

A Survey of Streelow Creek Watershed

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GROUP III

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Introduction

It is the objective of this study to evaluate the Streelow Creek watershed and to formulate a rehabilitative plan for any problem areas which might exist. The Streelow Creek watershed is located 5.5 miles north of Orick California on Redwood highway.. It has an area of 1798 acres consisting of moderately steep (30%) to steep (70%) dissected mountain slopes with subrounded ridge tops. Elevations range from 57 to 744 feet. The creek itself is a small third order stream draining into Prairie Creek from the west. Vegetation is predominantly alder and second growth redwood and spruce, owing to the logging operations which occurred there from 1954 to 1964 by Arcata Redwood and Simpson Lumber companies. The network of spur roads also reflects the logging history of this area. The watershed is now part of Redwood National Park.

Before a management plan was developed, much time and work was spent on reconnaissance to the watershed, on maps and aerial photos of the area, and on general research of the area. This work was necessary to give consideration to the numerous factors which influence the watershed. These factors generally include those induced by man and those which are natural to the area.

Man decides the fate of his resources through policy making and actual land use. Social and economic factors, water rights, and land ownership in turn affect policy decision

making and how the land will be used. Natural characteristics which influence the management plan include physiography, geology, soils, climate, vegetation, and hydrology among others. These characteristics are fixed and unchangeable so management can only modify the conditions to which they apply (Satterlund, 1972).

This study will first cover these areas of consideration. An evaluation and management plan will then be made for treatment of land areas, stream and stream channel, and roads.

WATER RIGHTS AND DEVELOPMENT

The Redwood National Park System was expanded on March 27, 1978 by the Congressional Act of PL 95 250. Streelow Watershed Basin lies within this expansion.

Current Water Resource Development

The current watershed resource development is to rehabilitate the watershed by reforestation and stream clearing of log debris in order to improve the watershed's water quality and and Salmonoid Fisheries.

Existing Water Policies

The existing water policies are concurrent with its management plan which is to use water for development which is necessary for the visiting public and the operation of the park. Concern and protection of the water resource are the primary concern to management. Park waters, surface or ground, may be withdrawn for consumptive use so long as such withdrawal is necessary for the use and management of the park and does not significantly alter the natural processes and ecosystems (U.S. Dept. of the Interior, 1978)

Current Water Rights

The Redwood National Park System has California Doctrine Water Rights. The RNPS does not have "reserved rights" because the subject land (Streelow Watershed Basin) has been in state ownership. Hence, the RNPS water rights will be obtained in accordance with California state laws.

Presently, RNPS has both riparian and junior appropriative water rights. The nature of their riparian rights is the ownership of land which abuts a stream, lake, or pond. The California courts have said that the rights is not a "mere easement or appurtenance" but is part and parcel of the riparian

real estate. The riparian right is an "usufruct": The right is to the use of water; there is no private property in the corpus of the water itself. But the right is not created by use and is not lost by nonuse. The riparian owner's right to use water is shared with other riparian landowners on the watercourse. A riparian has no right to a fixed quantity of water as against other riparian, but rather has a right to the use of the stream in common with the equal and correlative rights of other riparians (Anderson, 1977).

The nature of appropriative rights is based upon the California state administrative grant that allows the use of a specific quantity of water for a specific beneficial purpose if water is available in the source free from the claims of others with earlier appropriations. The right is initiated by an application for a permit. The place of use is not restricted to riparian land or even to the watershed basin. The right may be sold and its use or place of use changed, and it may cease to exist if it is not used (Archibald, 1977).

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PHYSIOGRAPHY AND GEOMORPHOLOGY

The Streelow's Watershed Basin is a sub-basin to the Prairie Creek Watershed of Humboldt County. The area is typical of much of Northern coastal region of California and Oregon. The topography is semi-rugged with many mountains that begin at 150 feet and commonly extend just above 450 feet.

Downwasting has been the greatest factor in shaping the relief of the area, increasing presently due to tectonic uplift. The major landforms are convex to concave in profile which are characteristic of humid regions.

According to Dr. Kelsey (1979), the northcoast region is considered geologically active because of the two opposing forces: tectonic uplift (Gorda^{-Pacific} plate sliding under the ^{Northwestern N. Am.} Pacific Coast plate) and degradation (climate and geological interplay). The average rate of uplift is .5-.75 feet (15.2-22.86cm) per 1,000 years. As a consequence, degradational forces are inevitable. The natural erosion rates of the northcoast region are extremely high as compared to other regions of the country. The annual suspended sediment yield is greater than 4,000 tons/mi²/year.

Accelerated erosion of the watershed can be interpreted from aerial photographs and from field observations. There were two main areas which were visited by foot, the southwestern and northern sub-basins of the watershed.

Southwestern Sub-Basin

The southwestern sub-basin was logged in 1963 and 1964 by Arcata Redwood Company. According to Robert Ziemer (1979), woody vegetation growing on slopes reinforce soils and enhances stability, conversely, its removal by clearcutting should weaken the soils and destabilize the slopes. The average slope of the area ranged from 30 to 70 per cent. The emerging consensus is that clearcutting and timber harvesting operations can and do accelerate both erosion and mass movement on steep mountain slopes (Gray, 1978).

According to Kelsey (1979), certain mass movement types in nature are associated with rock types and type of slopes. The area visited had moderate to steep slopes and was underlined with schistose sedimentary and soft sedimentary rocks. The major type of mass movement of the area was slumping.

According to Derek Rust (1979), the area had a high hazard potential for mass wasting due to the logging of the protective soil's vegetative cover. In addition, from photo interpretation of the area, Major Creek on the southwestern divide is eroding headward towards Streelow's southwestern headward stream. The distance between them is approximately 1100 feet. Stream piracy is inevitable with time. No rates were determined due to insufficient time range differences of aerial photos.

Northern Sub-Basin

The northern sub-basin drainage was logged intermittently in 1954 through 1962 by Sage and Simpson Lumber Company (Goodman, 1979). The area has revegetated well in 30 years. The logging roads with steep gradients have ~~ephemeral~~ gullies which undercut the road cutbanks (extending 10 feet or greater). Refer to Figure 1, ^{page 7} According to Heele (1975), sediment production is usually highest in the youthful stage of gullies. These areas are potential sites for debris slides. Other road cutbanks without evidence of gullying have extreme mechanical and chemical weathering of the parent material which is fracturing, hence undercutting the road cutbank.

Along the eastern road leading toward the mouth of the stream, many mass movements of slumping were observed.

Eastern Sub-Basin

This area was not traversed except along the southwestern stream channel prior to the northern-southwestern fork.

The stream is classified as underfit. The floodplain was approximately 75-100 feet. The terrace was six to fifteen feet in height and extended five

to twenty feet horizon tally.

The present stream is in equilibrium and is classified as a meander. The fluvial stream processes are eroding the outside (concave), Refer to Figure 2, bank and depositing material on the inside bank. The stream bank is composed of silty clay which is very cohesive. This material is presently being eroded and deposited further downstream.

Overview

The watershed is reaching its mature stage. The area is geologically active with high natural and accelerated erosion of earthflow and slump mass movements. Hence, this area is still not in its dynamic equilibrium geomorphically. Where dynamic equilibrium does not exist, it is obvious that the forces exerted by streamflow lead to sediment production and deposition--in short, to active land-form development (Heede, 1975).



FIGURE 1



FIGURE 2

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GEOLOGY

The Streelow Creek Watershed lies within the Northwest trending Coast Range Geological Province of California (Oakeshott, 1971). The northern region is considered tectonically active due to the Gorda Plate subducting underneath the North American Plate off the northern California coast. The active tectonics result in high uplift rates and faulting. Combining the effects of the high uplift rates, tectonically sheared and faulted rock formations, and the high rainfall, the north coast has one of the largest erosion rates in the world.

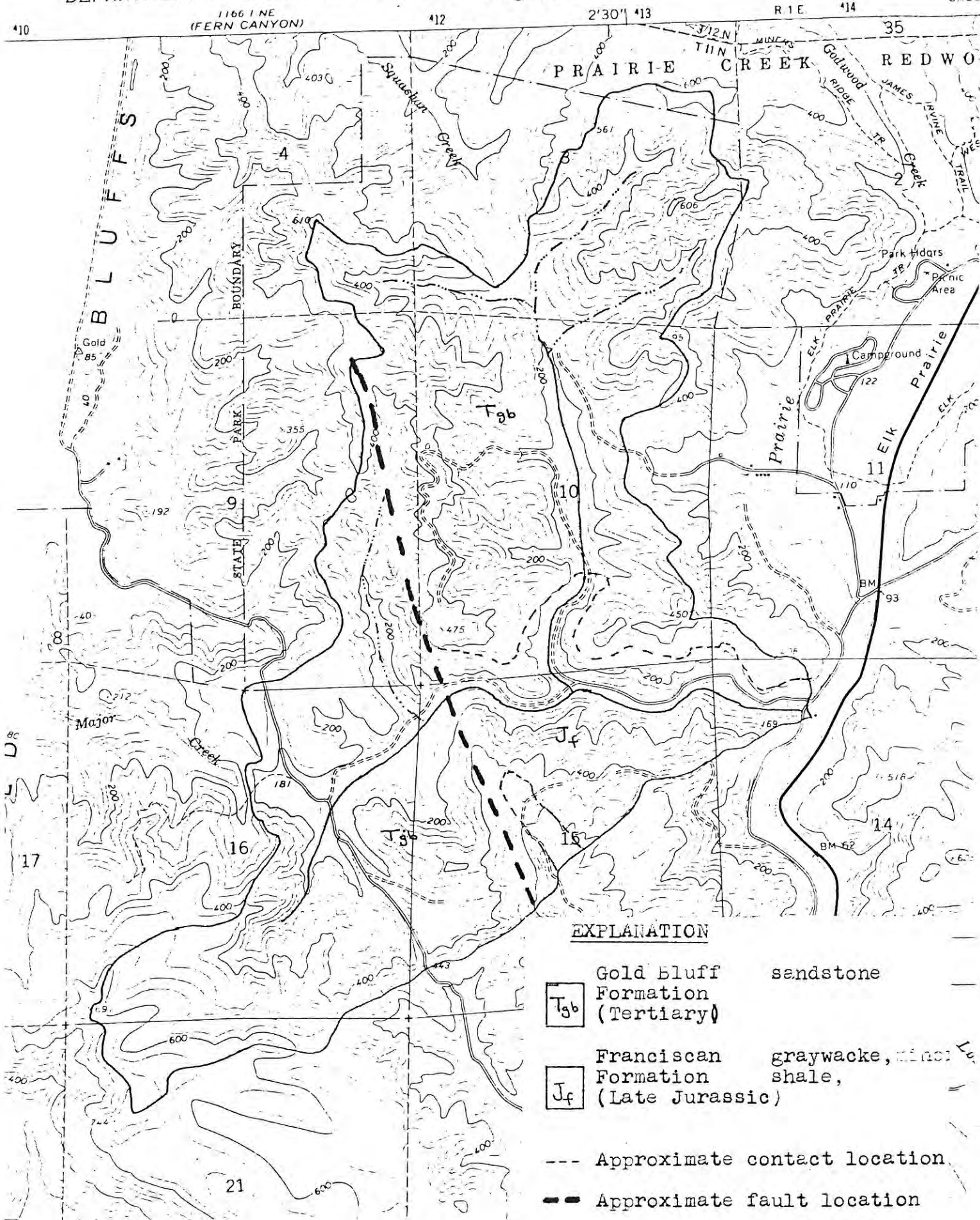
In the Streelow Creek Watershed Franciscan rocks of upper Jurassic age form the basement and are overlaid by the Gold Bluffs formation, Tertiary in age.

The Franciscan formation comprises 17% of the Streelow Creek Watershed. (Figure 1). It consists primarily of massive graywacke with minor interbedded shale. The graywacke is fine to coarse grained, poorly sorted, well-indurated rock. Dark gray to greenish-gray fresh, it weathers to light gray or dark brown. Beds of graywacke vary in thickness with most between 1 to 3 feet. Generally sheared, the beds are non-graded and lack internal structure.

Gold Bluff formation comprises 73% of the Streelow Creek Watershed. It consists primarily of semi-consolidated sandstone, with small lenses and interbeds of clays, silts, and pebble conglomerates. The sandstone is composed of fine to medium grains and is moderate to well-sorted. Weathering from light to medium brown, the sandstone exhibited parallel laminations, small and large scale high angle cross stratifications, and red wavy iron leachment staining.

Geology effects the orientation, shape, stream direction, and rock lithology. The orientation, shape, and stream direction of the Streelow Creek Watershed is structurally controlled by the northwest trend of the coastal province. Tectonically active, the area has many northwest trending faults which determine, to a large degree, the shape of drainage basins, and stream directions. Where the

Figure 1.



stream valleys lie parallel to incoming storms (See Quantitative Characteristics, Figure 2), as with Streelaw, high flood peaks are likely to occur.

Rock lithology influences infiltration rates and erosion rates. Franciscan graywacke has a lower infiltration rate than the porous Gold Bluff sandstone. The porosity of the Franciscan is low due to cementation of recrystallization of grains. Water infiltrates through rock fractures. Therefore, the drainage density on Franciscan graywacke is greater and the drainage pattern exhibits a structurally controlled trellis type form. The Franciscan formations exhibited soil creep on steep slopes with high moisture content, and slumping in areas adjacent to the fault. Slumping of the Franciscan was possible due to the sheared nature, and concentration of water.

The Gold Bluff's sandstone, having a greater porosity and erodable equally in all directions, forms a dendritic drainage ~~form~~ with a lower drainage density.

The erosion rates of the Franciscan graywacke and Gold Bluff sandstone vary according to the type of mass movement. The Franciscan graywacke is subject to debris slides and rock slides (Kelsey, 1979). Due to its fractured nature, water does not concentrate within confined beds causing earthflows or slumps. Precipitation falling directly on the bare rock will not cause any surface erosion due to its highly fractured nature and hardness.

