# LAND USE OF THE REDWOOD CREEK BASIN

REDWOOD
NATIONAL PARK

## REDWOOD NATIONAL PARK

### RESEARCH AND DEVELOPMENT

TECHNICAL REPORT 9

SEPTEMBER 1984

SEDIMENT BUDGET PROJECT

In 1978, the National Park Service initiated a study project to formulate a sediment budget for the Redwood Creek basin. This investigation documents and quantifies sediment source areas in the watershed, changes in sediment storage in tributary and mainstem stream channels, and sediment transport out of the basin.Results are presented in a series of Technical Reports and Data Releases, and condensed versions will be published in scientific journals.

NOTICE

This document contains information of a preliminary nature, and was prepared primarily on an interim basis. This information may be revised or updated prior to publication in a forthcoming U.S. Geological Survey Professional Paper.

# LAND USE OF THE REDWOOD CREEK BASIN

REDWOOD NATIONAL PARK

RESEARCH AND DEVELOPMENT

TECHNICAL REPORT 9

SEPTEMBER 1984

SEDIMENT BUDGET PROJECT

In 1978, the National Park Service initiated a study project to formulate a sediment budget for the Redwood Creek basin. This investigation documents and quantifies sediment source areas in the watershed, changes in sediment storage in tributary and mainstem stream channels, and sediment transport out of the basin.Results are presented in a series of Technical Reports and Data Releases, and condensed versions will be published in scientific journals.

NOTICE

This document contains information of a preliminary nature, and was prepared primarily on an interim basis. This information may be revised or updated prior to publication in a forthcoming U.S. Geological Survey Professional Paper.

# LAND USE
# OF THE
# REDWOOD CREEK BASIN

DAVID W. BEST

Redwood National Park
Arcata Office
791 Eighth Street
Arcata, California 95521
September, 1984

CONTENTS

Page

ABSTRACT . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .iii

I. INTRODUCTION . . . . . . . . . . . . . . . . . . . . . . . . . 1
A. Overview . . . . . . . . . . . . . . . . . . . . . . . . . . 1
B. Basin Description. . . . . . . . . . . . . . . . . . . . . . 1
C. Distribution of Forest Types . . . . . . . . . . . . . . . . . 3

II. STUDY METHODS . . . . . . . . . . . . . . . . . . . . . . . . 5

III. LAND USE IN THE REDWOOD CREEK BASIN. . . . . . . . . . . . . . . .12
A. Demand for Forest Products . . . . . . . . . . . . . . . . . .12
B. Landownership. . . . . . . . . . . . . . . . . . . . . . . . .12
C. Regulation of Timber Harvest . . . . . . . . . . . . . . . . .12
D. Timber Taxation. . . . . . . . . . . . . . . . . . . . . . . .13
E. Changing Harvest Practices . . . . . . . . . . . . . . . . . .13

IV. TIMBER HARVEST . . . . . . . . . . . . . . . . . . . . . . . .15
A. Forest Clearing. . . . . . . . . . . . . . . . . . . . . . . .15
B. Pre-1936 Timber Harvest . . . . . . . . . . . . . . . . . . .15
C. 1936-1948 Timber Harvest . . . . . . . . . . . . . . . . . . .15
D. 1949-1954 Timber Harvest . . . . . . . . . . . . . . . . . . .16
E. 1955-1962 Timber Harvest . . . . . . . . . . . . . . . . . . .16
F. 1963-1966 Timber Harvest . . . . . . . . . . . . . . . . . . .17
G. 1967-1970 Timber Harvest . . . . . . . . . . . . . . . . . . .17
H. 1971-1978 Timber Harvest . . . . . . . . . . . . . . . . . . .18
I. Post-1978 Timber Harvest . . . . . . . . . . . . . . . . . . .18

V. SUMMARY. . . . . . . . . . . . . . . . . . . . . . . . . . . .19

VI. REFERENCES CITED . . . . . . . . . . . . . . . . . . . . . . .20

APPENDIX A: USE OF THE LAND USE MAPS. . . . . . . . . . . . . . . . .21
APPENDIX B: LAND USE MAPS . . . . . . . . . . . . . . . . . . . . . .25

ILLUSTRATIONS

TABLES
1. Summary of Land Use in Redwood Creek basin as of 1978. . . . . . . . . 8
2. Summary of Timber Harvest in the Redwood Creek basin . . . . . . . . . 8
3. Summary of Land Use in Lower basin as of 1978. . . . . . . . . . . . . 9
4. Summary of Timber Harvest in the Lower basin . . . . . . . . . . . . . 9
5. Summary of Land Use in Middle basin as of 1978 . . . . . . . . . . . .10
6. Summary of Timber Harvest in Middle basin. . . . . . . . . . . . . . .10
7. Summary of Land Use in Upper basin as of 1978. . . . . . . . . . . . .11
8. Summary of Timber Harvest in Upper basin . . . . . . . . . . . . . . .11

FIGURES
Figure 1 Redwood Creek basin. . . . . . . . . . . . . . . . . . . . . . . 2
Figure 2 Generalized Vegetation of Redwood Creek basin. . . . . . . . . . 4
Figure 3 Timber Harvest in the Redwood Creek basin. . . . . . . . . . . . 6
Figure 4 Timber Harvest in the Upper, Middle, and Lower Watersheds. . . 7

ABSTRACT

Prior to the initiation of timber harvest in the 1930's, 82 percent of the Redwood Creek basin in northwestern California supported virgin coniferous forests. The downstream, lower-elevation areas frequented by coastal fog were dominated by redwood forests, while Douglas-fir and associated hardwoods were found in the drier, upstream areas. The remaining area, principally on ridges and south-facing slopes on the east side of the basin, supported equal amounts of prairie grassland and hardwood forests.

Timber harvest is first visible on the 1936 aerial photographs. Most of the early logging was cable-yarded clearcuts using steam donkeys, but this accounts for less than three percent of all timber harvest in the basin. Tractor yarding, which involves dragging logs downhill to bulldozer-constructed roads and landings, has been the principal yarding method since its introduction to the watershed in the late 1930's. Large tractors capable of handling massive redwood logs were well suited for logging the old-growth redwood forests, and as larger and more powerful machines were developed, the timber companies built up their equipment inventories (Janda et al., 1975). This method accounts for 85 percent of all logging. Locally, steep cutblocks were logged using cable yarding systems, which accounts for approximately 12 percent of logging in the basin. During the 1950's, timber companies most frequently used seed tree leave cuttings in the harvest and regeneration of coniferous forests. Considerable residual timber was left uncut by this method, often as much as 60 percent or more of the original stand.

Intensive logging first began during the early 1950's in the upper and middle portions of the watershed as a result of increased demand for Douglas-fir spurred by the post-World War II housing boom. The 1949-1954 period showed the most intense logging in the watershed, with 19 percent of the coniferous forests harvested within these six years alone. Demand for Douglas-fir plus poor access to the coastal redwood effectively placed much of the redwood forests in a reserve status until the late 1960's.

During the 1960's, the timber companies reverted to clearcutting. This change occurred because residual timber did not experience the expected rapid release in growth following thinning, and seed trees were not always an effective method for restocking cut areas (Janda et al., 1975). Between 1954 and 1962, the rate of timber cutting declined substantially, especially in the upstream portions of the watershed where Douglas-fir dominated. Between 1962 and 1966 there was a slight, overall increase in timber harvest as a result of large increases in the lower watershed, which offset a decrease in the middle watershed. By 1966, 55 percent of the total forests had been logged, which corresponds to 34 percent of the forests in the lower watershed, 73 percent in the middle watershed, and 57 percent in the upper watershed. Between 1970 and 1978, timber harvest again declined substantially in the upper and middle portions of the watershed, while increasing dramatically in the lower watershed. Roughly 20 percent of the lower watershed coniferous forests were logged during this eight year period. By 1978, 69 percent in the forests of the lower watershed had been logged, 92 percent in the middle watershed, and 81 percent in the upper watershed. During this period, entry into previously cut areas to remove residual timber became increasingly important, accounting for over 40 percent of all logging.

## I. INTRODUCTION

### A. Overview

The timber of the Redwood Creek Basin is unquestionably its most economically valuable resource (Janda et al., 1975). Because of this, over the last half century, 81 percent of the coniferous forests have been logged, requiring construction of roughly 2,000 km of roads and over 9,000 km of skidtrails. A combination of past poor road construction and logging practices, a sequence of intense winter storms, and inherently unstable slopes have resulted in severe erosional problems and acceleration of erosion rates. As the sediment supply has exceeded the transport capacity of Redwood Creek several problems have resulted. These include aggradation (filling in of the channel with sediment), channel widening, bank erosion, loss of riparian and old-growth vegetation, disruption of the pool/riffle sequence, and destruction of fish habitat. Most of the major erosion problems such as gullying and streamside landslides were initiated during infrequent, large storms which occurred in 1953, 1955, 1964, 1972, and 1975. Aerial photographs suggest the December, 1964 storm caused the most dramatic changes, especially in the upper portions of the watershed where recent logging had been most intense.

One goal of the sediment budget project at Redwood National Park is to quantify sediment sources, storage and transport throughout the Redwood Creek basin. Timber harvest and road building activities have been related to increased rates of erosion in recent studies (Janda et al., 1975; Weaver et al., 1981). Quantifying the causal relationship between accelerated erosion rates and land use, intense winter storms, and inherently unstable slopes is difficult. As a first step to clarify the above relationship, this report summarizes the history of land use and logging in the Redwood Creek watershed. Land use maps produced from the interpretation of aerial photographs, detail dates of logging, cut block boundaries, and yarding methodology. These maps are contained in Appendix B. The data from these maps were tabulated to summarize logging in the watershed, to document changing harvest practices, and to estimate the remaining timber supply.

### B. Basin Description

Redwood Creek drains a 720 km² watershed located within the coast range of northern California (Figure 1). The creek descends from elevations of nearly 1,500 m and enters the Pacific Ocean near the town of Orick. There are 74 tributary basins drained by second order or higher streams which flow directly into Redwood Creek. Tributary channels are characteristically low order, high gradient streams draining small watersheds. The unusual elongate geometry (elongation ratio = 0.34) of the Redwood Creek basin is a reflection of the structural control exerted on the course of the creek by the Grogan fault. The drainage basin is characterized by high-relief, moderate to steep hillslopes, and narrow valley bottoms. Janda et al. (1975) estimated the average hillslope gradient to be about 0.26 (14.4 degrees). The steepest hillslopes are located adjacent to stream channels, forming narrow incised canyons extremely susceptible to mass wasting. In the upstream portions of the watershed (inland of most summer fog) incised canyons are typical of

