

RECENT WATERSHED CONDITIONS OF
STRELOW CREEK BASIN
IN THE VICINITY OF
REDWOOD NATIONAL PARK, CALIFORNIA

Prepared
by
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Abstract

This report describes the physical and hydrologic characteristics of Streelaw Creek Watershed, which is located in Redwood National Park, California, and also discusses how previous logging practices contribute to the total sediment yield of the area.

May 29, 1963

INTRODUCTORY SUMMARY

Streelow Creek watershed (2.81 sq. mi.) is located within Redwood National Park, in the northcoast region of California. The basin is characterized by moderate to steep slopes, highly erodible bedrock and soils, and extensive land-surface disturbance from previous logging activities. Streelow Creek is a small 3rd order stream with a drainage density of 2.08 mi./mi². It has an overall stream length of 5.66 mi. Despite its small size, the watershed has a high sediment yield, and it is an important contributor to the problem of sedimentation in the area. Factors that contribute to this high sediment yield are the area's unstable geology and soils; high precipitation rates (70 in./yr.), which frequently occur during intense winter storms; and logging history, which disturbed over 90 percent of the surface area within the last three decades and left 40 percent of that land covered with skid trails, haul roads, and landings.

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INTRODUCTION

Previous land-use practices, intense precipitation, and the erodible underlying geology are factors that have contributed to the erosive nature of Streelov Creek Watershed. The sediment yield rates for small streams, such as Streelov Creek, are a fraction of those for larger rivers, but the large numbers and total stream lengths of these small streams make them important contributors to the overall sediment yield of northern California.

Streelov Creek is a tributary of Prairie Creek and a sub-tributary of Redwood Creek. Streelov Creek and Redwood Creek have similar geology, experience the same rainfall intensity, and have both been heavily impacted by previous logging practices. Extensive U.S.G.S. research on Redwood Creek Basin has documented a set of geologic, climatic, and land management conditions that have combined to cause Redwood Creek to be the most highly erosive of all north-coast rivers (Janda et al, 1975).

Purpose

The purpose of this report is to present and evaluate the physiographic and hydrologic characteristics of Streelov Creek Watershed. This study includes the stream channel proper and the area

within the topographic boundaries of the watershed.

Since the formation of Redwood National Park in 1966, there has been an ongoing process to devise a viable land management plan for the park. This report is intended to add to the pre-existing body of knowledge on north coast rivers and sediment yield within the Redwood Creek unit and facilitate the creation of an appropriate management plan.

METHODS AND MATERIALS

This study was broken down into the following three components: (1) research, (2) office and map work, and (3) field investigation. The research phase was used to accumulate information on the following: precipitation records, land-use history, geology of the area, vegetation and soils in the area, and the results of previous, more extensive studies in adjacent basins.

In the office, opisometers, planimeters, air photos (1977), and topographic maps were used to determine watershed boundaries, physiographic characteristics, and locations for the sample plots investigated in the field.

In the field, standard watershed evaluation forms (Appendix A) were used to evaluate the following three site types: (1) Two 100-ft land transects, one disturbed with south exposure and one relatively undisturbed with north exposure; (2) Two 50-ft stretches of stream and channel; (3) Two 500-ft reaches of roads, one remnant haul road and one skid road. The field investigations were conducted during four separate trips into the field.

The .6 method and an audio pycometer were used to measure stream velocity. A ring infiltrometer was employed to determine the infiltration rates of each land and road transect. Only one (dry run) application of water was needed for each test because soil was still in a saturated state at the time of the study.

BASIN DISCRIPTION

Location

Streelow Creek lies within the Redwood Creek Unit of Redwood National Park. The confluence of Streelow and Prairie Creeks is .8 mi upstream of Prairie Creek Fish Hatchery and it is approximately 5 mi north of Orick, California (Fig. 1:p4). The watershed is located on the westside of U.S. 101, and the main channel flows, generally, west to east. The upper basin is accessible from Davidson Road, and the lower basin is within walking distance of Prairie Creek Park Headquarters.

Climate

The regional climate is cool and moist, and rainfall is seasonally abundant. The area experiences nearly constant average temperatures. Seasonal average temperatures vary only 15 degrees, between 45° F and 65° F (Fig. 2: p5).

Records indicate precipitation primarily falls between June and October, and an average annual precipitation of 70.94 in. is recorded at Orick, California (Fig. 3: p6). The area experiences frequently prolonged, moderately intense winter storms (Fig. 4: p7). It is this climatic feature that contributes significantly to the high surface runoff, the

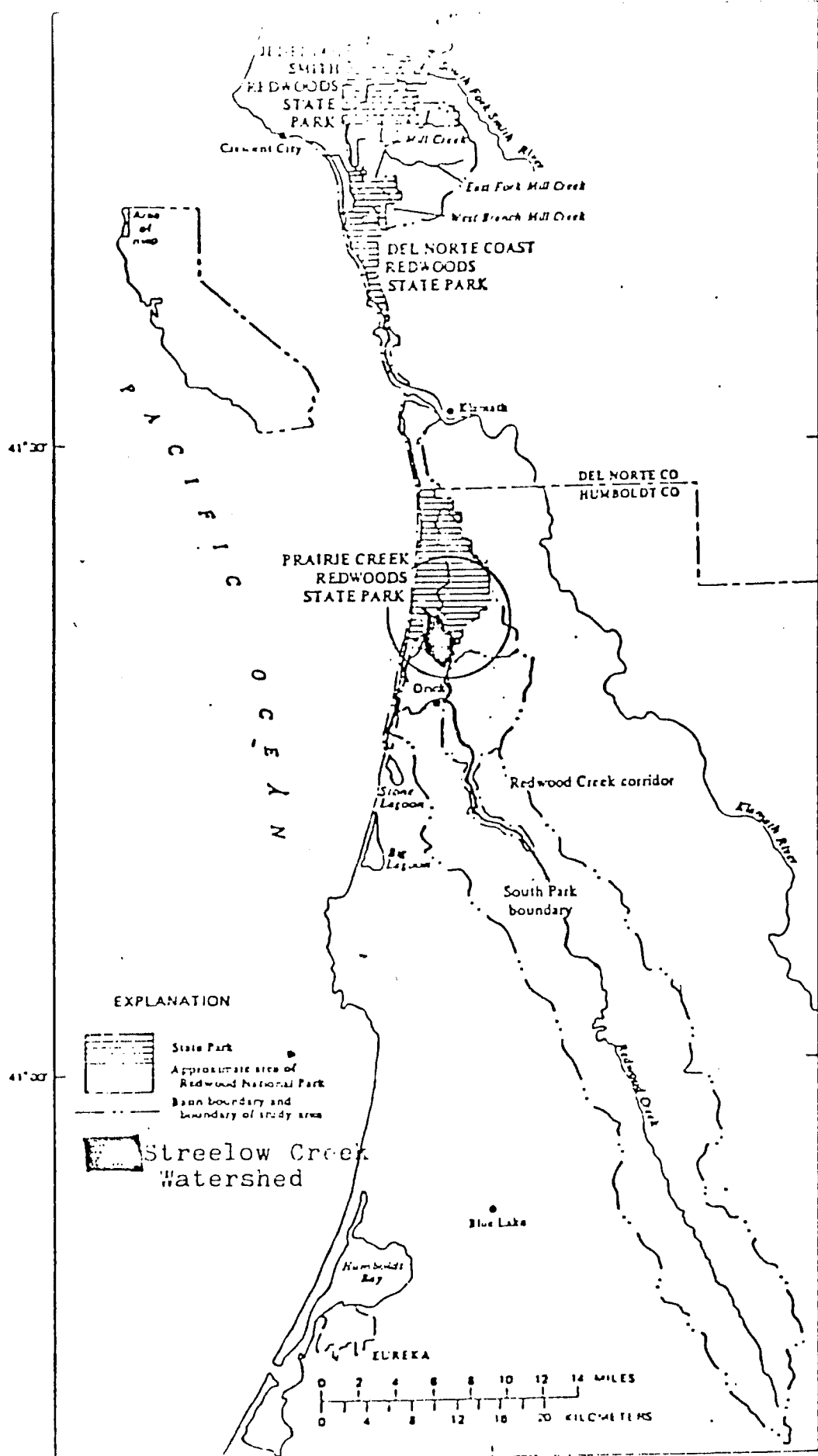


Figure 1. Location map for Streelaw Creek Watershed (from Janda, R.J. 1977. Summary of watershed conditions in the vicinity of Redwood National Park, Calif. U.S. Geol. Survey open-file rept.)

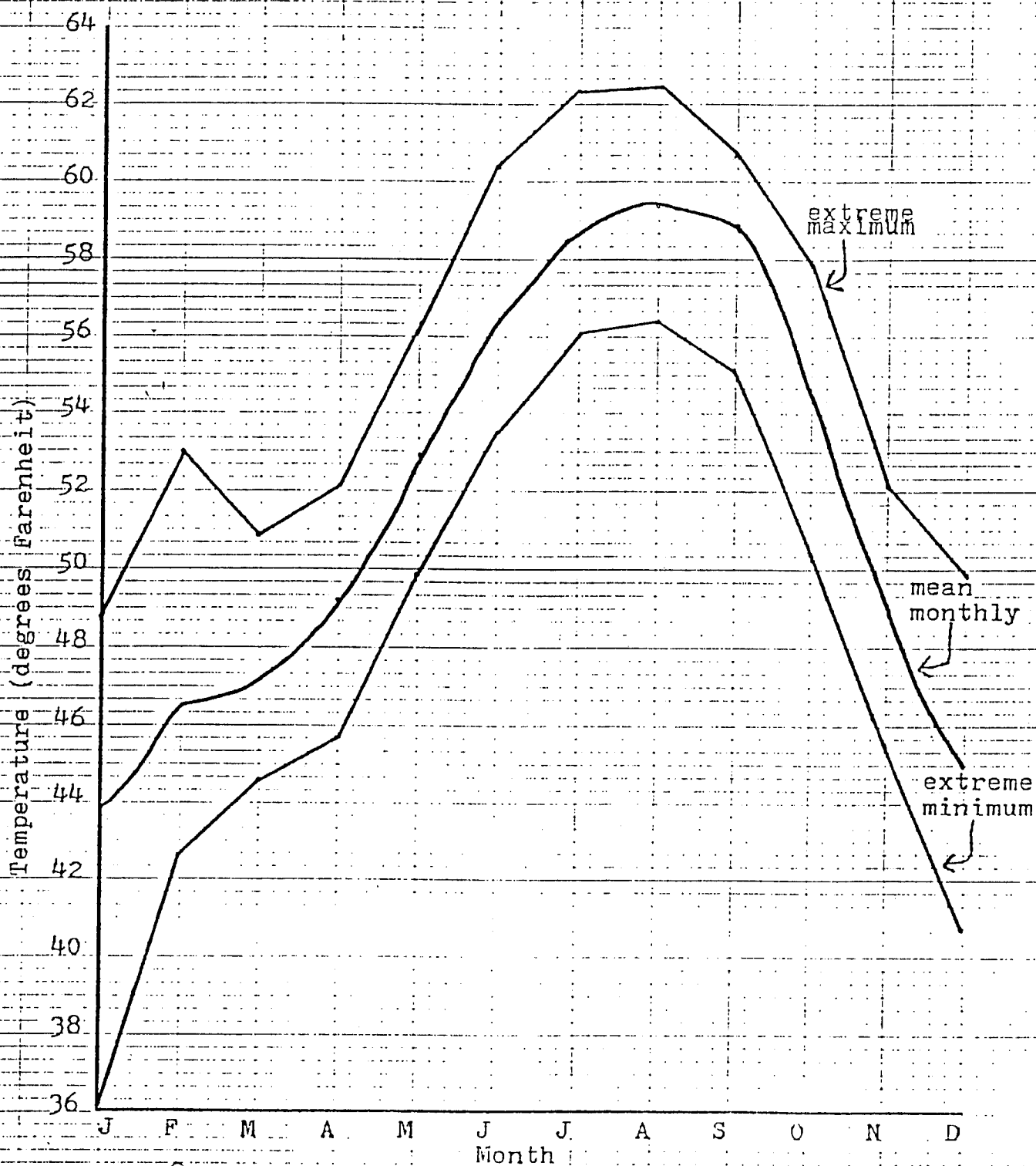


Fig. 2. Extreme maximum, extreme minimum, and mean monthly temperature at Orick, Ca., 1941-1970. (Data from Elford and McDonough).