The Gold Bluff's sandstone normally has a high porosity. Therefore, it has a low erosion rate due to its high infiltration rate. After land disruption, logging in this case, the surface porosity is reduced by compaction and inwash of fines and it is subject to surface erosion; gullies and rills. Surface erosion then enlarges the affected area by armoring the surface and deposition of fines over unaffected surfaces.

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SOILS

The soils of the Streelow Creek Watershed are either forming in place on moderately to steep slopes where they are subject to erosion, or else they occur as a result of deposition on the lower level landforms from such erosion in the past. The soil processes indicative of the watershed begin with the development of residual soils on the upper watershed slopes, then proceed with subsequent erosion, transport, and deposition of these as parent material for soils along the lower stream side flats.

The Streelow Creek drainage basin can be divided into southwestern, northern and eastern sub-basins. The northern and eastern sub-basins have most of their soils developing on moderately to steep slopes, whereas the southwestern sub-basin has 60% of residual soils on moderately to steep slopes and 40% on undulating to hilly slopes.

The southwestern sub-basin has predominately well weathered regolith of fine to medium textured surface horizons and fine textured subsurface horizons which overlies schistose sedimentary and soft sedimentary rocks. These soils have moderate permeability, good drainage (either by runoff or percolation), and moderate to high erosion hazards (the susceptibility of a soil to erosion after disturbance of protective vegetative cover). These soils have medium to extremely high timber productive indexes.

The northern sub-basin has well weathered regolith of medium textured surface horizons and fine to medium textured subsurface horizons which overlies soft sedimentary rocks. These soils have moderate permeability, good drainage, and high erosion hazards. These soils have very high timber productive indexes.

The eastern sub-basin has well weathered regolith of medium textured surface horizons and fine and fine to medium textured subsurface horizons which overlies schistose sedimentary and sandstone and shale rocks. These soils have

moderate permeability, good drainage, and moderate to high erosion hazards. These soils have medium, high, and extremely high timber productive indexes.

Overall, Streelow's Watershed Basin has well-weathered regolith composed of fine to medium textured surface horizons and fine to medium textured sub-surface horizons overlying schistose sedimentary, soft sedimentary, sandstone and shale rocks.

The drainage basin soils have moderate permeability, good drainage, and moderate to high erosion hazards. The soil's timber productive indexes range from medium, high, to extremely high ratings. Refer to Tables 1A, B, and C for Streelow's Watershed Basin's summary of site class, soil type, erosion hazard, average slope and parent material in percent and total acres.

TABLE 1A

Soil Series Symbol & Nomenclature	Site Class ¹	Percent of Area	Total Acres	Erosion Hazard ²
Empire; 920	II	63.83%	1147.7	High
Empire; 920	I	1.48%	26.6	High
Hely; 921	II	7.38%	132.7	High
Melborne; 814	III	10.33%	185.7	Moderate
Melborne; 814	II	5.17%	93.0	Moderate
Mendocino; 915	II	1.48%	26.6	Moderate
Orick; 813	II	10.33%	185.7	Moderate
TOTAL		100.00%	1798.0	

¹ Douglas fir and Redwood types are graded in terms of the total height that average dominant and codominant Douglas fir trees reach at 100 years of age--by 300 foot classes.

² Erosion hazard refers to probable susceptibility of a soil to erosion after material disturbance of protective vegetative cover.

TABLE 1B

Site Class	% of Area	Acres	Average Slope	Parent Material
I-(200'/100 yrs)	1.48	26.6	50%	Soft Sedimentary
II-(170'/100 yrs)	10.33	1585.7	54%	Soft & Schistose Sedimentary
III-(140'/100 yrs)	88.19	185.7	65%	Sandstone & Shale
TOTAL	100.00%	1798.0		

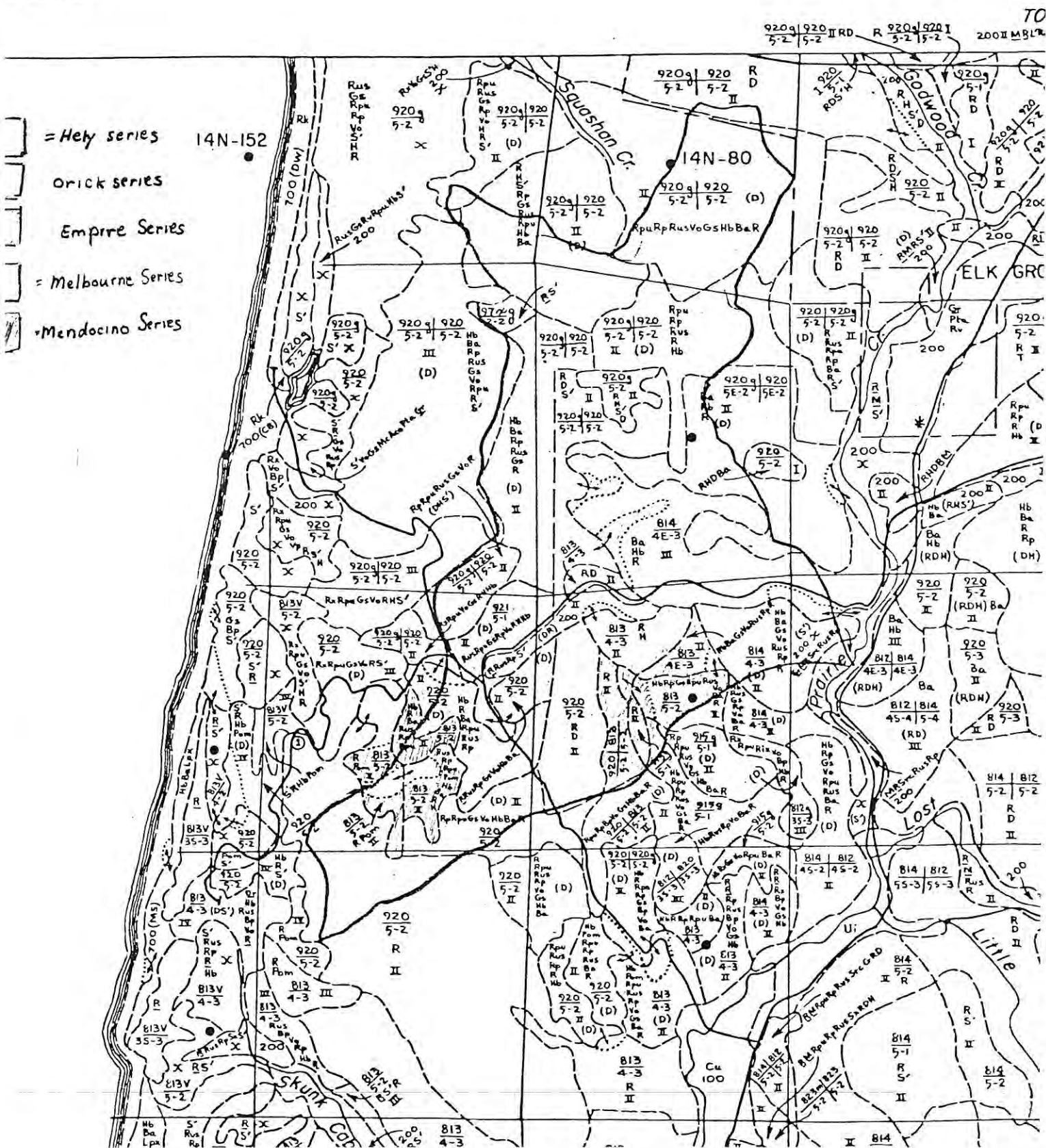
TABLE 1C

Erosion Hazard	% of Area	Total Acres
Moderate	72.69%	1307.0
High	27.31%	491.0

SPECIES COM
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CALIFORNIA RESOURCES



Climate

The north coastal region is an area characterized by dry summers and wet winters moderated by the Pacific ocean. Fog is the predominate feature of North Coast weather generally occurring daily during the summer and frequently during the rest of the year. The fog is considered to have considerable influence in reducing evapotranspiration in the region.

The region's humidity is relatively high. A serious fire hazard is only infrequent.

Winds are light, and are from a northwest or northeast direction most of the time. It is only during intense summer or winter storms that damaging winds (windthrow) are experienced.

Thunderstorms are rare along the coast and coastal valleys, thus precipitation intensities are generally low. The two year and one hundred return period rainfall amounts for various durations of precipitation are shown in Table 1.

Table 1. Rainfall Intensity (inches) for Northern California.

Location	2-year return period			100-year return period		
	1-hour	6-hour	24-hour	1-hour	6-hour	24-hour
Northern Mtns.	.70	3.50	6.50	1.80	7.35	14.30
Central Coast	.60	1.50	3.50	1.20	3.00	7.00

When the high intensity precipitation is less than 3 hours duration it is usually associated with summer thunder-showers, while for longer periods the greatest intensity is

usually during large area winter storms. Harvey Kelsey (1979) stated that it is the infrequent larger intensity storms which may cause up to 51% of the entire suspended sediment load a river may take on over a ten year period.

Precipitation along the mountainous coast is highly erratic. Mean monthly precipitation is shown in Table 2.

Table 2. Mean monthly precipitation for Orick Prairie Creek Park averaged over 30 years from 1941 to 1970.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	13.06	8.96	8.50	4.85	3.71	1.24	.36	.67	1.16	5.56	10.05	11.99
Ext Hi	24.87	17.51	19.29	14.28	10.18	4.31	4.77	5.67	3.73	26.54	21.51	22.24
Ext Lo	2.33	1.70	1.11	.56	.11	.00	.00	.00	.03	.52	1.35	2.87

According to McDonough and Elford (1974), approximately 90% of the precipitation occurs as rainfall between October and April. Since a large portion of the precipitation is caused by orographic cooling of the predominantly westerly winds, rainfall is well correlated with elevation; higher elevations on west slopes receive more rain than do lower elevations. Areas under 3000 feet elevation receive between approximately 35 to 70 inches of rain annually, while areas above this elevation can receive in excess of 100 inches of rain per year.

Table 3. Mean monthly temperatures for Orick Prairie Creek Park

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Highest	71	70	77	88	90	99	95	97	95	90	71	67
Mean Max.	50.8	54.3	56.3	59.4	62.7	66.3	69.2	69.6	70.6	64.8	56.6	52.0
Mean Temp	43.7	46.0	47.4	50.0	53.3	56.8	59.3	59.5	58.9	54.5	48.6	45.3
Mean Min.	36.6	37.7	38.4	40.6	43.8	47.2	49.3	49.4	47.2	44.1	40.5	38.5
Lowest	19	23	26	29	32	34	38	39	31	28	25	22

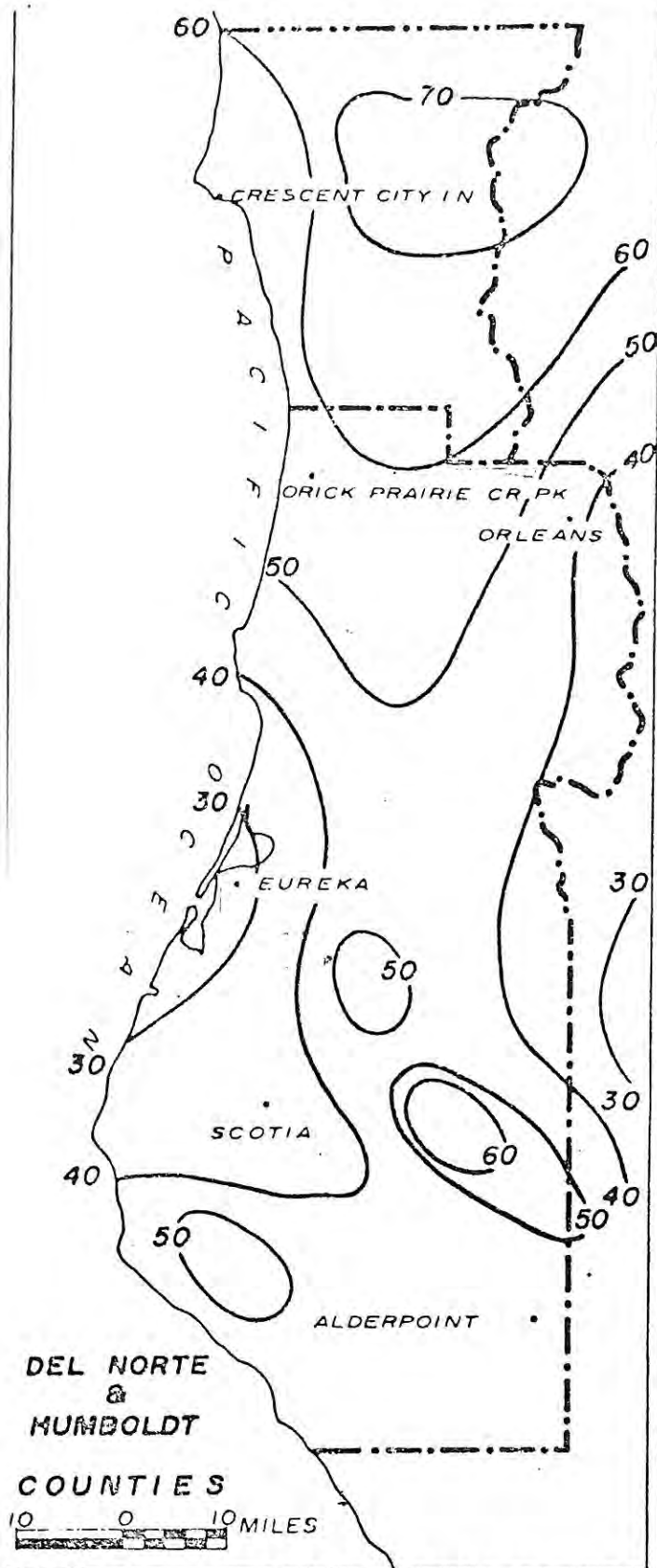


Figure 1. Annual Precipitation Will Be Less Than This Amount 1 Year in 10 (Inches).

