B-5-1 Road

Watershed Rehabilitation Project Summary Report

Michael Kenning

February 1989

TABLE OF CONTENTS

page

List of Maps and Tables.....ii

Rehabilitation Unit 88-5 Summary.....1

Erosion Features.....3

Erosion Control Rehabilitation Work.....4

Introduction.....4

Heavy Equipment Work.....5

Heavy Equipment Costs.....6

Evaluation of Heavy Equipment Work and Costs.....7

Labor Intensive Work.....7

Refereences Cited.....23

Appendices (materials on Archive File 88-5 at South Operations Center, Orick)

1) IFB Contract #CX-8480-8-0005

2) Photo Points with maps and descriptions

3) Geomorphic Maps: 5x of 1:6000 scale, 1978 photo # 5-7
5-9
6-11
6-12

2x of 1:12000 scale, 1978 photo # 4-12
4-14
5-13

4) Field notes and drafted cross-sections

LIST OF MAPS AND TABLES

page

Map A Unit Location Map....9

Map B Logging History Map....10

Map C Rehabilitation Treatments Map, Northern Section....11

Map C Rehabilitation Treatments Map, Southern Section....12

Table 1 Rehabilitation Work Cost Summary....13

Table 2 Summary of Heavy Equipment Costs and Comparison of Contract VS HERE Costs....15

Table 3 Haul Road Stream Crossing Costs....16

Table 4 Deep Drain Excavation Costs....17

Table 5 Skid Trail Stream Crossing Costs....18

Table 6 Blade Endhauled Exported Outslope Costs....19

Table 7 Cross-Road Drain Costs....20

Table 8 Miscellaneous Costs....21

Table 9 Labor Intensive Costs....22

REHABILITATION UNIT 88-5 SUMMARY

UNIT NAME: B-5-1 road and slopes.

LOCATION DESCRIPTION: Unit within the upper reaches of Tom McDonald and Bridge Creek watersheds, approx. 9 air miles south of Orick. T9N R1E S 13, 14, 15, 23, 24. (Map A, pg 9).

TOTAL UNIT ACERAGE: 535 MILES OF ROAD TREATED: 3.7

TOTAL REHABILITATION PROJECT COST: $73,486 (Table 1, pg 14)

GEOLOGY DESCRIPTION: Bedrock consists of the schist of Redwood Creek, a part of the Franciscan assemblage. (Harden and others, 1982).

GEOMORPHIC DESCRIPTION: Elevation ranges between 1,900 - 2,600 feet. Slopes generally less than 40%. Slopes locally steeper than 50% at inner gorge of streams and at scarps. First and second order streams have rectangular drainage patterns and lie within large, well incised valleys.

SOIL DESCRIPTION: Well-drained brown soils are the most common, followed by well-drained red soils. Imperfectly drained soils are found along some stream channels and within landslide features (Popenoe and Martin, 1985).

LAND USE/LOGGING HISTORY: Logging began in late 1950s with tractor-yarded selective cuts along the north and eastern slopes of Rodgers Peak. Part of the B-5-1 road was constructed during this time to haul timber logged above the road. B-5 road was used to haul timber logged below the B-5-1. B-5-1 road construction was completed by mid 1960s. Road was not surfaced with imported rock and "Humboldt" crossings were used at streams. Most of area immediately surrounding the peak was tractor-yarded and clear cut in mid 1960s. However many hardwoods were not removed. Areas selectively cut were relogged by tractor from the early 1970s to the mid 1970s. (Map B, pg 10).

EROSION FEATURES: (See report text and Map C)

Rehabilitation Work Summary continued on page 2

SUMMARY (Cont'd)

REHABILITATION WORK SUMMARY: See report text for details of the IFB contract.

I. Total Heavy Equipment Cost: $43,767 (Table 1, pg 13)

Heavy Equipment Used: D-8 w/winch, U-blade, 28" tracks.
D-8 w/2 rear mounted ripper teeth, U-blade, 24" tracks.
Case 220-B hydraulic excavator w/2.75 yd^3 bucket.

#	Types of Treatment	Total Cost	Quantity	Unit Cost	Rate
9	Haul Rd Stream Xing Exc	$14,112	11,624 yd^3	$1.21/$yd^3$	78 yd^3/pc-hr
3	Deep Drain Excavations	$1,854	618 yd^3	$3.00/$yd^3$	75 yd^3/pc-hr
6	Skid Tr Stream Xing Exc	$1,772	752 yd^3	$2.36/$yd^3$	72 yd^3/pc-hr
698 ft	Exported Outslope (dozer)	$6,700	3,163 yd^3	$2.12/$yd^3$	125 yd^3/pc-hr
122	Cross Road Drains	$5,819	5,730 ft	$1.02/ft	143 ft/pc-hr
2	Inboard Ditches	$480	240 ft	$2.00/ft	N/A
	Ripping	$8,930	19,000 ft	$0.47/ft	1,070 ft/pc-hr
	Miscellaneous	$4,106			

II. Total Labor Intensive Cost: $6,127 (Table 1, pg 13)

Labor Intensive Work Summary:

Brushing: Cleared brush for surveys along cross section lines. Cost of $297 @ 25 person-hours

Straw Mulch:

Number of bales	322
Total acerage covered	3.8
Total Cost	$4,630 @ 354 person-hrs
Unit Cost	$14.38/bale

Other: Construction of 6 waterbars on skid trails at various locations to prevent future water diversions onto skid trails or to divert gully flow off skid trails. Cost = $1,200 @ 220 person-hrs.

DISCUSSION: See report text.

EROSION FEATURES

The erosion features on this site are relatively minor compared to past rehabilitation sites. This is due to the gentle topography, close proximity to the drainage divide, low channel gradients, and generally cohesive and well drained soils.

A few of the swales of tributary streams have small, but active blockslides, usually less than 100 feet wide. These are located near SX-1, SX-3, and SX-5 (Map C). All have skid trails constructed in or close to the headscarp zone and the slides appear to be slow moving. The headscarps are generally 5 feet or less in height. Some of the skid trails show small rotational offsets and sheared black schist is often found in the cutbanks. The B-5-1 road had 1-2 feet of vertical offset at RX-2 and RX-5. The side scarps are indistinct except for the left side scarp below RX-2, which has been vertically offset several feet. This side scarp has carried flow from an inboard ditch diversion at RX-2, which caused the formation of a large gully (~10ft wide X 8ft deep). The B-5-1 road was constructed by the mid 1960s in this reach, and the diversion is visible on the 1968 and later aerial photos. The flow of this stream was diverted towards the scarp at the time of mapping, but the flow went subsurface before the gully/scarp, and somehow reemerged in its proper channel.