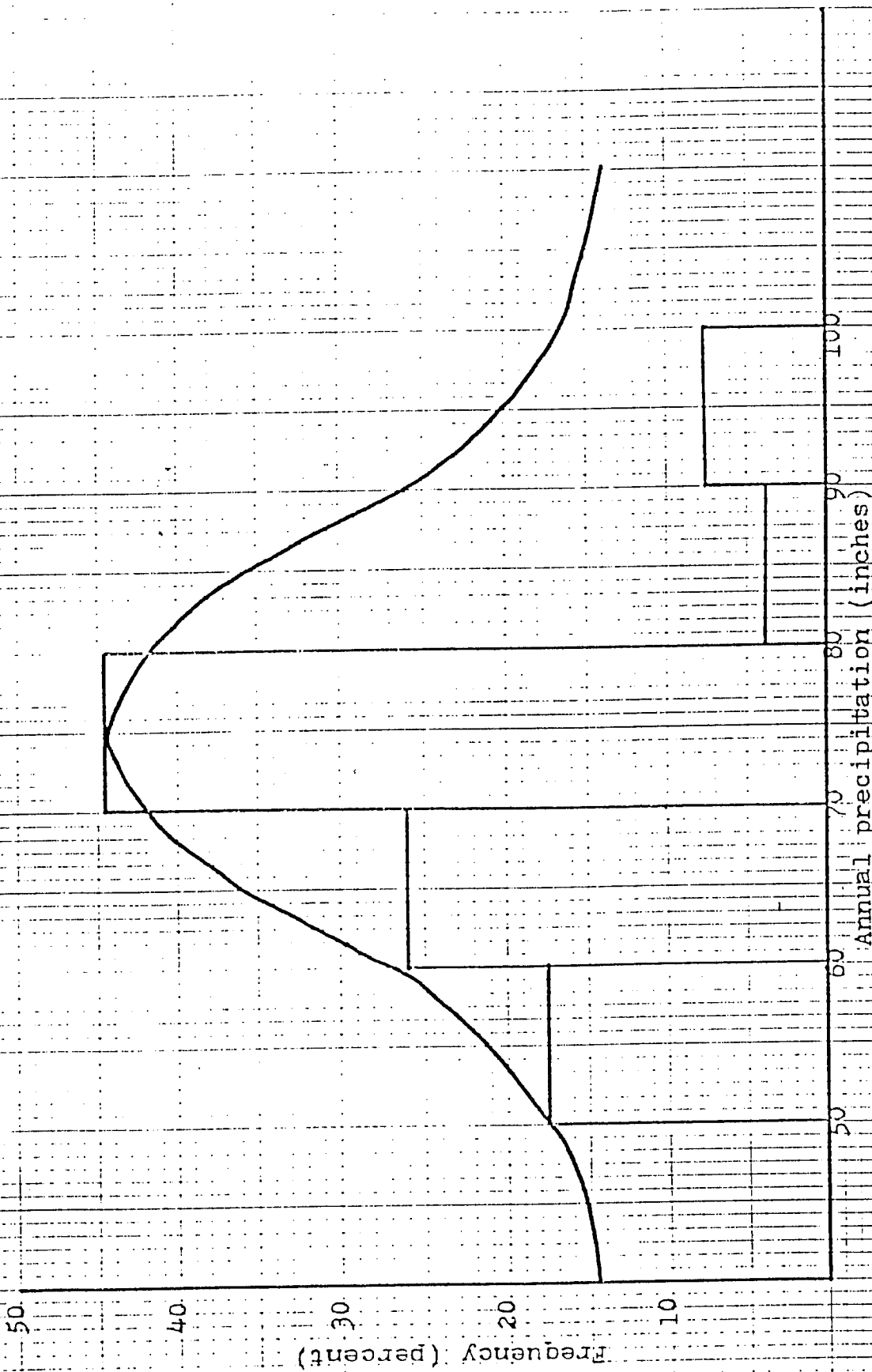


Fig. 3. Frequency distribution of annual precipitation at Orick, Ca., 1950-1978; the mean is 70.94" and the standard deviation is 11.84. (Data from the National Oceanic and Atmospheric Administration.)

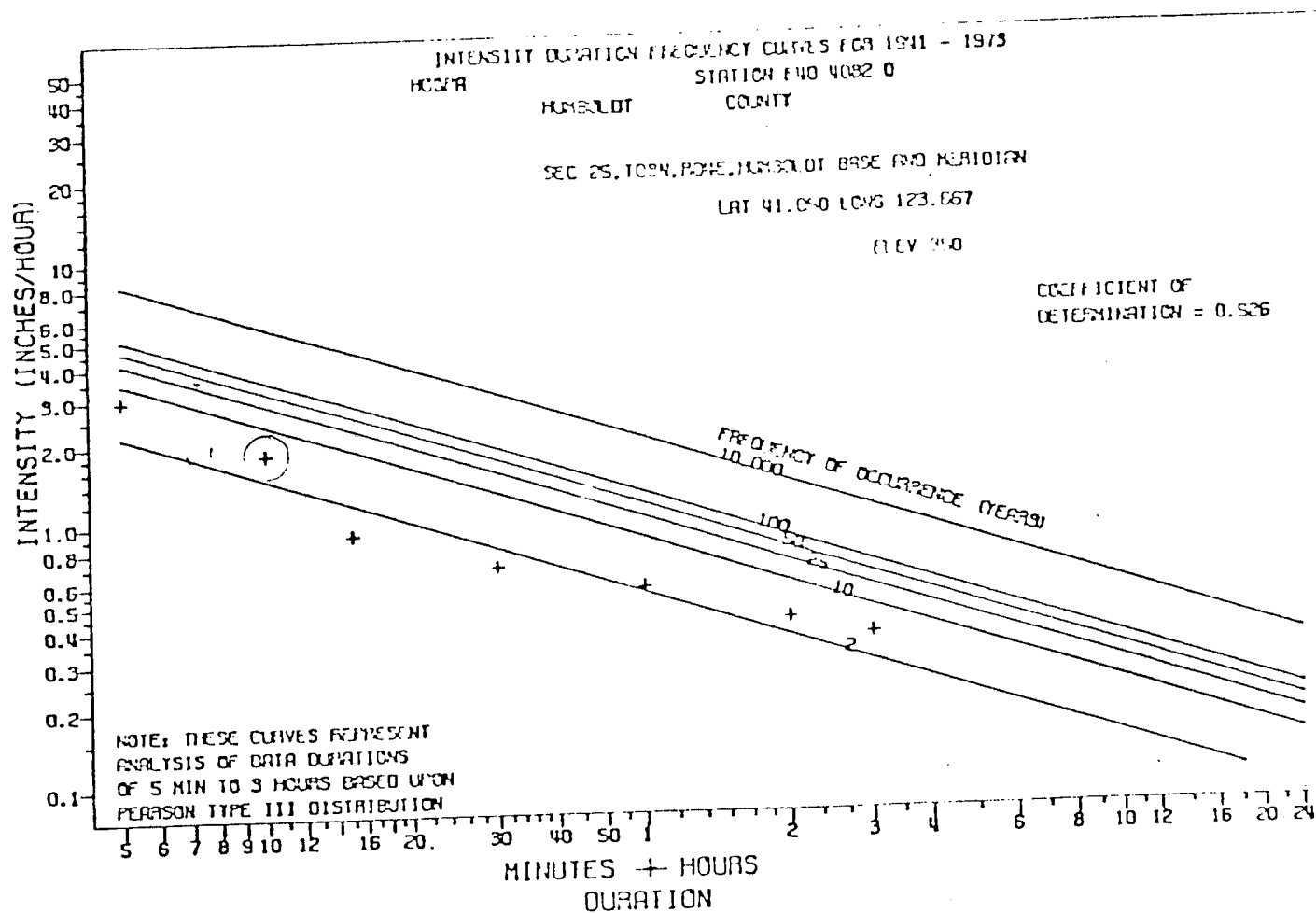


Figure 4. Intensity Duration Curves showing precipitation intensity-duration-frequency curves for Hoopa, CA, 1941-1973. (Reprinted from Ca. Dept. of Water Resources, Bulletin 195, Vol. 3).

predominant fluvial process responsible for surface erosion. The major erosion-causing storms in 1953, 1955, 1964, 1972, and 1975, even when viewed from a historical perspective going back to the late 19th century, appear to have been exceptionally intense (Janda, 1977: p70). Note that these storms coincide with a period of intensified logging causing maximum surface disturbance (Fig. 6: p10).

The relative humidity is greater than 80 percent during morning hours, and during the day the relative humidity generally remains at 60 percent. There are small monthly differences in these humidity levels, which are characteristic of a coastal redwood biome (California, State of, 1979).

Geology

The bedrock in the basin consists of the Cretaceous Franciscan formation, which contains interbedded greywacke, shales, minor conglomerates, and thin bedded chert. Overlying the formation is a variable thickness of Plio-Pleistocene nonmarine sedimentary rocks, which consist of poorly sorted sands and gravels of the undifferentiated Gold Bluffs formation (DeMonthe, 1972). This unit acts as a mammoth reservoir that feeds underground water into individual beds of the underlying Franciscan formation.

In the portion of StreeLOW Creek basin adjacent to and upslope of the main channel, the Gold Bluffs formation is not present (Fig. 5: p9). This leaves the Franciscan formation as the pervasive underlying material which, when exposed, weathers to a mixture of noncohesive soils that are highly susceptible to erosion by running water and of clayey soils

