

Summary Report
WATERSHED REHABILITATION UNIT 88-1
LOWER MAY CREEK

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Redwood National Park
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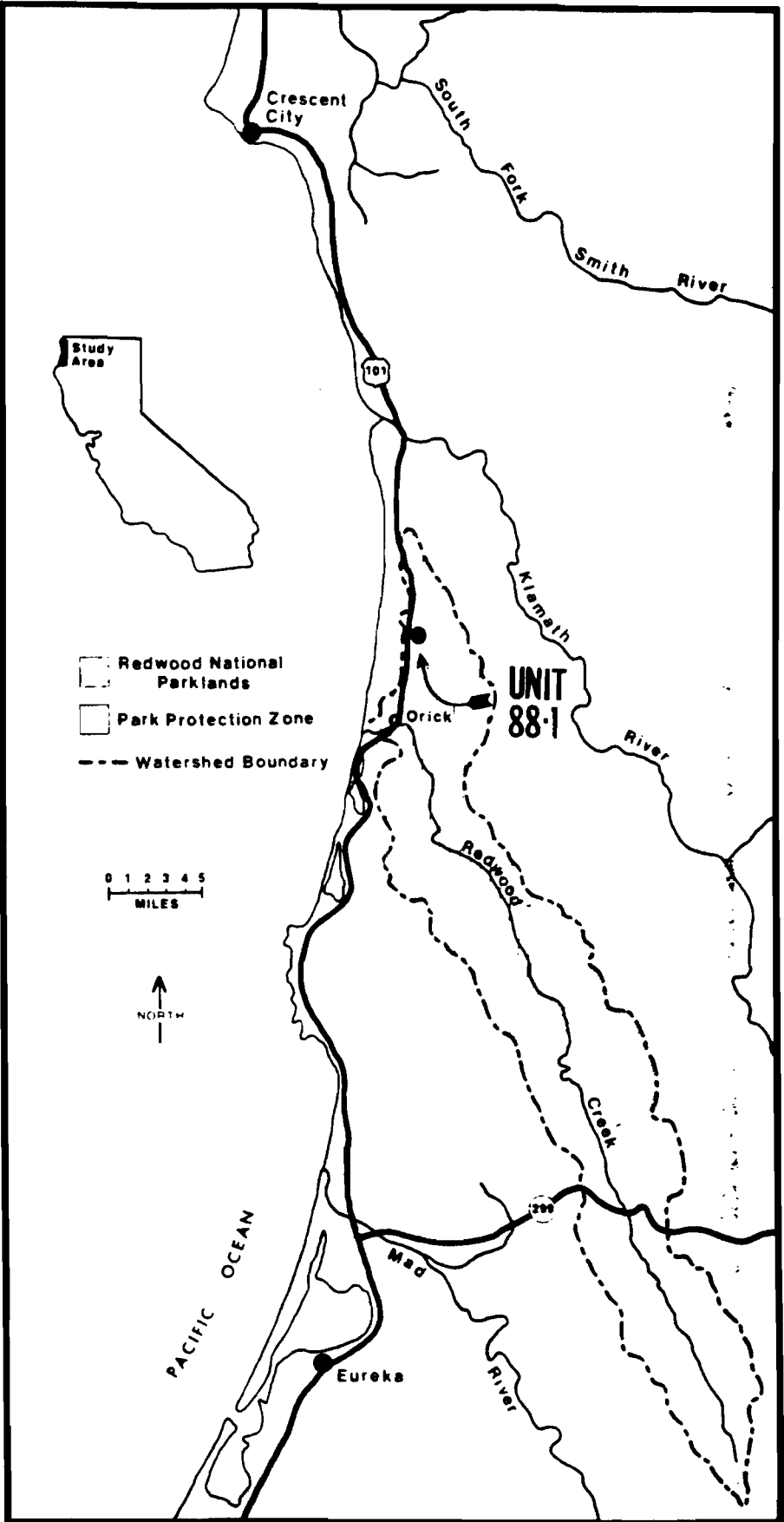
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MAP A: LOCATION



**Watershed Rehabilitation Unit 88-1
Lower May Creek (101 Bypass)**

INTRODUCTION

The Lower May Creek Rehabilitation project addressed erosion problems associated with logged-over lands in the lower May Creek Watershed, about 4.5 miles north of Orick, California (Map A). May Creek is a tributary stream to Prairie Creek, which is the largest tributary to Redwood Creek, as well as an anadromous fish-bearing stream. The unit was completed by hourly rental agreement in 1988 to assure that access to the site would not be lost due to new U.S. Hwy 101 construction (Park Bypass Route).