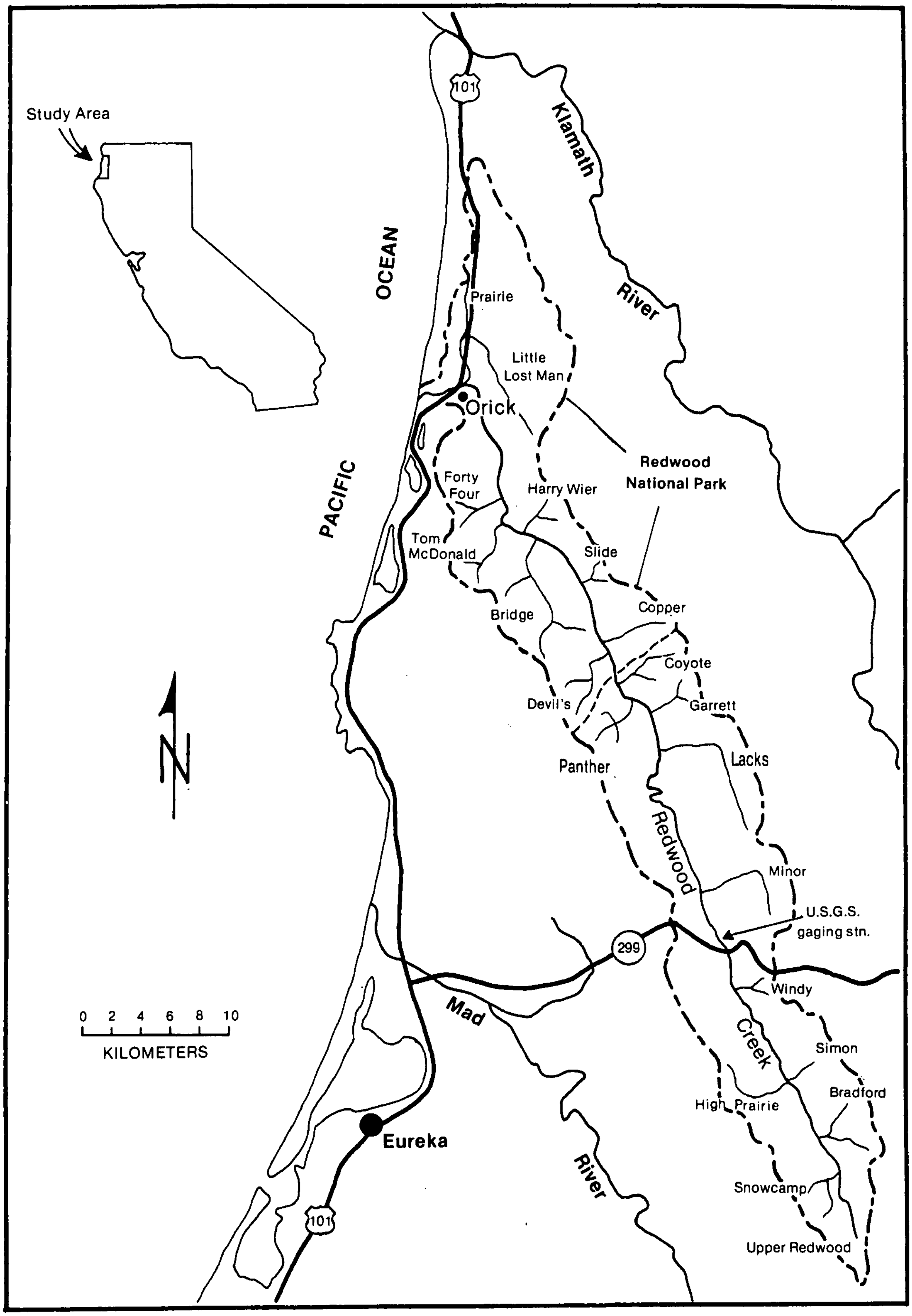



Figure 1: Redwood Creek basin. Based on differences in climate, land use history, and vegetation, the basin is divided into the upper, middle, and lower watersheds. The upper watershed is that area above the U.S. Geological Survey gaging station near State Highway 299, the middle watershed is the area between the gaging station and Redwood National Park, and the lower watershed is the area within Redwood National Park and in the vicinity of Orick, California.

Redwood Creek and most tributaries. Within these canyons, some of the best timber was located. Moderate and low hillslope gradients are generally found only in mid- and upper-slope positions.

C. Distribution of Forest Type

Prior to disturbance by white settlers roughly 82 percent of the watershed supported virgin coniferous forests, 9 percent supported oak-woodland, and the remaining 9 percent was prairie grassland (Figure 2). Under natural (or pre-harvest) conditions the coastal, northwestern one-third of the basin supported mixed stands of coniferous forests dominated by redwood and Douglas-fir. The inland, southern two-thirds supported mixed stands of Douglas-fir and associated hardwoods. The oak-woodland forests are dominated by Oregon white oak, and except for a brief period between 1979 and 1981, have never been intensively logged. Locally, however, settlers cut hardwoods for fenceposts, firewood, and in the case of tanoak, for tannins.

Ground observations suggest the distribution of coniferous forests, oak-woodland, and prairie depends largely on available soil moisture during the dry summer months. Slope aspect, elevation, soil type, and occurrence of summer fog are important factors influencing the vegetation of a site. Figure 2 is a generalized vegetation map showing the pre-harvest distribution of the major forest types, prairie grassland and oak-woodland areas. In general, prairies are confined to the driest sites along ridge divides, and almost all lie on the east side of Redwood Creek. In the lower watershed, prairies are continuous only along the watershed divide. They occasionally extend downslope along tributary ridge divides and are bordered by Douglas-fir and lesser amounts of hardwood and redwood. In the middle and upper portions of the watershed prairies are more common. They occur on all positions of the hillslopes and are most often bounded by oak-woodland.

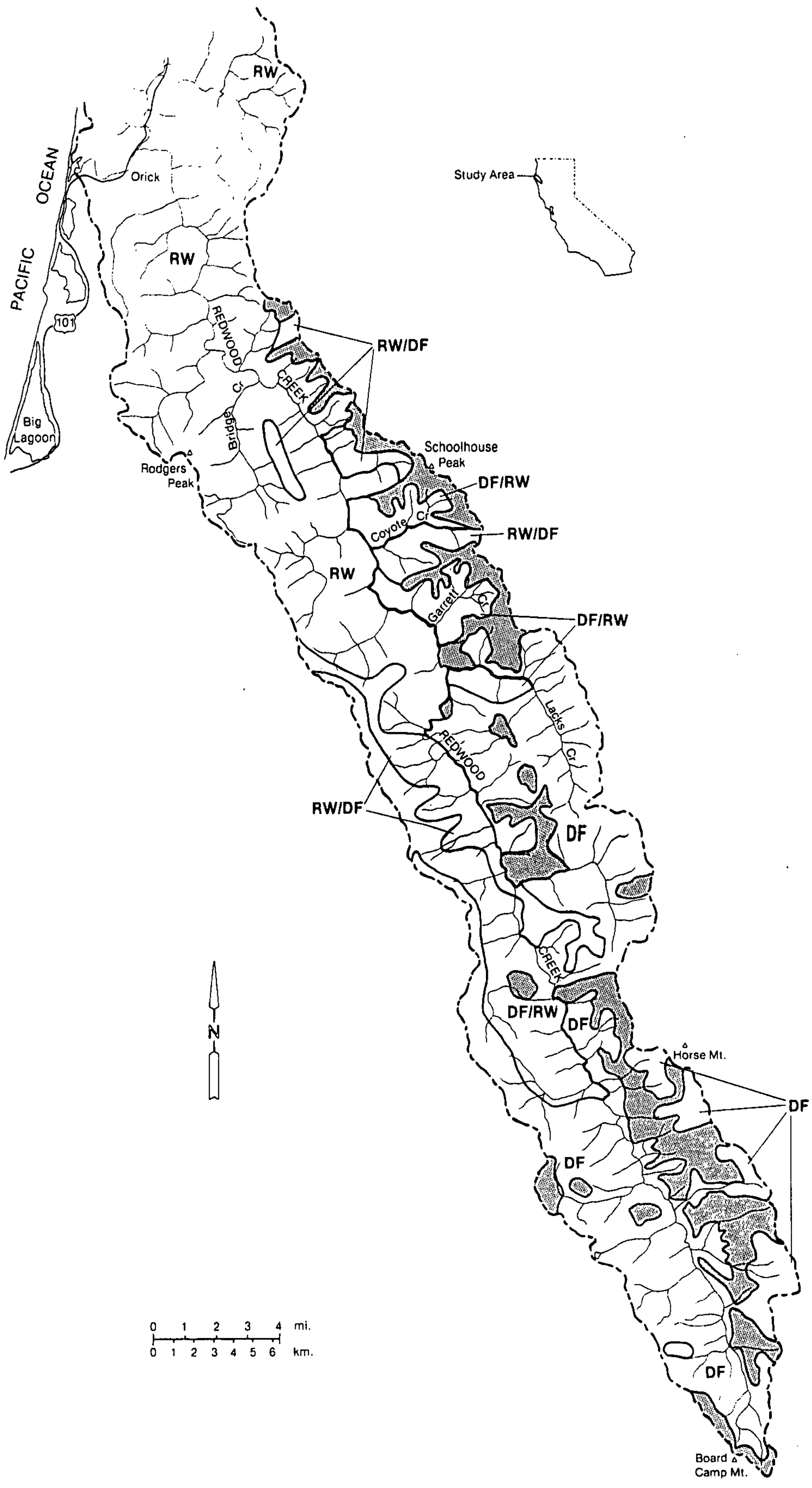



Figure 2: Generalized vegetation of the Redwood Creek basin. RW: Redwood dominated forest with lesser amounts of Douglas-fir and hardwood. RW/DF: Redwood dominated forest with significant amounts of Douglas-fir. DF/RW: Douglas-fir dominated forest with significant amounts of redwood. DF: Predominately Douglas-fir with associated hardwood. Prairie, brush, and hardwood forests are shown by the stippled pattern.

## II. STUDY METHODS

One product of this study is a set of landuse maps detailing the history of logging and landuse in the basin upstream of Redwood National Park (Figure 1). These maps (Appendix B) are based on interpretation of aerial photographs taken in 1936, 1947, 1954, 1962, 1966, 1970 and 1978. Additional photographs from 1972, 1973, 1974, 1975 and 1976 were used to analyze areas within Redwood National Park.

The maps were prepared by reviewing aerial photographs chronologically and tracing cutblock boundaries onto mylar overlaying 1:10,000 scale base maps. The base maps were prepared by Humboldt County for its own record of land ownership and logging in the basin. Copies are on file in the Arcata office of Redwood National Park. The county prepared these maps using both aerial photographs and dates of logging supplied by timber companies.

Much of the cutblock linework was already in place on the county maps and was simply traced directly onto the mylar overlay. Where the county maps lacked information, accuracy, or detail, cutblock boundaries were drawn freehand using road locations, topographic features, and adjacent cutblock boundaries as references.

Several data were recorded for each cutblock. These include the photoperiod when logging occurred (bracketed by available aerial photographs), method of yarding (tractor or cable system), and measures of the degree of ground surface disturbance and the quantity of timber remaining following logging. The map area of each landuse unit (any combination of the above data) was measured using a planimeter and the data tabulated to produce the landuse and logging summaries in Tables 1-8.

Because of differences in climate, logging history, and plant ecology, the basin was divided into three sections called the upper, middle, and lower watershed (Figure 1). The upper watershed includes all land upstream of the U.S.G.S. stream gaging station near state Highway 299, and it has a drainage area (A) of 173 $km^2$. The middle watershed includes all land downstream of the gaging station but upstream of the Redwood National Park boundary (A = 246 $km^2$). The lower watershed includes all land downstream of the park boundary including the town of Orick and surrounding floodplain (A = 197 $km^2$). Prairie Creek (A = 104 $km^2$), which enters Redwood Creek near the mouth is the largest tributary basin in the watershed, but was excluded because it drains terrain geologically and physiographically different from the rest of the watershed.