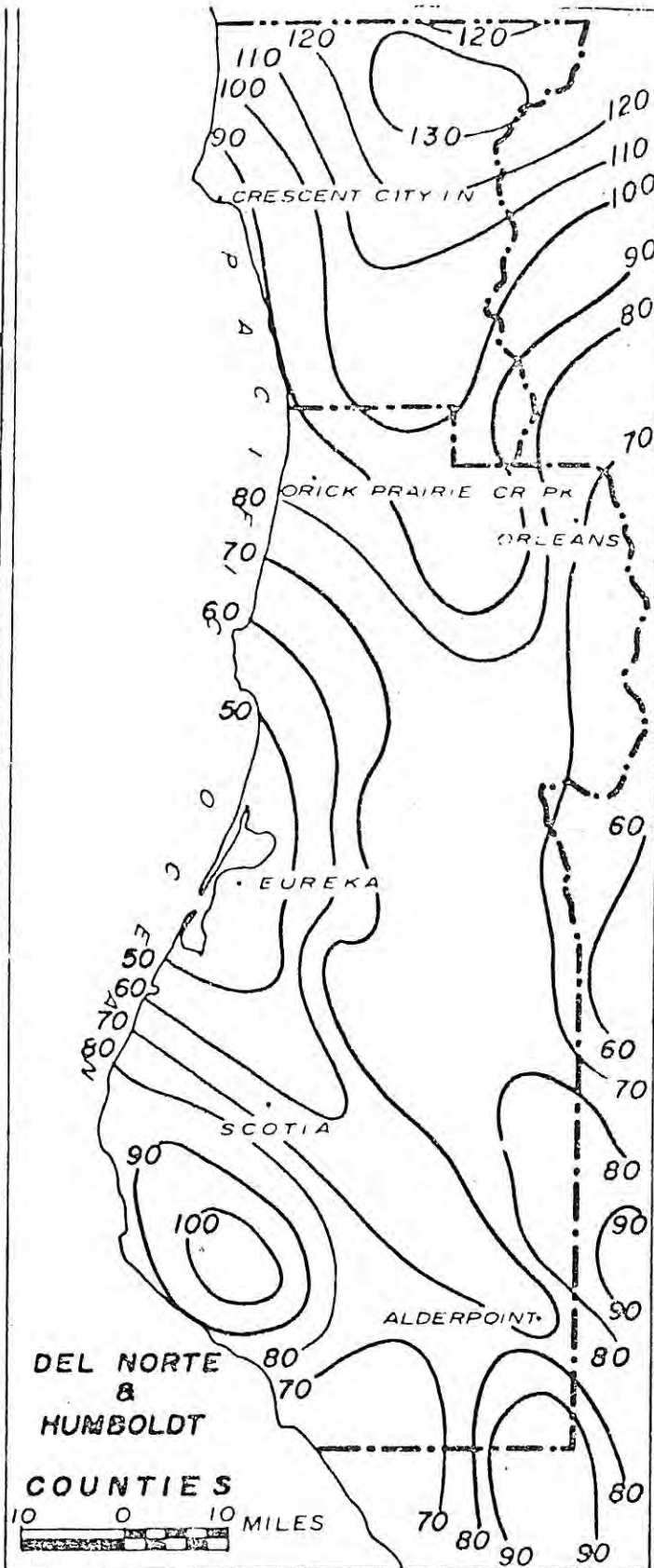


Figure 2. Annual Precipitation Will Be Less Than This Amount 9 Years in 10 (Inches).

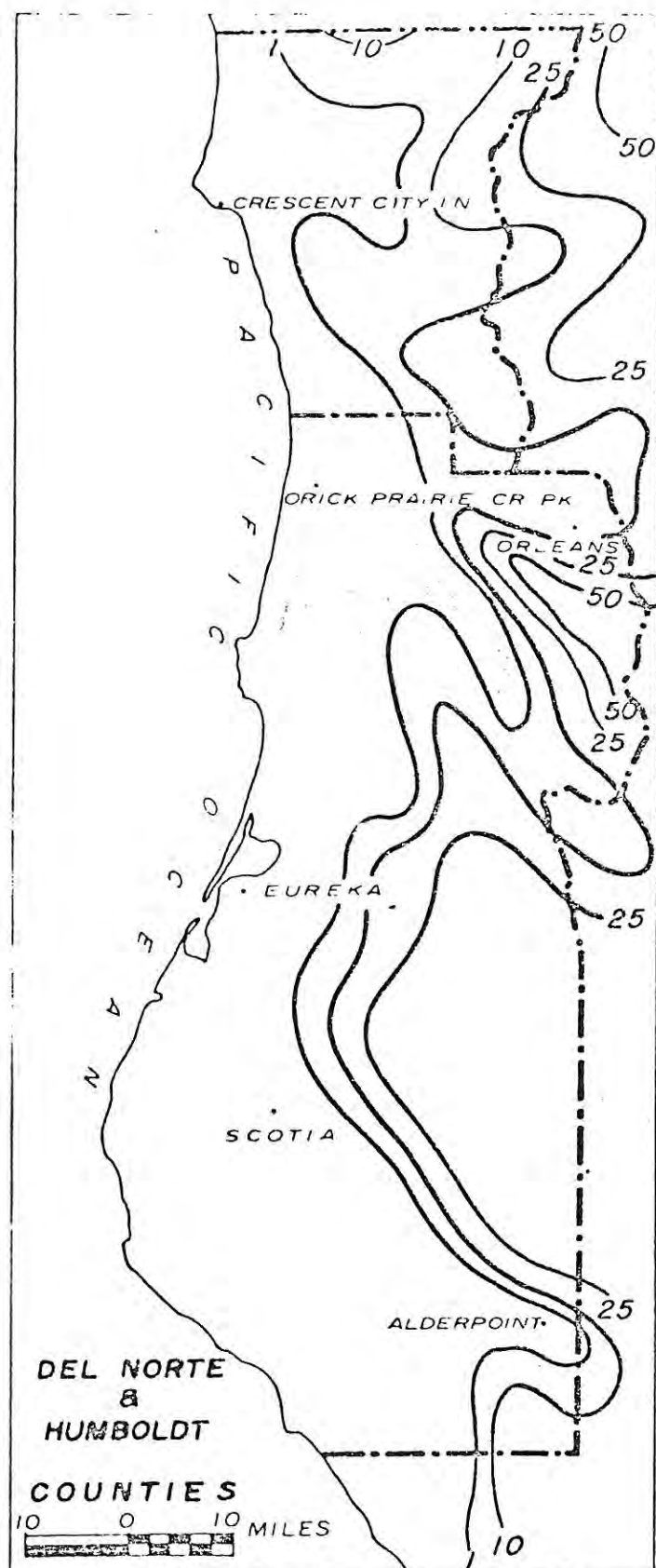


Figure 3. Average Seasonal Snowfall (Inches).

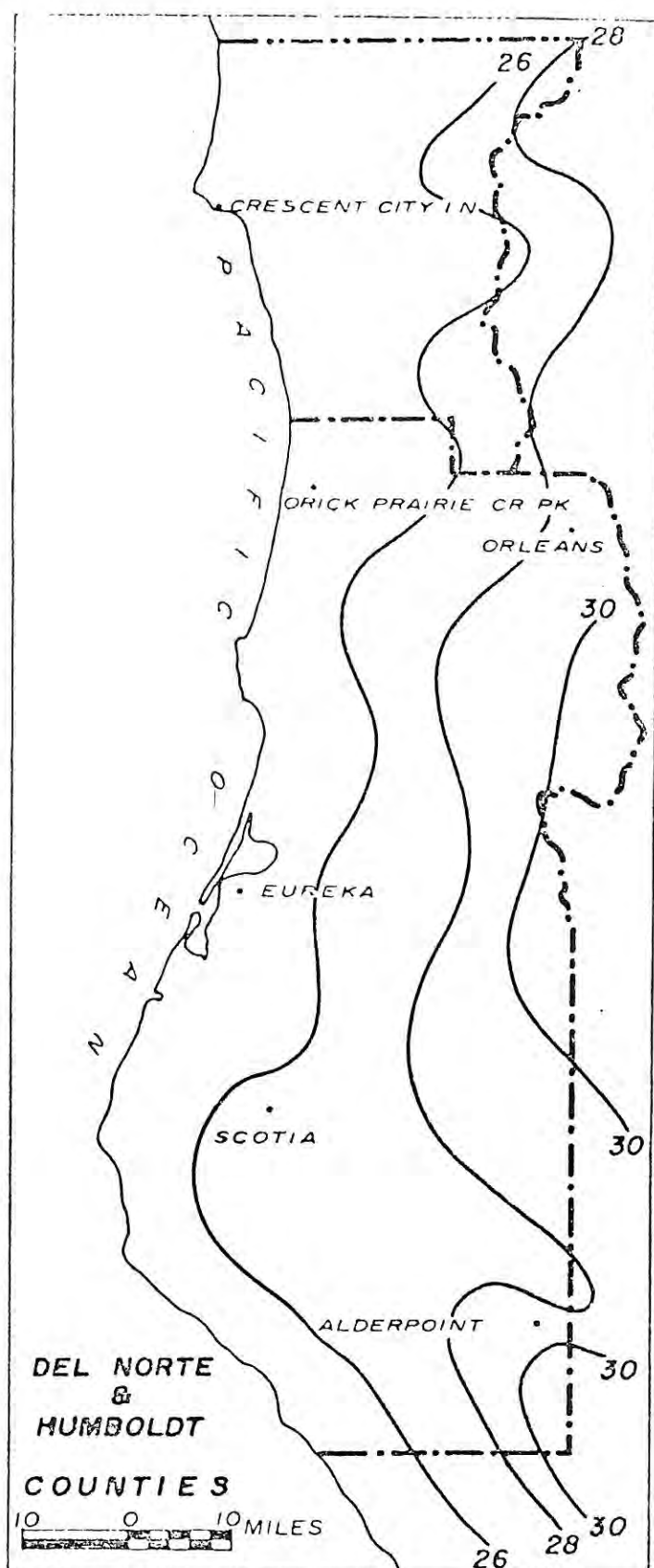


Figure 4. Average Annual Potential Evapotranspiration (Inches).

Vegetation

The vegetational changes in these former pure redwood stands in the hilly landscape of this watershed are quite variable. Climax dominants with redwood are Western hemlock, Western red-cedar, grand fir, and Sitka spruce.

On the upland soils, common associates is Douglas-fir along with tanoak, Pacific madrone, California-laurel and red alder.

Various shrubs and herbs are found on redwood slopes. The uneven height and density of different tree species admit enough light for the development of a dense undergrowth of huckleberry, salal, Oregon grape, thimbleberry, and many species of ferns. On redwood flats, the shade by these stands is so dense that no ground cover other than redwood sorrel and sword fern will grow beneath it.

Natural succession which has occurred on most of these sites after extensive harvesting depends on many factors. The succession in the development of second growth stands is comprised of a series of simple and relatively rapid stages influenced by the proximity of seed sources, how the slash was handled, and the soil surface conditions. In most of the area in this watershed regeneration is poor with aerially seeded Douglas-fir slowly establishing itself. In most of the watershed red alder, California-laurel, and maple have appeared soon after harvest of the old growth. One or more of several species of fire weeds (Epilobium and Erechites) often enter on clearcut and slash burned areas. Coyote bush, scotch broom, and manzanita, along with other hardwood vegetation have also worked to hinder the growth of the coniferous seedlings.

QUANTITATIVE CHARACTERISTICS
OF STREELow CREEK

Purpose of Measurements

The study of quantitative and discriminate characteristics of drainage basins provides a means of describing the interrelationships in morphological systems and process-response systems. Linear, aerial, and relief aspects of basins can be used to compare different morphological systems and predict responses to a given process. Although the quantitative characteristics are useful tools they are inadequate alone; it is an attempt to simplify a complex, interrelated, three dimensional entity which varies over time into a two dimensional or single index.

Measurement of Characteristics

A summation of measured characteristics of Streelow Creek is listed in Table 1. Measurements were calculated from the U.S.G.S. 7.5 Minute Topographical Map, Orick Quadrangle, 1966. Definitions of the measured characteristics and their calculations are listed in the appendix.

TABLE 1
QUANTITATIVE CHARACTERISTICS
OF STRELOW CREEK

Area of Watershed	1737.5 Ac.
Length of Permanent Streams	3.41 Mi.
Length of Intermittent Streams	2.65 Mi.
Slope Aspect:	
North	30.3 %
East	25.6 %
South	24.0 %
West	20.1 %
Stream Aspect:	
Streelw Creek - Upper Watershed	North
Lower Watershed	East
Southern Tributary- Upper Watershed	Northeast
Lower Watershed	East
Drainage Pattern	Dendritic
Mean Elevation	400.5 Ft.
Median Elevation	313 Ft.
Total Relief	687 Ft.
Basin Altitude Index	240 Ft.
Main Channel Slope Index	151.8 Ft./Mi.; 2.87 % Slope
Mean Slope of Main Channel	194.9 Ft./Mi.; 3.69 % Slope
Drainage Density	2.24 Mi./Mi. ²
Compactness Coefficient	1.62
Stream Order of Main Channel	3rd Order

DESCRIPTION AND INTERPRETATION
OF QUANTITATIVE CHARACTERISTICS

Area of Watershed: 1737.5 acres

The area of the watershed affects the magnitude of floods, minimum flows, and average flows. (Wisler, 1959)

Streelow Creek would tend to exhibit a greater magnitude flood flow per amount of precipitation than larger basins. Due to its small size, the distance from the drainage divides to the main channel is short and runoff quickly concentrates into Streelow Creek. All the tributaries would therefore contribute to the main channel shortly after precipitation begins resulting in a storm hydrograph exhibiting a short lag time, steep rising limb, high peak flow and a moderate falling limb. Also contributing to high flood peaks would be the greater intensity of precipitation found in small basins. Since the maximum intensity of precipitation for any given frequency varies inversely with area covered by the storm, small watersheds will exhibit a steep rising limb and high peak flows on storm hydrographs.