- REDWOOD NATIONAL PARK
 --- PRAIRIE CREEK REDWOODS STATE PARK
 ~~~~~ ALTERNATIVE B RIGHT OF WAY  
 [ ] GOLD BLUFFS FORMATION  
 (GEOLOGIC BOUNDARIES ARE TENTATIVE)  
 [ ] FRANCISCAN FORMATION  
 (GEOLOGIC BOUNDARIES ARE TENTATIVE)  
 [ ] STREAM DEPOSITS  
 BEACH SANDS etc

 Streelow Creek  
 Watershed

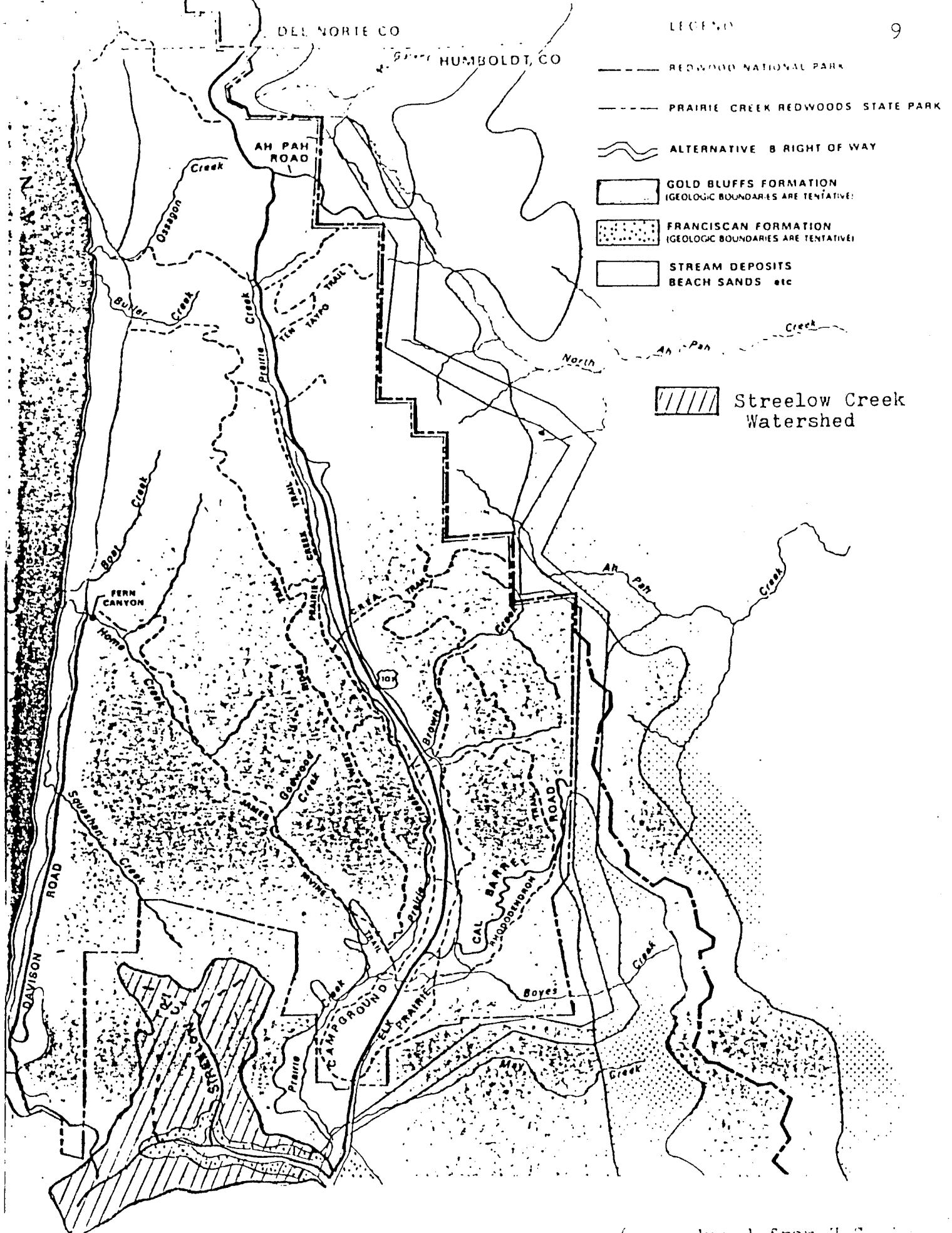


FIG. 5. GEOLOGY

(reproduced from U.S. Trans., 1911)

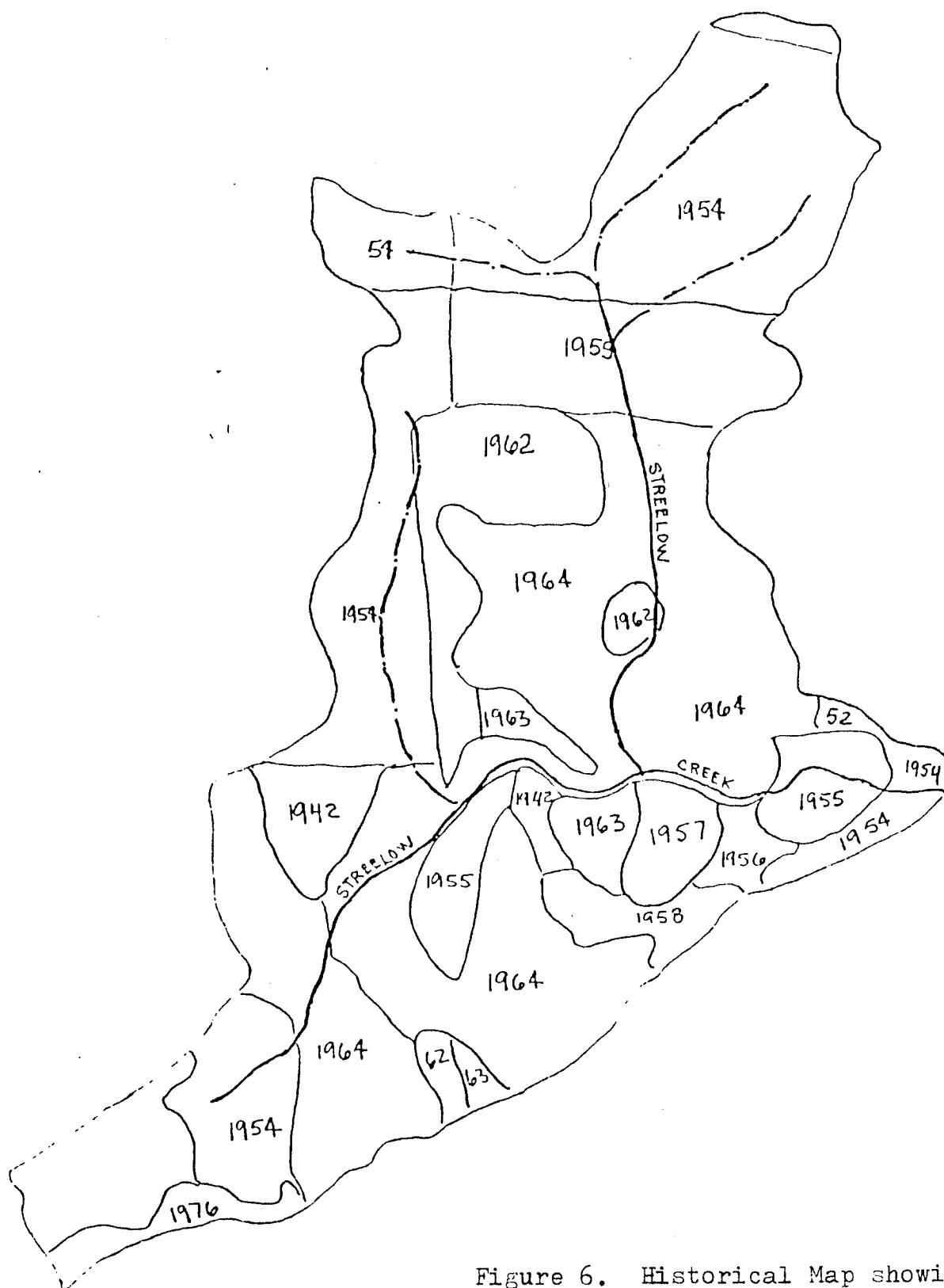


Figure 6. Historical Map showing logged areas within the StreeLOW Creek Watershed, Covering the years 1942-1976.

that are susceptible to mass failure when wet (Janda, 1977). This latter group of rocks underlies much of northwestern California and is widely known for its highly erosive potential.

### Soils

The area has clay and gravelly loam soils that are moderately to strongly acidic, and they extend to depths of 4 ft or more. All soils within the basin have a moderate to high potential for erosion damage. The area's slopes are hilly to steep (20 to 70 percent), thereby increasing the possibility of erosion damage. The most common soil series present are the Melbourne and Mendocino (U.S. Dept. Trans., 1981).

All of these soils are moderately to rapidly permeable in the undisturbed state, and drainage ranges from imperfect (Melbourne) to good. The infiltration rates observed in the field were averaged and tabulated as follows: 9 ml/sec for undisturbed land, .5 ml/sec for skid trails, and .05 ml/sec for haul roads. Disturbed soils cannot accept much water during periods of intense rainfall, thereby increasing surface runoff.

### Vegetation

The area is predominantly a second-growth coniferous forest. Douglas Fir and Redwood are the primary overstory species. In the upper portion of the watershed, exposed soils are widespread and logging slash is abundant. Early successional shrubs and plants are common throughout the basin.

Riparian vegetation is found adjacent to the streams where Red

Alder is the common overstory species. Sword Fern and sedges are found in the understory. Large logs and slash were often pushed into the streams, in conjunction with previous logging activities, and used as bridges. These Humboldt Bridges' cause restrictions in the stream channel, and they contribute significantly to streambank erosion (Freeland, 1983 pers. comm.)

### Wildlife

Prairie Creek State Park and Redwood National Park contain a variety of wildlife habitats. Representative species associated with each habitat are listed in Appendix B. Abundant elk, deer, coyote, and bear sign were observed in the field.

The deer and elk in the basin are of importance to this discussion because of their contribution to sediment yield. Their populations tend to concentrate in burned and logged over areas. Abandoned skid trails become well traveled deer trails, exposing wide paths and further compacting the soil. Heavy deer use prolongs the period of time that logged or burned areas are exposed to erosion (U.S.D.A., 1970).

### Land Use

Steelelow Creek Basin has been severely impacted by previous land-use practices, especially tractor and clearcut logging. Over 90 percent of the land surface has been disrupted in the last three decades (Fig. 6: p10). Forty percent of the harvested area was covered with roads, skid trails, layouts, and landings. Air photos show that over 30 percent of the upper basin has not been revegetated. Areas of sheet

gully erosion are highly visible. Bare ground, exposed to the high kinetic energy from raindrops, shows pedestals up to 5 in high under large rocks. This displaced soil ends up in the stream as sediment.

Areas logged prior to 1955 often show excessive and improperly located skid trails, landings, and inadequate postharvest erosion control treatment. During the late 1950's, erosion control treatments became standard practice on national forest land. However, the present sediment rates from logged areas in the national forests still reflect the 20-to-25 year old logging; these rates are higher than would be expected if the areas had been logged under present standards.

## **HYDROLOGIC PARAMETERS**

### **Physiography**

Streelow Creek Watershed has a total relief of 611 ft. and a mean elevation of 278 ft. A more accurate descriptor of median elevation is derived from the hypsometric curve of the watershed (Fig. 7: p14). This graph shows that half of the watershed's surface area lies above 320 ft in elevation. The graph is also indicative of a mature watershed at tectonic equilibrium.

Relief ratio is an indicator of the drop in elevation per linear foot of the basin (ft/ft). Relief ratio was determined to be 0.065. Roughness, the up and down nature of the basin, is  $1.8 \times 10^{-6}$ . The basin's roughness and ruggedness ( $7.1 \times 10^{-10}$  ft/ft) are consistent with small watersheds that are moderately dissected by streams.

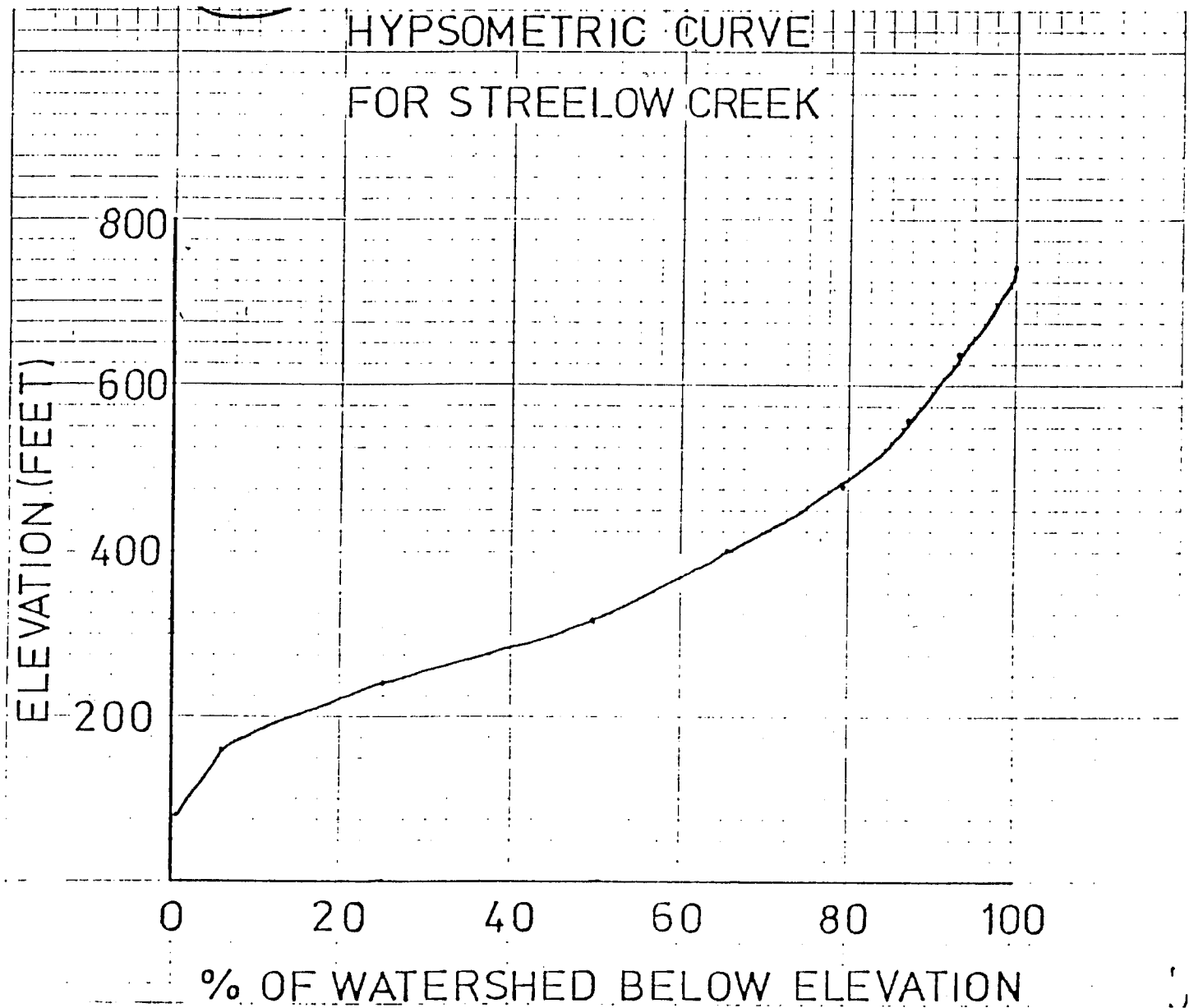


Figure 7. Hypsometric Curve for Streelow Creek Watershed showing the median elevation for the watershed.

### Hydrologic and Watershed Characteristics

The basin has a surface area of  $2.81 \text{ mi}^2$  and a drainage density of  $2.08 \text{ mi}/\text{mi}^2$ . The average annual discharge is 3550 cfs (7075 acre-ft). Cumulative frequency distributions of annual discharges were calculated using standard statistical techniques (Fig. 8:p16, Fig. 9: p17). Stream discharge was measured at 3.2 cfs at the time of field study.

Streelow Creek is a 3rd order stream, according to Strahler's stream ordering technique, which leads to an average bifurcation ratio of 2.5 : 2 (Table 2: p18). The ordering was done using only perennial and intermittent streams delineated on a U.S.G.S. topographic map (1 : 2400 scale). Generally, each stream order tends to be uniform in velocity and gradient within specific geologic and climatic conditions (Freeland, 1983 pers. comm.).

The  $2.81 \text{ mi}^2$  basin has a compactness coefficient of 1.06, which indicates a fairly compact watershed and short concentration time of sediment. The compactness coefficient and the basin circularity of .41 is characteristic of a flashy watershed. The basin has a form factor of .44, which is the ratio of average width to axial length. The drainage pattern is dendritic in shape. The main channel slope index is 1.52. There are 3.4 mi of 1st order streams, 1.7 mi of 2nd order streams and .76 mi of 3rd order streams for a total of 5.86 mi of streams (Tables 1,2: p18). A water budget was devised for the basin (Table 3: p19). Note the high runoff values for January and February, and that over 60 percent of the annual average precipitation is available for runoff.

46 8040

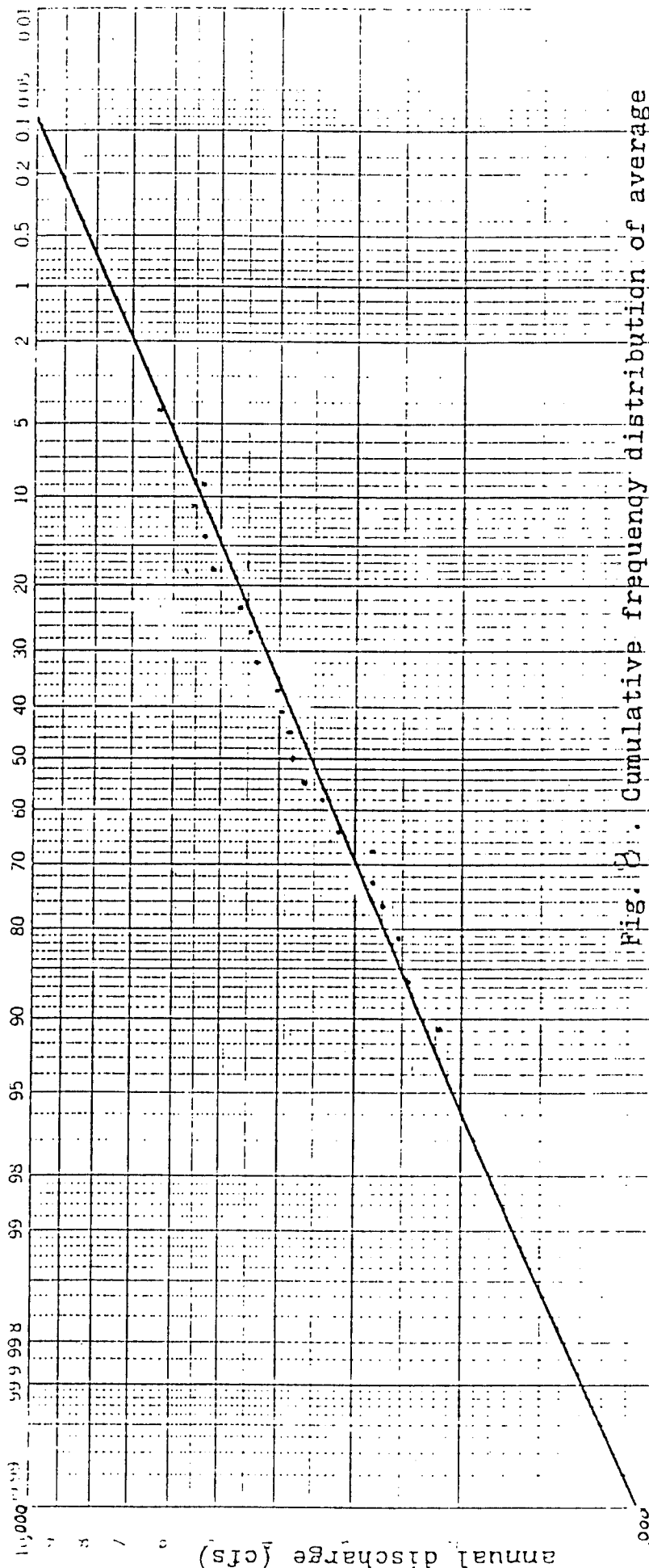


Fig. 2. Cumulative frequency distribution of average annual discharge of Streeflow Creek in cubic feet per second (cfs). Percentages indicate the probability that the annual discharge will be greater than or equal to the values represented by the graph.

Fig. 9. Cumulative frequency distribution of annual discharge of Streelow Creek in acre-feet. Percentages indicate the probability that the annual discharge will be greater than or equal to the values indicated by the graph.

annual discharge (acre-feet)

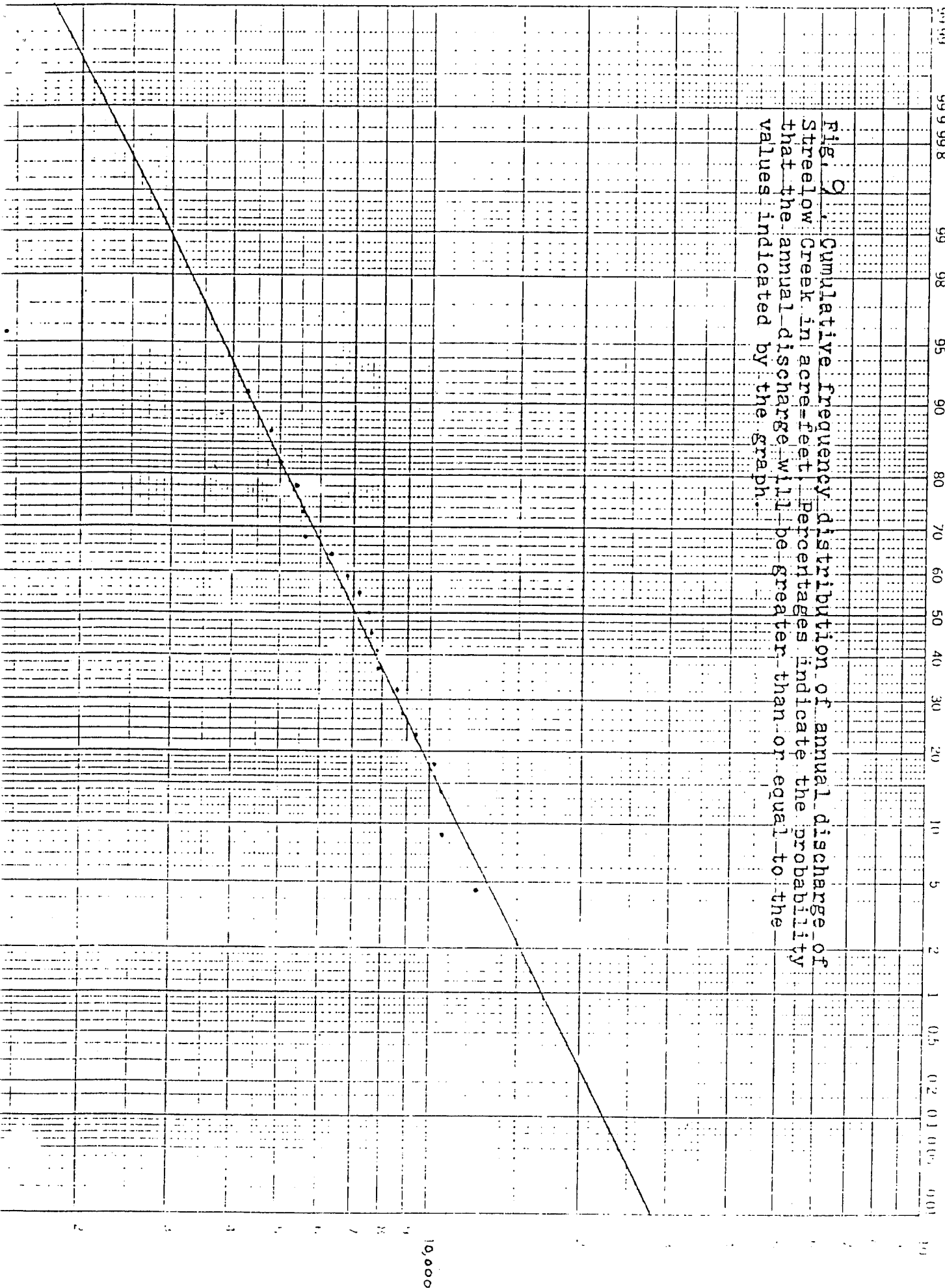


Table 1. A Summary of Selected Physiographic Characteristics for Streelow Creek

total relief: 611 feet  
mean elevation: 278 ft.  
median elevation (from hypsometric curve): 320 ft.  
aspect of main drainage: East  
relief ratio (linear): .065  
relief ratio (roughness):  $1.8 \times 10^{-6}/\text{ft.}$   
ruggedness:  $7.1 \times 10^{-10}/\text{ft.}^2$

Table 2 . A Summary of Selected Hydrologic Characteristics for Streelow Creek

area: 2.81 mi<sup>2</sup>      7.28 km<sup>2</sup>      7798 acres

average annual discharge: 3550 cfs

average annual precipitation: 70.94 in., 180.19 cm.  
(standard deviation: 11.84 in., 30 cm.)

stream lengths:  
1st order- 3.4 mi.  
2nd order- 1.7 mi.  
3rd order- 0.76 mi.  
total- 5.86 mi.

drainage density: 2.03 mi/mi<sup>2</sup>.

bifurcation ratio: 2.5:2

drainage pattern: dendritic

main channel slope index: 2.5%

channel index: 1.52      form factor: 0.44

compactness coefficient: 1.06

basin circularity: 0.41

Table 3. Long-term average monthly water balance at Orick, Ca., for a clay loam soil with an available water capacity of 325 mm under brushy regenerating conifer forest with a rooting depth of 3 m. All values in mm.

|                             | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Year |
|-----------------------------|------|------|------|------|-----|------|------|------|-------|------|------|------|------|
| 1. P                        | 332  | 228  | 216  | 123  | 94  | 32   | 9    | 17   | 29    | 141  | 255  | 305  | 1781 |
| 2. PET                      | 22   | 26   | 32   | 39   | 50  | 56   | 69   | 73   | 58    | 42   | 29   | 20   | 516  |
| 3. P-PET                    | 310  | 202  | 184  | 84   | 44  | -24  | -60  | -56  | -29   | 99   | 226  | 285  | 1265 |
| 4. Acc.Pot.WL               |      |      |      |      |     | -24  | -84  | -140 | -169  |      |      |      |      |
| 5. SM                       | 325  | 325  | 325  | 325  | 325 | 310  | 280  | 225  | 200   | 299  | 325  | 325  |      |
| 6. SM                       | 0    | 0    | 0    | 0    | 0   | -15  | -30  | -55  | -25   | 99   | 26   | 0    |      |
| 7. AET                      | 22   | 26   | 32   | 39   | 50  | 37   | 39   | 72   | 54    | 42   | 29   | 20   | 467  |
| 8. D                        | 0    | 0    | 0    | 0    | 0   | 19   | 30   | 1    | 4     | 0    | 0    | 0    | 82   |
| 9. S                        | 310  | 202  | 184  | 84   | 44  | 10   | 0    | 0    | 0     | 0    | 200  | 285  | 1319 |
| 10. Total avail. for runoff | 503  | 454  | 411  | 290  | 189 | 105  | 58   | 29   | 14    | 7    | 3    | 100  | 193  |
| 11. RO                      | 251  | 227  | 205  | 145  | 94  | 57   | 29   | 15   | 7     | 4    | 100  | 192  | 1326 |
| 12. Detention               | 252  | 227  | 206  | 145  | 95  | 58   | 29   | 14   | 7     | 3    | 100  | 193  |      |

P- precipitation; PET- potential evapotranspiration; P-PET is the difference;

Acc. Pot. WL- accumulated potential water loss derived by accumulating negative values in row 3; SM- soil moisture; SM- change in soil moisture during the month;

AET- actual evapotranspiration; D- soil moisture deficit; S- soil moisture

surplus; RO- runoff.

Precipitation and temperature data from Elford and McDonough. Calculations based on Dunne and Leopold.

### Stream Evaluation

The stream was evaluated as fair to good overall, using criteria on the stream evaluation form (Appendix A: p ). The stream channel in the upper basin was in the worst condition. It was choked with very fine sediment, and there was evidence that the stream had overflowed its banks on numerous occasions during the previous winter. The middle reaches of the creek were in good condition: there was minimal streambank failure, well developed riffles, and abundant aquatic life. The lower stream reach, near the confluence with Prairie Creek, was in fair condition. The water in Streeflow Creek had a brown tint, indicating high concentrations of tannin, from the decomposing woody material buried in the stream.

During a cursory examination of Prairie Creek, upstream from the confluence with Streeflow and May Creeks, an almost pristine stream was noted with many gravel bars/beds and negligible streambank failure. Downstream of Streeflow Creek, Prairie Creek was sediment laden, the channel appeared to be aggrading, and streambank failure was evident.

## SUMMARY

Streelow Creek drains a 2.81 mi watershed in the coastal region of northwestern California. The creek begins near an elevation of 600 ft and flows east for approximately 5 mi until it empties into Prairie Creek. The basin is underlain by the Franciscan Melange, which is widely known for its' highly erodible nature. The soils in the basin are also highly erodible when encountered on slopes of greater than 30 percent.

Over 90 percent of the watershed has been severely impacted by previous logging practices, and the effects are still noticeable after 30 years. Altered drainage patterns, loss of topsoil, soil compaction, destruction of ground cover and subsequent decreased evapotranspiration, decreased infiltration rates, increased runoff rates, and decreased soil moisture are among the results of the logging activities. Downstream from the logged lands, the effects include the aggradation of streambeds, the loss of anadromous fish-spawning habitat due to increased sedimentation, increased streamside slope failures, greater bank erosion, loss of streamside Vegetaion, and higher winter stream discharge.

The basin receives an average annual precipitation of 70 in: much of this rainfall comes during frequently prolonged and moderately intense winter storms. Over 60 percent of this average annual precipitation is translated into runoff. When infiltration rates are reduced by land surface disturbance (skid trails, haul roads, layouts, and landings), then this runoff contributes to the process of fluvial erosion (surface

runoff).

Mean annual erosion rates for the north coast area, in general, result in sediment yields in excess of 4,000 tons per square mile per year (Janda et al, 1979). If sediment yield for Streelow Creek was to be measured accurately and quantitatively, a more intense sediment study would be required, however, in this study there was much evidence of high sediment yield from the basin. Pedestals of soil under large rocks and the absence of the A and B soil horizons in portions of the exposed upper basin indicate that large amounts of soil have been displaced. Another bit of indirect evidence is the poor condition of Prairie Creek, downstream of Streelow Creek, relative to its' condition further upstream.

Various surveys and pilot rehabilitation activities are presently underway within Redwood National Park. I am certain that Streelow Creek will be considered for some type of watershed rehabilitation and erosion control program after the pilot programs have been evaluated for effectiveness. The upper basin shows prominent drainage disturbance and is highly susceptible to erosion, and this area would surely meet the criteria for rehabilitation.

