RX 114+12																	
	4010-2																	
	11010-1																	
	11040-1																	
	11040-3																	
	11040-4																	
	2040-4																	
	2040-5																	
	2040-9																	
	2040-10																	
	2050-1																	
	6030-1																	
	6040-1																	
	1010-1																	
	5010-2																	
	5020-1																	
	5040-1																	
	5040-2																	
	5070-1																	
	5070-3																	
	5080-3																	
	8020-1																	
	10030-2																	

Rehab Project #	Worksite #	MM Feature	Hillslope Position	Topogr. Position	BIS	%Slope Above	%Slope Below	Dist. to Stream	Activity Level	Avg Scarp Ht.	Range Scarp Ht.	Features Present	Tr=5 Qpk	Tr=18 Qpk	Drainage Area (sq miles)
1	2	58	59	60	61	62	63	64	65	66	67	68	97	98	115
86-4	RX1	2	3	1	0			0,20	1	2	1,3	2,6,10	109	183	0.5
86-4	RX2		3										28	35	0.1
86-4	RX3		3										21	26	0.1
86-4	RX4	2	3	1	0	58	62	0	1	1	0,2	2,6,7,8,9	6	7	0.0
86-4	RX5														0.0
86-4	RX6	5	3	1	0			0	1	5	3,7	6,8	56	95	0.2
80-3	SX1-1		3										66	110	0.2
80-3	SX2-1	7	3	1	0	30	35	0,10	1	5	4,6	2,6,9	21	26	0.1
80-3	SX3-1	7	3	1	1	22	35	0,20	1	2	.5-3	1,4,5,6	6	8	0.0
80-3	SX4-1		3										13	16	0.0
86-3	RX12		2										30	38	0.1
86-3	RX13		2										13	16	0.0
86 3	RX14		2										6	7	0.0
86-3	RX3		2										22	28	0.1
86-3	RX6		2										38	67	0.2
86-3	RX9		2										25	32	0.1
86-3	RX1		2										6	7	0.0
86-3	RX2		2										8	10	0.0
86-3	RX4		2										49	85	0.2
86-3	RX5														0.0
86-3	RX7	7	2	1	0			0	1	1	0,2	2,6,10	12	15	0.0
86-3	RX8		2										8	10	0.0
86-3	RX10		2										4	5	0.0
88-3	RX2		3										19	23	0.1
88-3	RX3		3										6	7	0.0
88-3	RX4		3										6	7	0.0
88-3	RX5		3										6	7	0.0
88-3	RX6		3										67	114	0.3
88-3	RX7		2										11	14	0.0
88-3	RX8		2										102	171	0.4
88-3	RX1		3										196	326	0.9
90-3	RX20+35		3										52	83	0.2
90-3	RX25		3										23	28	0.1
90-3	RX12+00		3										239	388	1.0
83-2	RX-1		1										11	14	0.0
83-2	RX-2		1										8	11	0.0
83-2	RX-3		1										5	4	0.0
83-2	RX-4		1										11	19	0.1
83-2	RX-5		1										7	9	0.0
83-2	RX-6		1										3	4	0.0
83-2	RX-7		1										6	8	0.0
83-2	RX-8		1										7	9	0.0