The size of the basin affects minimum flows during the summer months. Minimum flow is regulated by the rate of groundwater influx into the main channel. During dry periods groundwater supplies may be replenished by localized storms which may cover only a small area. The probability of precipitation falling on the basin would vary directly with the size of the basin. Streelow Creek would exhibit a decrease in sustained flow during the summer months with possible fluctuations during localized storms.

The average flow of small basins is significantly related to any change in land use. Any change in basin characteristics will exhibit a more marked effect on total discharge in small watersheds since the land influences a greater percentage of yield per unit stream than in larger basins.

Length of Permanent Streams/Intermittent Streams: 3.41/2.65 miles

The length of streams is an indication of the basin slope and degree of drainage (Wisler, 1959). Streelow Creek's steep slopes tend to have numerous small intermittent tributaries while flat regions tend to exhibit fewer but longer perennial tributaries. To compare different basin lengths, stream of the same order are used.

Lithology and rock structure also affects stream length (Morisawa, 1968). Streams flowing on Gold Bluff Sandstone tend to be longer, drain a greater basin area and have a lower drainage density than streams flowing over Franciscan Graywacke.

Slope Aspect: 30.3% North, 25.6% East, 24.0% South, 20.1% West

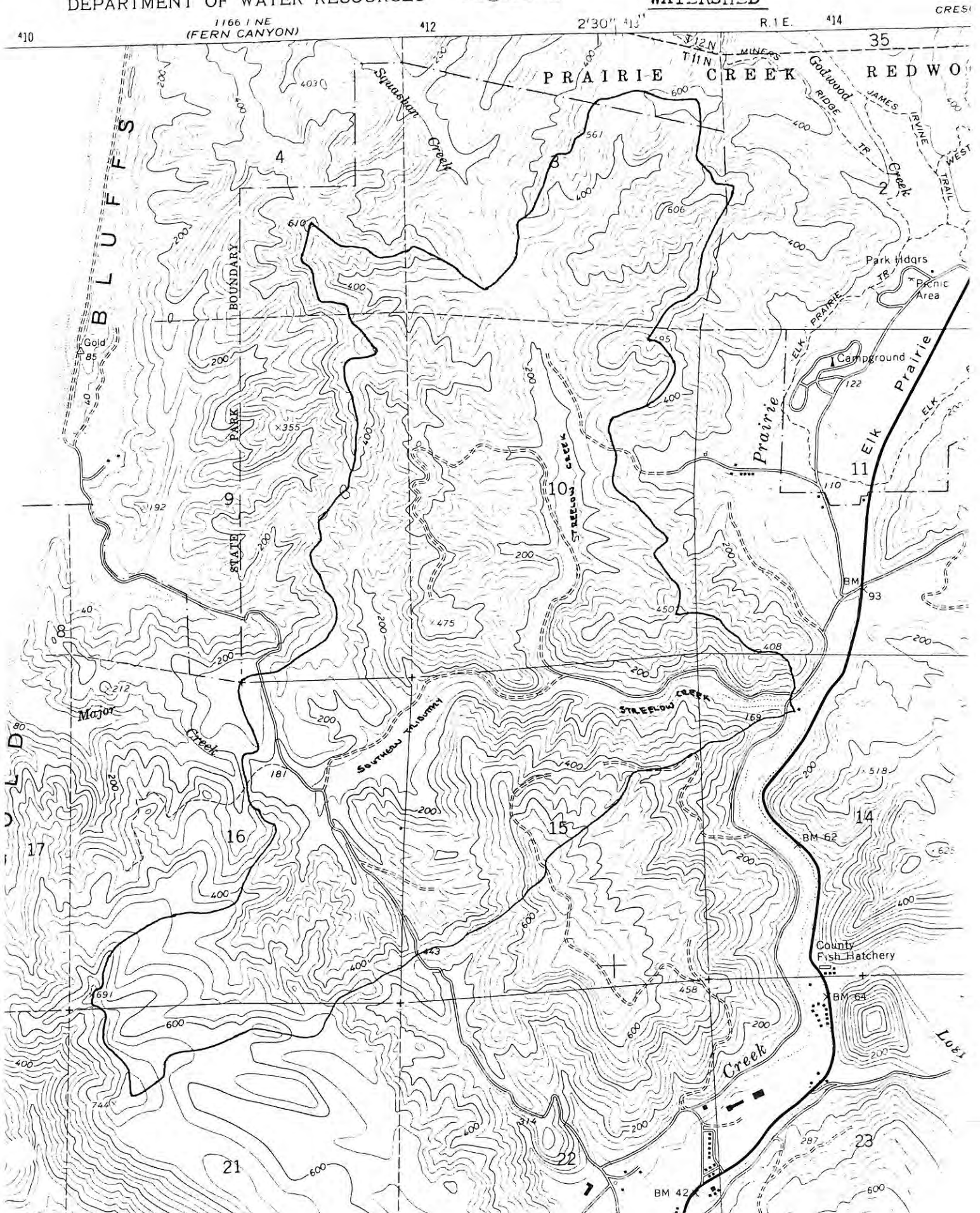
Orientation of a watershed may influence the amount of precipitation and insolation it receives (Morisawa, 1968). Slope orientations for the Streelow Creek Watershed were tabulated (Table 2) resulting in a slight northeastern trend.

Upon studying the data and the topographic map of the watershed (Figure 1), I failed to find a correlation between the slight northeastern trend and its influence on total precipitation, although several aspect-related correlations may be made.

A correlation could be postulated with the overall northeast shape of the basin and magnitude of discharge resulting from a given precipitation. The general arrival of winter storms is from the northwest (Figure 2). As the storm migrates southeast across the watershed, initial precipitation which has fallen in the upper reaches of Streelow Creek, is added to the main channel as direct precipitation falling. The simultaneous input would result in large peak flows.

The amount of precipitation which falls into the basin is influenced by the orientation and elevation of its western drainage divide. Along the northwestern border the north trending boundary creates a "rain shadow effect" (Figure 2).

ASPECT AND SLOPE CLASS OF STEELOW CREEK



The southwestern boundary exhibits a break in the divide (extended up Major Creek) eliminating the rain shadow effect. Note the perennial nature of Streelow Creek's southern tributary (Figure 2).

The slight northeastern trend noted in Table 2 can be correlated with insolation. Insolation varies with slope aspect; south facing slopes receiving the greatest solar radiation, followed by west, east, and north slopes. Due to the greater percent of north and east facing slopes (56%), the Streelow Creek Watershed should have slightly greater runoff and more developed drainage systems than southwest oriented basins.

Stream Aspect: Northeast

The overall aspects of the streams of the Streelow Creek Watershed follows the trend of data tabulated in Table 2. The northward trend of Streelow Creek in its upper watershed is influenced by the northern structural trend of the coast ranges. The eastern flow in the lower part of the watershed probably follows paths of lithological weakness through the Franciscan formation.

Drainage Pattern: Dendritic, with slight structural control.

Drainage patterns reveal the lithology and rock structure of the Streelow Creek Watershed. Streelow Creek exhibits a "characteristic" dendritic pattern on Gold Bluff's sandstone, and a more linear dendritic pattern on Franciscan Graywacke; superimposed on the northwest structural trend of the coast ranges. The "characteristic" dendritic pattern reveals that the Gold Bluff's sandstone has a relatively homogeneous lithology with possibility of stream flow equal in all directions. Drainage channels within the more resistant by highly fractured Franciscan Graywacke tend to follow a more linear dendritic pattern, following zones of weakness in the rock strata. Both patterns are superimposed on the northwest structural trend of the coast ranges. The overall dendritic pattern should result in high peak discharges for Streelow Creek due to the simultaneous

discharge of its tributaries into the main channel.

Mean Elevation/Median Elevation: 400.5/313 feet

Mean elevation is used for comparison of different basins. Median elevation is derived from a hypsometric curve (Figure 3). The curve shows that 50 percent of the Streelow Creek Watershed area lies above 313 feet, which is called the median elevation.

Elevation influences temperature and type of precipitation. Temperature remains above freezing within the basin so that rain is the principle form of precipitation. Temperature also affects evapotranspiration, soil moisture, humidity, and type of vegetation.

Total Relief: 687 feet

Total relief can be correlated to amount of runoff, slope, sediment production, ^{and} types of precipitation falling on the basin. The greater the relief, the greater the runoff, slope and sediment production. In Streelow Creek all precipitation will be in the form of rain.

Basin Altitude Index: 240 feet

The basin altitude index isolates the main channel's altitude from the effects of its steeper headwaters and its lower base level.

Main Channel Slope Index: 151.8 feet/mile, 2.87% slope.

The main channel slope index isolates the channel slope from the effects of the steeper headwaters where degradation is the dominant process, and the lowest base level where aggregation dominates. The index reveals the characteristic slope of the main channel (Figure 4).

Mean Slope: 194.9 feet/mile, 3.69% slope.

Mean slope reveals the total relief of the channel over its length. Compared with the main channel slope index the influence of the steep headwaters