Most of the gullies on the many skid trails are no larger than 2ft X 1ft and are not a large erosion problem. The gullies were probably formed shortly after logging, and most appear to carry water only during heavy storms. Some gullies have downcut to bedrock in places where the soils are thin. Due to harsh climate conditions, regrowth of conifers is slow on skid trails where soils are thin. Many of the skid trails have dozer constructed waterbars in areas reentered for logging in the mid 1970s. Some are still effective, but a few have been breached at the upper end.

The stream valleys of the larger drainages are very wide and deep with respect to the size of the present channel. Some of the valleys are well defined nearly all the way to the drainage divide. The stream valleys appear to follow the location of possible joints or faults as evidenced by the sharp, right angle bends of the valleys and their tributaries.

These wide, but low gradient channel bottoms were a "natural" path for the bulldozers to take during logging operations, and many of the skid trail crossings were also used to provide access to the channel bottom. The streams therefore contain many large bucked logs and smaller organics, covering the original thalweg. Subsurface flow can be heard under the organics during the summer months in many of the channel bottoms. Because of the well incised nature of many of the streams and the large sediment

storage sites available, only those skid trail crossings that had either a high diversion potential or had a debris torrent potential were excavated during the rehabilitation work.

The stream crossings on the B-5-1 were all Humboldt crossings, with the exception of RX-1, and RX-5, which used 18 and 12 inch diameter culverts respectively. All the crossings, except for RX-1, were in various stages of failure. The crossing at RX-6 was impassable to vehicles at the time of mapping due to a 4ft X 2ft gully. The presence of an unusually large number of bucked logs just below several of the road crossings indicate past washouts of the crossings. On crossings RX-4, RX-6, and RX-7, skid trails above the B-5-1 merged with the road, forming a wedge of fill extending several tens of feet above the road.

All of the haul road crossings and several of the adjacent road benches were a source of sediment delivery to the upper reaches of Tom McDonald and Bridge Creeks. Since removal of these sediment sources was cost effective, rehabilitation efforts focused on the excavation and storage of this material.

EROSION CONTROL REHABILITATION WORK

Introduction

The first part of the rehabilitation project involved aerial photo interpretation and geomorphic mapping by M. Kenning and R. Mita in the summer of 1984, and later by M. Horns and E. Wosika. Prescriptions were formulated and an IFB contract covering both the B-5-1 and the B-5-1-1 was prepared by E. Wosika and M. Kenning in 1985-86. Due to the low priority of the site and the resignation of several rehabilitation people, the contract was not issued in 1986 and 1987.

The site was rescheduled for rehabilitation as an IFB contract for 1988. The prescriptions were field checked by M. Kenning. and a few changes were made in the depth and extent of cuts at the road crossings. A peer review was held, and suggestions for further changes were made. The effected worksites were resurveyed and drafted, this time for only the B-5-1 road and slopes. Due to the above changes, and to changes in the contract specifications (section C) and plan sheet format (section J), the contract was essentially redone.

The costs for all the above work are included in the Evaluation section of the Technical Work of Table 1. The extensive prescription and survey and design costs are reflected in the Technical work costs, which are almost a third of the project costs for the site.

Heavy Equipment Work

The contract (#CX-8480-8-0005) was awarded on July 12 to Twin Parks Lumber Company of Arcata, California for the amount of $39,936.70. Other bids received were: $53,937.00 from W.K. Construction of Miranda, California; $78,931.29 from Carl M. Kjer & Sons of Arcata; and $99,150.00 from Patrick Environmental Inc. of Springfield, Oregon.

The total final cost of the heavy equipment contract, $43,767, can be found in Table 1 and on the Unit Cost Summary (pg 2). The cost of each bid item is listed in the Bid Schedule for the contract, and can be found in the archive file for Unit 88-5 at the South Operations Center in Orick. The difference between the final cost and the original bid cost is due to an enlargement in volume for most of the road crossings and their adjacent outslopes.

The equipment used by the contractor arrived on site on July 28 and is listed on page 2. The equipment operators were: J. Franke, the owner/operator of the dozers, and W. Larkin, the excavator and dozer operator. The excavator was rented from a local dealer.

Excavation began on Saturday, July 30 at the downstation (western) end, and except for a 2 day break during the second week, some work was done every day. Due to a delay in awarding the contract, the work began fairly late, and the contractor was eager to work as many days as possible. The work day was about 11 hours long, although this varied quite a bit depending on the condition of the excavator, which had a total down time of 27 hours during the project. The downtime was due mostly to hydraulic leaks, and several trips into town for parts were necessary. By comparison, the D-8 winch Cat was down for a total of 7 hours.

Over 90% of the B-5-1 road was treated by ripping and constructing cross-road drains approximately every 150 feet apart. The excavator dug most of the drain and the cat completed them. Since inboard ditches are lacking or are overgrown, most of the drains will only get flow from the cutbanks. This allowed for a relatively small size for many of the drains. The small size also reduced the destruction of trees on the fillslopes. The canopy these trees provide will help shade the seedlings that will be planted later.

The D-8 ripper cat was used for the excavation and pushing of fill as well as for ripping the road surface for all cross-road drain reaches and fillsites. When the excavator was not needed, for example at the beginning of some RXs, the excavator operator would jump off the machine and get on the idle D-8. Two cats were needed for much of the excavation work due to the long push

distances (approaching 600 ft), and the large size of the excavator.

The 220-B excavator with its 2.75 yd^3 bucket and long reach was able to get material that would have been difficult, if not impossible for the cat to get. All of the crossings were wet and muddy at depth, and this made the excavator a very useful tool for getting at the wet fill and organics. The cat would have no doubt gotten stuck if it had been used near the bottom of the crossings. The winch on the cat could have been used to choke the logs out, but the excavator was able to do the job much faster, with no need for a choker setter.

Most of the in-place stumps encountered were well above the final elevation of the crossings, so they weren't much help in defining a more precise location as the excavations progressed. For most of the road crossings, original ground was not encountered. This is because of all the trash left in the channel from past logging operations, both above and below the road excavations. Many buried, bucked logs were encountered not only in the fill in the road prism, but also at the expected final grade of the crossings. Some were removed, which increased the volume of the crossing. However, many of the logs were well imbedded into at least one of the sidebanks and there did not appear to be a danger of the logs diverting flow against the sidebanks. These logs were left in place and they should act as a knickpoint and hopefully will minimize future erosion as the channel adjusts to the new hydraulic conditions.