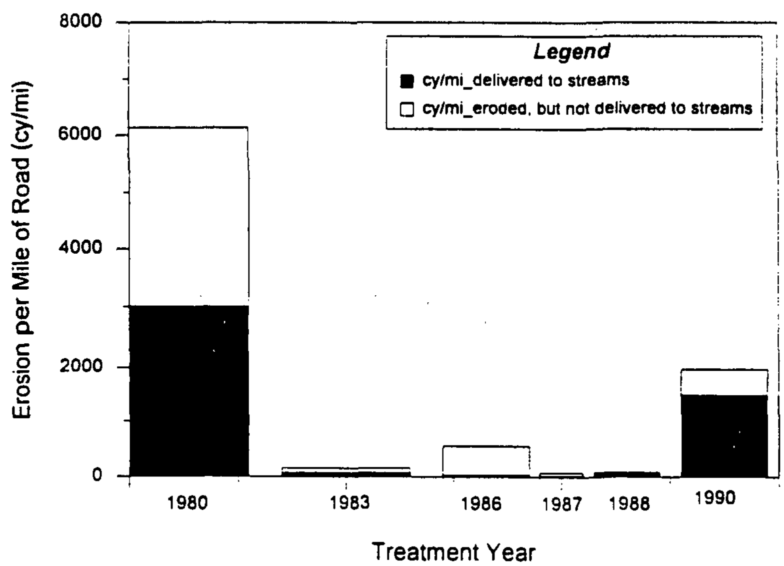
Rehab Project #	Worksite #	MM Feature	Hillslope Position	Topogr. Position	BIS	%Slope Above	%Slope Below	Dist to Stream	Activity Level	Avg. Scarp Ht.	Range Scarp Ht.	Features Present	Tr=5 Qpk	Tr=18 Qpk	Drainage Area (sq miles)
1	2	58	59	60	61	62	63	64	65	66	67	68	97	98	115
83-2	RX-9		1										11	13	0.0
83-2	RX-10		1										11	14	0.0
80-3	SX2-2		3										5	6	0.0
80-3	SX1-2		3										223	362	1.0
80-3	SX3-2		3										51	83	0.2
87-5	RXE102+00														0.0
87-5	RXE100+00		1										3	4	0.0
87-5	RXE95+00		1										6	7	0.0
87-5	RX79+05		1										4	5	0.0
87-5	RXE44+00		1										53	83	0.2
88-5	RX-9		1										7	8	0.0
88-5	RX-8														0.0
88-5	RX-7		1										24	30	0.1
87-3	RX-1		3										9	11	0.0
87-3	RX-2		3										12	14	0.0
87-3	RX-7		3										63	105	0.2
87-3	RX-8														0.0
87-3	RX-9		3										8	10	0.0
87-3	RX-10	2,6	3	1	1	19	40	0,6	3	3	2,4	2,5,10	4	5	0.0
87-3	RX-6		3										2	3	0.0
87-3	RX-4	4	3	1	1	40	23	0	1	9	4,12	1,2,5,6,10	6	7	0.0
88-8	RX 134+29														0.0
88-8	RX 120+50														0.0
88-8	RX 114+12														0.0
	4010-2	6	3												
	11010-1	6	2												
	11040-1	6	2												
	11040-3	6	2												
	11040-4	6	2												
	2040-4	6	2	1											
	2040-5	6	2	1											
	2040-9	6	2												
	2040-10	6	2												
	2050-1	6	2												
	6030-1	6	1	3											
	6040-1	6	2												
	1010-1	6	3	1											
	5010-2	6	3												
	5020-1	6	1												
	5040-1	6	1	2											
	5040-2	4	3												
	5070-1	6	3												
	5070-3	6	3												
	5080-3	6	3	1											
	8020-1	6	2												
	10030-2	6	3	1											

Appendix XII. Medium and high priority, road reach failures (1997 storm erosion).

	Upper/Middle Hillslope			Lower Hillslope		
	treated	minimally treated	untreated	treated	minimally treated	untreated
Total Volume of Erosion (cy)	371	2277	41510	968	6843	10115
Miles of Roads Inventoried (mi)	3	6	20	2	5	27
Volume of Erosion per Miles of Road Inventoried (cy/mi)	**128**	**400**	**2076**	**461**	**1488**	**377**
Total Volume of Sediment Delivered to Channel (cy)	109	106	36960	718	2232	8710
Volume of Sediment Delivered to Channel per Miles of Road Inventoried (cy/mi)	**37**	**19**	**1848**	**342**	**485**	**324**

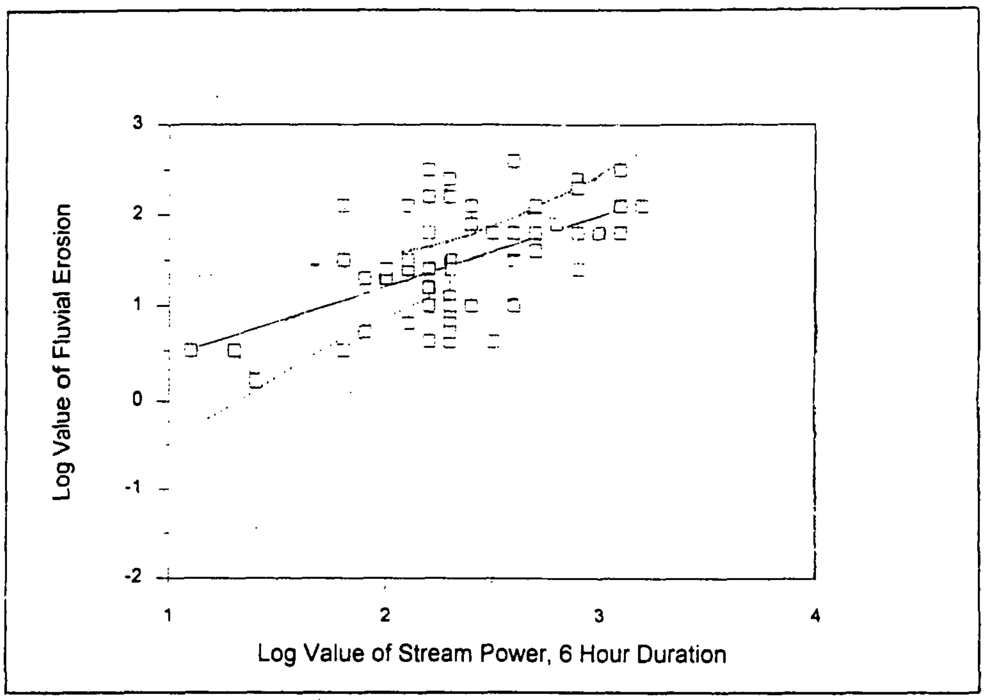
Appendix XIII. Erosion and subsequent sediment delivery to streams per year of treatment in the Bridge Creek watershed.