Figure 3 Distribution of Elevation
of Streelow Creek Watershed

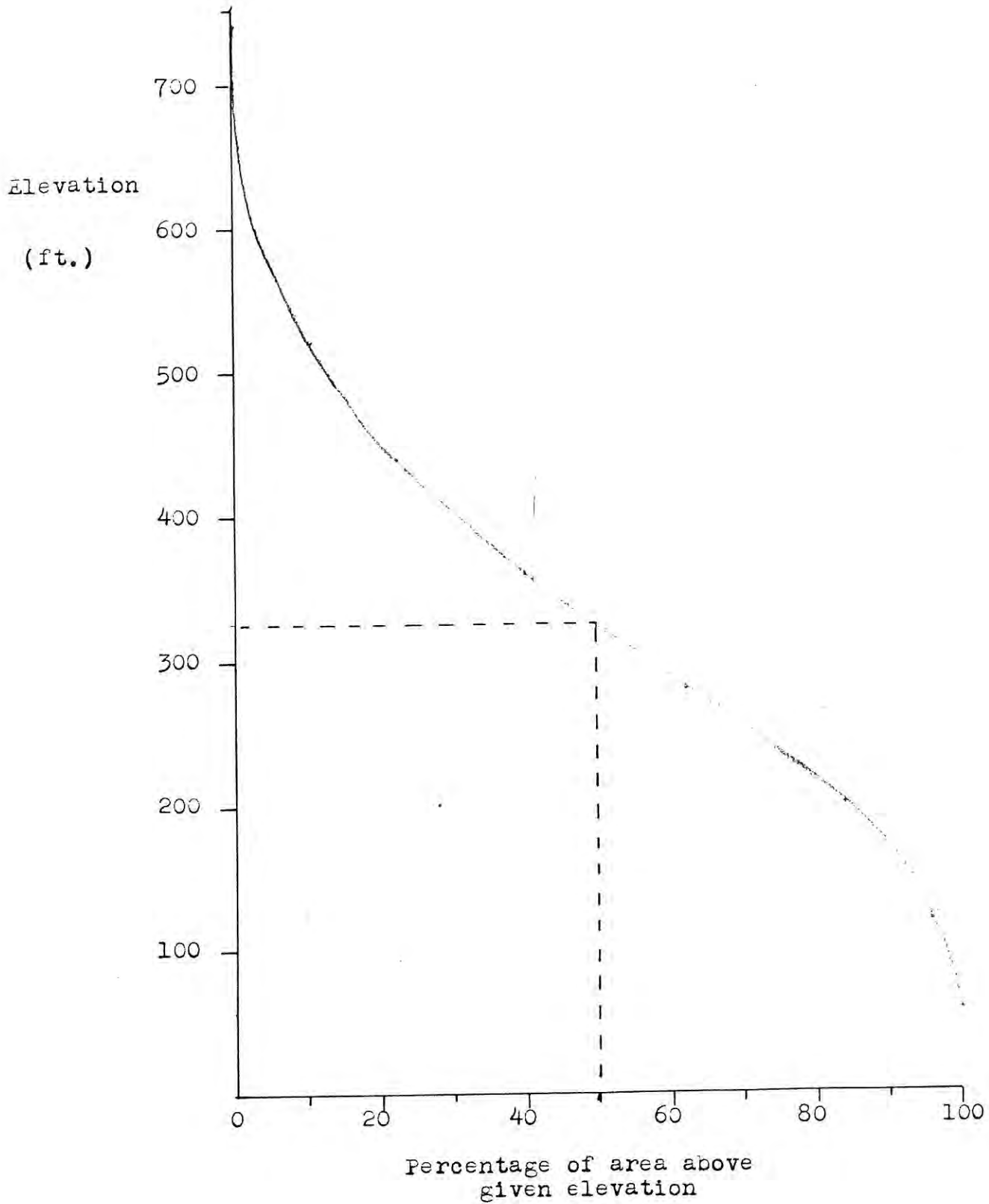
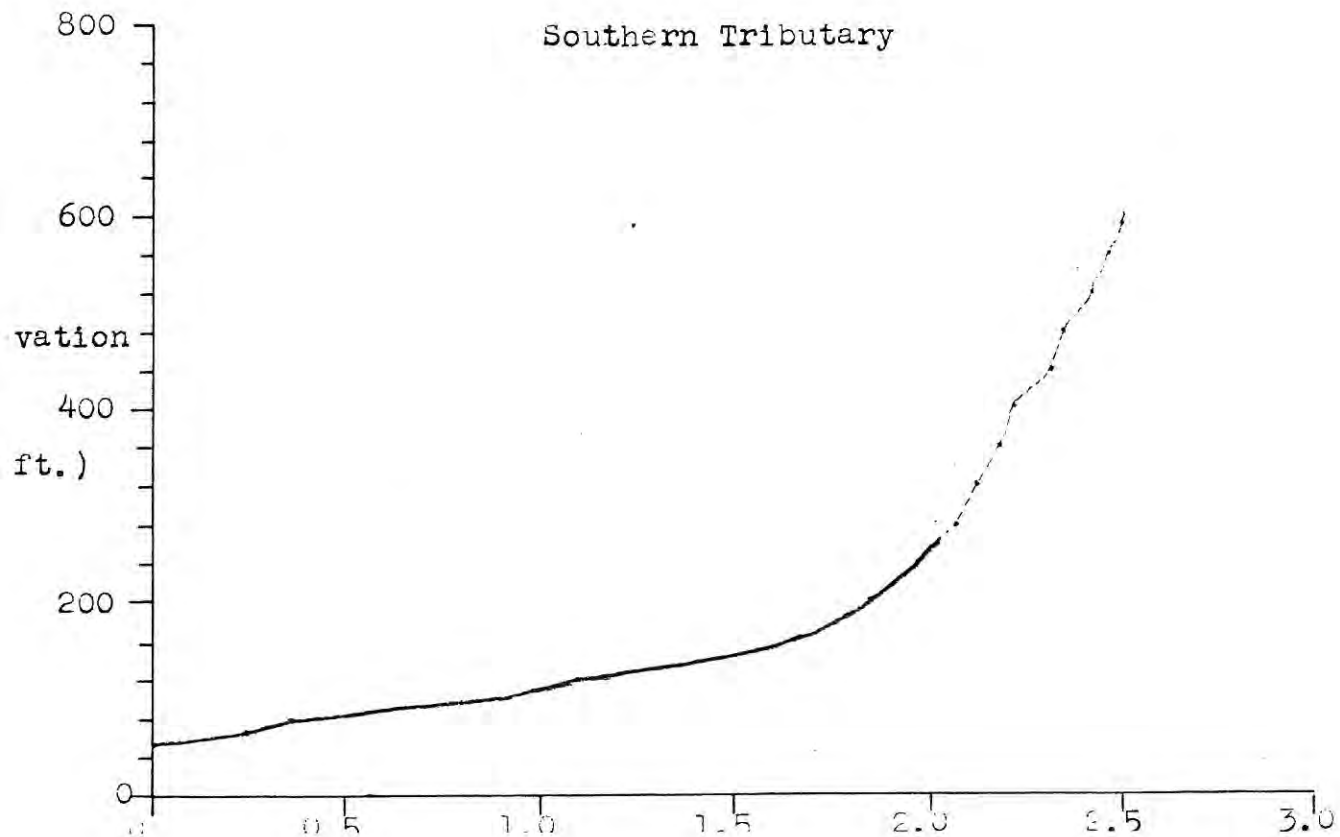
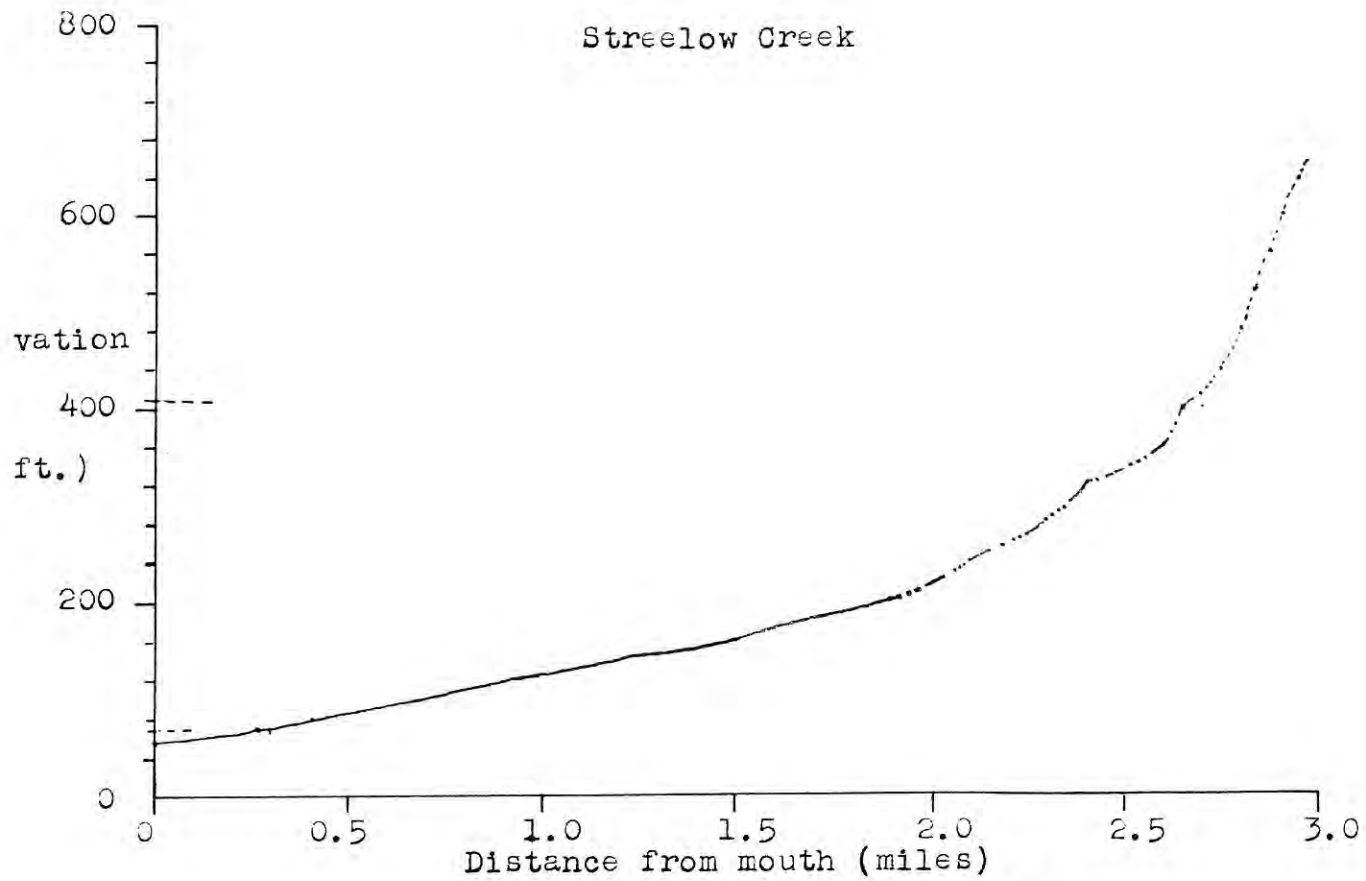


FIGURE 4. Longitudinal Profiles of Streelow Creek and Southern Tributary



and lower base level can be determined. Slope magnitude affects infiltration rates, surface runoff, soil moisture, ground water flow, drainage patterns, stream velocities and sediment production; which in turn contributes to a characteristic hydrograph for the basin.

Drainage Density: 2.24 miles/miles²

Drainage density reveals the infiltration capacity of soils or rock lithology/structure covering the basin's surface. Low drainage densities, such as Streelow's, are favored in regions of highly resistant or highly permeable subsoil materials, under dense vegetative cover, with low relief. High drainage density is favored in regions of weak or impermeable subsurface materials, sparse vegetation and mountainous relief (Strahler, 1964).

Determination of drainage density from the topographic map results in what seems to be an erroneously low number. The lowest drainage densities reported by Strahler (1964) were 3 to 4 mi/m², on resistant sandstone in the Appalachian Plateau Province. I would postulate that Streelow's low drainage density results from the fact that not all streams are represented on the map.

Compactness Coefficient: 1.67

Compactness coefficients are an attempt to correlate basin shape with stream discharge characteristics. Narrow basins with high bifurcation ratios tend to exhibit attenuated flood-discharge periods. Round or fan shaped basins of low bifurcation ratios tend to exhibit sharp peak flood discharges.

Compactness coefficients are a measure of basin shape with 1 equaling a circle. Therefore, as the coefficient approaches 1, flood discharges become more flashy; with greater peaks.

Stream Order: 3rd Order (Figure 5)

Stream orders are used to compare different drainage networks. It allows comparison of stream characteristics in basins whose difference in linear scales

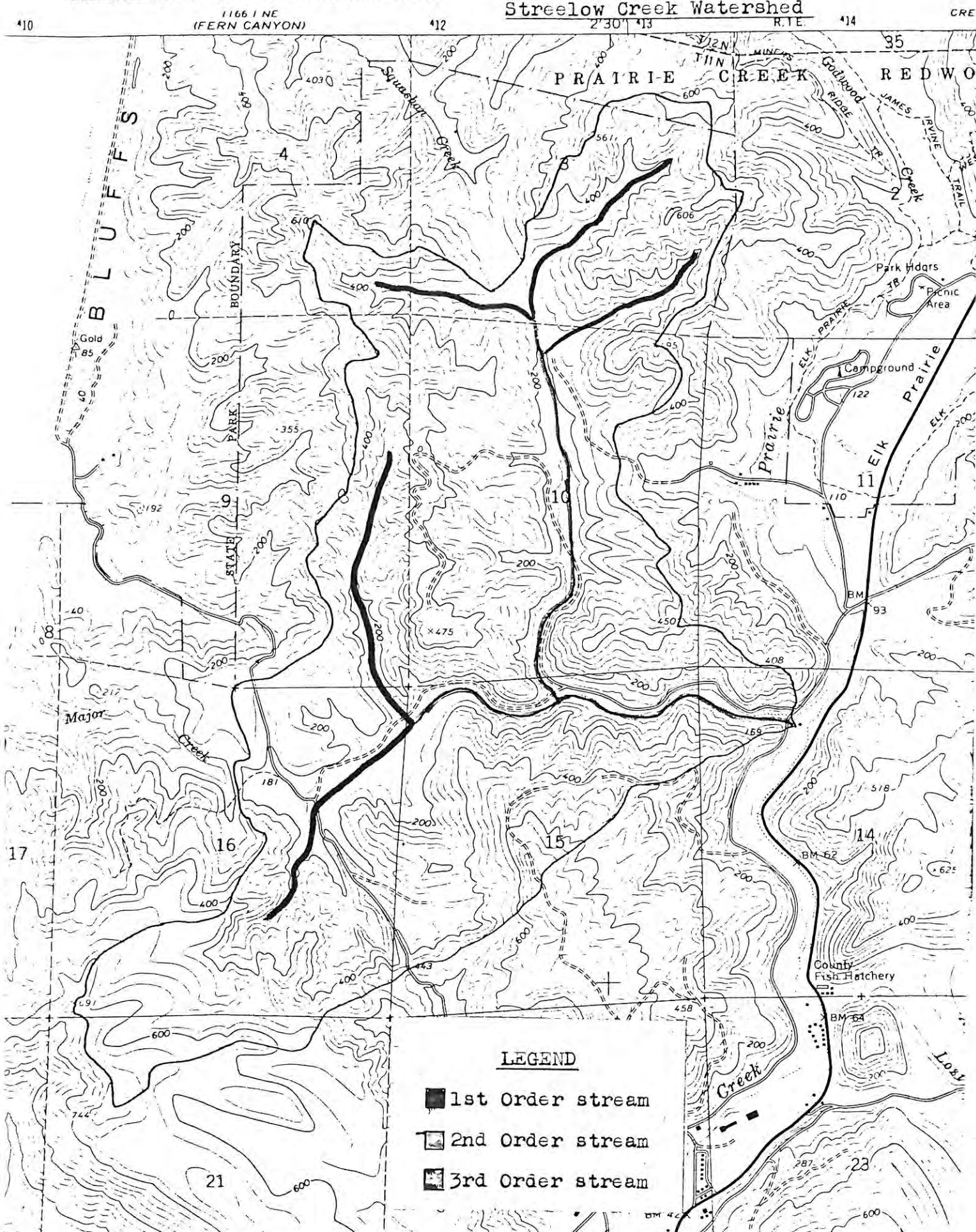
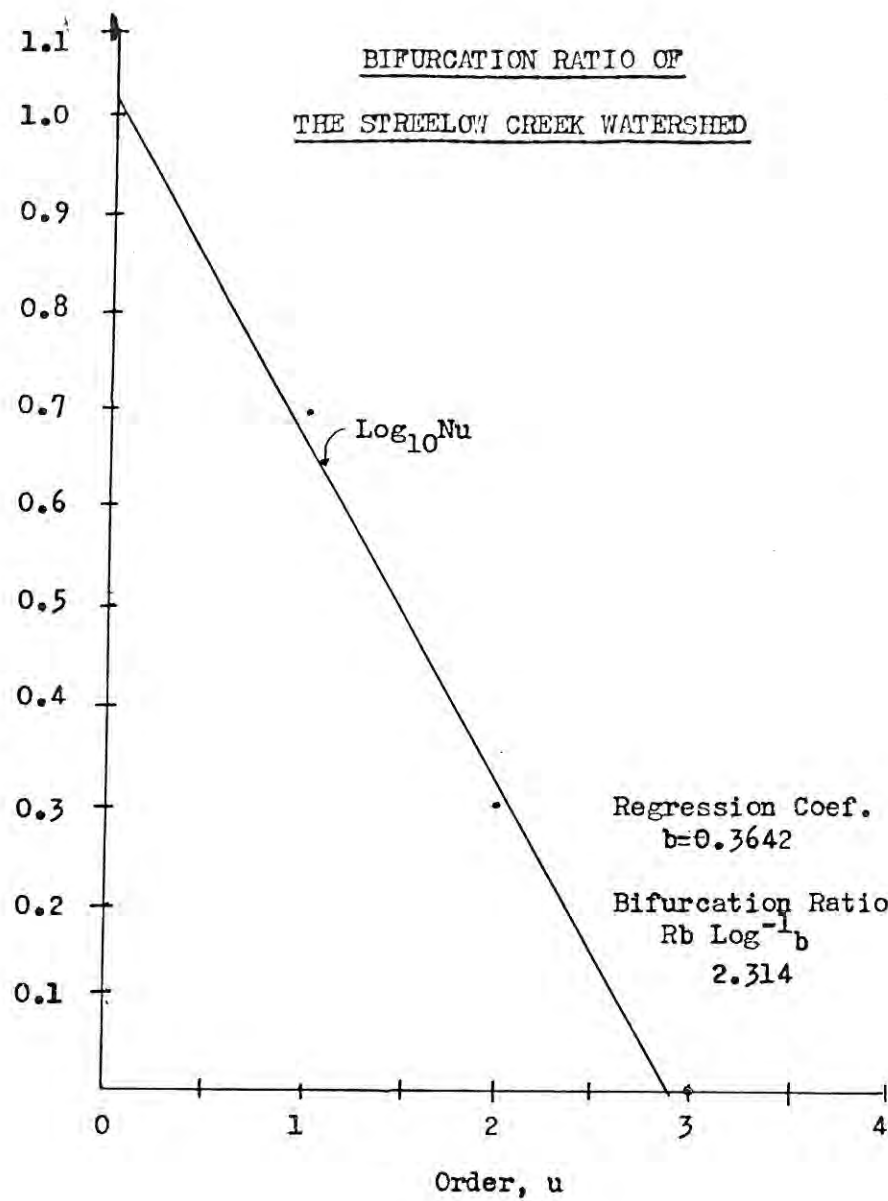


FIGURE 6

Log of
umber of
Streams
 $\log_{10} Nu$



Order u	Number Nu	$\log_{10} Nu$
1	5	0.69897
2	2	0.30103
3	1	0.00000

is great. Relationships have been computed for stream order and number of streams, area of streams, gradients, and relief of basin (Morisawa, 1968).