Heavy Equipment Costs

Table 1, along with the summary on page 2, lists the totals for each type of erosion control treatment. Haul road crossings account for nearly one third of the total heavy equipment contract costs. The location and details of each type of treatment (except for ripping) can be found in Tables 3 through 7 and on Map C. For those worksites that were more that 15% above the estimate, a negotiated price of \$2.50/yd^3 was used for the extra volume. The worksites were: RX-2, RX-3, RX-5, EOS 53+05, and EOS 142+40. These worksites increased more that expected due to large organics encountered which were removed to achieve a more stable excavation.

The averages at the bottom of each table were computed as a weighted mean where possible. This was done for quantities like cost per yard that were derived from other measured quantities. Averages for other columns,such as dist. to fillsite and average cut depth were obtained from measurements made in the field or from surveyed cross sections, and were not weighted.

In addition to other information, Tables 3 through 7 provide a comparison of the contract costs with the expected costs had the

job been done by equipment rental. This is called HERE and stands for Heavy Equipment Rental Equivalent. This is computed by using the actual hours of each piece multiplied by the average hourly costs for that piece. The comparisons are summarized in Table 2.

Evaluation of Heavy Equipment Work and Costs

The contract took approximately $17^{1}/_{2}$ days to complete. Both equipment operators have several years experience with the Park rehabilitation program. They have worked together on other sites, both under equipment rental contracts and IFB contracts. Because they understood the erosion treatments so well, detailed explanations by the COR were minimal. The worksites were done to specifications and the results were very good.

The HERE and contract costs in Table 2 show wide fluctuations in the government savings or losses. Savings were realized on the RXs, but losses were suffered on all the other treatments, except in the Miscellaneous category. This is because the contractor skewed his bids. Several of the RXs were bid at $\$0.70/yd^3$, which is below the average HERE cost of $\$1.30/yd^3$. However the contractor made up for it in the Ripping charge, which was over $7,000 more than the HERE cost.

The Miscellaneous cost in the HERE column is so high due mostly to the large amounts of idle time on all 3 pieces of equipment, especially the ripper cat. There were 2 operators for the 3 pieces of equipment. This reduced labor costs for the owner/operator of the 2 cats. During the last week, when the ripper cat finished up and departed for the K&K road, there was only one operator (W. Larkin) for the excavator and winch cat. All this made for a lot of idle time as shown in Table 8. Following the HERE rules, the full hourly rates are included in the idle time, but, had the site been done by equipment rental, the Park would not have paid for all that idle time. Either the extra cat would have been kept busy on this site or on another. If moved to another site by lowboy, then moving costs would increase, which further complicates comparisons.

The HERE costs for Paid breaks are higher than under equipment rental because of the long lunch breaks the operators often chose to take.

Labor Intensive Work

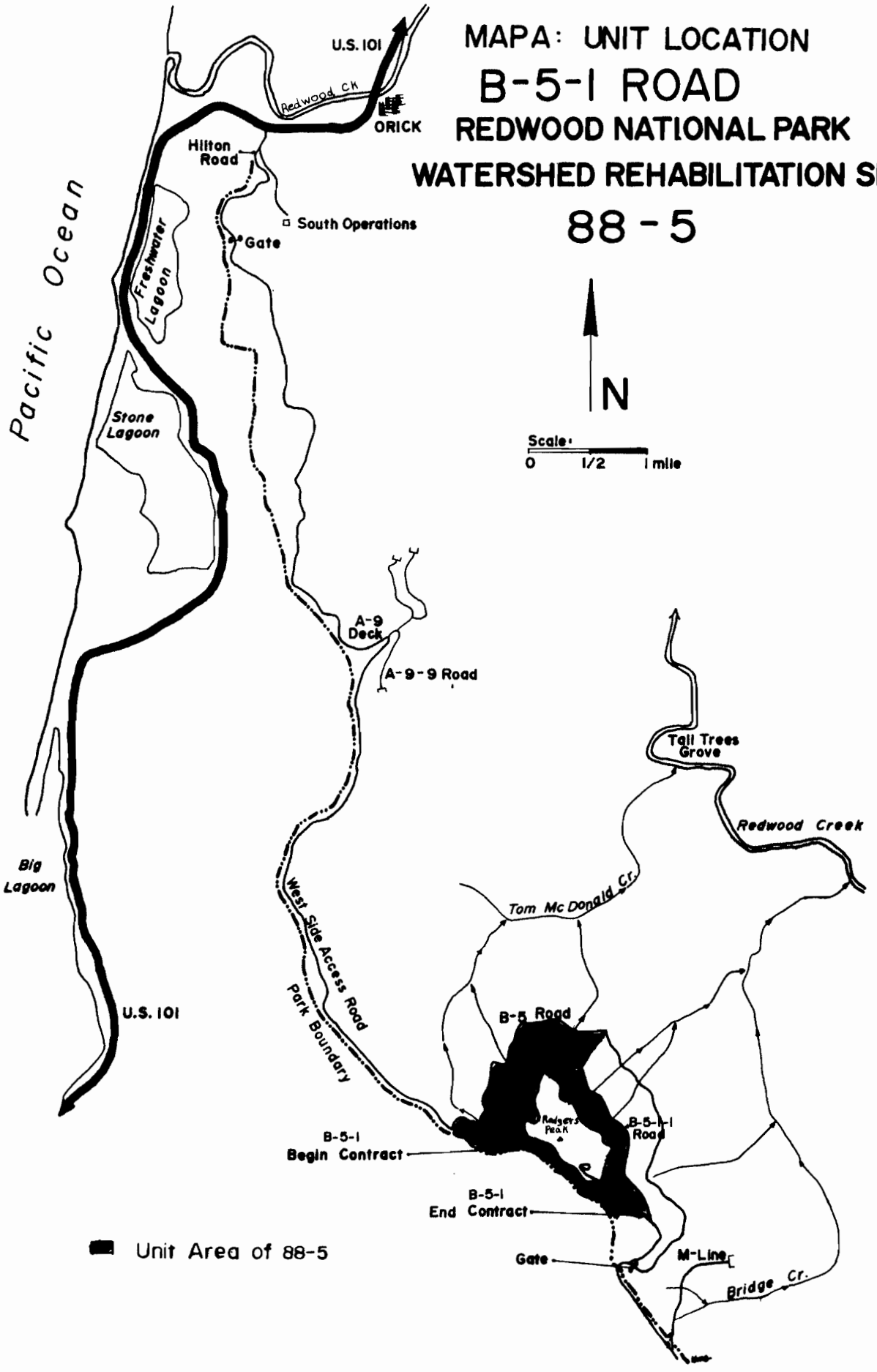
Table 1 lists the labor intensive costs done on the site and Table 9 itemizes the cost and person-hours. The work is divided into Primary and Secondary Treatments.