SEE p. 52 - INFERS 1997 EROSION ONLY

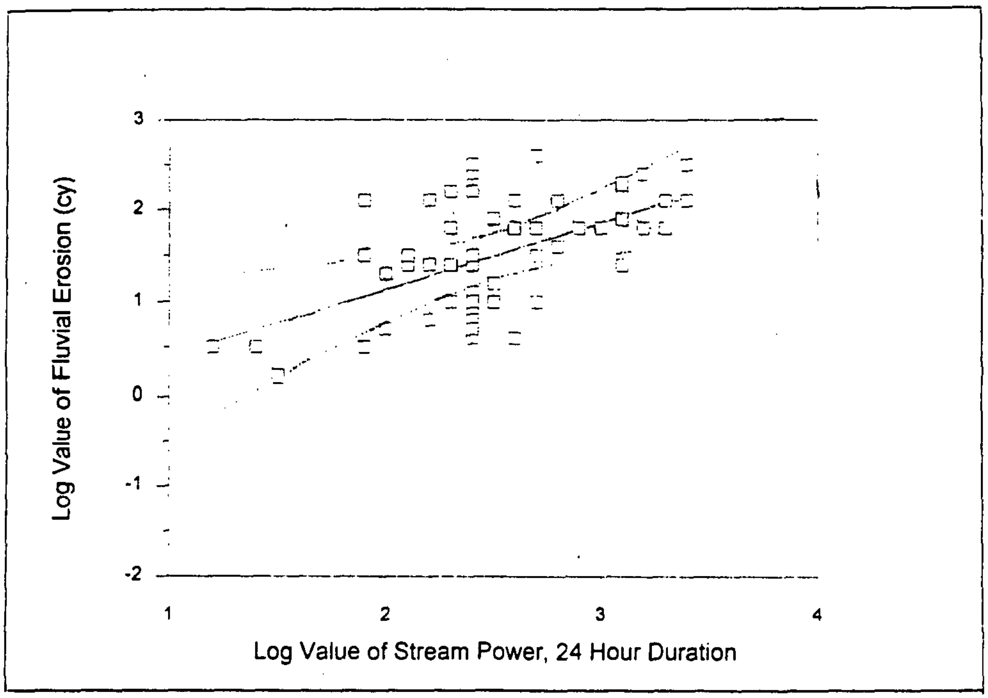


Appendix XIV. Volumes of Bridge Creek road reach failure sites (erosion since treatment).

	Export	Minimally	Fill
Outslope	Outslope	Treated	Site
1040	83	12	92
35	74	14	11
12	50	7	3
218	167	3	3
4	155	65	4
33	217	11	
117	255	311	
	462	2863	
	251	678	
	26	26	
	6	100	
	154	127	
		143	
		11	
		5	
		50	
		1180	
		9	
		3085	
		7	
		19	
		740	
		111	
		2166	
		83	
		246	
		667	
		78	
		558	
		90	
		82	


3
2
1
0
-1
-2
Log Value of Fluvial Erosion
1
2
3
4
Log Value of Stream Power, 6 Hour Duration

Appendix XVI. Fluvial erosion vs. stream power, based on 24 hour storm duration.



Appendix XVII. Stream crossing failures on treated stream crossings (1997 storm related erosion).

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P.69

Type of Treatment:	*Partial Excavation*	*Total Excavation*
Mean Failure Volume (cy)	121	130
Median Failure Volume (cy)	110	59
Standard Deviation	121	169
Minimum Failure Volume (cy)	3	3
Maximum Failure Volume (cy)	425	743
Total Volume of Erosion (cy)	2421	6257
Normalized Volume (Volume Divided by # of Sites Inventoried)	**115**	**112**
Number of Sites that Failed	20	48
Number of Sites Inventoried	26	60
% of Inventory Sites that Failed	**77**	**80**
% of Volume that is Fluvial Erosion	100	100

8678

→ checks w/ text on p.69