Once stream orders have been assigned the bifurcation ratio can be determined for each stream order and the total stream (Figure 6). Bifurcation ratios reflect the drainage pattern from which the maximum flood discharge characteristics may be determined. Bifurcation ratios have been found to be highly stable, showing little variation from region to region except where geologic controls dominate the stream pattern.

The bifurcation ratio of the Streelow Creek Watershed was calculated to be 2.314. Strahler (1957) found second to third order stream bifurcation ratios range from 2.8 to 4.9 for area where geologic structure does not distort the drainage pattern.

The slightly smaller ratio found for Streelow Creek could be attributed to the omission of possible first order streams on the topographical map. I would predict that Streelow's ratio would fall into a range of 3.2 to 3.5 with further study. Low ratios, 2.8 to 3.4, have been correlated with high peak flows (Strahler, 1964), which corresponds to Streelow's other measured characteristics.

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INTRODUCTION

Streelow is a small third order stream in Northwestern California. It is a tributary of Prairie Creek. It flows from north to southeast. It is not gauged.

Little Lost Man Creek is the closest gauged stream to Streelow Creek. Records have been kept since July 1975. Mean annual discharge ranges from 1760 Acre-feet (AF) to 10000 AF (see table 1). The mean annual discharge for the period of record is 6120 AF. Discharges from Redwood Creek near Orick, California since July 1975 have been about 73% of normal. This percentage was also assumed to apply to Little Lost Man Creek and Streelow Creek.

These data and observations were used to calculate discharges for Streelow Creek. The Streelow Creek watershed is 0.78 the size of Little Lost Man Creek watershed. Therefore mean annual discharge for the period of record would be 4774 AF. Since these flows were 73% of normal, mean annual discharge for a normal year should be 6540 AF. (see table 1).

The Holdridge (1962) method of calculating runoff was used to check these figures. Records from Orick for mean annual precipitation and temperature were used. Holdridge's method resulted in a calculated runoff of 6752 AF/year (see table 2). This figure is within 3.2% of the normal discharge for Streelow Creek. The extrapolations and corrections from Little Lost Man Creek are based on inadequate data; the Holdridge method has limitations. However, the close agreement between the discharge figures indicate values are at least ballpark figures.

METHODS/MATERIALS

Two stream transects were taken on May 12, 1979 along Streelow Creek. While inadequate for detailed description of the drainage area, time constraints precluded more extensive surveys. The U.S. Forest Service, Region 1, stream reach inventory and channel stability evaluation technique (Pfankuch 1974) for stream surveys was used.

Each transect was divided into three areas. The upper bank was that portion of the topographical cross-section from the break in the general slope of the surrounding land to the normal high water line. Terrestrial plants and animals inhabit these areas. The lower bank was the intermittently submerged portion of the channel cross-section from normal high water line to the water's edge during the summer low flow period. The channel bottom was the submerged, totally aquatic portion of the channel cross-section.

RESULTS/DISCUSSION

Transect #1 was located on the main stem of Streelow Creek (see fig. 1). It was considered typical of second order streams. Average stream width was 6.5 feet, average depth was 1.0 foot. The reach was 100 feet long. Average velocity of 1.2 feet/second was calculated by the Embury (1927) method. This method gives only rough estimates. Flow was 7.8 cubic feet per second (c.f.s.). Stream gradient was 5.0%. The pool to riffle ratio was 1:1 in this reach. Pool length was greater than pool width. The water's brownish tinge indicated a large concentration of organic acids resulting from slash decomposition. The bottom material had over 30% fine particles (see table 3). The overall condition of this reach was

rated fair (see appendix) (see table 4).

The upper bank landform was classed as poor with slopes exceeding 60%. Mass wasting was considered fair since extreme flows would undercut the unstable slopes and cause extensive channel changes. Potential and existing debris jams were rated poor. There were moderate to heavy amounts of large size redwood slash and cull logs in the upper bank area. Most of these logs appear fairly stable. However, extreme flows could cause large channel changes due to log gouging of the upper banks. Bank protection was excellent. More than 90% of the area was covered by annual herbs and grasses as well as Vaccinium parvifolium, red alder (Alnus rubra), and occasional Sitka spruce (Picea sitchensis) and redwood (Sequoia sempervirens). Growth and reproduction were vigorous with from 10 to 20% variably spaced canopy openings. The extensive roots stabilize the upper banks to an extent.

The lower bank condition was generally fair. Channel capacity was poor. Overbank flows appear common judging by the amount of slash and debris in the normal over-flow areas. Bank rock content was also poor with less than 20% of pea-sized gravels. These offer little resistance and often collapse with normal flows. Based on given parameters (Pfankuch 1974) obstructions were judged good. However, the lower bank has a high concentration of downed logs. Most were fairly stable and acted as partial flow deflectors, sediment traps and jetties during observed flows. Cutting was fair with frequent vertical banks from 12' to 24 inches high. Root mat overhang was noted as was some active sloughing. Cutting was mostly due to nibbling of the loosely consolidated banks. Deposition was also fair. Deposits were moderately frequent consisting of coarse sand and some gravel. Bars were enlarging inside the curves. Deposition was occurring in pools, behind log

Table 1. Mean annual discharges for Little Lost Man Creek and Streelow Creek.

Stream	Discharge Area in Sq. Mi.	Mean Annual Discharge ^{1/} 1975 1976 1977	Average Mean Annual Discharge	Normal Average Mean Annual Discharge
Little Lost Man Cr.	3.47	10000 6600 1760	6120	8384
Streelow Cr.	2.70	7800 5148 1373	4774	6540

^{1/} discharge figures are in acre-feet

Refs U.S.G.S. 1975, 1976, 1977.

Table 2. Mean annual discharge for Streelow Creek using the Holdridge method.

Area	Temperature (*C)	Rainfall (mm)	PET ^{1/}	PET Ratio	AET ^{2/}	Discharge (mm)(AF)
Orick	11.11	1800	655	.364	609	(1191) (6752)

^{1/} Potential Evapotranspiration
^{2/} Actual Evapotranspiration

Ref. Holdridge (1962)

Table 3. Size composition of bottom materials (total to 100%)
in Streelow Creek.

Transect number	Small boulders 1-3'	Large rubble 6-12"	Small rubble 3-6"	Coarse gravel 1-3"	Fine gravel 0.1-1"	Sand & finer <0.1"
1			10%	20%	40%	30%
2	15%	30%	20%	10%	15%	10%

Table #. Stream stability indicators in Streelow Creek watershed represented by two 100 foot stream transects.

PARAMETERS	REACH 1	REACH 2
<u>Upper bank</u>		
Landform slope	Poor	Excellent
Mass wasting	Fair	Good
Debris jam (existing/potential)	Poor	Poor
Vegetative bank protection	Excellent	Excellent
 <u>Lower bank:</u>		
Channel capacity	Poor	Good
Bank rock content	Poor	Poor
Obstructions (flow deflectors/sediment traps)	Good	Good
Cutting	Fair	Fair
Deposition	Fair	Good
 <u>Stream bottom</u>		
Rock angularity	Good	Good
Brightness	Good	Good
Consolidation	Good	Good
Bottom size distribution	Good	Good
Scouring/deposition	Fair-Good	Good
Clinging aquatic vegetation	Good	Fair

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obstructions and on the leeward side of log deflectors.

Stream bottom stability was good as were angularity and brightness. The rocks had rounded corners and edges and were smooth and flat. About 20% of the substrate appeared brighter. Smaller gravels were brighter and angular. Consolidation and packing were also good. Some overlapping was noted. The substrate was difficult to dislodge by hand. Some of the gravels probably move in normal flows. Good size distribution was noted with about 70% stable materials. Scouring and deposition were rated from fair to good. About 30% of the substrate appeared unstable. Pools were filling; cutting occurred at constrictions and outer portions of curves. Overall evaluation of scouring and deposition was fair because of the sedimentation caused by debris jams. Clinging algae and mosses were classified as good. They were common in slower portions and less common in swifter areas. Rush (Juncus sp.) was also on the stream bottom. (see table 4).

The channel bottom was fairly stable. This is not necessarily beneficial from a fisheries standpoint. The 30% fine content may preclude or, at least, reduce reproductive potential of resident cutthroat trout (Salmo clarkii). The fines can stifle intra-gravel movement of water through trout nests (redds). This can cause asphyxiation of alevins or concentrations of CO₂ and NH₃ to become toxic (Chapman 1962).

Additionally there was a large log jam about 300 feet downstream from this transect. The jam acts as a barrier to fish migrations. The pool bottom behind this dam was stable but the sandy bottom offered little substrate for aquatic insects. Other smaller log/debris jams occurred throughout the stream.

Transect #2 was located below the confluence of the two major forks of

Streelaw Creek (see fig 1). It was considered typical of the downstream portion of the creek. Average width was 10 feet; average depth was 1.5 feet. Transect length was 100 feet. Velocity was 1.6 feet per second calculated by the Embury (1927) method. Flow was about 22 c.f.s. Reach gradient was about 7.0%. Pool to riffle ratio was 1:2. Pool length was greater than width. The brown color persisted throughout the remainder of the stream. Size composition of bottom materials (table 3) indicated 50% rubble and 10% fines. While the overall rating was fair (see appendix), this reach was in better condition than the upper reach (see table 4).

The upper bank was in generally good condition. Landform slopes were excellent at less than 30%. Mass wasting was infrequent here. Slopes were vegetated and seemed stable. Debris jam potential was poor. There was a moderate accumulation of large redwood slash and cull logs. These logs could cause bank and channel alterations under very high flows. Vegetative bank cover was excellent with more than 90% cover of annual herbs and grasses and perennial shrubs. The red alder canopy was about 50% open. Sitka spruce, Douglas-fir (Pseudotsuga menziesii) and redwood sprouts were also common.

The lower stream bank was also generally good. Channel capacity seemed adequate for most flows. Bank rock content was poor with less than 20% fragments, consisting of pea gravel less than one inch in diameter. Obstructions were rated good. There was evidence of cross-current erosion of the bank due to log obstructions. Sediment was captured behind the obstructions. Cutting was fair. Banks were from 12 to 24 inches high with overhanging roots and sloughing. Most erosion was due to bank undercutting and nibbling of the loosely consolidated bank. Deposition was good. There were some fresh deposits on bars. Small rubble and coarse gravel were the dominant sizes. Most of the fine material was removed from the run and deposited in downstream pools.

Channel bottom stability was also good as were angularity and brightness. About 10% of the substrate (mostly small rubble and gravel) appeared "bright". Consolidation and packing were good with some overlapping rubble. The substrate was difficult to dislodge by hand. Based on size, angularity and brightness, scouring and deposition were good. Cutting was about 20% in constrictions. Deposition occurred in pools and inside stream bends. Particle size in the pools depended on velocity through the pools. In fast moving water the bottom materials were mainly rubbles and gravels. In slow moving water the bottom materials were sands and silts. Clinging moss and algae were fair and spotty usually occurring in backwater areas. No rooted aquatics were noted.

WATER QUALITY

There appear to be at least three main water quality concerns in Streelow Creek. Each may contribute to the less than expected aquatic insect populations. One is the probable presence of organic acids from decomposing slash and debris. PH's below 5.5 can have adverse effects on aquatic invertebrate emergence (Bell 1971). The second is temperature. Most of the intermittent drainages as well as portions of the perennial stream had less than 50% canopy closure. The waters were about 18*Centigrade. Because of water's high specific heat little cooling occurs even when it passes under a closed canopy. As a result Streelow Creek may have lethal summer temperatures. This decreases the carrying capacity for cutthroat trout immensely. A third water quality problem may be suspended solid concentrations resulting from active bank cutting and degrading of channels. This material is eventually deposited behind obstructions or flushed into larger streams. Regardless, algae may be scoured, invertebrates dislodged and trout spawning habitat

degraded (Mackenthun 1969). Stream aesthetics are also affected.