The Primary Treatments were the construction on 6 waterbars on skid trails surrounding the B-5-1. Waterbars have the same shape as cross-road drains, only they are smaller. The location of

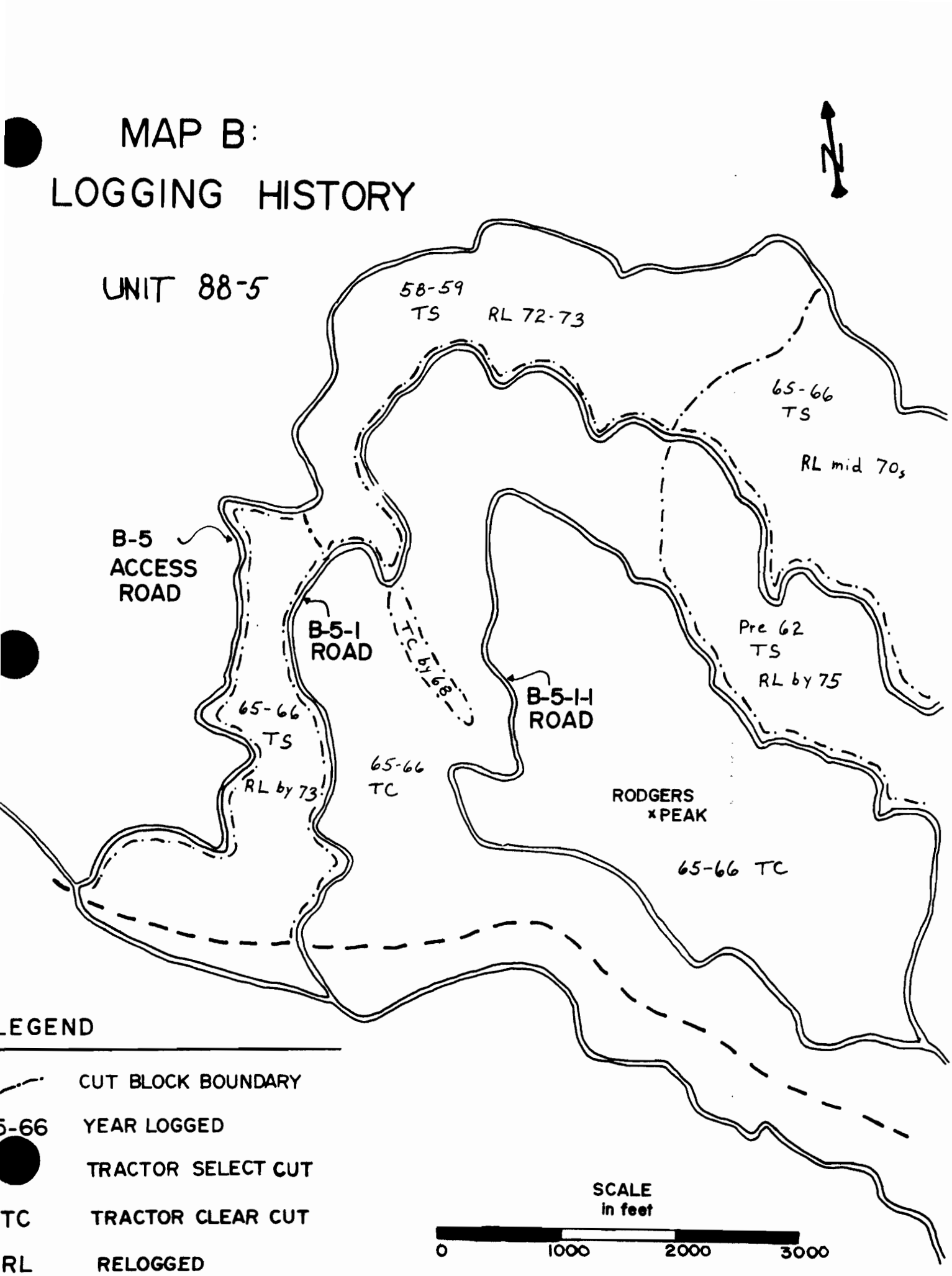
these waterbars is shown on Map C. Two of the waterbars (one next to the B-5, the other above RX-7) serve to prevent diversion out of stream channels. The rest of them serve to divert gully flow off the skid trails and onto the well vegetated slope where the erosive force can be dissipated. The work was done by 8 YCC labors divided into 3 crews under the supervision of the Park staff (K. Griffin and D. Smith) and the YCC leader. The worksites were either located some distance from the main contract work or they were not evaluated in time for inclusion in the contract. In either case the jobs were small enough to be done with hand labor. The use of hand labor eliminated the destruction of trees on the skid trails which would have resulted had heavy equipment been used. Also the work was an opportunity to educate the YCC people in the purpose and techniques of the Park's rehabilitation program.

Straw Mulch costs, listed under Secondary Treatments of Table 1, accounts for the majority of Labor Intensive costs. Heavy equipment was not involved with straw distribution. A total of 322 bales were spread on RXs, EOSs and their fillsites. Table 9 shows that most of the strawing costs involved distributing (including unloading) and spreading the bales. The high cost per bale ($14.38/bale) was due in part to the large number of people involved in spreading (Park laborers and Redwoods United) and to the long walking distances needed to get to the worksites. The long cross road drain reaches (which weren't strawed) required the spreaders to park their vehicles close to a mile away from the worksites. Reducing the number of spreaders and improving coordination between the laborers and rehab staff could reduce the straw costs.

The remaining Labor Intensive costs involved the brushing of vegetation so the worksites could be surveyed. The laborers were used only at those sites requiring intensive removal. The rehabilitation staff did the rest of the brushing at the time of surveying.