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## APPENDIX A

Sample field evaluation forms

Road Class SKID Sample No. 2 Date 5/21/83 Watershed STEELE CREEK Subbasin HAIRIE CR. Unit REDWOOD CR.  
 Sample Location: T. 11N, R. 1E, Sec. 15, 1/4 Sec. NW 1/4 of NE 1/4  
 Aerial Photo No. \_\_\_\_\_ Flt. Line No. \_\_\_\_\_ Yr. Flown 1974  
 Land use history Logging 1964 & 1957 (west 200' of transect)

| ITEM                                                      | Plot 1                                           | Plot 2 | <del>Plot 3</del> AVE TOTALS             |
|-----------------------------------------------------------|--------------------------------------------------|--------|------------------------------------------|
| Site Photos: Kind _____ I.D.No. _____                     |                                                  |        |                                          |
| Aspect                                                    | S.E.                                             |        | S.E.                                     |
| Length of section (5) 100 ft sections                     | 500 ft.                                          |        | 500 ft.                                  |
| 12' / 15' / 15' / 12' / 12'                               |                                                  |        | 13'                                      |
| Aver. width of section                                    |                                                  |        |                                          |
| 12' x 100 / 15' x 100 / 15' x 100 / 12' x 100 / 12' x 100 |                                                  |        | 6500 sq ft                               |
| Area of section                                           |                                                  |        |                                          |
| -12% / -5% / 0% / +2% / +9%                               |                                                  |        | 23%                                      |
| Maximum road gradient - %                                 |                                                  |        |                                          |
| +23% max. at stream crossing                              |                                                  |        | 0%                                       |
| Minimum road gradient - %                                 |                                                  |        | -1%                                      |
| Aver. road gradient - %                                   |                                                  |        |                                          |
| 150' upslope E / 50' up E. / cross stream / up WEST /     |                                                  |        | STREAM BISECTS ROAD TRANSECT             |
| Location w/ref. to stream                                 |                                                  |        |                                          |
| Dist. between road drainages                              | NONE                                             |        |                                          |
| % slope below drainage outlet                             |                                                  |        |                                          |
| Veget. type below road prism                              | (1st 3) (ALDER) - LAST 2<br>REDWOOD, ALDER, etc. |        | ALDER w/ REDWOOD on<br>EAST SIDE, FORBES |
| Live Gr 0/20/10/5 Bare 0/0/25 Rock - 2%                   |                                                  |        | 70% 10% 7% 7%                            |
| Litter depth below outlet                                 |                                                  |        |                                          |
| % trap efficiency below outlet                            |                                                  |        |                                          |
| Road surface erosion: out. erosion                        | MIN                                              |        | MINIMAL                                  |
| Water bars: dist. & condition                             | NO                                               |        |                                          |
| Side area ditches: condition                              | —                                                |        | good cond. but<br>hardly visible         |
| Culverts: kinds & condition                               | —                                                |        | —                                        |
| Road shoulders: slope condition                           | —                                                |        | —                                        |
| Grass / brush / forbs: % cover on road                    | —                                                |        | —                                        |
| Grass / brush / forbs: % cover off road                   | —                                                |        | —                                        |

| Plot 1                         |             |            | Plot 2 |  |  | Plot 3 |  |  |
|--------------------------------|-------------|------------|--------|--|--|--------|--|--|
| Cut Slope                      | Length (m.) | Width (m.) |        |  |  |        |  |  |
| Cause & Amount of Erosion      |             |            |        |  |  |        |  |  |
| Gravity Slide                  | cu. m./rate |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
| Sedimentation by Cause, Stream |             |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
| Trend of Cut Slope Condition   |             |            |        |  |  |        |  |  |
| Road Surface                   | Length(m)   | Width(m)   |        |  |  |        |  |  |
| Cause & Amount of Erosion      |             |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
| Sedimentation by Cause, Stream |             |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
| Trend of Surface Condition     |             |            |        |  |  |        |  |  |
| Fill Slope                     | Length(m)   | Width(m)   |        |  |  |        |  |  |
| 40m bridge 40' wide            |             | 40'        |        |  |  |        |  |  |
| Cause & Amount of Erosion      |             |            |        |  |  |        |  |  |
| Slump & Piping                 | cu. m./rate |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
| Sediment to Stream by Cause    |             |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
|                                | cu. m./rate |            |        |  |  |        |  |  |
| Trend of Fill Slope Condition  |             |            |        |  |  |        |  |  |

Other Important Features Affecting Road Stability, Erosion, & Drainage:

Stable stream crossing.

Stream crossing site at old Hum Bridge. Appears to have stabilized itself.

Recommendations:

INVENTORY DATA: (observed or measured on this date)

Stream - Width 11 ft. Ave. Depth 5 ft. Ave. Velocity 92 ft./sec. 2 ft./sec. cfs  
 Reach - 1-5 Stream Purbidity 3 Stream Simultaneity 3  
 Gradient 3 Order 3 Level 3 Stage 3 Ratio 3  
 Temperature 60 at 60 date 5/1, Others 3  
 of or cfs

| Key               | Stability Indicators by Classes                                                                                                      |                             |                                                                                                                     |      |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------|------|
|                   | FAIR                                                                                                                                 | GOOD                        | POOR                                                                                                                |      |
| 1                 | Bank slope gradient 40-60%.                                                                                                          | Bank slope gradient 60-75%. | Bank slope gradient 75-90%.                                                                                         | (8)  |
| 2                 | Moderate frequency & size, with some raw spots eroded by water during high flows.                                                    | (9)                         | Frequent or large, causing sediment nearly yearling or imminent danger of gage.                                     | (12) |
| 3                 | Present, volume and size are both increasing.                                                                                        | (6)                         | Moderate to heavy amounts, predominantly larger sizes.                                                              | (8)  |
| 4                 | 50-70% density. Lower vigor and still fewer species form a somewhat shallow and discontinuous root mass.                             | (9)                         | <50% density plus fewer species & less vigor indicate poor, discontinuous, and shallow root mass.                   | (12) |
| 5                 | Barley contains present peaks. Occasional overbank floods. V/D ratio 15 to 25.                                                       | (3)                         | Inadequate. Overbank flows common. V/D ratio > 25.                                                                  | (4)  |
| 6                 | 20 to 40% with most in the 1/2" to 1/4" diameter class.                                                                              | (6)                         | < 20% rock fragments of gravel sizes, 1/2" or less.                                                                 | (18) |
| 7                 | Occasionally frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting and filling of pools. | (6)                         | Frequent obstructions and deflectors cause bank erosion yearling. Sediment traps full, channel migration occurring. | (8)  |
| 8                 | Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident.                                                             | (12)                        | Almost continuous cuts, some over 24" high. Failure of overhangs frequent.                                          | (16) |
| 9                 | Moderate deposition of new gravel & coarse sand on old and some new bars.                                                            | (12)                        | Extensive deposits of predominantly fine particles, accelerated bar development.                                    | (16) |
| 10                | Corners & edges well rounded in two dimensions.                                                                                      | (3)                         | Well rounded in all dimensions. Surfaces smooth.                                                                    | (4)  |
| 11                | Mixture, 50-50% dull and bright, & 15% in 1/4-6%.                                                                                    | (3)                         | Predominantly bright, 65% exposed or exposed surfaces.                                                              | (4)  |
| 12                | Mostly a loose assortment with no apparent overlap.                                                                                  | (6)                         | No packing evident. Loose assortment, easily moved.                                                                 | (8)  |
| 13                | Moderate change in sizes. Stable materials 20-50%.                                                                                   | (12)                        | Marked distribution change. Stable materials 4-20%.                                                                 | (16) |
| 14                | 30-50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.                                  | (18)                        | More than 50% of the bottom in a state of flux or change nearly yearlong.                                           | (24) |
| 15                | Frequent but spotty, mostly in backwater areas. Seasonal floods make rocks slick.                                                    | (3)                         | Perennial types scars or absent. Yellow-green, short term bloom may be present.                                     | (4)  |
| FAIR COLUMN TOTAL |                                                                                                                                      |                             |                                                                                                                     | 42   |
| GOOD COLUMN TOTAL |                                                                                                                                      |                             |                                                                                                                     | 12   |
| POOR COLUMN TOTAL |                                                                                                                                      |                             |                                                                                                                     | 42   |

Size Composition of Bottom Materials (Total to 100%)  
 1. Exposed bedrock.....  
 2. Large boulders, 3'-4' Dia.....  
 3. Small boulders, 1-3'.....  
 4. Small rubble, 3/4".....  
 5. Coarse gravel, 1/2"-3/4".....  
 6. Fine gravel, 3/16"-1/2".....  
 7. Fine sand, 1/16"-3/16".....  
 8. Very fine sand, 3/16"-1/8".....  
 9. Silt & clay, < 3/16".....  
 10. Organic material.....

B-1 STREAM REACH INVENTORY AND CHANNEL STABILITY EVALUATION

REACH LOCATION, Survey Date \_\_\_\_\_ Time \_\_\_\_\_ Obs. \_\_\_\_\_  
 Forest \_\_\_\_\_ Agr. Dist. \_\_\_\_\_  
 Stream \_\_\_\_\_ P.V.I. \_\_\_\_\_  
 Bath Description & \_\_\_\_\_ W/S No. \_\_\_\_\_  
 Other Identification \_\_\_\_\_