Comparing the logging history of unequally sized areas can be misleading if differences in the extent of the watershed that orginally supported coniferous forests are not considered. Figures 3 and 4 show the logging history of the basin and show that the three parts originally had a different percent of the area in coniferous forests. The numbers on the vertical axes represent the percent of the basin area logged. The distinction between percent of coniferous forest logged and percent of the basin logged is interesting in cases where the non-coniferous forest portion of a watershed (prairie grassland and oak woodland) differs considerably between areas. A third comparison referred to within this report is the portion of all logging (hectarage logged by 1978) that had been harvested at the close of each period. This comparison is used in cases where the portion of the coniferous forests that have been logged differs considerably between areas. Specific hectarages and logging rates for the entire basin and for the three individual parts of the basin are listed in Tables 1-8.

Unless otherwise specified, the hectarage values presented refer only to first entry timber harvest. Many areas have been substantially re-logged (secondary logging) to remove residual timber. Although this type of timber harvest has become increasingly important in recent years (and now accounts for most of the annual acreage logged), its erosional impact is probably quite different from first entry logging since fewer skidtrails are used and little new road construction is required.

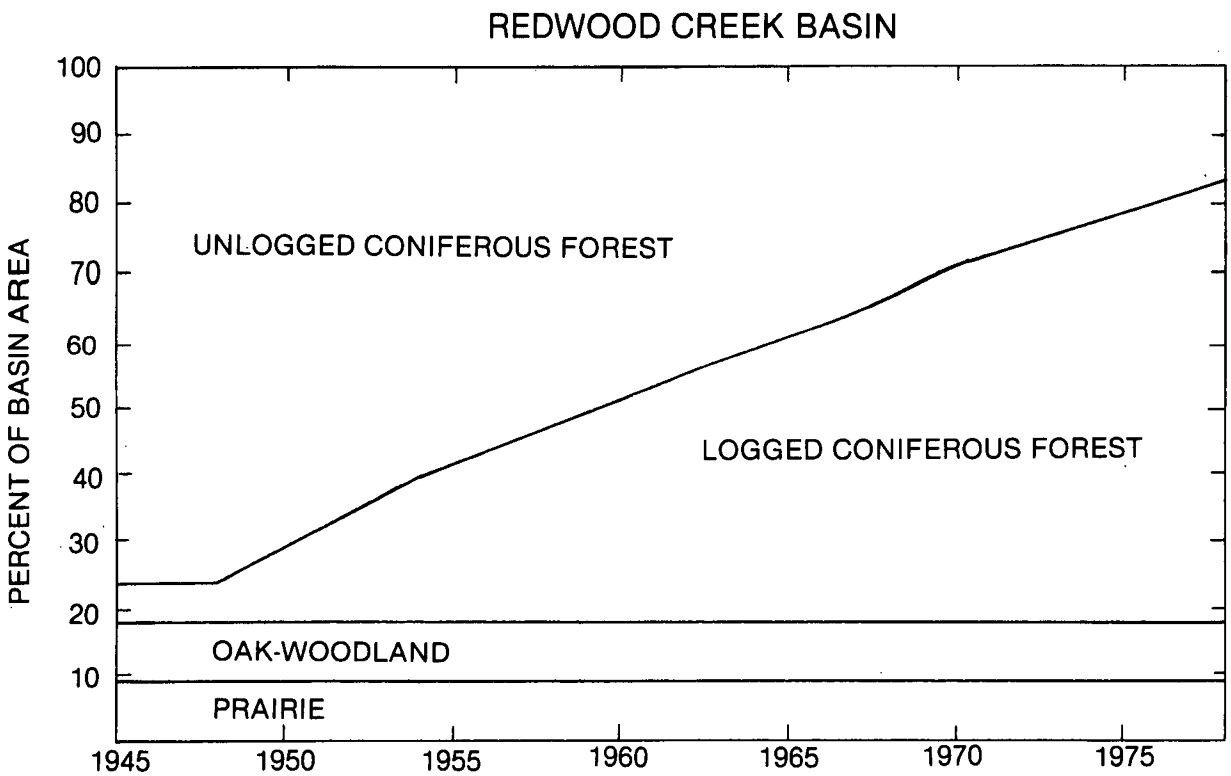



Figure 3: Timber harvest in the Redwood Creek basin showing changes in percent of basin logged between 1945 and 1978.

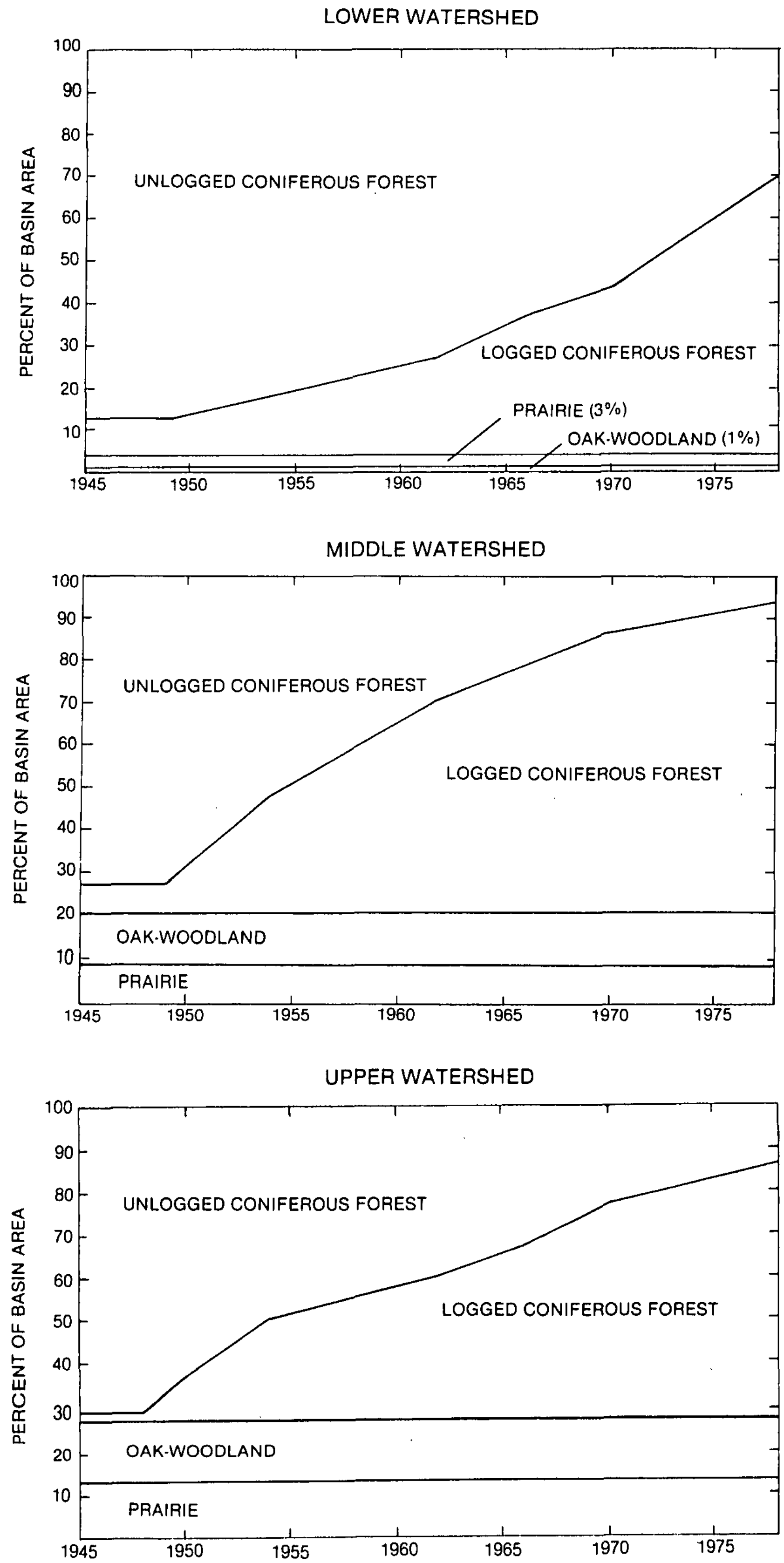



Figure 4: Timber harvest in the upper, middle, and lower watersheds in the Redwood Creek basin, showing percent of basin logged between 1945 and 1978.

TABLE 1

Summary of Land Use in Redwood Creek Basin as of 1978 (A=616km²)*

| | Area(ha) | Percent of Total Basin Area |
|---|---|---|
| Prairie Grasslands | 5,108 | 8.3 |
| Oak Woodlands | 5,563 | 9.0 |
| Uncut Conifer | 9,878 | 16.0 |
| Tractor Cut | 34,832 | 56.5 |
| Cable Cut | 3,577 | 5.8 |
| Miscellaneous Clearing | 1,333 | 2.2 |
| Unknown | 1,339 | 2.2 |
| | 61,630 | 100.0 |

TABLE 2

Summary of Timber Harvest in the Redwood Creek basin*

| Time Period | Area Logged (ha)[1] | Logging Rate (ha/yr) | Percent of Total Basin Area |
|---|---|---|---|
| pre-1948 | 2,853 | -- | 4.6 |
| 1949-1954 | 9,880 | 1,647 | 16.0 |
| 1955-1962 | 9,027 | 1,128 | 14.6 |
| 1963-1966 | 4,934 | 1,234 | 8.0 |
| 1967-1970 | 5,059 | 1,265 | 8.2 |
| 1971-1978 | 6,656 | 832 | 10.8 |
| | 38,409[2] | | 62.2 |

*Does not include Prairie Creek drainage (A=104 km²).

[1] Does not include relogging or miscellaneous clearing.
[2] Original Coniferous Forest: 50,580 ha

TABLE 3

Summary of Land Use in Lower Basin[1] as of 1978 (A=197km²)

| | Area (ha) | Percent of Total Basin Area |
|---|---|---|
| Prairie Grasslands | 541 | 2.7 |
| Oak Woodlands | 278 | 1.4 |
| Uncut Conifer Forest | 5,867 | 29.7 |
| Tractor Clearcut/Select Cut | 9,480 | 48.0 |
| Cable Clearcut | 1,306 | 6.6 |
| Miscellaneous Clearing | 1,049 | 5.3 |
| Unknown | 1,191 | 6.0 |
| | 19,712 | 100.0 |

TABLE 4

Summary of Timber Harvest in the Lower Basin[2] (A=197 km²)

| Time Period | Area logged (ha) | Logging Rate (ha/yr) | Percent of Total Basin Area |
|---|---|---|---|
| pre-1948 | 675 | -- | 3.4 |
| 1949-1954 | 1,275 | 212 | 6.5 |
| 1955-1962 | 1,714 | 214 | 8.7 |
| 1963-1966 | 1,790 | 448 | 9.1 |
| 1967-1970 | 1,430 | 358 | 7.3 |
| 1971-1978 | 3,902 | 488 | 19.8 |
| | 10,786[3] | | 54.8 |

[1] Does not include Prairie Creek tributary basin (A=104km²)
[2] Does not include relogging activities or miscellaneous clearing.
[3] Original Coniferous Forest = 18,800 ha.