MAPA: UNIT LOCATION
B-5-1 ROAD
REDWOOD NATIONAL PARK
WATERSHED REHABILITATION SITE
88-5
U.S. 101
Redwood Ck
ORICK
Hilton Road
South Operations
Gate
Freshwater Lagoon
Pacific Ocean
Stone Lagoon
N
Scale:
0 1/2 1 mile
A-9 Deck
A-9-9 Road
Tall Trees Grove
Redwood Creek
Big Lagoon
West Side Access Road
Park Boundary
Tom Mc Donald Cr.
U.S. 101
B-5 Road
Rodgers Peak
B-5-1 Road
B-5-1 Begin Contract
B-5-1 End Contract
Gate
M-Line
Bridge Cr.
Unit Area of 88-5

MAP B:
LOGGING HISTORY



88-5

MAP C

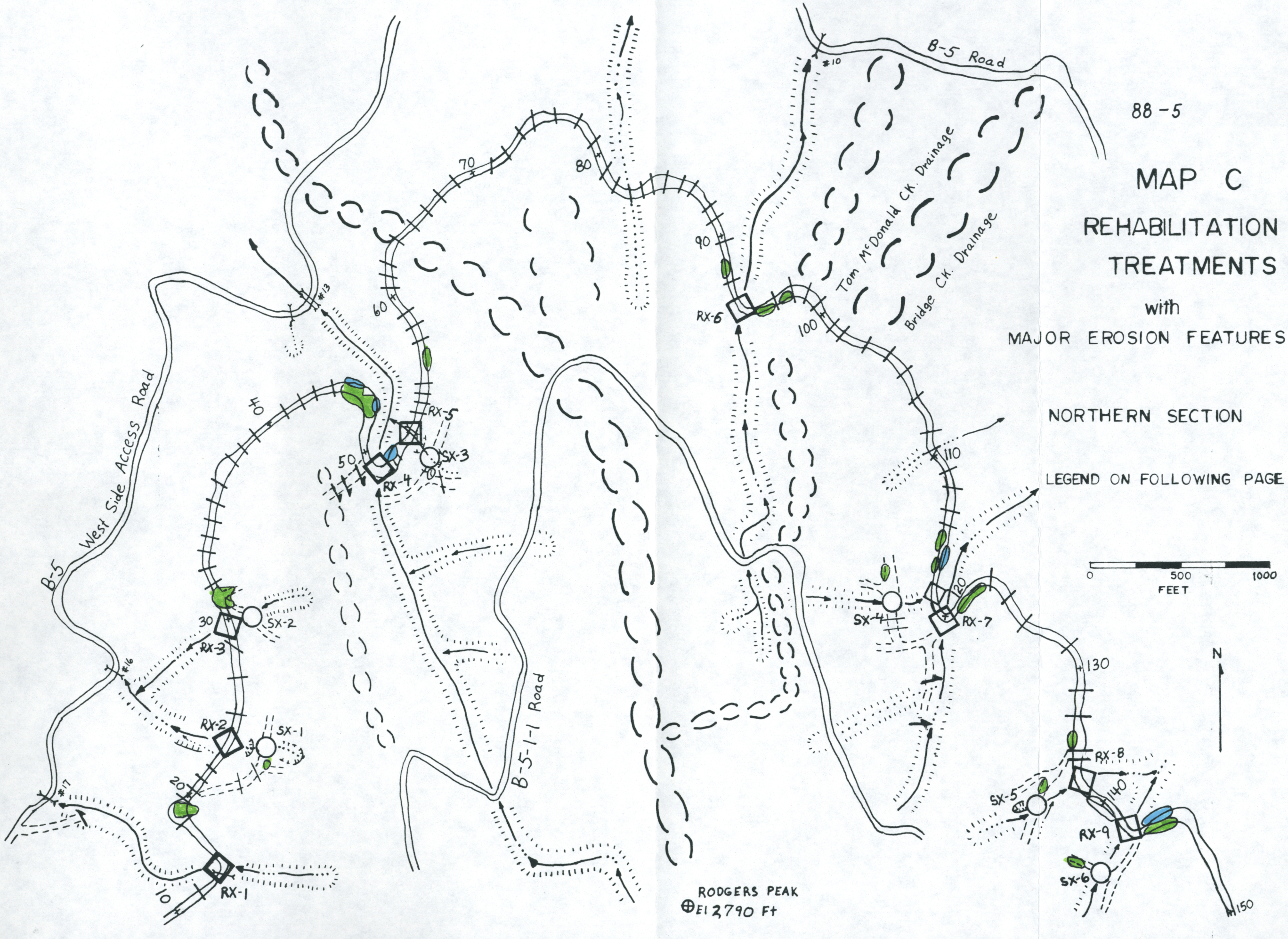
REHABILITATION TREATMENTS

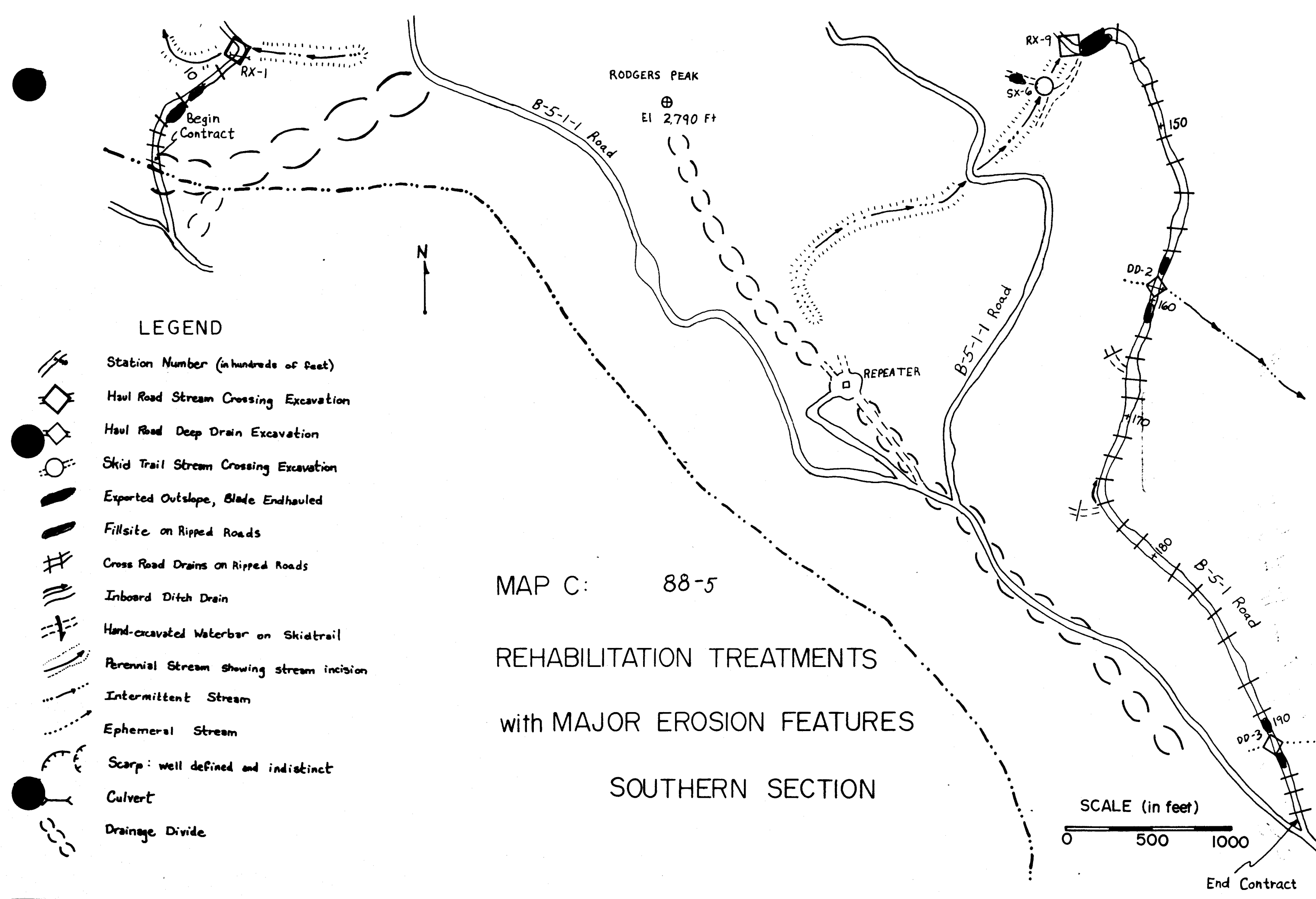
with

MAJOR EROSION FEATURES

NORTHERN SECTION

LEGEND ON FOLLOWING PAGE





LEGEND

- Station Number (in hundreds of feet)
- Haul Road Stream Crossing Excavation
- Haul Road Deep Drain Excavation
- Skid Trail Stream Crossing Excavation
- Exported Outslope, Blade Endhauled
- Fillsite on Ripped Roads
- Cross Road Drains on Ripped Roads
- Inboard Ditch Drain
- Hand-excavated Waterbar on Skidtrail
- Perennial Stream showing stream incision
- Intermittent Stream
- Ephemeral Stream
- Scarp: well defined and indistinct
- Culvert
- Drainage Divide

MAP C: 88-5

REHABILITATION TREATMENTS with MAJOR EROSION FEATURES SOUTHERN SECTION

TABLE 1

REHABILITATION WORK COST SUMMARY

Rehabilitation Unit 88-5 B-5-1 Road

	TOTAL QUANTITY	TOTAL COST	AVG COST/QUANTITY
HEAVY EQUIPMENT WORK: (Contract # CX-8480-8-0005)[1]			
Primary Treatments			
Haul Road Crossings	11,624 yd^3	$14,112	$1.21/$yd^3$
Deep Drains	618 yd^3	$1,854	$3.00/$yd^3$
Skid Trail Crossings	752 yd^3	$1,772	$2.36/$yd^3$
Exported Outslope Blade Endhauled	3,163 yd^3	$6,700	$2.12/$yd^3$
Cross-Road Drains	5,730 ft	$5,819	$1.01/ft
Inboard Ditch	240 ft	$480	$2.00/ft
Ripping	19,000 ft	$8,930	$0.47/ft
Miscellaneous Cost[2]	--	$4,100	--
TOTAL HEAVY EQUIPMENT COST		**$43,767**	
LABOR INTENSIVE WORK:			
Primary Treatments			
Construct Waterbars	6 WBs	$1,200	$200/bar
Secondary Treatments			
Straw Mulch[3]	322 bales	$4,630	$14.38/bale
Brush survey lines	--	$297	--