Downcutting in intermittent and first order streams probably adds significant quantities of suspended solids. This is particularly true in the through-fill drainage crossings where inadequate culverts are provided. This occurs at every intermittent stream crossing.

SUMMARY

Streelow Creek is in fair condition. Slow channel degradation is occurring. It is a slow process as material moves from pool to pool with each storm. The presence of debris dams, organic acids, high water temperatures and suspended solids are major problems from both a water quality and aquatic ecology viewpoint.

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The most obvious solution for reducing the organic acids is to remove the logging slash. However, the slash seems fairly stable and acts as deflectors and gabions. These promote run and pool development. As a result, most of the debris should be left. The possible improvement of chemical water quality would undoubtedly be counterbalanced by stream bed disturbance while removing the debris. In fact, most stream bed disturbance occurs when slash is removed from the bed (Burns 1972). It is recommended, however, that the major debris jams acting as fish migration barriers be removed. Removal should be done by hand using chain saws during low flow (August -September) periods. Once cut the debris should be hand carried above the extreme high water mark or removed from the watershed. This labor intensive work would be expensive but would at least eliminate the major obstructions to fish migrations and partially remove decaying debris responsible for the high organic acid content of the water. Willow could be planted along the major sediment bars both to bind the sediments and to act as shade. This planting should be restricted to the major sediment bars. Otherwise, the willow will utilize large amounts of water in transpiration and, once established, will tend to bind spawning gravels as well.

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Land Transects Methods/Materials

Three land transects were taken, one on May 12, 1979, and two on May 22, 1979, each covering a different area of the watershed. The form used for these transects was the USDA River Basin Survey- California Record for the investigation of National forest brush, woodland, or timberlands.

The transects run covered a 100 foot linear path, and approximately 50 feet on each side of the cloth tape data was taken. Information about vegetation, soils, erosion, and land practices were surveyed following the guidelines of the Basin Survey form.

Results/Discussion

Transect #1 was located on the main stem of Streelow Creek. 200 feet from the stream, the transect was densely covered with conifers, hardwoods, low bushes and ferns which acted to stabilize the ground except where slumping was occurring. The area of the transect was characterized by steep slopes and there was a dense litter matt. With this matt aiding to stabilize the area, no erosion was occurring here, except on the maximum slope where slumping occurred. About 20% of the sediment from these slopes was found to be entering the stream.

The overall condition of this area was stable, except for the slump, which could pose a major problem. As the slumping occurs the erosion hazard is ever increased. Eventually the remaining exposed surface area will become subject to sheet and gully erosion.

Transect #2 was located in the northwest section of Streelow Creek watershed, see Figure #1. The 100 foot transect was

found on a south facing aspect approximately 500 feet from the stream along a contour with an average 40% slope. The maximum slope was 120% and the minimum was 20%.

The vegetation was predominately Douglas-fir (Pseudotsuga Manziessii), redwoods (Sequoia sempervirens), and a high percentage of low brush, ferns and grasses. The soils were of the Melbourne series, and the texture was a sandy, clay loam. The infiltration rates were moderate when thoroughly wetted, partially due to a firm mull type of A1 horizon.

These loose soils on the steep slopes have begun slumping and there is extensive soil creep on the hillside, with no danger of any of it reaching the stream.

Clean logging occurred in 1956 in this area, and a few seed trees were left to regenerate the cut slopes. Aerial seeding was used as an additional revegetation attempt and the area has regenerated slowly over the past 20 years. Browsing by deer has posed a problem in the regeneration as was in evidence on many of the trees.

The eastern portion of the watershed was the site of the third transect, taken approximately 30 feet above a first order stream. The vegetation found on the slight slope (15%) consisted of 60% Douglas-fir, 60% bushes and 25% ferns, all successfully stabilizing the area. The hydraulic soil classification is type C; soils having slow infiltration rates when thoroughly wetted, and a slow rate of water transmission.

60% of the area was bare ground with no litter or humus found. With this lack of ground cover, sheet and gully erosion

are extensive, covering 40% of the surrounding land. This problem is compounded by a lack of ground cover and an 80% rock outcrop.

The average volume of the gullies is 1125 cubic feet and a large portion of soil is channeled through the gullies into the stream.

The major cause of this earth movement is due to logging, more specifically in this area, to a poorly located landfill. Immediately adjacent to the tributary the loosely packed soils of the fill are all being swept by precipitation into Streelow Creek. Pedastling is extensive and the poorly revegetated surrounding slopes are all contributing to this earth movement which began with logging this site 17 years ago (see appendix).

There are two main categories that cause landslides:

1) those that contribute to high shear stress by unbalancing the stable slopes, such as the removal of toes of slopes by stream action, and (2) those that contribute to low shear strength in the bedrock mass, such as faults, joints and cleavage (Kittredge, 1948). Natural geologic erosion is one cause of the mass movement in this watershed, since the watershed is located along a fault line (see geology section). Most of the accelerated erosion here is due to mans activities in the past, i.e. logging and poor management guidelines.

The worst erosional hazard in Streelow watershed now, after 10-20 years of attempted stabilization, is debris and soil entering into the stream due to gradual slumping.

Kojan (1967) determined that slumping and earthflows are especially important as an erosion process in the Northern Coast Ranges of California where large volumes of sediment are being added annually to some streams by slumping and earthflow activity.

The general trend of these transected areas is towards stability, with the erosion decreasing as trees and shrubs are gradually revegetating the area and natural armoring is slowly protecting the soil. Litter is building up in many areas, which acts as a mulch or protective covering on the surface, the main means the forest naturally influences erosion (Kittredge, 1948).

There are many management guidelines which could be recommended to improve existing conditions and to prevent future problems if logging were still continuing in the area. Since the land is no longer in production alternative management practices should be followed, and many have already been attempted with limited success. Gullies may be lined or paved with masonry or concrete or culverts properly installed (Kittredge, 1948). There are many artificial and more or less temporary methods that would require a certain amount of maintenance in contrast to vegetative controls, which maintain themselves. The area has more or less been revegetated, but the results are incomplete and more needs to be done. Coverings of brush or litter have been shown to be effective in maintaining infiltration at a maximum, and minimizing surface runoff and erosion. Mulches also reduce the losses by evaporation and can aid in establishing a new cover

of vegetation. Brush wattles in contour trenches is one method of control of erosion on road banks. Terracing is another means of conducting the water and stabilizing the area.

But this area is converting back to a natural state slowly and surely, on its own. And, left to itself, it will manage itself far more completely than man could do.

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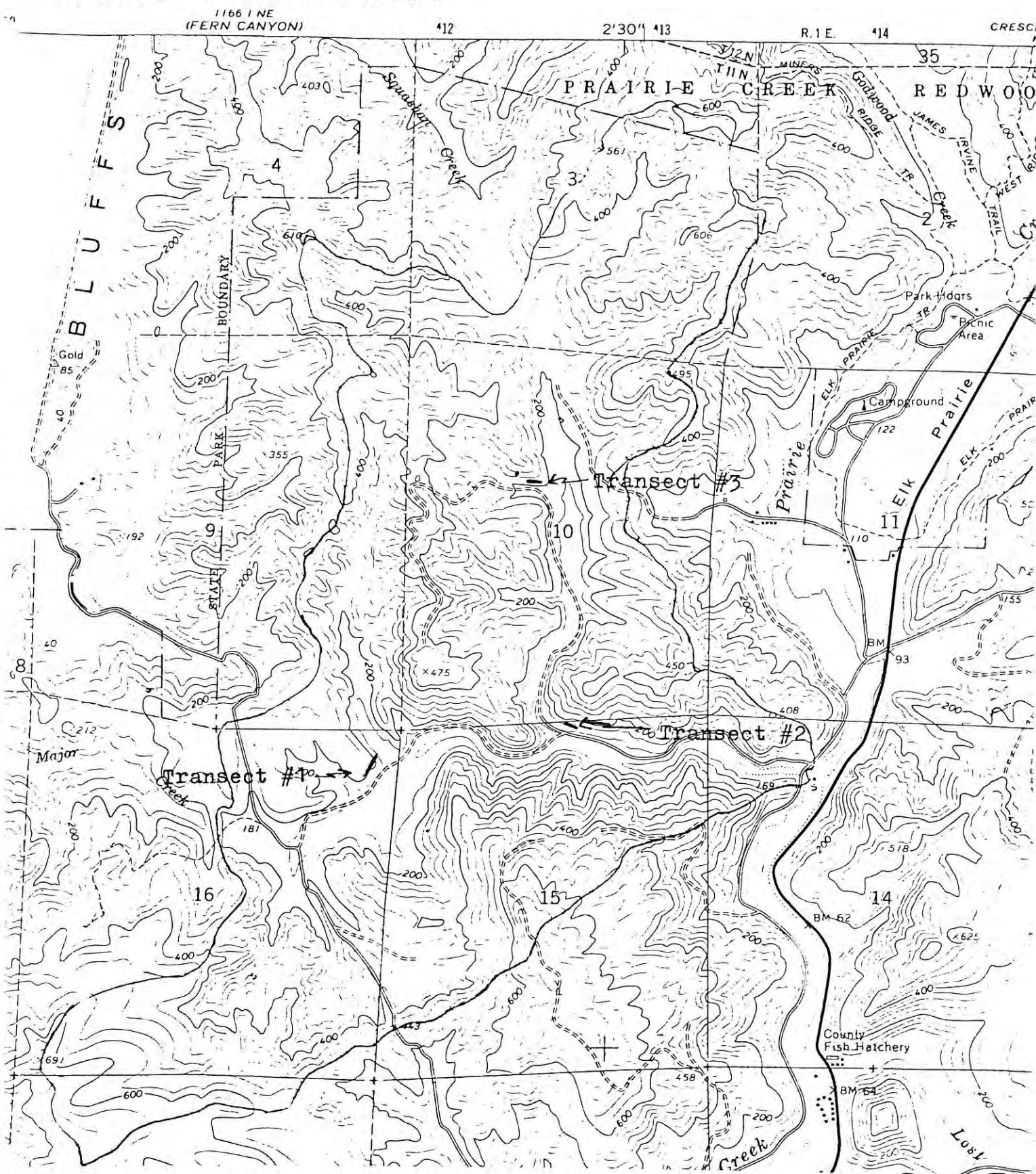


Figure 1. Map of Streelow Creek showing land transects.

Roads

The network of logging roads built during the years 1954 to 1964 on the Streelaw Creek watershed consists mainly of contour roads since the majority of the mileage tends to follow the creek at a more or less level grade. Valley roads are also present, running along gradients varying from moderately steep to level. The main haul road running through the southernmost portion of the watershed is a valley road. Few connecting roads exist, running perpendicular to the contours. The entire network within the watershed consists of 5.8 miles of road which average 28 feet in width. This makes the road density $1.9\text{mi}/\text{mi}^2$ for the entire watershed. This minimum of road mileage and the fact that most of the mileage is along contours reflects economic considerations when the roads were built for a maximum of efficiency with lowest road mileage. Contour roads are the most economical both in construction and collection (Huggard, 1958).

Two sections of one road were evaluated and assumed to be representative of the rest of the network (fig. R). Data from both sections are summarized in table D. The road standard for this road is secondary. It has a minimum of surfacing, fairly level grades, a drainage ditch running along its length, and few culverts. The road base consists of gravel mixed with a well packed earth layer. It has since become well vegetated with grass and small weeds. Culled

logs are used in many places instead of culverts where the road crosses small drainages. Culverts are used more frequently for the larger tributaries to the creek.

Section A was characterized by its nearly level gradient, large width which included a turnout, and its problem of being undermined by a small drainage passing underneath the road. This was the only place found where the practice of using culled logs instead of culverts caused problems. Potholes were formed in the middle of the road. A 3 $\frac{1}{2}$ foot ditch 1 foot deep, running parallel to the road seemed as though it was intended to channel the water to an 18 inch culvert located 3 feet from where the drainage passed under the road. According to Unggard (1958), when a road surface is full of potholes the surface should be scarified, and any depressions made up with 2 $\frac{1}{2}$ inch stone. A stabilizing dressing such as tar should then be applied to the surface along with stone chips and rolled in. This might be done after relocation of the culvert, already present, to a position where it would be useful in channeling the drainage under the road.

Section B was characterized by a steep cutbank and a 10% road gradient. The road surface itself was in good condition. There were no signs of erosion, gully or otherwise, which might be expected on such a slope. The cutbank on the other hand, was very sparsely vegetated and slumping occurred over the entire face exposing approximately 85% bare soil. Erosion

on this bank seemed to be accelerating, the material from which would wash down a drainage ditch between the road and the bank. A management plan for this type of situation might include first building a retainer wall to prevent further degradation and allow the bank to stabilize. Seeding with grass or planting the bank could then be done to insure a quick vegetative protective cover.

Management:

In general an intensive management plan is not required for the roads of this watershed. A small scale maintenance plan to improve drainage and stability would be sufficient. Road density for this area is minimal. The roads comprise only 18.25 acres or 1.02% of the watershed which is insignificant in terms of their addition to the total erosion loss of the watershed. According to Dr. Ray Rice (1979), not until an area is 80% roads does 10% of the erosion occur because of them. Road erosion is further reduced because most of the roads are built along contours which makes them less susceptible to erosion (Rice, 1979).