TABLE 5

Summary of Land Use in Middle Basin as of 1978 (A=246 km²)

| | Area (ha) | Percent of Total Basin Area |
|---|---|---|
| Prairie Grasslands | 2,226 | 9.0 |
| Oak Woodlands | 2,680 | 10.9 |
| Uncut Conifer Forest | 1,639 | 6.7 |
| Tractor Clearcut | 15,768 | 64.1 |
| Tractor Selection | 236 | 1.0 |
| Cable Clearcut | 1,715 | 7.0 |
| Miscellaneous Clearing | 176 | 0.7 |
| Unknown | 148 | 0.6 |
| | 24,588 | 100.0 |

TABLE 6

Summary of Timber Harvest in Middle Basin[1] (A=246 km²)

| Time Period | Area logged (ha) | Logging Rate (ha/yr) | Percent of Total Basin Area |
|---|---|---|---|
| pre-1948 | 1,768 | -- | 7.2 |
| 1949-1954 | 5,197 | 666 | 21.1 |
| 1955-1962 | 5,221 | 653 | 21.2 |
| 1963-1966 | 2,058 | 515 | 8.4 |
| 1967-1970 | 1,853 | 463 | 7.5 |
| 1971-1978 | 1,622 | 203 | 6.6 |
| | 17,719[2] | | 72.0 |

[1]Does not include relogging or miscellaneous clearing.
[2]Original Coniferous Forest = 19,504 ha.

TABLE 7

Summary of Land Use in Upper Basin as of 1978 (A=173 km²)

| | Area (ha) | Percent of Total Basin Area |
|---|---|---|
| Prairie Grasslands | 2,341 | 13.5 |
| Oak Woodlands | 2,605 | 15.1 |
| Uncut Conifer Forest | 2,372 | 13.7 |
| Tractor Clearcut | 8,462 | 48.8 |
| Tractor Selection | 886 | 5.1 |
| Cable Clearcut | 556 | 3.2 |
| Miscellaneous Clearing | 108 | 0.6 |
| | 17,330 | 100.0 |

TABLE 8

Summary of Timber Harvest in Upper Basin[1] (A=173 km²)

| Time Period | Area Logged (ha) | Logging Rate (ha/yr) | Percent of Total Basin Area |
|---|---|---|---|
| pre-1948 | 410 | -- | 2.4 |
| 1949-1954 | 3,408 | 568 | 19.7 |
| 1955-1962 | 2,092 | 262 | 12.1 |
| 1963-1966 | 1,086 | 272 | 6.3 |
| 1967-1970 | 1,776 | 444 | 10.2 |
| 1971-1978 | 1,132 | 142 | 6.5 |
| | 9,904[2] | | 57.2 |

[1] Does not include relogging or miscellaneous clearing.
[2] Original Coniferous Forest = 12,276 ha.

## III. LANDUSE IN THE REDWOOD CREEK BASIN

### A. Demand for Forest Products

Several factors have influenced the trends in landuse and timber harvest observed in the Redwood Creek Basin. These include a fluctuating demand for forest products, patterns in ownership of land (public or private), regulation of timber harvest practices, and timber taxation policies.

Since widespread timber harvest began in the early 1950's, the timber industry has necessarily adjusted the rate of timber cutting and mill production to changes in demand for forest products. When prices drop or demand sags companies often reduce timber cutting and rely on stockpiled reserves for their supply of timber. Likewise, increased demand for Douglas fir during the housing boom following World War II intensified timber harvest, mainly in the upper and middle portions of the watershed.

### B. Landownership

In the 1950's, less than five percent of the watershed was held in public ownership, mostly as several isolated parcels administered by the U.S. Forest Service. An even smaller portion was held by private landowners as vacation property. The remainder was held by a few (but large) family owned ranches or by timber companies. As timber harvest became the dominant landuse in the basin, some companies increased their holdings or acquired timber rights from ranches and ranchers began logging some of their forests. As a result, virtually all of the privately held lands have been available for timber harvest.

The effect of landownership on landuse has become increasingly apparent since the establishment of Redwood National Park. Creation of the Park in 1968, and subsequent expansion in 1978, removed roughly 40 percent of the watershed (including most of the remaining uncut redwood) from potential future harvest. By 1980, nearly all of the major remaining blocks of uncut timber were in public ownership (although many of the Forest Service parcels have been recently traded to timber companies to consolidate forest boundaries).

### C. Regulation of Timber Harvest

In 1945, California became the first state to regulate the private timber industry by enacting the Forest Practices Act. Under this act, logging practice rules were formulated by regional Forest Practice Committees comprised of timber owner and operators. Rules became effective only after ratification by two-thirds of the owners and operators in the region.

The 1971 court decision Bayside Timber Company vs. Board of Supervisors of San Mateo County, declared the law unconstitutional, primarily because the law created a clear case of industry regulating itself. In 1973, after two years of lobbying by both the timber industry and conservationists, the Z'berg - Nejedly Forest Practices Act was enacted, establishing the current basin policies followed by the California Department of Forestry in regulating timber harvest. Therefore, by the latter half of the 1970's, timber harvest in the Redwood Creek basin was being conducted under statutes that ensured better harvest practices than were prevalent in the two previous decades.

D. Timber Taxation

Prior to 1975, timber companies were taxed on the volume of standing timber (D. Goodwin, personal communication, 1983). The tax was difficult to administer since it required the county to keep detailed records of the quality, size, and density of standing timber as well as dates, location, and size of harvested areas. Since timber remained at full valuation until at least 70 percent of the stand was removed, the tax probably encouraged timber cutting. In 1975, the yield tax replaced the standing timber tax by instituting a flat rate for timber producing land and a tax on volume of timber harvested.

E. Changing Harvest Practices

Prior to 1936, the redwood forests were usually clearcut logged and yarded using steam donkeys. With introduction of the crawler tractor, seed tree leave and selection cutting were possible, and timber harvest that left a considerable portion of the original stand uncut became common. Cable systems are limited to clearcut logging since the overhead cables usually damage or destroy most remaining vegetation 2 to 3 m in height. Tractor yarded areas where a substantial portion of the stand was left uncut (often 60 percent or more of the original stand) has been referred to as selectively cut (Janda et al., 1975); however, the term "seed tree leave" cut is more appropriate. By definition, selection cutting is a practice where trees are removed as they reach maturity (Smith, 1962). It is used in all-aged silvicultural management where the forest is managed to have many ages of trees represented in the stand. Since the forests of the Redwood Creek Basin were essentially at maturity prior to logging, selection cutting never really occurred. In seed tree leave cutting, the majority of the stand is removed during the first harvest operation, and only trees with sufficient cone production to assure restocking of the area are left uncut (Smith, 1962). Aerial photographs show that in many of the early harvest areas, far more trees were left than was necessary for regeneration or to meet seed tree density requirements, thus appearing selectively cut. Because these areas have become primary candidates for future logging and are found throughout the watershed, the term has been retained. In this report, selectively cut refers to timber harvest where at least 60 percent of the stand remains uncut, and does not imply a silvicultural management practice.

During the early 1950's, when seed tree leave cutting was the most prevalent method of harvesting and restocking the redwood forests, the timber companies built up their inventories of crawler tractors and other equipment capable of handling massive redwood logs, and acquired skill and confidence in using this equipment (Janda et al., 1975). Over the next decade, procedures evolved toward more clearcutting, the use of larger cut blocks, use of tractor constructed lay outs (smooth beds of dirt onto which trees were felled to reduce stem breakage), and increased reliance on tractor yarding. Adjoining blocks of timber were harvested in successive years to minimize the costs associated with road construction and maintenance. In the early 1960's the timber companies decreased the use of selection and seed tree leave methods in favor of clearcutting. Foresters had noted that residual trees did not experience the rapid release of growth that was anticipated following original thinning of the stand (Janda et al., 1975). Additional reasons cited by the timber companies include severe stem breakage suffered by residual trees toppled during major wind storms, and inefficiency and poor reliability of using trees to restock cut areas (Janda et al., 1975).

The introduction of the tractor was especially important in the landuse history of the Redwood Creek basin since its use has dominated how timber harvest has been carried out, even to the present day. Tractor yarding on steep slopes is discouraged by geologists because it requires more road construction, especially in the steep inner canyons near stream channels, and because logs must be dragged downslope in what results in a converging network of intersecting skidtrails. The depth of skidtrail cuts usually exceeds one meter and they often intercept and concentrate surface flow. In cable yarding, logs are lifted or dragged upslope in a diverging network of shallow nonintersecting skidtrails and cableways to reach the road access at the top of the logged unit. Using cable yarding, road construction in the inner canyon near stream channels can often be eliminated.

## IV. TIMBER HARVEST

### A. Forest Clearing

Forest clearing first occurred late in the 19th and early in the 20th centuries as settlers cleared the trees from floodplains, low terraces, and areas adjacent to prairies to create more grazing and agricultural land (Janda et al., 1975). In the Redwood Creek watershed, forest clearing (interpreted as cleared acreage not appearing recently logged on 1936 aerial photographs) is less than three percent of the coniferous forests (1049 ha), and nearly all of this occurred within the coastal floodplain area.

### B. Pre-1936 Timber Harvest

Timber harvest (as opposed to forest clearing) is visible on the 1936 aerial photographs, the earliest available for the basin. Most of the pre-1936 timber harvest was located in the headwaters of Devils Creek and Panther Creek (Figure 1) and was yarded using steam donkeys, a cable system where the yarding machinery was hauled from ridge to ridge along specially constructed rail routes. It differs from later forms of timber harvest in that less road construction was required.

Janda and others (1975) evaluated the erosional impact of early steam donkey yarding using aerial photographs and ground photographs from other nearby areas. They indicate that early steam donkey yarding techniques resulted in large clearcut areas, heavy concentrations of slash, and intense localized ground disturbance surrounding landings and skidtrails. However, surface drainage patterns were altered much less than by large scale tractor-yarded clearcuts typical of the 1960's.

Little of the hectarage logged by 1936 was tractor yarded. Roughly 240 ha opposite the mouth of Minor Creek near Redwood Valley Road had been selectively logged and 140 ha were clearcut in the headwaters of Durdee Creek using tractors.

### C. 1936-1948 Timber Harvest

Between 1936 and 1948 tractor yarding became the dominant logging method in the Redwood Creek watershed. An additional 800 ha were logged: 131 ha were clearcut and tractor yarded along the present route of the Bald Hills Road (near the Orick mill site), several hundred ha were cable logged on the slopes above Tom McDonald Creek (west of Bridge Creek); several hundred ha were selectively logged and tractor yarded northwest of Devils Creek, and 250 ha were selectively cut and tractor yarded in the headwaters of High Prairie Creek. By 1948, 3,914 ha had been logged, totalling eight percent of the coniferous forests and six percent of the basin drainage area.

Photographs reviewed by Janda et al. (1975) show that by 1947, the cableyarded clearcuts in the headwaters of Panther Creek and Devils Creek were well vegetated. The streams draining the cutover area did not show excess aggradation or an unusual amount of streamside landsliding. Most of the main haul roads, landings, cable ways and skidtrails were still unvegetated. By 1954, there was excellent regeneration and over 90 percent revegetation of the ground surface. Only the main haul roads, landings, and railroad grades remained bare, and many were partially vegetated. Some of the second growth appeared to be thickets of hardwood trees rather than coniferous forests (Janda et al., 1975). Redwood appears to be represented less in the regenerating forests than Douglas-fir, which is typical of many logged areas previously dominated by redwoods (Veirs and Lennox, 1981).

D. 1949-1954 Timber Harvest

The 1949-1954 period saw the most intense period of timber harvest in the watershed. It also brackets a period of timber harvest dates determined from aerial photographs, making computation of a logging rate (area logged/number of years in photo period) possible. For these reasons it is used as a comparison standard for all later harvest (Tables 1-8).