TOTAL LABOR INTENSIVE COSTS:		**$6,127**	--

TABLE 1 (Cont'd)

REHABILITATION WORK COST SUMMARY

Rehabilitation Unit 87-2 B-5-1 Road

TECHNICAL WORK:		
Evaluation of Rehabilitation Unit		
Map Unit	302 person-hours (p-h)	$3,021
Prescribe Treatments	316 p-h	$3,852
Survey and Design	446 p-h	$5,247
Contract Preparation	281 p-h	$3,608
Supervision of Work		
Heavy Equipment (C.O.R.)	196 p-h	$2,971
Documentation		
Photo Points	84 p-h	$1,045
Summary Report	289 p-h	$3,848
TOTAL TECHNICAL WORK:		**$23,592**
TOTAL PROJECT COSTS		**$73,486**

[1] Davis-Bacon wage rates did not apply to this contract, which was awarded to Twin Parks Lumber Company of Arcata, California.

[2] Miscellaneous costs include lowboy charges (bid items 1 & 2 in the Bid Schedule), record keeping (Bid Item 4), and Misc. costs (Bid Item 6).

[3] Straw mulch includes bale cost and delivery ($3.13/bale), placement, and spreading.

TABLE 2

SUMMARY OF HEAVY EQUIPMENT COST AND

COMPARISON OF CONTRACT VS HERE[1] COSTS

Rehabilitation Unit 88-5 B-5-1 Road

Treatment	Number of worksites	Total Quantity	Total Costs		Government Savings (+) or losses (-)	Average Unit Costs	
			Contract	HERE		Contract	HERE
Haul Road Crossings	9	11,624 yd^3	$14,112	$15,164	+ $1,052	$1.21/$yd^3$	$1.30/$yd^3$
Deep Drains	3	618 yd^3	$1,854	$882	- $972	$3.00/$yd^3$	$1.43/$yd^3$
Skid Trail Crossings	6	752 yd^3	$1,772	$1,130	- $642	$2.36/$yd^3$	$1.50/$yd^3$
Exported Outslope	5	3,163 yd^3	$6,700	$2,743	- $3,957	$2.12/$yd^3$	$0.87/$yd^3$
Cross-road Drains, Inboard Ditches & Waterbars	124	5,970 ft	$6,299	$4,147	- $2,152	$1.06/ft	$0.69/ft
Ripping	--	3,800 ft	$8,930	$1,727	- $7,203	$2.35/ft	$0.45/ft
Miscellaneous	See Table 8		$4,100	$25,169	+ $21,069	—	--
TOTALS:			**$43,767**	**$50,962**	**+ $7,195**	—	--

[1] HERE (Heavy Equipment Rental Equivalent) = actual hours worked for each task using hourly cost of $88.89 for D-8 w/winch; $97.31 for D-8 w/rippers; and $123.93 for Case 220-B excavator w/2.75 yd^3 bucket. These are the average costs for similar equipment which was bid for hourly work in 1988.