All of the rehabilitation unit lies immediately upstream of where the 101 Bypass route crosses May Creek. Most of the unit encompasses a tributary to May Creek. Both May Creek and the tributary stream are routed through man-made "engineered" channels to a concrete arch that will eventually be some 40 feet below the road grade of the new Hwy 101. The confluence of the streams is now at the entrance to the arch (Map B).

Geology/Geomorphology

The site is underlain by weakly consolidated silts, sands, and gravels of the Gold Bluffs Formation. These are derived mainly from metamorphic and plutonic terrane of the Klamath Mountains and are thought to represent an ancestral coastal plain of the Klamath River. The Gold Bluffs Fm. is Plio-Pleistocene in age and soil development on the youngest units indicate that they are older than late Pleistocene (Harden and others, 1982).

These materials are prone to both fluvial erosion and mass wasting. Mass movements are most likely where the sediments are stratified and differences in texture may allow groundwater to be perched. Undercut banks will often fail as debris slides.

The unit is characterized by mostly northerly facing slopes (Map B). Overall relief is about 300 feet and the slopes are 20-75%. Headwater swales drain into stream channels that lose gradient rapidly. Both May Creek and the tributary stream occupy broad, low gradient valleys which may be a result of infilling due to Holocene sea-level rise.

Soils

The rehabilitation unit is dominated by Empire Series soils which are the major soils formed on Gold Bluffs sediments (Popenoe, 1988). These are deep (39-59 in.), well drained, brown soils with well-developed B horizons. Empire Soils may have rapid to slow permeability, depending on textural stratification. Rio Dell Soils are found in the lower, moist slopes of the rehabilitation unit and are similar to the Empire Soils except that they have thicker, darker A horizons.

Logging History

Roads were built into the area in 1955 and 1956 and the entire 260 acres of the tributary watershed was logged in 1956 (Map C). The area around the mainstem of May Creek was logged around the same time. The unit was harvested as a "seed tree leave" and yarded by crawler tractor. The seed trees were never salvaged from the unit.