Between 1949 and 1954, 9,880 ha of the coniferous forests were logged. Roughly 20 percent of the original forests, 16 percent of the basin drainage area (Figure 3) and 25 percent of all logging occurred during these years. Although this was, overall, the most intense period of timber harvest, it differed throughout the watershed. By 1954, 16 percent of the original coniferous forests in the lower watershed, 36 percent in the middle watershed, and 31 percent in the upper watershed had been logged (Figure 4). These comprise 15, 28, and 22 percent of their respective drainage areas. By comparison, timber harvest during this period accounts for 34 percent of all logging in the upper watershed, 29 percent in the middle watershed, and only 11 percent in the lower watershed. Over half the logging during this period occurred in the middle watershed alone, and by 1954, 39 percent of all logging in this area had occurred. About one-third of the total acreage logged during this period was located in the upper watershed. The smaller size and less extensive forests in this area were more than enough to offset initially slow harvest during the 1936-1948 period so that by 1954, 39 percent of all logging in the upper watershed had also occurred.

Beginning in this period, timber harvest with tractors replaced cable yarding that had been most common during earlier years. By 1948, sixty-two percent of the area logged in the lower basin (including steam donkey logging, but excluding forest clearing) and 50 percent of the hectarage logged in the middle basin had been cable yarded. Between 1949 and 1954, only 15 percent of logging in the middle portion of the watershed and 9 percent of the logging in the upper watershed utilized cable yarding. Between 1954 and 1962 these figures are 7 and 14 percent respectively. Since 1962 cable yarding has been limited to steep slopes such as the east side of Lacks Creek. Between 1971 and 1978 cable yarding in these areas accounted for 22 percent of all logging in the middle watershed.

E. 1955-1962 Timber Harvest

Between 1955 and 1962 the rate of timber harvest declined substantially in the upper portion of the watershed, and remained the same in the middle and lower watershed. Timber harvest decreased to less than half the previous average in the upper watershed. Overall, the harvest rate for the entire watershed declined to about 70 percent of the previous period average.

### F. 1963-1966 Timber Harvest

Between 1963 and 1966, the rate of timber harvest slightly increased above the previous period average, but overall the average equalled three-quarters the 1949-1954 rate. The rate remained essentially unchanged in the upper watershed, decreased substantially in the middle basin, and doubled in the lower watershed. By 1966, roughly 55 percent of the original coniferous forests had been logged, comprising 45 percent of the basin drainage area (Figure 3). This accounts for roughly 70 percent of the area logged by 1978. By portions of the watershed, this is 55 percent of all logging in the lower watershed, 80 percent in the middle watershed, and 71 percent in the upper watershed, (or respectively, 34, 73, and 57 percent of the coniferous forests and 33, 58, and 40 percent of their drainage areas) (Figure 4).

More important than the amount of timber harvest is the timing and distribution of harvest. 1962 and 1966 aerial photographs show that much of the recent logging in the upper watershed occurred in the narrow inner canyon along Redwood Creek and its tributaries. For access, substantial new, near-channel road construction was required, and the entire area was yarded using tractors. As a result, intensive timber harvest occurring just prior to the 1964 storm probably played a key role in the initiation of many new landslides during this period (see Kelsey et al., in press; Pitlick, 1983).

### G. 1967-1970 Timber Harvest

Between 1967 and 1970, timber harvest continued at a slightly lower rate in the middle watershed, declined moderately in the lower watershed, and increased considerably in the upper watershed (mostly as a result of an unusually large 830 ha tractor-yarded clearcut in the vicinity of Noisy Creek) (Figure 4). Timber harvest in the upper watershed for this period averaged roughly 80 percent of the 1949-1954 rate.

By 1970, 83 percent of the area logged by 1978 had been harvested, comprising 65 percent of the original coniferous forests, and 53 percent of the basin drainage area (Figure 3). Most of the recently cut land visible on the 1966 and 1970 photographs was within a small number of very large cutblocks.

### H. 1971-1978 Timber Harvest

Timber harvest rates between 1971 and 1978 declined substantially in both the middle and upper portions of the watershed because the old-growth timber supply was dwindling. Most of the easily accessible timber had been harvested, so logging was concentrated on remaining uncut forests in the lower watershed and on the residual timber stands. Increased demand for redwood and depletion of timber supplies elsewhere resulted in an increased rate of timber harvest in the lower watershed.

By 1978, 81 percent of the original forests had been logged, totalling 66 percent of the basin drainage area (Figure 3). This includes 69 percent of the original forests in the lower watershed, 91 percent in the middle watershed, and 81 percent in the upper watershed; averaging to 65, 72, and 57 percent of their respective drainage areas (Figure 4).

Tractor clearcutting characteristic of the mid to late 1970's differs from that of the late 1960's and early 1970's in several respects. During the 1960's in the upper basin, roads often followed the steep inner gorge near stream channels, where choice timber was found. Many roads had steep gradients designed to access all positions of the hillslope. Skidtrails frequently followed or crossed ephemeral stream channels. In contrast, ground disturbance associated with the more recent logging is generally greater than that resulting from earlier tractor yarding, reflecting increased harvest efficiency. Less remnant vegetation is left, and more skidtrails are required. However, fewer skidtrails cross stream channels, and improved construction techniques reduced the risk of major streamflow diversions. In addition, new forest practice rules limited the cutblock size, leading to smaller logged areas.

As the value and use of timber products has increased and supply declined, the timber companies have increasingly re-entered previously logged areas to remove residual timber. In the 1960's this type of harvest accounted for only 15 percent of the total acreage logged, and usually occurred only in areas with abundant residual timber. Substantial new road and skidtrail construction was usually required, resulting in disturbance comparable to the original logging operation. During the 1970's, secondary timber harvest shifted from high density seed tree cuts typical of the early years to smaller clearcuts areas where trees were left because of small size, poor quality, or inaccessibility. The erosional impact of this type of harvest is probably quite different than first entry logging since fewer roads and skid- trails are used.

Between 1971 and 1978, re-logging in the upper watershed accounted for 29 percent of the area logged. In the middle watershed re-logging accounted for 31 percent of the hectarage logged between 1967 and 1970, and 49 percent between 1971 and 1978.

I. Post-1978 Logging

Timber harvest in the lower watershed essentially ended with expansion of Redwood National Park in 1978. Re-logging accounted for the majority of the logging in the upper and middle watersheds from 1978 to 1981. Fifty percent of the area logged in the upper watershed and 65 percent of the area logged in the middle watershed was re-logged.

## V. SUMMARY

Logging is the dominant land use in the Redwood Creek basin. Early logging activities cleared the broad floodplains near the coast for grazing and agriculture. Early commercial logging was done by steam donkeys that cable-yarded timber from extensive clearcut tracts of land in the upper slopes of the middle watershed. In the late 1930's, crawler tractors replaced steam donkeys as the yarding machines and partial cutting of timber became the dominant harvest method. The most intensive logging period in the Redwood Creek basin was 1949-1954, and this activity was concentrated in the upper and middle watersheds. During the 1960's, the harvest technique reverted to clearcutting using tractor yarding. During this time, timber harvest became most concentrated in the redwood-dominated lower watershed, and logging continued steadily there until the expansion of Redwood National Park in 1978. In the 1970's, a trend to more regulated and smaller tractor harvest cuts, and to the increased use of cable yarding systems for timber harvest on steeper slopes started. Reentry of previously logged areas to remove residual old-growth timber became the dominant logging activity in the middle and upper watersheds by 1978. The timing and spatial distribution of logging in the Redwood Creek basin indicates that the most intensive logging occurred in the upper basin in the fifteen years before the 1964 flood. Therefore, the logging history provides a data base for the discussion of relative effects of logging and major storms on erosion rates.

## VI. REFERENCES CITED


Arvola, T.F. 1976. Regulation of logging in California, 1945-1975. Division of Forestry, Department of Conservation, The Resources Agency, State of California. Sacramento. 98 p.

Fritz, E. 1959. Characteristics, utilization, and management of second-growth redwood. Foundation for American Resources Management, San Francisco, California. 29 p.

Harden, D.R., H.M. Kelsey, S.D. Morrison, and T.A. Stephens. 1981. Geologic map of the Redwood Creek drainage basin, Humboldt County, California. U.S. Geological Survey, Water Resources Division, Open-File Report 81-496.

Janda, R.J., K.M. Nolan, D.R. Harden, and S.M. Colman. 1975. Watershed conditions in the drainage basin of Redwood Creek, Humboldt County, California, as of 1973. U.S. Geological Survey, Water Resources Division, Open-File Report 78-25.

Kelsey, H.M., M.C. Coghlan, J. Pitlick, and D.W. Best. Geomorphic analysis of streamside landsliding in the Redwood Creek basin. (in press).

Munz, P.A. and Deck, D.D. 1959. A California Flora. University of California Press, Berkeley, California. 1681 p.

Pitlick, J. 1983. Sediment routing in tributaries of the Redwood Creek basin: northwestern California. Redwood National Park Technical Report 8. National Park Service, Arcata, California. 67 p.

Smith, D.M. 1962. The Practice of Silviculture. Seventh edition. John Wiley. New York. 578 pp.

## APPENDIX A
## USE OF THE LANDUSE MAPS

The landuse maps were prepared by chronologically reviewing each set of photographs. Additional timber harvest not previously recorded, yarding methods used, resulting ground disturbance, and amount of timber remaining after logging were noted. Since some photosets were incomplete, actual harvest date may be earlier than recorded. These areas are estimated to be less than five percent of the total.

### Cutblock Boundaries and Period Cut

Most of the linework on the maps delineate the various landuse types and cutblocks. Areas were classified as either prairie grassland (Pr), oak-woodland (Hw), brush (Br), uncut coniferous forest (UC:78) or logged coniferous forest (X: ).

For each logged area, the photo year when logging was first observed is noted. For example, X:62 means that logging was first observed on the 1962 photos and occurred sometime between the previous photo year (1954) and 1962. In some cases the previous photo was not available, and logging occurred sometime between two photo periods. The notation "X: by 62" is used to indicate that logging had occurred by 1962, but not necessarily within the previous photo period. Finally, in many cases the county base map specified a cutting date provided by timber companies, and these were noted on the landuse map.

Specific cutting dates are useful in distinguishing logging which occurred prior to or after the 1964 storm since the storm falls between available photographs (1962 and 1966). Many of the county dates were found to be incorrect and were not included. Specific dates are recorded as X:1962, indicating the year 1962 and not the 1955-1962 photoperiod (which would be X:62).

Because of incomplete coverage of the 1936 and 1947-48 photos, interpretation using 1954 photos based on levels of revegetation observed elsewhere, and information from Janda et al. (1975) were used to distinguish some areas cut before or after 1948. The notation OL:54 means older logging in 1954 and distinguishes areas with considerable revegetation from those recently logged in 1954.

Reentry into previously logged areas is indicated by the notation Dx: followed by the date new logging was observed.

Areas yarded using tractors are labeled Tr and those using cable systems as Cbl. An ellipse with hatched lines in its interior locates major cable landings.

## Ground Disturbance

A relative measure of ground disturbance based on concentrations of skid-trails, degree of revegetation and depth of cut has been employed. Skidtrail concentrations were determined by measuring, in at least three directions, the number of times trails intersect a straight line of known length. The readings are averaged to calculate the distance between skidtrails and roughly indicate skidtrail density. The degree of revegetation and depth of skidtrail cuts is indicated by the level of contrast between the skidtrail and surrounding area. Bright, clear and unvegetated skidtrails suggest more recent logging or greater depth of cut. Partially obscured or vegetated skidtrails suggest either longer time since disturbance, or shallow disruption of the soil mantle.