| Key                    | Stability Indicators by Classes                                                                            |                             |                                                                                                                        |                             | Fair and Poor on previous slide |
|------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------|
|                        | EXCELLENT                                                                                                  | GOOD                        | POOR                                                                                                                   | VERY POOR                   |                                 |
| 1                      | Bank slope gradient < 30%.                                                                                 | Bank slope gradient 30-40%. | Bank slope gradient 40-50%.                                                                                            | Bank slope gradient 50-60%. |                                 |
| 2                      | No evidence of past or any potential for future mass wasting into channel.                                 | (3)                         | Infrequent and/or very small, mostly healed over. Low future potential.                                                |                             |                                 |
| 3                      | Essentially absent from immediately channel area.                                                          | (2)                         | 70-90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.                            |                             |                                 |
| 4                      | 90% plant density. Vigor and variety suggests a deep, dense, soil binding, root mass.                      | (3)                         | Adequate. Overbank flows rare. Width to Depth (W/D) ratio 8 to 15.                                                     |                             |                                 |
| 5                      | Single for present plus some increases. Peak flows common. W/D ratio < 7.                                  | (1)                         | 40 to 60%, mostly small boulders to cobbles 0-12".                                                                     |                             |                                 |
| 6                      | 65% with large, angular boulders and old logs firmly embedded. Flow pattern without cutting or deposition. | (2)                         | Some present, causing erosive forces currents and minor pool filling. Obstructions and deflectors never and less firm. |                             |                                 |
| 7                      | Pools and riffles stable.                                                                                  | (2)                         | Some, intermittently at outcures and constrictions. Bar banks may be up to 10'.                                        |                             |                                 |
| 8                      | Little or none evident. Infrequent raw banks less than 6" high generally.                                  | (4)                         | Some new increase in bar formation, mostly from coarse gravels.                                                        |                             |                                 |
| 9                      | Little or no enlargement of channel or point bars.                                                         | (4)                         | Rounded corners and edges. Surfaces smooth and flat.                                                                   |                             |                                 |
| 10                     | Sharp edges and corners. Plane surfaces roughened.                                                         | (1)                         | Mostly dull, but may have up to 30% bright surfaces.                                                                   |                             |                                 |
| 11                     | Surfaces dull, darkened, or stained. Gen. not "bright".                                                    | (1)                         | Moderately packed with some overlapping.                                                                               |                             |                                 |
| 12                     | Assorted sizes tightly packed and/or overlapping.                                                          | (2)                         | Distribution shift slight.                                                                                             |                             |                                 |
| 13                     | No change in sizes evident. Stable materials 80-100%.                                                      | (4)                         | Stable materials 50-50%.                                                                                               |                             |                                 |
| 14                     | Less than 5% of the bottom affected by scouring and deposits.                                              | (6)                         | 5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.                             |                             |                                 |
| 15                     | Abundant. Growth largely moss-like, dark green, perennial. In swift water too.                             | (1)                         | Corrosion. Algal forest in low velocity & pool areas. Very low and swift water areas.                                  |                             |                                 |
| EXCELLENT COLUMN TOTAL |                                                                                                            |                             |                                                                                                                        | 12                          |                                 |
| GOOD COLUMN TOTAL      |                                                                                                            |                             |                                                                                                                        | 42                          |                                 |
| POOR COLUMN TOTAL      |                                                                                                            |                             |                                                                                                                        | 42                          |                                 |
| VERY POOR COLUMN TOTAL |                                                                                                            |                             |                                                                                                                        | 12                          |                                 |

Add values in each column and record in spaces below. Add column values to Grand Total. Add column values to Grand Total.  
 Active ratings < 30 = Excellent, 30-40 = Good, 40-50 = Fair, 50-60 = Poor, 60-70 = Very Poor, 70-80 = Bad, 80-90 = Very Bad, 90-100 = Catastrophic.  
 (Scores above may be locally adjusted by Forest Hydrologist.)

PLOT 10115 1 South slope, undisturbed EWATERSHED UNIT Greenlow ParkPLOT LOCATION W 1/4, N.E. 1/4, Sect 16 R 1 E T 11 NSURVEY PARTY Phil, John, Bob, MikeDATE 4/30VEGETATION TYPE MIXED (fir, spruce, RW, ALDER) % COVER 75% canopy 95% ground& CONDITION 2-3 growth, undisturbed, mixed AGEREINWOOD & ALDER DOMINATE overstoryDiversity, Rubus, SALAL, Ferns, CHAMASPRUCE, SCHOLBS — ground cover

SOIL TYPE \_\_\_\_\_

HYDROLOGIC SOIL GROUP \_\_\_\_\_

SLOPE: MAX. % \_\_\_\_\_ MIN. % \_\_\_\_\_ AVG. % \_\_\_\_\_

MORPHOLOGY \_\_\_\_\_

SLOPE

LENGTH \_\_\_\_\_

0%

ASPECT SouthDISTANCE TO STREAM 260 ftLITTER DEPTH 1-3"

% COVER \_\_\_\_\_

1st infiltr: 175 mlHUMUS DEPTH .5 - 1"

% COVER \_\_\_\_\_

Start: 10:53 to 11:28 minfin: 11:16% BARE GROUND < 5%% ROCK OUTCROP 02nd 170 mlSHEET & RILL EROSION: % AREA noneStart: 11:21:30fin: 11:25total3 1/2

AVG. DEPTH \_\_\_\_\_

VOLUME \_\_\_\_\_

NO. OF YEARS 7-10 yrs

CAUSE \_\_\_\_\_

GULLY EROSION: AVG. DEPTH \_\_\_\_\_

AVG. WIDTH \_\_\_\_\_

AVG. LENGTH \_\_\_\_\_

VOLUME \_\_\_\_\_

NO. OF YEARS \_\_\_\_\_

CAUSE \_\_\_\_\_

MASS EARTH MOVEMENTS (LANDSLIDES, MUDFLOWS, ETC.): none visible

VOLUME \_\_\_\_\_

% SEDIMENT REACHING STREAM: \_\_\_\_\_

|                         |  |          |  |  |  |
|-------------------------|--|----------|--|--|--|
| Observation No.         |  |          |  |  |  |
| Stream distance         |  | 50'      |  |  |  |
| Gradient (%)            |  | 1.5%     |  |  |  |
| Altitude (meters)       |  |          |  |  |  |
| Avg Chan Width (m)      |  | 3        |  |  |  |
| Avg Chan Depth (m)      |  | .3       |  |  |  |
| Velocity (m/s)          |  |          |  |  |  |
| Air Temp. (°C)          |  |          |  |  |  |
| Water Temp (°C)         |  |          |  |  |  |
| Time                    |  | noon     |  |  |  |
| Sky condition           |  | clear    |  |  |  |
| Pools (%)               |  | <5       |  |  |  |
| Width avg.              |  | 4'       |  |  |  |
| range                   |  |          |  |  |  |
| Length avg.             |  | 6'       |  |  |  |
| range                   |  |          |  |  |  |
| Depth avg.              |  | 1.5'     |  |  |  |
| range                   |  |          |  |  |  |
| Cause (Bo, Fa, Log)     |  | scouring |  |  |  |
| Shelter (Bo, BR, Lg)    |  |          |  |  |  |
| Riffles (%)             |  | 30       |  |  |  |
| Whitewater (%)          |  | 0        |  |  |  |
| Bedrock                 |  | -        |  |  |  |
| Pool Bo-Rocks           |  | 100      |  |  |  |
| Bottom L. Rubble        |  | -        |  |  |  |
| Type (%) S. Rubble      |  | 33       |  |  |  |
| Gravel                  |  | 33       |  |  |  |
| Fines                   |  | 34       |  |  |  |
| Bedrock                 |  | 0        |  |  |  |
| Boulders                |  | 10       |  |  |  |
| Riffle Rocks            |  | 20       |  |  |  |
| Bottom L. Rubble        |  | 10       |  |  |  |
| Type (%) S. Rubble      |  | 15       |  |  |  |
| Gravel                  |  | 35       |  |  |  |
| Fines                   |  | 10       |  |  |  |
| Vegetation LB           |  | 70       |  |  |  |
| Canopy (%) RB           |  | 90       |  |  |  |
| Conif. LB               |  | 0        |  |  |  |
| Veget. RB               |  | 100      |  |  |  |
| Comp. Decid. LB         |  | 100      |  |  |  |
| RB                      |  | 0        |  |  |  |
| Morning                 |  | 70       |  |  |  |
| Shading Noon            |  | 80       |  |  |  |
| Afternoon               |  | 90       |  |  |  |
| Aquat. Veg (A, C, R, N) |  |          |  |  |  |
| Cad. Fly                |  |          |  |  |  |
| Aquatic May Fly         |  |          |  |  |  |
| Food Sto. Fly           |  |          |  |  |  |
| Organisms Diptera       |  |          |  |  |  |
| (A, C, R, N) Beetles    |  |          |  |  |  |
| Crusta.                 |  | C        |  |  |  |
| Other                   |  | C        |  |  |  |
| Overall food (A, C, R)  |  |          |  |  |  |
| Fish (Anad., Resid.)    |  |          |  |  |  |
| Number Average Sz       |  |          |  |  |  |
| Fish of # < 3 cm        |  |          |  |  |  |
| Size # 3-15 cm          |  |          |  |  |  |
| (cm.) # 15-30           |  |          |  |  |  |
| # > 30 cm               |  |          |  |  |  |

|                                 |  |                                |  |  |  |
|---------------------------------|--|--------------------------------|--|--|--|
| Observation No.                 |  |                                |  |  |  |
| Stream distance                 |  |                                |  |  |  |
| Mass Wasting (m <sup>3</sup> )  |  | fair out of sloping / silty    |  |  |  |
| Chan. Stab. Score               |  | 92                             |  |  |  |
| Barrier Type                    |  | -                              |  |  |  |
| Removal Priority                |  |                                |  |  |  |
| Height (m)                      |  |                                |  |  |  |
| (Pass, ?, Impass)               |  |                                |  |  |  |
| Total Flow (m <sup>3</sup> /s)  |  |                                |  |  |  |
| Diversion (m <sup>3</sup> /s)   |  | -                              |  |  |  |
| Screened (Yes, No)              |  |                                |  |  |  |
| Springs (l/s)                   |  | -                              |  |  |  |
| Tributaries (m <sup>3</sup> /s) |  | -                              |  |  |  |
| Turbidity (H, M, L)             |  |                                |  |  |  |
| Compaction (H, M, L)            |  |                                |  |  |  |
| Pollution (H, M, L, N)          |  |                                |  |  |  |
| Color (apparent)                |  | brown (tannic acid conc. high) |  |  |  |
| pH                              |  |                                |  |  |  |
| Conductivity                    |  |                                |  |  |  |
| Fishing Use (H, M, L)           |  |                                |  |  |  |
| Dis. Oxygen (p.p.m.)            |  |                                |  |  |  |

## OTHER PARAMETERS OR OBSERVATIONS

|  |  |  |  |  |  |
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## NOTES:

Vel. measurements 4 (runs)

run 1 0.000 .81

run 2 0.000 1.11

run 3 0.000 .842

run 4 0.000 .937

3.699

Ave ... .92 ft/sec

**APPENDIX B**

Fauna and habitats

## APPENDIX B: FAUNA AND HABITATS, REDWOOD NATIONAL PARK

| <u>Species</u>                   | <u>Habitat Type</u> |                         |            |                      |                 |                  |                |                |               |                     |