TABLE 3

HAUL ROAD STREAM CROSSING COSTS

Rehabilitation Unit 88-5 B-5-1 Road

Worksite[1]	ACTUAL EQUIPMENT HOURS D-8 Winch	D-8 Ripper	220-B Excav	Bid Cost	HERE Cost	Volume (yd^3)	Bid Unit Price ($/$yd^3$)	HERE2 Unit Price ($/$yd^3$)	Average[3] Excavation Rate (yd^3)/pc-hr)	Average Dist to Fillsite (one-way)
RX-1 @ Sta 13+58	16.25	7.50	8.50	$4,718	$3,228	1,887	$2.50	$1.71	59	390 ft4
RX-2 @ Sta 23+20	6.25	2.00	2.25	$1,194	$1,029	580	$2.06	$1.77	55	350 ft
RX-3 @ Sta 29+75	5.75	2.75	8.00	$2,865	$1,770	1,574	$1.82	$1.12	95	140 ft
RX-4 @ Sta 51+20	15.25	5.25	9.00	$1,510	$2,982	2,157	$0.70	$1.38	73	370 ft
RX-5 @ Sta 54+37	3.00	0.25	3.00	$291	$663	377	$0.77	$1.76	60	430 ft
RX-6 @ Sta 93+90	8.00	5.75	5.25	$1,055	$1,921	1,507	$0.70	$1.27	79	210 ft
RX-7 @ Sta 120+00	7.75	4.00	5.75	$1,198	$1,791	1,712	$0.70	$1.05	98	325 ft
RX-8 @ Sta 138+02	3.50	0.75	5.00	$739	$1,004	1,056	$0.70	$0.95	114	160 ft
RX-9 @ Sta 141+80	5.25	--	2.50	$542	$776	774	$0.70	$1.00	100	160 ft
TOTALS:	71.25 Hrs	28.25 Hrs	49.25 Hrs	$14,112	$15,164	11,624				
WTD MEAN:							$1.21/$yd^3$	$1.30/$yd^3$	78 yd^3/pc-hr	282 ft

[1] All crossings in this table were bid as a Unit Price. Actual yardages of RXs 1, 2, 3, and 5 were more that 15% over the original estimated volume. An agreement was reached with the contractor for a payment of $2.50/$yd^3$ for that portion above the 15% ceiling.

[2] HERE (Heavy Equipment Rental Equivalent) = actual hours worked for each task using hourly costs of $88.89 for D-8 w/ winch; $97.31 for D-8 w/rippers; and $123.93 for Case 220-B excavator w/2.75 yd^3 bucket. These are the average costs for similar equipment which was bid for hourly work in 1988.

[3] Excavation rate is based on the total hours of excavating equipment.

TABLE 4

DEEP DRAIN EXCAVATION COSTS

Rehabilitation Unit 88-5 B-5-1 Road

Worksite[3]	ACTUAL EQUIP HRS D-8 Winch	ACTUAL EQUIP HRS 220-B Excav	Bid Cost	HERE Cost	Volume (yd^3)	Bid Unit Price ($/$yd^3$)	HERE[1] Unit Price ($/$yd^3$)	Excavation[2] Rate (yd^3/pc-hr)	Average Dist to Fillsite (one-way)
DD-1 @ Sta 118+70	3.25	2.25	$540	$568	180	$3.00	$3.15	33	330 ft
DD-2 @ Sta 159+00	0.50	1.25	$954	$199	318	$3.00	$0.63	182	60 ft
DD-3 @ Sta 191+67	0.25	0.75	$360	$115	120	$3.00	$0.96	120	40 ft
TOTALS:	4.00	4.25	$1,854	$882	618				
WTD. MEAN:						$3.00	$1.43	112	143 ft

[1] HERE (Heavy Equipment Rental Equivalent) = actual hours worked for each task using hourly costs of $88.89 for D-8 w/ winch; and $123.93 for Case 220-B excavator w/2.75 yd^3 bucket. These are the average costs for similar equipment which was bid for hourly work in 1988.

[2] Excavation rate is based on the total hours of excavating equipment.

[3] Each DD was bid for a lump sum payment. Worksites were not resurveyed, but volume removed is thought to be close to the pre heavy equipment survey.

TABLE 5

SKID TRAIL STREAM CROSSING COSTS

Rehabilitation Unit 88-5 B-5-1 Road

Worksite	ACTUAL EQUIPMENT HOURS D-8 Winch	D-8 Ripper	220-B Excav	Bid Cost	HERE Cost	Volume (yd^3)	Bid Unit Price ($/$yd^3$)	HERE[1] Unit Price ($/$yd^3$)	Excavation[2] Rate (yd^3/pc-hr)	Average Dist to Fillsite (one-way)
SX-1 (LS)[3]	--	0.50	1.00	$180	$173	60	$3.00	$2.88	40	40 ft
SX-2 (UP)	1.00	--	1.00	$242	$213	242	$1.00	$0.88	121	60 ft
SX-3 (LS)	--	--	0.75	$180	$93	60	$3.00	$1.55	80	40 ft
SX-4 (LS)	1.00	--	1.25	$630	$244	210	$3.00	$1.16	93	150 ft
SX-5 (LS)	0.25	--	1.00	$285	$146	95	$3.00	$1.54	76	50 ft
SX-6 (LS)	2.25	--	0.50	$255	$262	85	$3.00	$3.08	31	70 ft
TOTALS:	4.50	0.50	5.50	$1,772	$1,130	752 yd^3				
WEIGHTED MEAN: (except for last column)							$2.36	$1.50	72	67 ft

[1] HERE (Heavy Equipment Rental Equivalent) = actual hours worked for each task using hourly costs of $88.89 for D-8 w/winch; $97.31 for D-8 w/rippers; and $123.93 for Case 220-B excavator w/2.75 yd^3 bucket. These are the average costs for similar equipment which was bid for hourly work in 1988.

[2] Excavation rate is based on the total hours of excavating equipment.

[3] (LS) = Lump Sum payment; (UP) = Unit Price payment. Lump Sum worksites were not resurveyed, but volume removed is thought to be close to the pre heavy equipment survey.