Using these criteria, four levels of disturbance of the ground surface were developed. The user should remain aware that these do not imply higher erosion rates or greater erodibility. They reflect observations at the date of the photograph, but because they are based on measured concentration of skidtrails (which change little through time until fully obscured by vegetation), they also reflect disturbance at the time of harvest. Areas where skidtrails were not visible because of vegetation or shadows were disregarded. The classifications include minimal (GD:D), low (GD:1), moderate (GD:2) and severe ground disturbance (GD:3).

GD:D Minimal Disturbance

Ground disturbance is visible, but minimal. Examples include selectively cut areas where occasional roads and skidtrails are marginally visible through tree canopy, small (less than 20 ha) isolated blocks of uncut old-growth within tractor logged areas, and previously logged areas with nearly complete revegetation obscuring skid trails and many haul roads.

GD:1 Low Ground Disturbance

This classification includes most cable yarded areas and low disturbance tractor logged areas with very low skid trail concentrations. Extreme low slope areas are included even though concentration of skid trails may be high. It is important to define ground surface disturbance separately from vegetation disturbance. Cable logging usually removes all overstory vegetation and much of the understory as well. The ground surface disturbance, however, seldom exceeds 25 cm in depth. Tractor logging, while leaving much of the original vegetation and ground surface intact, results in greater ground disturbance, since the depth of skidtrail cuts often exceeds one m.

GD:2 Moderate Ground Disturbance

This includes more disturbed cable yarded areas, most of the combination cable/tractor yarded areas, and tractor yarded areas with moderate to high concentrations of skid trails.

GD:3 Severe Ground Disturbance

*This classification includes tractor yarded areas with high to very* high concentrations of skid trails and areas with moderate concentration of skidtrails if they have high contrast.

Large cutblocks with an early cutting history often contain two or more ground disturbance classes. Instead of breaking the block into smaller units, the percentage of each classification was estimated. For example, if the area showed additional logging the following photo year, it was considered one continuous logging operation. Many of these areas have been isolated since they are particularly common in the 1962-1966 period and therefore span the 1964 storm.

Stands with residual old-growth were classified in the following manner:

R:3 Substantial Remaining Old Growth

This classification contains numerous coniferous trees of commercial size and quality. They are easily recognizable on aerial photographs as old-growth overstory and were intentionally left during cutting. Most frequently they are found in small groups or in larger blocks, and are less often scattered evenly throughout the cut area. These trees were probably left because of poor accessibility, because they were not considered merchantible at the time of harvest, or because of seed tree requirements.

R:2 Minor to Moderate Remaining Old Growth

Some overstory coniferous trees remain, but they comprise less than five percent of the original stand. Often these areas contain commercial quality old-growth trees left as seed trees, but more frequent ly they contain moderate size conifers and large hardwoods which were part of the original stand. These trees are usually found scattered throughout the cut area. Borderline classification involves distinguishing between commercial conifers and large hardwoods not of commercial quality.

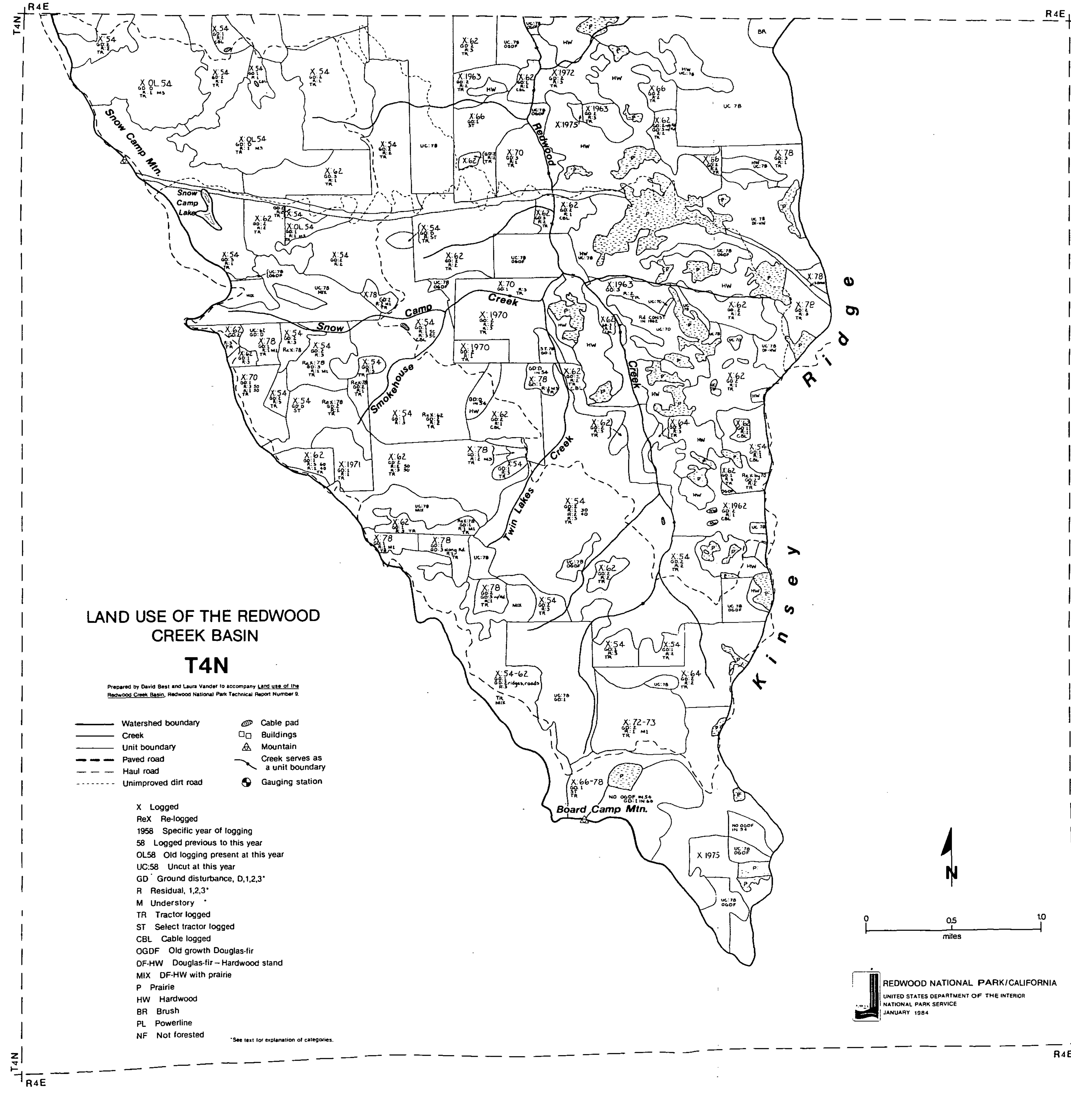
R:1 Little or No Remnant Overstory

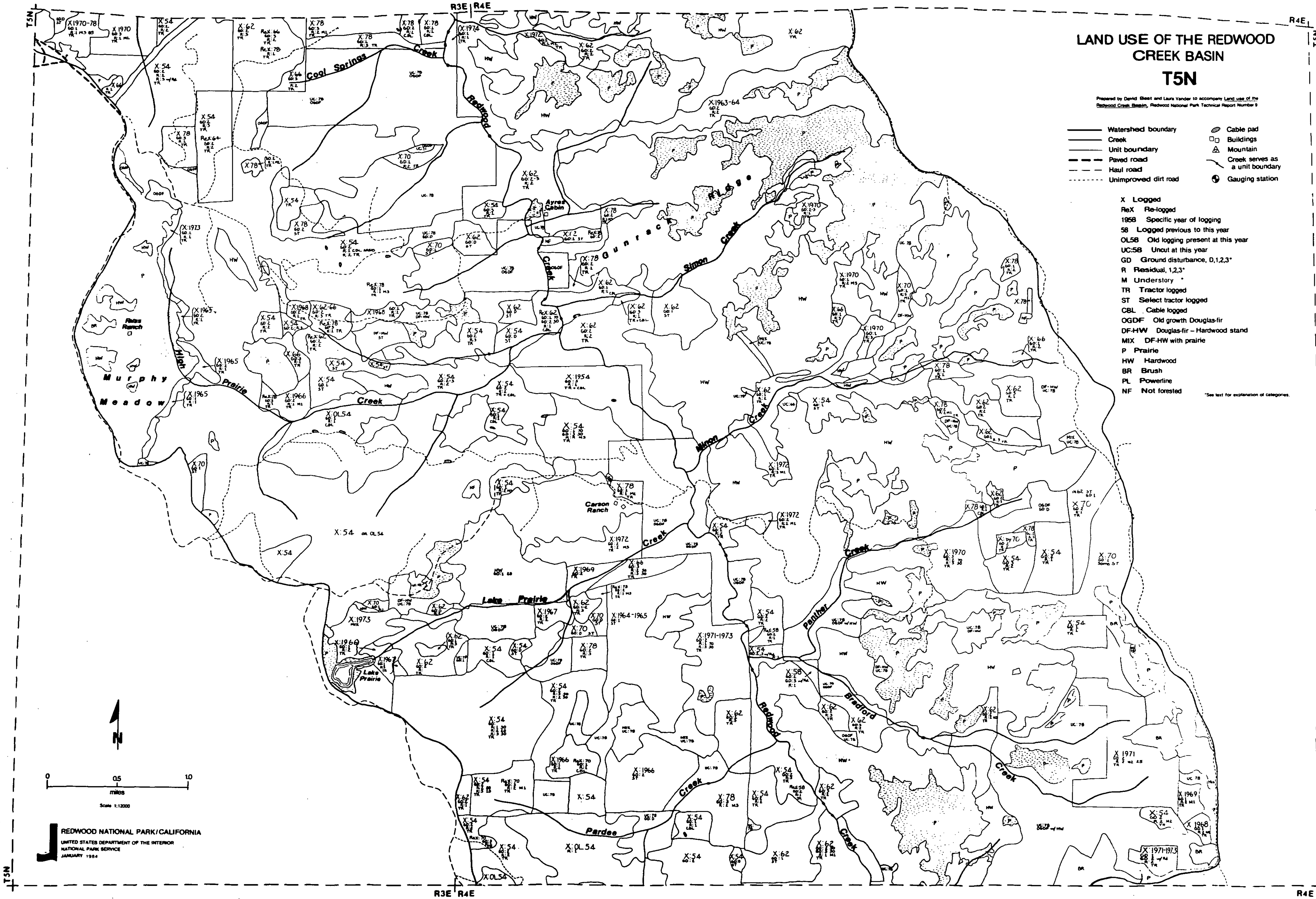
Near complete removal of overstory vegetation with only occasional moderate or small trees scattered throughout the cut area occur here. These areas were harvested with the intention of removing all commercial quality trees, although some areas have a low density of poor quality seed trees. These areas are typical of nearly all cable-yarded units, most post-1970 tractor yarded areas, and many earlier clearcuts.