|----------------------------------|---------------------|-------------------------|------------|----------------------|-----------------|------------------|----------------|----------------|---------------|---------------------|
|                                  | Marine              | Offshore Rocks, Islands | Intertidal | Seashore/Sand/Gravel | Saltwater Marsh | Freshwater Marsh | Rivers/Streams | Coastal Strand | Coastal Shrub | Riparian Vegetation |
| <u>Invertebrates</u>             |                     |                         |            |                      |                 |                  |                |                |               |                     |
| Green Anemone                    | X                   | X                       | X          |                      |                 |                  |                |                |               |                     |
| Acorn Barnacle                   | X                   | X                       | X          |                      |                 |                  |                |                |               |                     |
| California Mussel                | X                   | X                       | X          |                      |                 |                  |                |                |               |                     |
| Common Sea Star                  |                     | X                       | X          |                      |                 |                  |                |                |               |                     |
| <u>Reptiles &amp; Amphibians</u> |                     |                         |            |                      |                 |                  |                |                |               |                     |
| Western Fence Lizard             |                     |                         |            |                      |                 |                  | X              |                | X             | X                   |
| Red-bellied Newt                 |                     |                         |            |                      |                 |                  | X              |                |               | X                   |
| Pacific Giant Salamander         |                     |                         |            |                      |                 |                  | X              |                |               | X                   |
| Northern Pacific Rattlesnake     |                     |                         |            |                      |                 |                  |                | X              | X             | X                   |
| Common Garter Snake              |                     |                         |            |                      |                 | X                | X              | X              | X             | X                   |
| Rubber Snake (Boa)               |                     |                         |            |                      |                 |                  |                |                | X             | X                   |
| Western Toad                     |                     |                         |            |                      |                 | X                | X              | X              | X             | X                   |
| <u>Fish</u>                      |                     |                         |            |                      |                 |                  |                |                |               |                     |
| King Salmon                      | X                   |                         |            |                      |                 |                  | X              |                |               |                     |
| Silver Salmon                    | X                   |                         |            |                      |                 |                  | X              |                |               |                     |
| Steelhead Trout                  | X                   |                         |            |                      |                 |                  | X              |                |               |                     |
| Coast Cutthroat                  | X                   |                         |            |                      |                 |                  | X              |                |               |                     |
| <u>Birds</u>                     |                     |                         |            |                      |                 |                  |                |                |               |                     |
| Double-crested Cormorant         | X                   | X                       | X          |                      |                 |                  |                |                |               |                     |
| Common Raven                     |                     |                         |            |                      |                 |                  | X              |                | X             | X                   |
| Common Egret                     |                     |                         |            |                      | X               | X                | X              |                |               |                     |
| Killdeer                         |                     |                         |            |                      | X               | X                | X              |                |               | X                   |
| American Goldfinch               |                     |                         |            |                      |                 |                  |                | X              | X             |                     |
| Common Murre                     | X                   | X                       |            |                      |                 |                  |                |                |               |                     |
| Western Gull                     | X                   | X                       | X          | X                    | X               | X                | X              |                |               |                     |
| Red-tailed Hawk                  |                     |                         |            |                      |                 |                  |                |                | X             | X                   |
| Great Blue Heron                 |                     |                         |            |                      | X               | X                | X              |                |               |                     |
| Steller's Jay                    |                     |                         |            |                      |                 |                  | X              | X              | X             | X                   |
| Belted Kingfisher                | X                   |                         | X          |                      |                 |                  |                |                | X             |                     |
| Mallard                          |                     |                         |            |                      |                 | X                | X              |                |               |                     |

| <u>Species</u>               | <u>Habitat Type</u> |                         |            |                      |                 |                  |                |                |               |                     |                       |
|------------------------------|---------------------|-------------------------|------------|----------------------|-----------------|------------------|----------------|----------------|---------------|---------------------|-----------------------|
|                              | Marine              | Offshore Rocks, Islands | Intertidal | Seashore/Sand/Gravel | Saltwater Marsh | Freshwater Marsh | Rivers/Streams | Coastal Strand | Coastal Shrub | Riparian Vegetation | Coastal Spruce Forest |
|                              |                     |                         |            |                      |                 |                  |                |                |               |                     | Redwood Forest        |
|                              |                     |                         |            |                      |                 |                  |                |                |               |                     | Prairie               |
| <u>Birds (Cont.)</u>         |                     |                         |            |                      |                 |                  |                |                |               |                     |                       |
| Kestrel                      |                     |                         |            |                      |                 |                  |                |                |               | X                   | X                     |
| Great Horned Owl             |                     |                         |            |                      |                 |                  |                |                |               | X                   | X                     |
| Brown Pelican                | X                   | X                       |            | X                    |                 |                  |                |                | X             | X                   | X                     |
| Red-shafted Flicker (Common) |                     |                         |            |                      |                 |                  |                |                | X             | X                   | X                     |
| Varied Thrush                |                     |                         |            |                      |                 |                  |                |                | X             | X                   | X                     |
| White-crowned Sparrow        |                     |                         |            |                      |                 |                  |                | X              | X             | X                   | X                     |
| <u>Mammals</u>               |                     |                         |            |                      |                 |                  |                |                |               |                     |                       |
| Black Bear                   |                     |                         |            |                      |                 |                  | X              | X              | X             | X                   | X                     |
| Bobcat                       |                     |                         |            |                      |                 |                  |                | X              | X             | X                   | X                     |
| Coyote                       |                     |                         |            |                      |                 |                  |                | X              | X             | X                   | X                     |
| Black-tailed Deer            |                     |                         |            |                      |                 |                  |                | X              | X             | X                   | X                     |
| Roosevelt Elk                |                     |                         |            |                      |                 |                  |                | X              | X             | X                   | X                     |
| River Otter                  |                     |                         |            |                      |                 |                  | X              |                | X             | X                   |                       |
| Raccoon                      |                     |                         |            |                      |                 |                  |                | X              | X             | X                   |                       |
| Harbor Seal                  | X                   | X                       | X          | X                    |                 |                  | X              |                |               |                     |                       |
| Steller's Sea Lion           | X                   | X                       |            | X                    |                 |                  |                |                |               |                     |                       |
| California Sea Lion          | X                   | X                       |            | X                    |                 |                  |                |                |               |                     |                       |
| California Gray Whale        | X                   |                         |            |                      |                 |                  |                |                |               |                     |                       |

## **APPENDIX C**

Additional precipitation data

Table Maximum annual precipitation and depth-duration-frequency table for Hoopa, Ca. (Reprinted from Ca. Dept. of Water Resources, Bulletin 195, Vol. 1).

| MAXIMUM ANNUAL PRECIPITATION (UNITS-INCHES)<br>1 TO CONVERT TO MILLIMETERS MULTIPLY BY 25.4                    |  |              |      |                                                    |      |      |      |      |        |         |           |       |
|----------------------------------------------------------------------------------------------------------------|--|--------------|------|----------------------------------------------------|------|------|------|------|--------|---------|-----------|-------|