TABLE 6

BLADE ENDHAULED EXPORTED OUTSLOPE COSTS

Rehabilitation Unit 88-5 B-5-1 Road

EOS Worksite @ Station	ACTUAL EQUIPMENT HOURS D-8 Winch	D-8 Ripper	220-B Excav	Bid Cost	HERE Cost	Volume (yd^3)	Bid Unit Price ($/$yd^3$)	HERE[1] Unit Price ($/$yd^3$)	Excavation Rate (yd^3/pc-hr)	Road Length Treated	Avg Vol per ln-ft	Avg[2] Road Width [Removed]	Avg Cut Depth	Avg Dist to Fillsite (one-way)
46+65 (LS)[3]	2.50	--	2.50	$2,222	$532	635	$3.50	$0.84	127	140 ft	4.5	63 ft [18 ft]	22 ft	60 ft
47+63 (LS)	1.50	--	3.00	$1,880	$505	537	$3.50	$0.94	119	127 ft	4.2	72 ft [19 ft]	16 ft	75 ft
53+05 (UP)	3.50	2.00	2.00	$790	$754	736	$1.07	$1.02	98	103 ft	7.2	56 ft [30 ft]	17 ft	575 ft
116+45 (LS)	0.75	--	2.75	$750	$407	250	$3.00	$1.63	71	185 ft	1.4	20 ft [8 ft]	11 ft	35 ft
142+40 (UP)	1.25	--	3.50	$1,058	$545	1,005	$1.05	$0.54	212	143 ft	7.0	48 ft [22 ft]	19 ft	40 ft
TOTALS:	9.50 Hrs	2.00 Hrs	13.75 Hrs	$6,700	$2,743	3,163 yd^3				698 ft				
AVERAGES:							$2.12	$0.87	125 yd^3/pc-hr		4.5 yd^3/ft	52 ft	17 ft	157 ft

[1] HERE (Heavy Equipment Rental Equivalent) = actual hours worked for each task using hourly costs of $88.89 for D-8 w/winch; $97.31 for D-8 w/rippers; and $123.93 for Case 220-B excavator w/2.75 yd^3 bucket. These are the average costs for similar equipment which was bid for hourly work in 1988.

[2] Averages for road widths, road widths removed, and cut depths were measured off cross-sections that were drafted from surveys made at control points along the outslope reaches.

[3] LS = Lump sum payment; UP = Unit Price payment ($/$yd^3$).

TABLE 7

CROSS-ROAD DRAIN (XRD) COSTS

Rehabilitation Unit 88-5 B-5-1 Road

Treatment	ACTUAL EQUIPMENT HOURS D-8 Winch	D-8 Ripper	220-B Excav	Bid Cost	HERE Cost	Total # of feet of XRDs	Total # of XRDs	Avg Length per Drain	Bid Unit Price ($/ft)	HERE[1] Unit Price ($/ft)
XRD[2]	22.75	0.50	16.75	$6,299	$4,147	5,970 ft	124	47 ft	$1.06/ft	$0.69

[1] HERE (Heavy Equipment Rental Equivalent) = actual hours worked for each task using hourly costs of $88.89 for D-8 w/winch; $97.31 for D-8 w/rippers; and $123.93 for Case 220-B excavator w/2.75 yd^3 bucket. These are the average costs for similar equipment which was bid for hourly work in 1988.

[2] This treatment includes 2 waterbars constructed by the excavator on skid trails above the B-5-1 road. It also includes ~140 feet of inboard ditch construction.

TABLE 8

MISCELLANEOUS COSTS

Rehabilitation Unit 88-5 B-5-1 Road

	ACTUAL EQUIPMENT HOURS			COST	
Category	D-8 Winch	D-8 Ripper	220-B Excav	Contract	HERE[1]
Paid Breaks	10.50	5.00	9.00	--	$2,535
Travel & Fuel	2.50	1.25	2.25	--	$623
Discussion	3.00	1.00	3.75	--	$829
Idle	47.00	84.75	50.25	--	$18,652[2]
Mobilization (Bid Item 1 & 2)[3]	--	--	--	$2,000	$2,530[4]
Record Keeping (Bid Item 4)	--	--	--	$100	--
Miscellaneous (Bid Item 5)	--	--	--	$2,000	--
TOTALS:	63.00	92.00	65.25	**$4,100**	**$25,169**

[1] HERE (Heavy Equipment Rental Equivalent) = actual hours for each task using hourly costs of $88.89 for D-8 w/winch; $97.31 for D-8 w/rippers; and $123.93 for Case 220-B excavator w/2.75 yd^3 bucket. These are the average costs for similar equipment which was bid for hourly work in 1988.

[2] Large cost assumes full payment for equipment which was often idle, but was on the site, ready to work. There were 2 operators for 3 pieces of equipment, and, for the last week, 1 operator for 2 pieces of equipment.

[3] From the Bid Schedule (section B), in the archive files for Unit 88-5.

[4] Estimated costs based on mobilization costs on other rehab units this year.

TABLE 9

LABOR INTENSIVE COSTS

Rehabilitation Unit 88-5 B-5-1 Road

Labor Category	Materials	NPS Labor	Redwoods United (RUI)	Youth Conservation Corps (YCC)	TOTALS
Straw Mulch Costs:					
Straw, 322 bales (cost & delivery @ $3.13/bale)	$1,008	—	—	—	$1,008
Distributing	—	$1,778 (145 person-hrs)	—	—	$1,778 (145 p-h)
Spreading	—	$953 (84 p-h)	$891 (125 p-h)	—	$1,844 (209 p-h)
TOTAL STRAW COSTS:	$1,008	$2,731	$891	—	**$4,630** (354 p-h)
Brushing Costs: (for surveys)	—	$297 (25 p-h)	—	—	**$297**
Waterbar Construction (6 WBs on skid trails)	—	$435 (40 p-h)	—	$765 (180 p-h)	**$1,200** (220 p-h)
TOTAL LABOR COSTS:	**$1,008**	**$3,463**	**$891**	**$765**	**$5,119**

REFERENCES CITED

Harden, D.R., Kelsey, H.M., Morrison, S.D., and Stephens, T.A., 1982, Geologic map of the Redwood Creek drainage basin, Humboldt County, California: Water Resources Investigations, Open-file report 81-496

Popenoe, J., and Martin, R., Soils of the B-5-1 Roads on Rodgers Peak: unpublished in-house report, 6p.



Unit: 88-5 Date: 6-20-1988, PP5, STA 23+20 DwnSTR. RX2, 35mm, (MK+KG)



Unit: 88-5 Date: 10-25-88, PP5, Post H.E. RX4



Unit: 88-5 Date: 6-20-1988, PP10A, STA 47+85. Upslope FS & Eas. 35mm MK & K6 & NV



Unit: 88-5 Date: 10-25-1988. PP10A. Post H.E. Fos + Eas.



Unit: 88-5 Date: 6-20-1988, PP13A, STA 52+10. DWN RX4. 35mm, MK & KG & NV.



Unit: 88-5 Date: 10-25-1988, PP13A, RX4. Post H.E.



Unit: 88-5 Date: 6-21-1988, PP19A, STA 117+39. DWNSTA EOS. 35mm, MK & KG.



Unit: 88-5 Date: 10-20-1988, PP19A. Post H.E., EOS 116 +