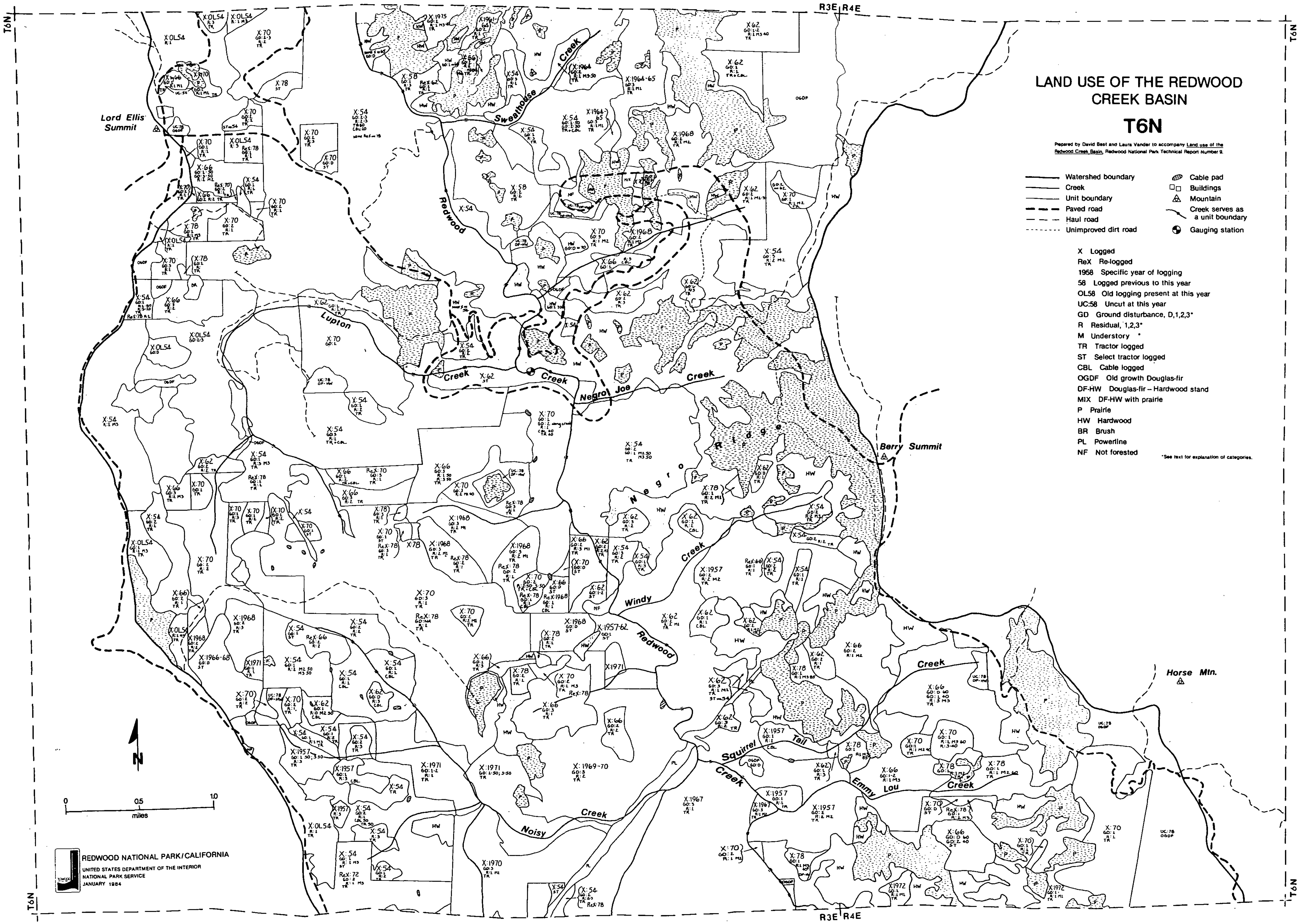
Roads

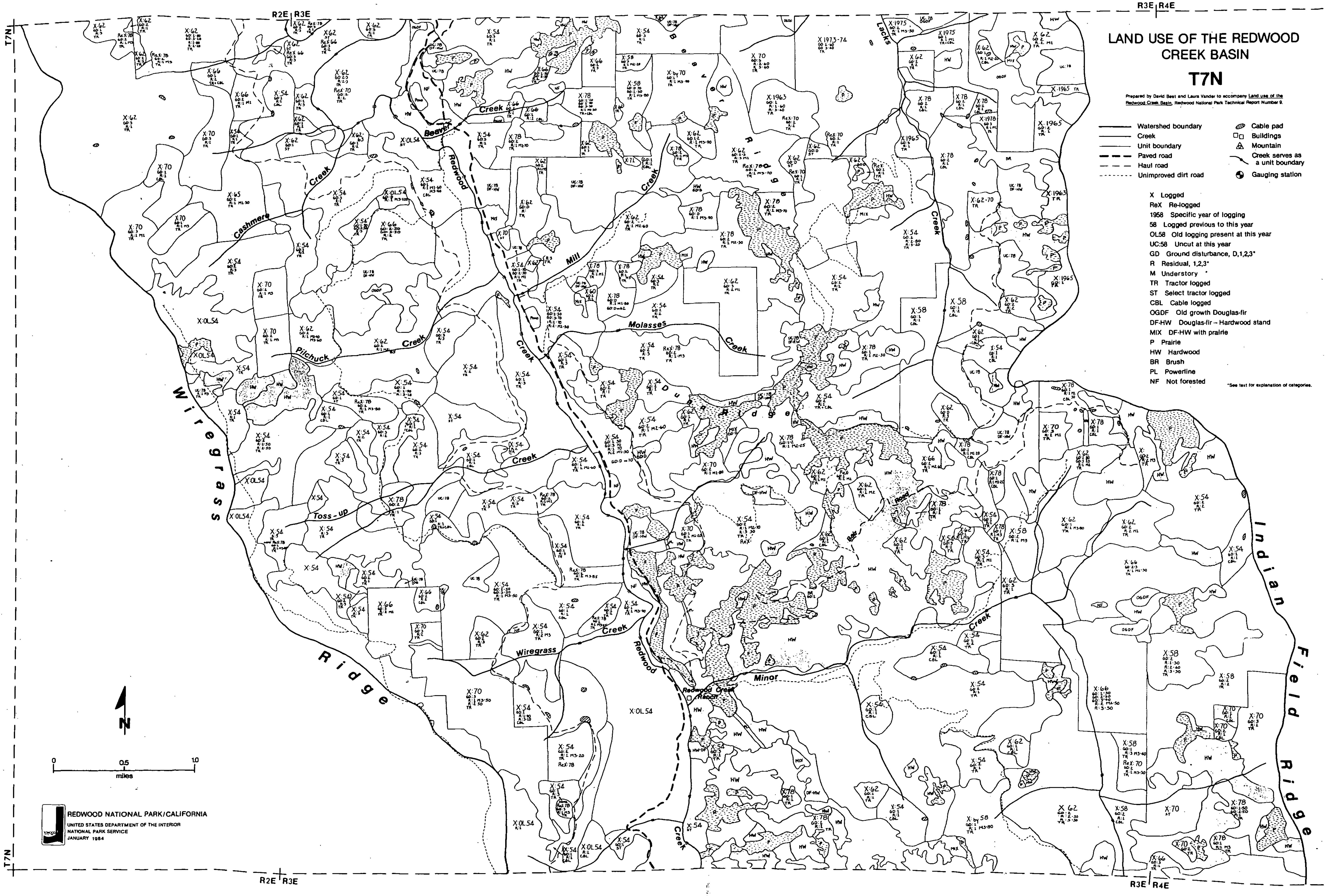
Only a few of the 2,000 km of roads in the Redwood Creek basin are provided for orientation. Roads have been classified as primary paved roads, main rocked haul roads, and unimproved dirt roads.

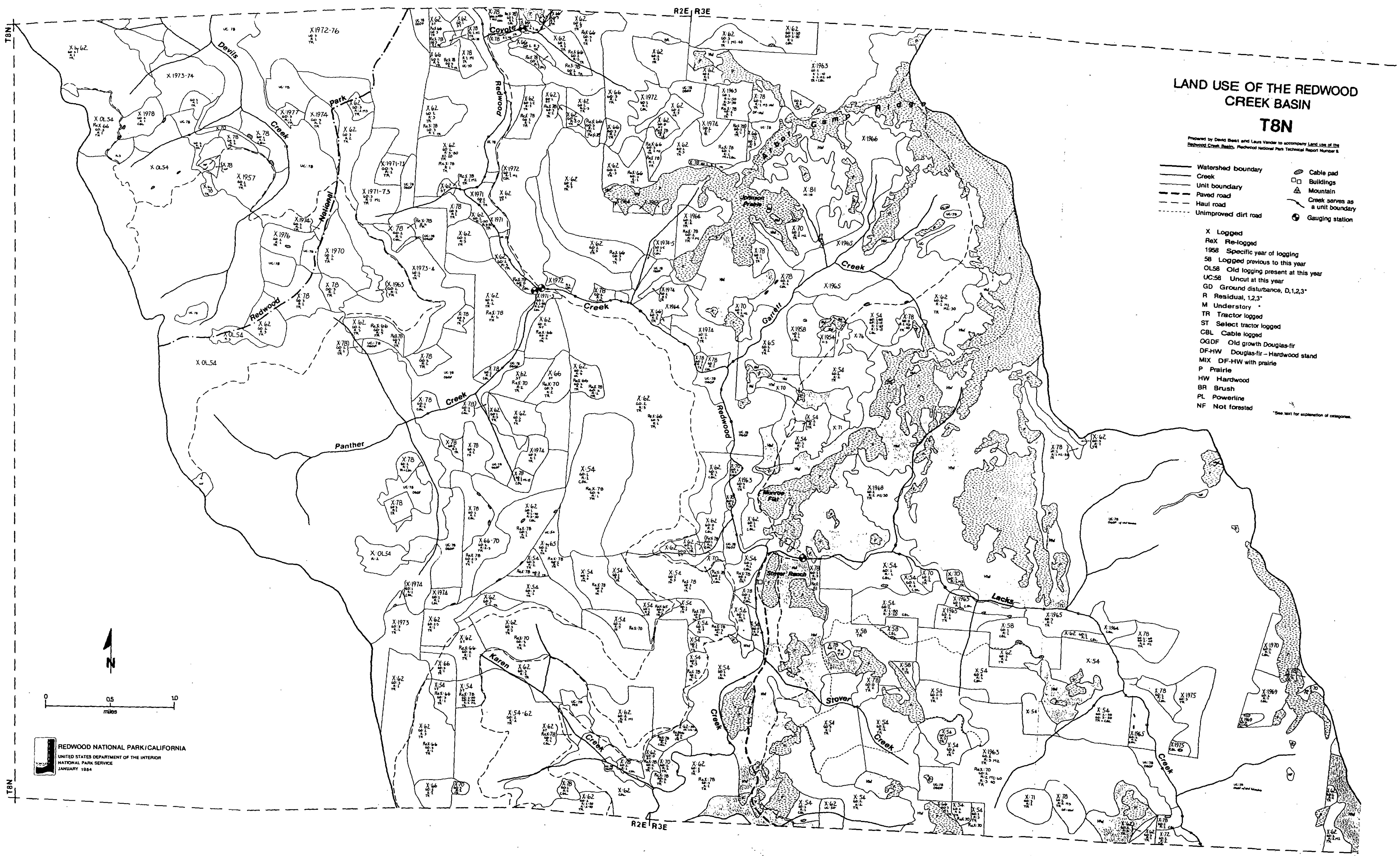
All of the paved roads in the basin are included on the maps, including the relocated Highway 299, Bald Hills Road, Redwood Valley Road, Chezem Road, and a portion of Snow Camp Road. All are maintained and open to public travel. The main rocked haul routes include both public and private logging roads. Principal use is by the timber industry and most are maintained. Only the most important unimproved dirt roads used for access to the watershed have been included.