| STATION NO.                                                                                                    |  | STATION NAME |      | ELEV SEC TWP RNG LOT PPM LATITUDE LONGITUDE COUNTY |      |      |      |      |        |         |           |       |
| BSN CDEEP SUP<br>F40 40B2 0                                                                                    |  | HOOPA        |      | 350                                                | 25   | 02N  | 04E  | H    | 41.050 | 123.647 | HUMPHOLDT |       |
| M=MINUTES, H=HOURS, D=DAYS, C YR=CALENDAR YEAR, W YR=WATER YEAR, F YR=FISCAL YEAR<br>***** = NO DATA AVAILABLE |  |              |      |                                                    |      |      |      |      |        |         |           |       |
|                                                                                                                |  | DURATION     |      |                                                    |      |      |      |      |        |         |           |       |
|                                                                                                                |  | 5M           | 10M  | 15M                                                | 30M  | 1H   | 2H   | 3H   | 6M     | 12M     | 24M       | C-YR  |
| YEAR                                                                                                           |  |              |      |                                                    |      |      |      |      |        |         |           |       |
| 1941                                                                                                           |  | 0.42         | 0.40 | 0.44                                               | 0.72 | 0.73 | 0.77 | 1.05 | 1.93   | 3.11    | 5.10      | 50.53 |
| 1942                                                                                                           |  | 0.17         | 0.19 | 0.20                                               | 0.24 | 0.35 | 0.66 | 1.19 | 1.47   | 1.93    | 2.87      | 61.72 |
| 1943                                                                                                           |  | 0.09         | 0.12 | 0.15                                               | 0.27 | 0.49 | 0.92 | 1.25 | 2.11   | 3.58    | 4.98      | 41.77 |
| 1944                                                                                                           |  | 0.09         | 0.12 | 0.19                                               | 0.27 | 0.39 | 0.76 | 0.96 | 1.76   | 1.51    | 2.32      | 45.92 |
| 1945                                                                                                           |  | 0.09         | 0.12 | 0.45                                               | 0.73 | 0.74 | 0.77 | 1.04 | 1.78   | 2.93    | 3.96      | 46.34 |
| 1946                                                                                                           |  | 0.09         | 0.12 | 0.25                                               | 0.46 | 0.62 | 1.03 | 1.37 | 1.92   | 2.32    | 3.46      | 33.96 |
| 1947                                                                                                           |  | 0.09         | 0.12 | 0.14                                               | 0.21 | 0.35 | 0.66 | 0.85 | 1.39   | 1.88    | 3.09      | 34.70 |
| 1948                                                                                                           |  | 0.09         | 0.12 | 0.21                                               | 0.27 | 0.42 | 0.67 | 0.78 | 1.38   | 2.22    | 3.47      | 38.64 |
| 1949                                                                                                           |  | 0.09         | 0.12 | 0.21                                               | 0.27 | 0.52 | 0.73 | 0.90 | 1.37   | 1.53    | 2.04      | 33.70 |
| 1950                                                                                                           |  | 0.09         | 0.12 | 0.17                                               | 0.27 | 0.45 | 0.75 | 1.00 | 1.90   | 3.43    | 5.18      | 72.50 |
| 1951                                                                                                           |  | 0.09         | 0.12 | 0.20                                               | 0.30 | 0.45 | 0.75 | 1.00 | 1.90   | 3.43    | 5.18      | 72.50 |
| 1952                                                                                                           |  | 0.09         | 0.12 | 0.18                                               | 0.27 | 0.54 | 0.66 | 0.85 | 1.44   | 2.23    | 3.62      | 57.51 |
| 1953                                                                                                           |  | 0.09         | 0.12 | 0.18                                               | 0.23 | 0.38 | 0.70 | 0.81 | 1.44   | 2.23    | 3.62      | 57.51 |
| 1954                                                                                                           |  | 0.09         | 0.12 | 0.17                                               | 0.30 | 0.57 | 0.67 | 0.91 | 1.81   | 3.12    | 5.56      | 45.96 |
| 1955                                                                                                           |  | 0.09         | 0.12 | 0.20                                               | 0.31 | 0.50 | 0.75 | 1.00 | 1.55   | 2.83    | 4.08      | 58.66 |
| 1956                                                                                                           |  | 0.09         | 0.12 | 0.15                                               | 0.22 | 0.29 | 0.51 | 0.59 | 0.96   | 1.58    | 2.27      | 55.70 |
| 1957                                                                                                           |  | 0.09         | 0.12 | 0.19                                               | 0.31 | 0.47 | 0.60 | 1.12 | 1.75   | 2.71    | 3.62      | 52.58 |
| 1958                                                                                                           |  | 0.09         | 0.12 | 0.20                                               | 0.30 | 0.44 | 0.66 | 1.02 | 1.64   | 2.74    | 4.41      | 61.58 |
| 1959                                                                                                           |  | 0.09         | 0.12 | 0.17                                               | 0.25 | 0.45 | 0.78 | 0.93 | 1.40   | 1.94    | 3.12      | 61.58 |
| 1960                                                                                                           |  | 0.09         | 0.12 | 0.14                                               | 0.27 | 0.40 | 0.73 | 1.05 | 1.78   | 3.04    | 3.92      | 39.17 |
| 1961                                                                                                           |  | 0.09         | 0.12 | 0.27                                               | 0.44 | 0.63 | 1.01 | 1.22 | 2.10   | 3.45    | 4.44      | 61.25 |
| 1962                                                                                                           |  | 0.09         | 0.12 | 0.20                                               | 0.30 | 0.45 | 0.75 | 0.78 | 1.41   | 2.15    | 2.35      | 53.96 |
| 1963                                                                                                           |  | 0.09         | 0.12 | 0.17                                               | 0.31 | 0.57 | 1.02 | 1.40 | 2.04   | 2.92    | 3.97      | 54.61 |
| 1964                                                                                                           |  | 0.09         | 0.12 | 0.20                                               | 0.32 | 0.40 | 0.75 | 1.05 | 1.91   | 2.70    | 3.84      | 54.61 |
| 1965                                                                                                           |  | 0.09         | 0.12 | 0.22                                               | 0.41 | 0.70 | 1.25 | 1.80 | 3.45   | 6.45    | 10.63     | 72.16 |
| 1966                                                                                                           |  | 0.09         | 0.12 | 0.22                                               | 0.41 | 0.70 | 1.25 | 1.80 | 3.45   | 6.45    | 10.63     | 72.16 |
| 1967                                                                                                           |  | 0.09         | 0.12 | 0.22                                               | 0.41 | 0.70 | 1.25 | 1.80 | 3.45   | 6.45    | 10.63     | 72.16 |
| 1968                                                                                                           |  | 0.09         | 0.12 | 0.22                                               | 0.41 | 0.70 | 1.25 | 1.80 | 3.45   | 6.45    | 10.63     | 72.16 |
| 1969                                                                                                           |  | 0.09         | 0.12 | 0.22                                               | 0.41 | 0.70 | 1.25 | 1.80 | 3.45   | 6.45    | 10.63     | 72.16 |
| 1970                                                                                                           |  | 0.09         | 0.12 | 0.22                                               | 0.41 | 0.70 | 1.25 | 1.80 | 3.45   | 6.45    | 10.63     | 72.16 |
| 1971                                                                                                           |  | 0.09         | 0.12 | 0.22                                               | 0.41 | 0.70 | 1.25 | 1.80 | 3.45   | 6.45    | 10.63     | 72.16 |
| 1972                                                                                                           |  | 0.09         | 0.12 | 0.20                                               | 0.31 | 0.41 | 0.71 | 0.83 | 1.55   | 2.90    | 3.78      | 59.65 |
| 1973                                                                                                           |  | 0.09         | 0.12 | 0.20                                               | 0.31 | 0.41 | 0.71 | 0.83 | 1.55   | 2.90    | 3.78      | 59.65 |

| PRECIPITATION DEPTH-DURATION-FREQUENCY TABLE                               |              |       |       |       |       |       |       |          |           |           |        |  |
|----------------------------------------------------------------------------|--------------|-------|-------|-------|-------|-------|-------|----------|-----------|-----------|--------|--|
| STATION NO.                                                                | STATION NAME | ELEV  | SEC   | TWP   | RNG   | LOT   | RMM   | LATITUDE | LONGITUDE | COUNTY    |        |  |
| BSN CDEEP SUP<br>F40 40R2 0                                                | HOOPA        | 350   | 25    | 02N   | 04E   |       | H     | 41.050   | 123.647   | HUMPHOLDT |        |  |
| MAXIMUM PRECIPITATION (IN) FOR INDICATED DURATION D=DAYS H=HOURS M=MINUTES |              |       |       |       |       |       |       |          |           |           |        |  |
| RETURN PERIOD<br>IN YEARS                                                  | 5M           | 10M   | 15M   | 30M   | 1H    | 2H    | 3H    | 6H       | 12H       | 24H       | C-YR   |  |
| 2                                                                          | 0.23         | 0.27  | 0.21  | 0.41  | 0.41  | 0.77  | 0.99  | 1.61     | 2.49      | 3.66      | 54.37  |  |
| 5                                                                          | 0.31         | 0.38  | 0.28  | 0.42  | 0.49  | 1.04  | 1.34  | 2.16     | 3.36      | 4.93      | 67.46  |  |
| 10                                                                         | 0.36         | 0.45  | 0.33  | 0.49  | 0.61  | 1.21  | 1.56  | 2.52     | 3.91      | 5.74      | 74.99  |  |
| 20                                                                         | 0.41         | 0.50  | 0.37  | 0.55  | 0.71  | 1.37  | 1.76  | 2.85     | 4.43      | 6.50      | 81.32  |  |
| 25                                                                         | 0.43         | 0.52  | 0.39  | 0.57  | 0.75  | 1.42  | 1.83  | 2.96     | 4.59      | 6.74      | 83.25  |  |
| 40                                                                         | 0.43         | 0.53  | 0.39  | 0.57  | 0.75  | 1.44  | 1.86  | 3.01     | 4.67      | 6.85      | 87.13  |  |
| 50                                                                         | 0.47         | 0.58  | 0.43  | 0.63  | 1.05  | 1.77  | 2.07  | 3.27     | 5.07      | 7.45      | 88.90  |  |
| 100                                                                        | 0.51         | 0.63  | 0.47  | 0.69  | 1.14  | 1.71  | 2.21  | 3.57     | 5.54      | 8.14      | 94.15  |  |
| 200                                                                        | 0.56         | 0.68  | 0.50  | 0.75  | 1.24  | 1.85  | 2.39  | 3.86     | 6.00      | 8.81      | 99.10  |  |
| 1000                                                                       | 0.65         | 0.80  | 0.59  | 0.88  | 1.45  | 2.17  | 2.80  | 4.53     | 7.02      | 10.31     | 109.74 |  |
| 10000                                                                      | 0.78         | 0.96  | 0.71  | 1.04  | 1.74  | 2.61  | 3.36  | 5.43     | 8.43      | 12.38     | 123.55 |  |
| PMF                                                                        | 1.55         | 1.90  | 1.40  | 2.08  | 3.44  | 5.15  | 6.63  | 10.74    | 16.64     | 24.46     | 277.87 |  |
| MEAN                                                                       | 0.247        | 0.302 | 0.223 | 0.332 | 0.549 | 0.822 | 1.059 | 1.714    | 2.660     | 3.905     | 55.353 |  |
| CLOCK MM. CORR.                                                            | 1.000        | 1.000 | 1.000 | 1.000 | 1.140 | 1.070 | 1.040 | 1.070    | 1.010     | 1.000     | 1.000  |  |
| CALCULATED SKWM                                                            | 0.0          | 0.0   | 2.772 | 2.141 | 0.919 | 1.247 | 1.245 | 2.133    | 2.494     | 2.604     | -0.470 |  |
| REGIONAL SKWM                                                              | 1.100        | 1.100 | 1.100 | 1.100 | 1.100 | 1.100 | 1.100 | 1.100    | 1.100     | 1.100     | 0.400  |  |