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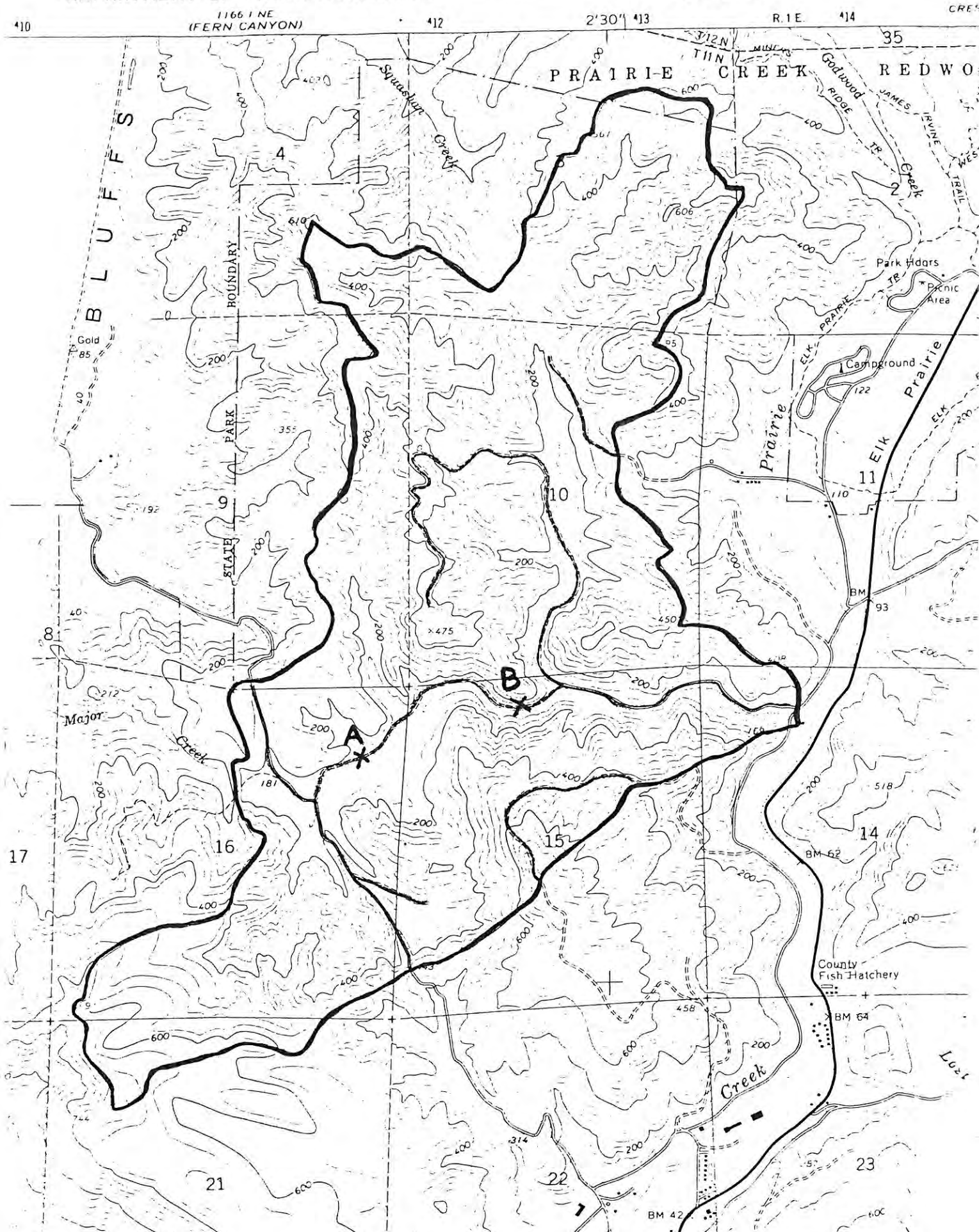


Table D

Road Transect Data for
Steelelow Creek Watershed

<u>Sample Section</u>	<u>Section A</u>	<u>Section B</u>
Length (ft.)-	24	56
Ave. width (ft.)-	30	47
Total Area (ft. ²)-	720	2744
Drainage-	3.5 ft. ² ditch 18 in. culvert	7.5 ft. ² ditch
Distance from stream (ft.) -	200	100
Ground Cover % live, % litter, % bare -	50, 25, 25	50, 10, 40
Vegetation-	alder, spruce redwood, ferns, grass	alder, spruce ferns, grass
<u>Road</u>		
Width (ft.)-	16	24
Gradient (%) -	3	10
Erosion	2 potholes 2.8x2 ft. 3x2.3 ft.	none
Cause-	drainage undermining road	-
<u>Out Bank</u>		
Area (ft. ²)	96	1400
Slope (%)	2	90
Erosion	none	4 slumps 35.6 ft. ³ 41.2 ft. ³ 32.5 ft. ³ 20.3 ft. ³
Cause	-	precipitation sparse veg. steep slope

Current Management

During the months following the park enlargement legislation and prior to completion of the General Management Plan, the National Park Service will be taking several interim actions to increase visitor use opportunities within Redwood National Park.

There is also a rehabilitation program in Redwood National Park to reduce erosion problems on park land, accelerate the revegetation of the expanded park and cooperatively develop land use standards for the park protection zone. The program will include an analysis of watersheds, roads and the main channel of Redwood Creek to determine what corrective actions are most appropriate.

The problems associated with cutover lands were addressed directly in the legislation which expanded the park. Section 101(a)(6) of Public Law 95-250, March 27, 1978, authorized "the development and implementation of a program for the rehabilitation of areas within and upstream from the Park contributing significant sedimentation because of past logging disturbances and road conditions and, to the extent feasible, to reduce risk of damage to streamside areas adjacent to Redwood Creek." Section 105 of the public law authorized \$33,000,000 to be appropriated as of October 1, 1978, to carry out the rehabilitation provisions of the act.

The long-term goal is to return the downstream portion of the Redwood Creek drainage basin that is within the national park to a reasonable facsimile of its natural state, keep-

ing in mind that some man-induced erosion from upstream land practices will continue. The immediate goal is to manage the existing stream sediment load to reduce its impact on the resources of Redwood National Park.

As of yet most of the work done has been concentrated on maintenance of the road network and on establishment of research plots to increase knowledge of rehabilitation techniques. A study of the road network has begun to determine those roads that should have long range use or be eliminated.

Appendix

WATERSHED SURVEY -- FIELD DATA

10a

PLOT #2

WATERSHED UNIT _____

PLOT LOCATION streelaw creek

SURVEY PARTY group 3 DATE May 12, 1979

VEGETATION TYPE conifers, shrubs, ferns % COVER 85% Alder

& CONDITION Stable ground cover except 5% spruce

where slumping 10% redwood

SOIL TYPE _____ 10% ferns & shrubs

HYDROLOGIC SOIL GROUP _____

SLOPE: MAX. % MIN. % AVG. % MORPHOLOGY SLOPE LENGTH

10% 1% 4% _____ 50'

ASPECT SE DISTANCE TO STREAM 200'

LITTER DEPTH 2" % COVER 80%

HUMUS DEPTH 1" % COVER 90%

% BARE GROUND 7% % ROCK OUTCROP 3%

SHEET & RILL EROSION: % AREA 40%

AVG. DEPTH _____ VOLUME _____

NO. OF YEARS _____

CAUSE _____

GULLY EROSION: AVG. DEPTH _____

AVG. WIDTH _____

AVG. LENGTH _____ VOLUME _____

NO. OF YEARS _____ CAUSE _____

MASS EARTH MOVEMENTS (LANDSLIDES, MUDFLOWS, ETC.): slumping on max. slope

VOLUME 35' x 15' x 5'

% SEDIMENT REACHING STREAM: 20%

10a

WATERSHED SURVEY -- FIELD DATA

LOT #3

WATERSHED UNIT _____

LOT LOCATION NW Steep Creek

SURVEY PARTY group 3 DATE May 22, 1979

VEGETATION TYPE conifers, hardwoods, shrubs, ferns % COVER 20% Alder

CONDITION stable ground cover above 30% Douglas-fir
and below slump 30% Redwood
10% brush & ferns

SOIL TYPE _____

HYDROLOGIC SOIL GROUP B

SLOPE: MAX. % MIN. % AVG. % MORPHOLOGY SLOPE LENGTH
120% 20% 60% 45% slope 80'

SPECT 5 DISTANCE TO STREAM 500'

WATER DEPTH 1" % COVER 70%

MUD DEPTH 1/2" % COVER 90%

BARE GROUND 10% % ROCK OUTCROP 7%

WATER & RILL EROSION: % AREA N/A

AVG. DEPTH _____ VOLUME _____

NO. OF YEARS _____

CAUSE _____

WATER EROSION: AVG. DEPTH N/A

AVG. WIDTH _____

AVG. LENGTH _____ VOLUME _____

NO. OF YEARS _____ CAUSE _____

MASS EARTH MOVEMENTS (LANDSLIDES, MUDFLOWS, ETC.): _____

_____ VOLUME _____

SEDIMENT REACHING STREAM: _____

10a

WATERSHED SURVEY -- FIELD DATA

PLOT #4

WATERSHED UNIT _____

PLOT LOCATION E Steeple Creek

SURVEY PARTY group 3 DATE May 22, 1979

VEGETATION TYPE conifers shrubs ferns % COVER 60% Douglas-fir

& CONDITION stable ground cover 60% bushes

25% Ferns

SOIL TYPE _____

HYDROLOGIC SOIL GROUP C

SLOPE: MAX. % MIN. % AVG. % MORPHOLOGY SLOPE LENGTH

25% 15% 15% Hill Slope 40'

Landfill

ASPECT E DISTANCE TO STREAM 25'

LITTER DEPTH 0" % COVER 0%

MUS DEPTH 0" % COVER 0%

% BARE GROUND 60% % ROCK OUTCROP 80%

SHEET & RILL EROSION: % AREA N/A

AVG. DEPTH _____ VOLUME _____

NO. OF YEARS _____

CAUSE _____

GULLY EROSION: AVG. DEPTH 2'

AVG. WIDTH 1 1/2'

AVG. LENGTH 25' VOLUME _____

NO. OF YEARS 1 CAUSE Logging

MASS EARTH MOVEMENTS (LANDSLIDES, MUDFLOWS, ETC.): _____

_____ VOLUME _____

SEDIMENT REACHING STREAM: _____



CALCULATIONS OF QUANTITATIVE CHARACTERISTICS

MEASUREMENTS TAKEN FROM U.S. TOPOGRAPHIC MAP, ORISKANY
7.5 MIN, 1966.

AREA OF WATERSHED = 1737.5 AC

MAP SCALE 1" = .379 mi

250000 = 1"² = .143 m²/in²

474.6 DOTS/250000 IN² = 8.48 IN²

8.48 IN² / .143 m²/in² = 2.71 m²
= 1737.5 AC

LENGTH OF STREAMS

PERMANENT = (8") (.379 mi/in) = 3.41 mi

INTERMITTENT = (7") (.379 mi/in) = 3.79 mi

ELEVATION CLASS	# OF DOTS	%	CUMULATIVE %
57-119	15	3.10	49.99
120-199	59	12.22	96.89
200-279	108	22.36	84.67
280-359	108	22.36	62.31
360-439	79	16.36	39.95
440-519	60	12.42	23.59
520-599	36	7.45	11.17
600-680	16	3.31	3.72
680-744	2	0.41	0.41
	<u>483</u>		

MEAN ELEVATION = 400.5'

$744' + 57' / 2 = 400.5'$

MEDIAN ELEVATION = 313'

TAKEN FROM HYDROGRAPHIC CURVE (FIGURE 3)

AT 50%

TOTAL RELIEF = 687'

$744' - 57' = 687'$

BASIN ALTITUDE INDEX = 240'

COMPUTED AS THE AVERAGE OF THE ALTITUDES OF POINTS
10% AND 85% OF THE DISTANCE ALONG THE MAIN CHANNEL
UPSTREAM FROM THE GAGING STATION OR MOUTH

(.85) (2.99 mi) = 2.54 mi = 410' (FROM FIGURE 4)
(.10) (2.99 mi) = 0.29 mi = 70' " " "
 $\frac{410' + 70'}{2} = 240'$

MAIN CHANNEL SLOPE INDEX % 151.8'/mi, 2.87% slope

COMPUTED AS THE DIFFERENCE IN ALTITUDE IN FEET
DIVIDED BY THE DIFFERENCE OR DISTANCE IN MILES
BETWEEN THE POINTS AT 100% AND 85% OF THE
MAIN CHANNEL LENGTH UPSTREAM FROM THE GAUGING
STATION OR MOUTH.

$$\begin{aligned} (85) (2.99 \text{ mi}) &= 2.54 \text{ mi} = 410' \text{ (FROM FIGURE 4)} \\ (10) (2.99 \text{ mi}) &= \frac{1.024 \text{ mi}}{2.24 \text{ mi}} = \frac{70'}{340'} \end{aligned}$$

$$340' / 2.24 \text{ mi} = 151.8' / \text{mi}$$

$$\% = \left[340' / (2.24 \text{ mi}) (5280' / \text{mi}) \right] 100 = 2.87 \% \text{ slope}$$

MEAN SLOPE OF MAIN CHANNEL % 194.9' / mi, 3.69% slope

$$640' - 57' / 2.99 \text{ mi} = 194.9' / \text{mi}$$

2.99 mi = CHANNEL LENGTH

640' = ELEVATION AT DIVERGE

57' = BASE ELEVATION
(MOUTH)

$$\left[640' - 57' / (2.99 \text{ mi}) (5280' / \text{mi}) \right] 100 = 3.69 \%$$

DRAINAGE DENSITY % 2.24 mi/mi²

$$Dd = L/A$$

L = LENGTH OF STREAMS (ALL CLASSES) IN MILES

A = AREA OF BASIN, mi²

$$6.06 \text{ mi} / 2.71 \text{ mi}^2 = 2.24 \text{ mi} / \text{mi}^2$$

COMPACTNESS COEFFICIENT % 1.62

$$Kc = P / 2 \sqrt{\pi A} \Rightarrow .282 P / \sqrt{A}$$

P = PERIMETER OF BASIN IN MI

A = AREA OF BASIN, mi²

$$= (.282) \frac{9.475 \text{ mi}}{\sqrt{2.71 \text{ mi}^2}}$$

$$= 1.62$$

STREAM ORDER % 3.20

SEE FIGURE 5, 6.