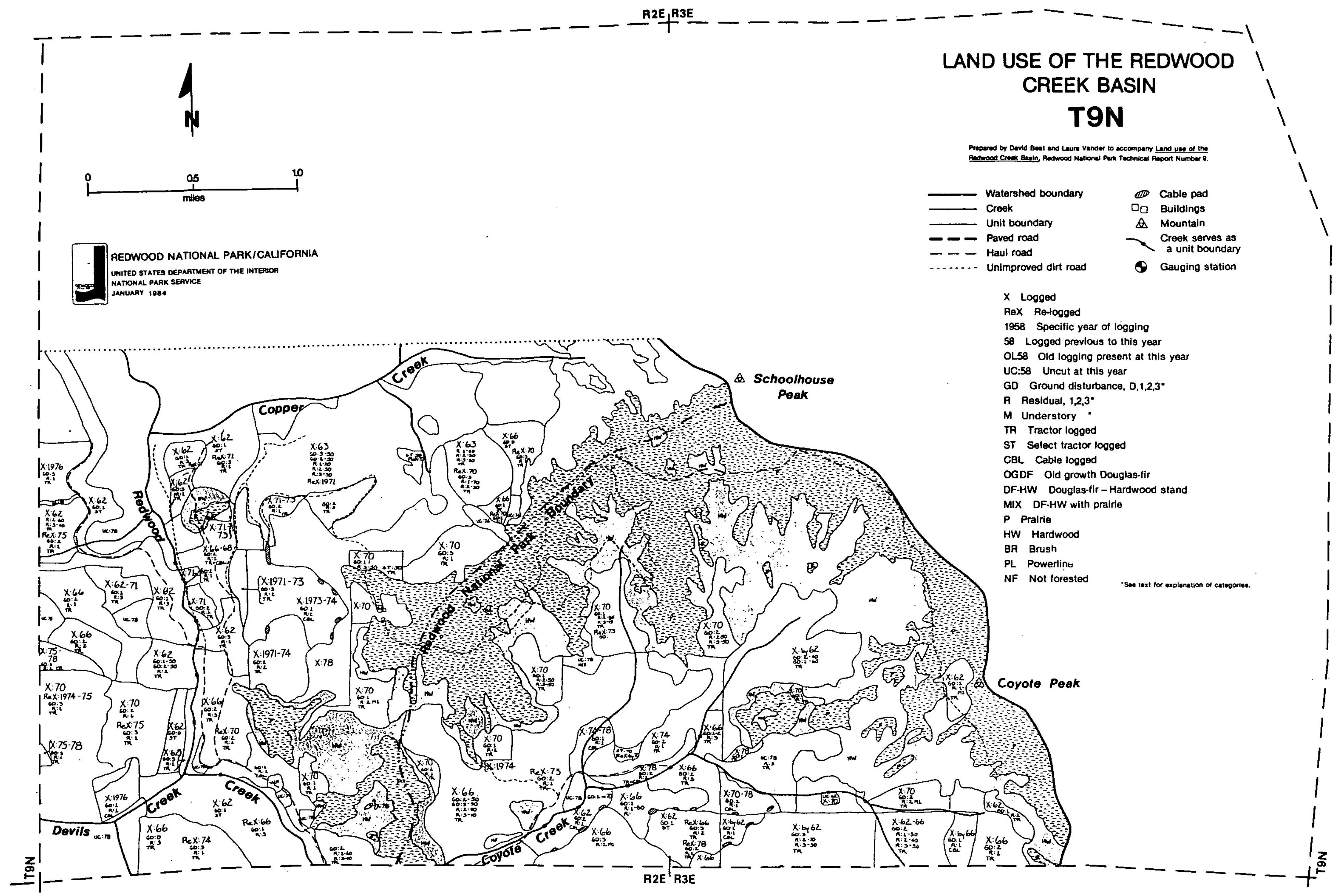

LAND USE OF THE REDWOOD CREEK BASIN
T4N
Prepared by David Best and Laura Vander to accompany Land use of the Redwood Creek Basin, Redwood National Park Technical Report Number 9.
Watershed boundary
Creek
Unit boundary
Paved road
Haul road
Unimproved dirt road
Cable pad
Buildings
Mountain
Creek serves as a unit boundary
Gauging station
X Logged
ReX Re-logged
1958 Specific year of logging
58 Logged previous to this year
OL58 Old logging present at this year
UC:58 Uncut at this year
GD* Ground disturbance, D,1,2,3*
R Residual, 1,2,3*
M Understory *
TR Tractor logged
ST Select tractor logged
CBL Cable logged
OGDF Old growth Douglas-fir
DF-HW Douglas-fir – Hardwood stand
MIX DF-HW with prairie
P Prairie
HW Hardwood
BR Brush
PL Powerline
NF Not forested
*See text for explanation of categories.
Snow Camp Mtn.
Snow Camp Lake
Snow Camp Creek
Smokehouse Creek
Twin Lakes Creek
Redwood Creek
Kinsey Ridge
Board Camp Mtn.
R4E
T4N
N
0
0.5
1.0
miles
REDWOOD NATIONAL PARK/CALIFORNIA
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
JANUARY 1984


LAND USE OF THE REDWOOD CREEK BASIN
T5N
Prepared by David Best and Laura Vander to accompany Land use of the Redwood Creek Basin, Redwood National Park Technical Report Number 9
Watershed boundary
Creek
Unit boundary
Paved road
Haul road
Unimproved dirt road
Cable pad
Buildings
Mountain
Creek serves as a unit boundary
Gauging station
X Logged
ReX Re-logged
1958 Specific year of logging
58 Logged previous to this year
OL58 Old logging present at this year
UC:58 Uncut at this year
GD Ground disturbance, 0,1,2,3*
R Residual, 1,2,3*
M Understory *
TR Tractor logged
ST Select tractor logged
CBL Cable logged
OGDF Old growth Douglas-fir
DF-HW Douglas-fir – Hardwood stand
MIX DF-HW with prairie
P Prairie
HW Hardwood
BR Brush
PL Powerline
NF Not forested
*See text for explanation of categories.
R3E R4E
T5N
Cool Springs Creek
Redwood Creek
Gunrack Ridge
Simon Creek
Ayres Cabin
Ross Ranch
Murphy Meadow
High Prairie Creek
Minon Creek
Carson Ranch
Lake Prairie
Lake Prairie Creek
Panther Creek
Bradford Creek
Pardee Creek
N
0 0.5 1.0
miles
Scale 1:12000
REDWOOD NATIONAL PARK/CALIFORNIA
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
JANUARY 1984


LAND USE OF THE REDWOOD CREEK BASIN
T6N
Prepared by David Best and Laura Vander to accompany Land use of the Redwood Creek Basin, Redwood National Park Technical Report Number 9.
Watershed boundary
Creek
Unit boundary
Paved road
Haul road
Unimproved dirt road
Cable pad
Buildings
Mountain
Creek serves as a unit boundary
Gauging station
X Logged
ReX Re-logged
1958 Specific year of logging
58 Logged previous to this year
OL58 Old logging present at this year
UC:58 Uncut at this year
GD Ground disturbance, D,1,2,3*
R Residual, 1,2,3*
M Understory *
TR Tractor logged
ST Select tractor logged
CBL Cable logged
OGDF Old growth Douglas-fir
DF-HW Douglas-fir – Hardwood stand
MIX DF-HW with prairie
P Prairie
HW Hardwood
BR Brush
PL Powerline
NF Not forested
*See text for explanation of categories.
R3E R4E
T6N
Lord Ellis Summit
Berry Summit
Horse Mtn.
Redwood Creek
Lupton Creek
Sweathouse Creek
Negro Joe Creek
Negro Ridge
Windy Creek
Squirrel Tail Creek
Emmy Lou Creek
Noisy Creek
N
0
0.5
1.0
miles
REDWOOD NATIONAL PARK/CALIFORNIA
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
JANUARY 1984


LAND USE OF THE REDWOOD CREEK BASIN
T7N
Prepared by David Best and Laura Vander to accompany Land use of the Redwood Creek Basin, Redwood National Park Technical Report Number 9.
Watershed boundary
Creek
Unit boundary
Paved road
Haul road
Unimproved dirt road
Cable pad
Buildings
Mountain
Creek serves as a unit boundary
Gauging station
X Logged
ReX Re-logged
1958 Specific year of logging
58 Logged previous to this year
OL58 Old logging present at this year
UC:58 Uncut at this year
GD Ground disturbance, D,1,2,3*
R Residual, 1,2,3*
M Understory *
TR Tractor logged
ST Select tractor logged
CBL Cable logged
OGDF Old growth Douglas-fir
DF-HW Douglas-fir – Hardwood stand
MIX DF-HW with prairie
P Prairie
HW Hardwood
BR Brush
PL Powerline
NF Not forested
*See text for explanation of categories.
R2E R3E
R3E R4E
T7N
Wiregrass Ridge
Indian Field Ridge
Redwood Creek
Beaver Creek
Mill Creek
Molasses Creek
Cashmere Creek
Pilchuck Creek
Toss-up Creek
Wiregrass Creek
Minor Creek
Lacks Creek
Redwood Creek Ranch
N
0 0.5 1.0
miles
REDWOOD NATIONAL PARK/CALIFORNIA
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
JANUARY 1984


LAND USE OF THE REDWOOD CREEK BASIN
T8N
Prepared by David Best and Laura Vander to accompany Land use of the Redwood Creek Basin, Redwood National Park Technical Report Number 9.
Watershed boundary
Creek
Unit boundary
Paved road
Haul road
Unimproved dirt road
Cable pad
Buildings
Mountain
Creek serves as a unit boundary
Gauging station
X Logged
ReX Re-logged
1958 Specific year of logging
58 Logged previous to this year
OL58 Old logging present at this year
UC:58 Uncut at this year
GD Ground disturbance, D,1,2,3*
R Residual, 1,2,3*
M Understory *
TR Tractor logged
ST Select tractor logged
CBL Cable logged
OGDF Old growth Douglas-fir
DF-HW Douglas-fir – Hardwood stand
MIX DF-HW with prairie
P Prairie
HW Hardwood
BR Brush
PL Powerline
NF Not forested
*See text for explanation of categories.
R2E R3E
T8N
Devils Creek
Park
National
Redwood Creek
Panther Creek
Coyote Creek
Karen Creek
Garrett Creek
Johnson Prairie
Lacks Creek
Stover Creek
Stover Ranch
Minor Creek
Ridge
N
0
0.5
1.0
miles
REDWOOD NATIONAL PARK/CALIFORNIA
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
JANUARY 1984



R2E R3E
LAND USE OF THE REDWOOD CREEK BASIN
T9N
Prepared by David Best and Laura Vander to accompany Land use of the Redwood Creek Basin, Redwood National Park Technical Report Number 9.
N
0 0.5 1.0
miles
REDWOOD NATIONAL PARK/CALIFORNIA
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
JANUARY 1984
Watershed boundary
Creek
Unit boundary
Paved road
Haul road
Unimproved dirt road
Cable pad
Buildings
Mountain
Creek serves as a unit boundary
Gauging station
X Logged
ReX Re-logged
1958 Specific year of logging
58 Logged previous to this year
OL58 Old logging present at this year
UC:58 Uncut at this year
GD Ground disturbance, D,1,2,3*
R Residual, 1,2,3*
M Understory *
TR Tractor logged
ST Select tractor logged
CBL Cable logged
OGDF Old growth Douglas-fir
DF-HW Douglas-fir – Hardwood stand
MIX DF-HW with prairie
P Prairie
HW Hardwood
BR Brush
PL Powerline
NF Not forested
*See text for explanation of categories.
Schoolhouse Peak
Coyote Peak
Copper Creek
Redwood Creek
Redwood National Park Boundary
Devils Creek
Coyote Creek
T9N
R2E R3E