| SKWM USED                                                                  | 1.100        | 1.100 | 1.100 | 1.100 | 1.100 | 1.100 | 1.100 | 1.100    | 1.100     | 1.100     | 0.400  |  |

SLOPE OF LOG INTENSITY / LOG TIME = -0.570 1 INTERCEPT (TIME=1 HOUR) = 0.567 1 COEFFICIENT OF DETERMINATION = 0.9  
1HR INTERCEPT / MEAN YR = 0.01025 1 AVERAGE CALC CV / USED CV = 1.

|                   |        |        |        |        |        |        |        |        |        |        |        |
|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| KURTOSIS          | 0.0    | 0.0    | 10.140 | 7.213  | 3.298  | 0.177  | 0.075  | 10.959 | 13.214 | 13.364 | 7.816  |
| M                 | 3      | 3      | 32     | 32     | 33     | 33     | 33     | 33     | 33     | 33     | 33     |
| RECORD YEAR       | 1941   | 1941   | 1941   | 1945   | 1970   | 1970   | 1980   | 1980   | 1984   | 1984   | 1990   |
| RECORDED MAXIMUM  | 0.480  | 0.600  | 0.650  | 0.730  | 0.750  | 1.250  | 1.800  | 3.450  | 4.450  | 10.630 | 72.500 |
| NORMALIZED MAX    | 1.133  | 1.144  | 3.543  | 2.996  | 1.443  | 2.591  | 3.090  | 3.942  | 4.350  | 4.350  | 1.555  |
| CALC. COEFF. VAR  | 0.335  | 0.355  | 0.339  | 0.400  | 0.222  | 0.201  | 0.227  | 0.257  | 0.335  | 0.335  | 0.199  |
| REC'D. COEFF. VAR | 0.351  | 0.351  | 0.351  | 0.351  | 0.351  | 0.351  | 0.351  | 0.351  | 0.351  | 0.351  | 0.268  |
| USED COEFF. VAR   | 0.351  | 0.351  | 0.351  | 0.351  | 0.351  | 0.351  | 0.351  | 0.351  | 0.351  | 0.351  | 0.268  |
| MEAN/ZA           | 0.0045 | 0.0055 | 0.0040 | 0.0060 | 0.0099 | 0.0148 | 0.0191 | 0.0310 | 0.0480 | 0.0705 | 1.0000 |
| PP10/ZA           | 0.0046 | 0.0051 | 0.0049 | 0.0069 | 0.0114 | 0.0171 | 0.0228 | 0.0365 | 0.0544 | 0.0807 | 1.0000 |
| PP25/ZA           | 0.0047 | 0.0055 | 0.0050 | 0.0070 | 0.0104 | 0.0171 | 0.0228 | 0.0365 | 0.0544 | 0.0807 | 1.0000 |
| PP50/ZA           | 0.0048 | 0.0057 | 0.0053 | 0.0077 | 0.0114 | 0.0171 | 0.0228 | 0.0365 | 0.0544 | 0.0807 | 1.0000 |
| PP100/ZA          | 0.0049 | 0.0058 | 0.0054 | 0.0078 | 0.0115 | 0.0172 | 0.0229 | 0.0366 | 0.0545 | 0.0808 | 1.0000 |
| PP1000/ZA         | 0.0117 | 0.0145 | 0.0107 | 0.0158 | 0.0262 | 0.0397 | 0.0505 | 0.0718 | 0.1024 | 0.1483 | 1.0000 |
| PP10000/ZA        | 0.0141 | 0.0174 | 0.0127 | 0.0190 | 0.0315 | 0.0471 | 0.0604 | 0.0827 | 0.1174 | 0.1637 | 1.0000 |
| PMF/ZA            | 0.0277 | 0.0343 | 0.0253 | 0.0376 | 0.0622 | 0.0930 | 0.1198 | 0.1640 | 0.2301 | 0.3420 | 1.0000 |

Table . Precipitation depth-duration-frequency table for Orick, Ca. (Reprinted from Ca. Dept. of Water Resources, Bulletin 195, Vol. 2).

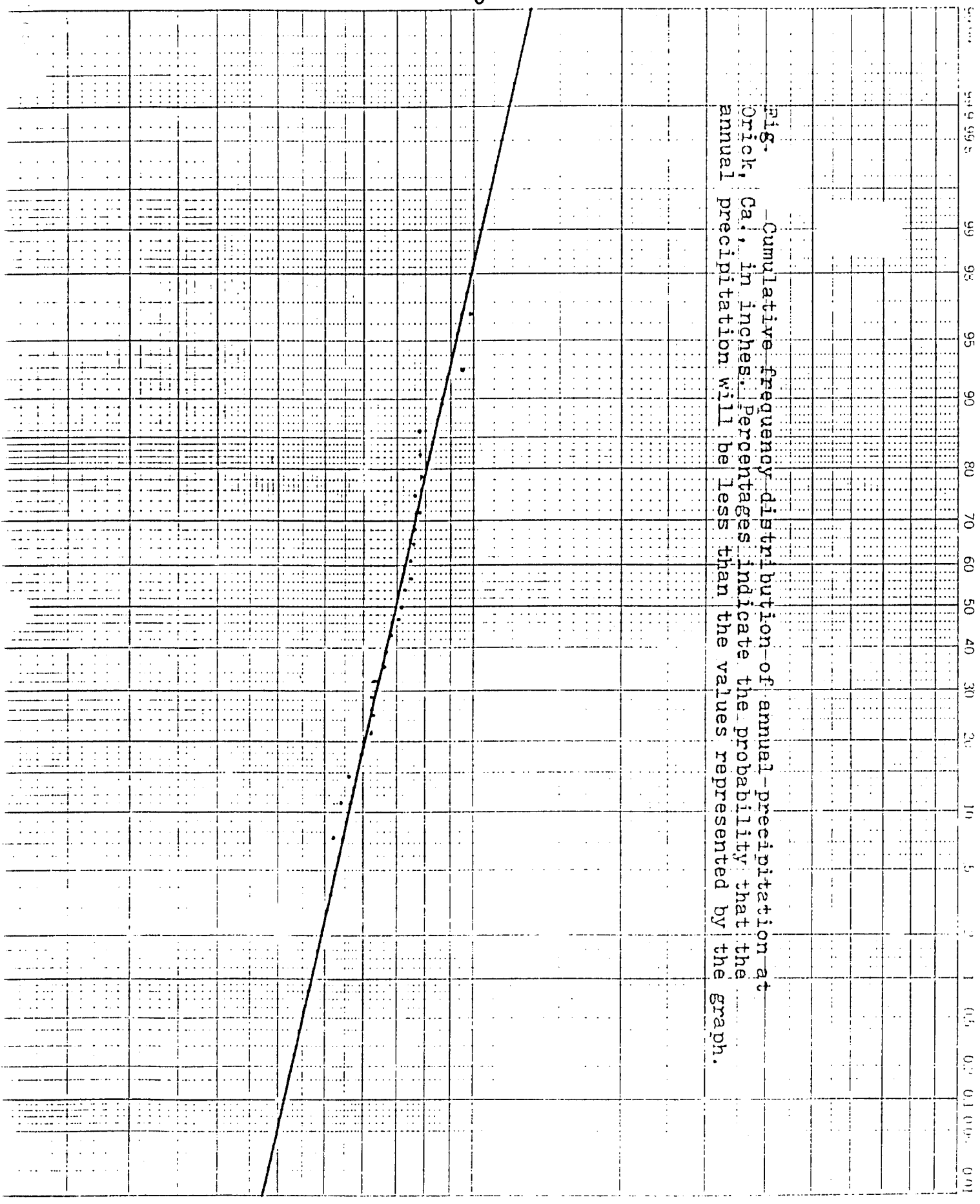
| PRECIPITATION DEPTH-DURATION-FREQUENCY TABLE                  |                                         |             |           |            |                |          |                    |                      |                      |        |        |        |        |
|---------------------------------------------------------------|-----------------------------------------|-------------|-----------|------------|----------------|----------|--------------------|----------------------|----------------------|--------|--------|--------|--------|
| STATION NO.<br>BSN ORDER SUM<br>F50 6498 0                    | STATION NAME<br>ORICK PHAIRE CHELA PARK | ELEV<br>161 | SEC<br>02 | TWP<br>11N | RNG LOT<br>01E | H-M<br>M | LATITUDE<br>41.637 | LONGITUDE<br>124.017 | COUNTY<br>CODE<br>12 |        |        |        |        |
| MAXIMUM PRECIPITATION FOR INDICATED DURATION (1-DAYS 4-HOURS) |                                         |             |           |            |                |          |                    |                      |                      |        |        |        |        |
| RETURN PERIOD<br>IN YEARS                                     | 10                                      | 20          | 30        | 40         | 50             | 60       | 80                 | 100                  | 150                  | 200    | 300    | 400    | 365L   |
| 2                                                             | 4.23                                    | 5.90        | 7.03      | 7.74       | 8.42           | 9.24     | 10.59              | 11.88                | 14.30                | 15.90  | 19.93  | 30.76  | 60.81  |
| 5                                                             | 5.69                                    | 8.11        | 9.59      | 10.50      | 11.39          | 12.39    | 14.04              | 15.74                | 18.83                | 21.04  | 26.22  | 40.54  | 80.71  |
| 10                                                            | 6.64                                    | 9.50        | 11.27     | 12.27      | 13.30          | 14.30    | 16.22              | 18.09                | 21.50                | 24.18  | 29.99  | 46.41  | 90.24  |
| 20                                                            | 7.51                                    | 10.90       | 12.84     | 13.92      | 15.07          | 16.21    | 18.19              | 20.22                | 23.96                | 27.01  | 33.37  | 51.66  | 104.52 |
| 25                                                            | 7.79                                    | 11.41       | 13.33     | 14.43      | 15.62          | 16.78    | 18.80              | 20.87                | 24.58                | 27.48  | 34.39  | 51.26  | 107.01 |
| 40                                                            | 7.92                                    | 12.32       | 14.34     | 14.68      | 15.89          | 17.95    | 20.04              | 22.20                | 26.03                | 29.66  | 36.49  | 51.52  | 112.04 |
| 50                                                            | 8.61                                    | 12.74       | 14.82     | 15.98      | 17.20          | 18.40    | 20.62              | 22.82                | 26.70                | 30.48  | 37.45  | 58.02  | 114.27 |
| 100                                                           | 9.40                                    | 14.03       | 16.26     | 17.47      | 18.89          | 20.13    | 22.34              | 24.67                | 28.70                | 32.95  | 40.35  | 62.53  | 121.03 |
| 200                                                           | 10.18                                   | 15.30       | 17.67     | 18.93      | 20.45          | 21.72    | 24.04              | 26.45                | 30.40                | 35.32  | 43.12  | 66.85  | 127.39 |
| 1000                                                          | 11.92                                   | 18.18       | 20.86     | 22.20      | 23.97          | 25.29    | 27.78              | 30.39                | 34.76                | 40.58  | 49.21  | 76.34  | 141.86 |
| 10000                                                         | 14.31                                   | 22.18       | 25.27     | 26.70      | 28.81          | 30.16    | 32.87              | 35.71                | 40.26                | 47.67  | 57.37  | 89.03  | 158.01 |
| PMP                                                           | 24.27                                   | 42.04       | 48.98     | 52.96      | 57.06          | 61.08    | 68.81              | 75.89                | 90.48                | 101.25 | 124.92 | 194.21 | 357.19 |
| MEAN                                                          | 4.513                                   | 6.404       | 7.564     | 8.275      | 8.994          | 9.796    | 11.149             | 12.441               | 14.797               | 16.840 | 20.734 | 31.995 | 71.153 |
| CLOCK HR. COR.                                                | 1.140                                   | 1.070       | 1.048     | 1.028      | 1.010          | 1.010    | 1.000              | 1.000                | 1.000                | 1.000  | 1.000  | 1.000  | 1.000  |
| CALCULATED SKEW                                               | 3.522                                   | 2.600       | 2.293     | 2.011      | 1.697          | 1.612    | 1.036              | .779                 | .367                 | .194   | -0.020 | -0.122 | .018   |
| REGIONAL SKEW                                                 | 1.104                                   | 1.300       | 1.290     | 1.100      | 1.100          | 1.008    | .908               | .800                 | .600                 | .800   | .700   | .700   | .400   |
| SKEW USED                                                     | 1.108                                   | 1.300       | 1.200     | 1.100      | 1.100          | 1.008    | .900               | .800                 | .600                 | .800   | .700   | .700   | .400   |
| KURTOSIS                                                      | 19.677                                  | 13.403      | 11.732    | 10.573     | 8.903          | 9.281    | 6.344              | 4.501                | 2.948                | 2.612  | 2.725  | 2.618  | 2.739  |
| N                                                             | 37                                      | 37          | 37        | 37         | 37             | 37       | 37                 | 37                   | 37                   | 37     | 37     | 37     | 37     |
| RECORD YEAR                                                   | 1951                                    | 1951        | 1951      | 1951       | 1951           | 1951     | 1951               | 1951                 | 1966                 | 1966   | 1974   | 1956   | 1.74   |
| RECORD MAXIMUM                                                | 11.500                                  | 16.190      | 17.790    | 19.270     | 19.420         | 21.050   | 21.260             | 21.670               | 23.710               | 25.060 | 30.400 | 46.910 | 94.010 |
| NORMALIZED MAX                                                | 4.035                                   | 4.629       | 4.005     | 4.017      | 3.838          | 3.896    | 3.416              | 2.804                | 2.151                | 2.012  | 1.944  | 1.840  | 2.649  |
| CALL. COEF. VAR                                               | .384                                    | .379        | .338      | .331       | .310           | .295     | .265               | .270                 | .280                 | .252   | .240   | .253   | .185   |
| REGN. COEF. VAR                                               | .351                                    | .371        | .365      | .360       | .356           | .349     | .340               | .340                 | .341                 | .339   | .335   | .338   | .261   |
| USED COEF. VAR                                                | .351                                    | .371        | .365      | .360       | .356           | .349     | .340               | .340                 | .341                 | .339   | .335   | .338   | .261   |
| MEAN/A                                                        | .0634                                   | .0900       | .1063     | .1163      | .1265          | .1377    | .1567              | .1748                | .2080                | .2339  | .2914  | .4497  | 1.0000 |
| MP10/A                                                        | .0933                                   | .1347       | .1583     | .1724      | .1869          | .2021    | .2280              | .2543                | .3022                | .3398  | .4215  | .6523  | 1.3529 |
| MP25/A                                                        | .1094                                   | .1604       | .1873     | .2024      | .2195          | .2358    | .2642              | .2933                | .3455                | .3919  | .4834  | .7486  | 1.5039 |
| MP50/A                                                        | .1218                                   | .1790       | .2082     | .2245      | .2429          | .2598    | .2890              | .3207                | .3753                | .4283  | .5264  | .8155  | 1.6060 |
| MP100/A                                                       | .1321                                   | .1972       | .2285     | .2455      | .2655          | .2829    | .3142              | .3467                | .4033                | .4631  | .5670  | .8788  | 1.7009 |
| MP1000/A                                                      | .1675                                   | .2555       | .2932     | .3120      | .3364          | .3554    | .3905              | .4272                | .4885                | .5703  | .6917  | 1.0729 | 1.9825 |
| MP10000/A                                                     | .2011                                   | .3117       | .3551     | .3752      | .4050          | .4239    | .4610              | .5019                | .5659                | .6700  | .8062  | 1.2512 | 2.2320 |
| PMP/A                                                         | .3974                                   | .5908       | .6884     | .7443      | .8019          | .8584    | .9558              | 1.0066               | 1.2717               | 1.4230 | 1.7557 | 2.7295 | 5.0208 |

annual precipitation (inches)

PROBABILITY PLOT

46 8040

Fig. Cumulative frequency distribution of annual precipitation at Orick, Ca., in inches. Percentages indicate the probability that the annual precipitation will be less than the values represented by the graph.



RECENT WATERSHED CONDITIONS OF  
STREELow CREEK BASIN IN THE  
VICINITY OF REDWOOD NATIONAL  
PARK, CALIFORNIA

Course  
311  
+ 10 Attend  

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321/375  
(B)

Prepared  
by  
John A. McCullah  
  
for  
Helen Larson  
Journalism 32  
Technical Writing

Paper  
Content 70/75  
Comp 68/75  
Format 42/50  

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well done (A-) 180/200  
-17SP  
(B+) 173/200

Abstract Good

This report describes the physical and hydrologic characteristics of Streelow Creek watershed and discusses how previous logging practices contribute to the total sediment yield of the area.

location?

May 29, 1983

John - well done, informative research report. Sound content and organization. Could've elaborated on logging effects more thoroughly in a section prior to conclusion. Comp skills much stronger than writing in audit.