MAP B. 88-1

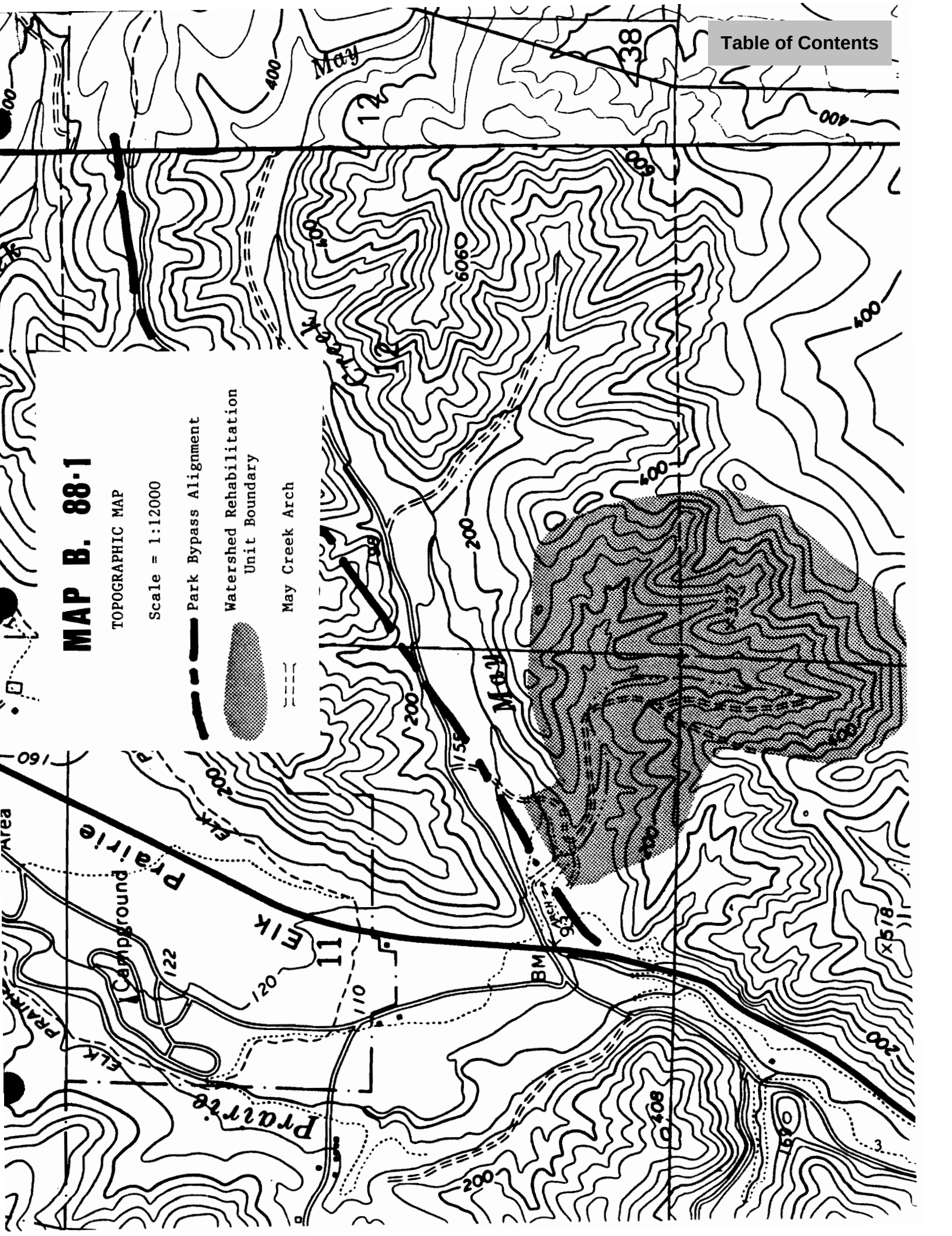
TOPOGRAPHIC MAP

Scale = 1:12000

Park Bypass Alignment

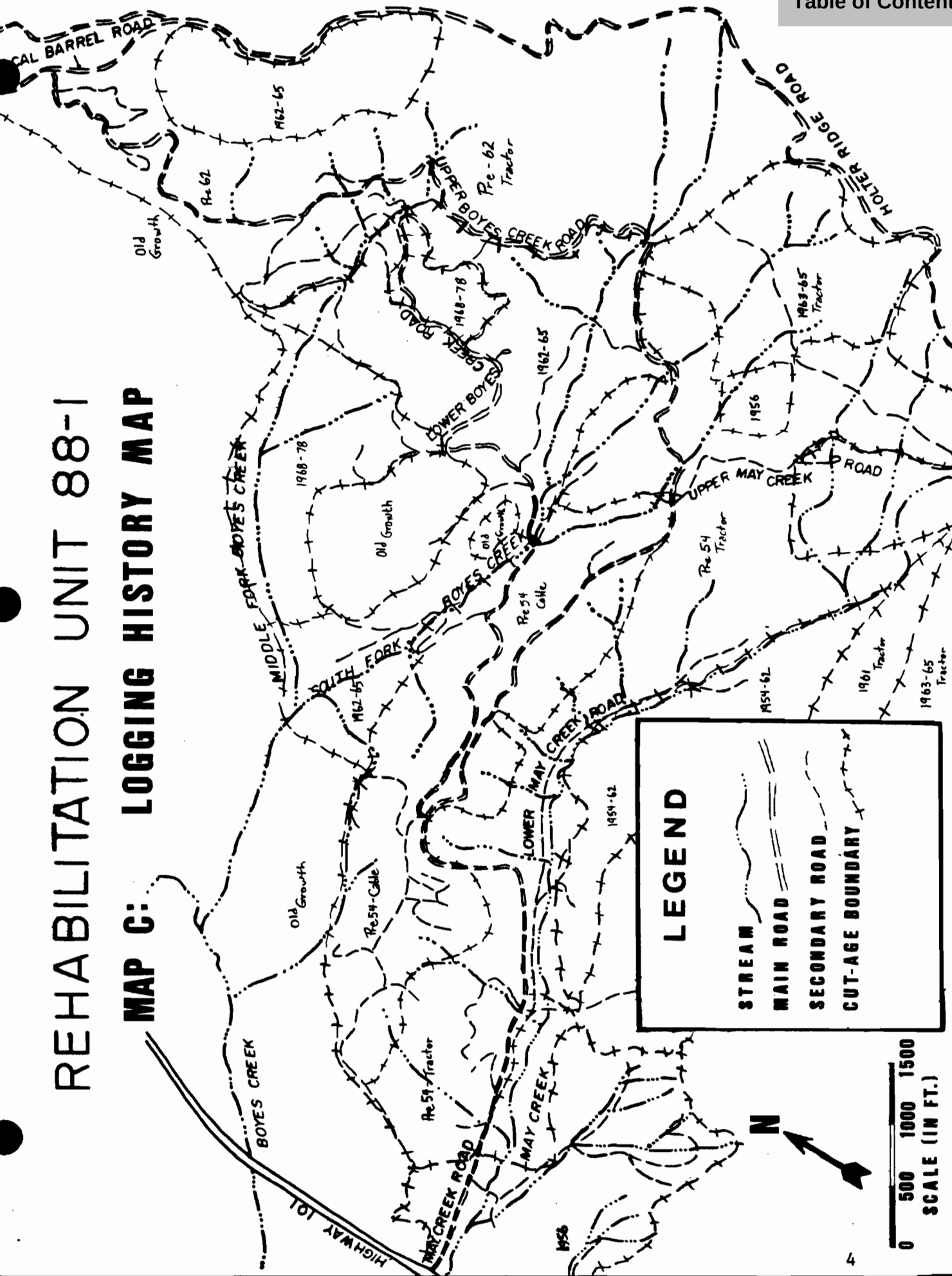
Watershed Rehabilitation
Unit Boundary

May Creek Arch



REHABILITATION UNIT 88-1

MAP C: LOGGING HISTORY MAP



Erosional Features

Considering that timber harvest occurred more than 30 years ago, there is an interesting lack of erosional features. The low gradient nature of the stream channels certainly contributes to the apparently minimal off-site impacts of this unit. However, potential sediment sources consist of numerous "Humboldt" style stream crossings. Many of these exhibit collapse features above buried channels, yet almost all are $\geq 75\%$ intact. Stream diversions or potential diversions are mostly absent from the site, although ridgetop skid-trail construction occasionally concentrates water away from natural swales.

REHABILITATION WORK

Field mapping, site evaluation, and prescription were accomplished between April and mid-June, 1988, by geologists of the RNP Rehabilitation Staff. Site morphology was mapped in the field on aerial photography at a scale of 1:2400 by D. Steensen, R. Kahler, and D. Short. Evaluation, prescription, and documentation were performed by D. Steensen and R. Kahler.

Rehabilitation treatments were oriented toward reducing existing and potential erosion and resulting sedimentation that could impact the main-stem of May Creek. The primary treatments consisted of removing one log bridge, removing one "Humboldt Crossing", and decompacting 0.7 miles of haul road (Map D). Secondary treatments included placing rock bank armor and applying straw mulch (Table 1).

Only the lowest-most Humboldt Crossing in the tributary drainage was treated. The numerous Humboldts in the upper drainage were not treated because of: 1) vigorous vegetal regrowth, 2) small catchment areas, 3) no diversion potential, and 4) a low gradient (.009-.01) to the trunk stream as well as a wide valley-bottom allowing a considerable storage element for introduced sediment. Most of the length of this stream is quite "choked" with logging debris and there has been a general lack of erosional activity over the past 30 years. This led to the decision to treat only those features that could have a reasonable chance of off-site impacts.

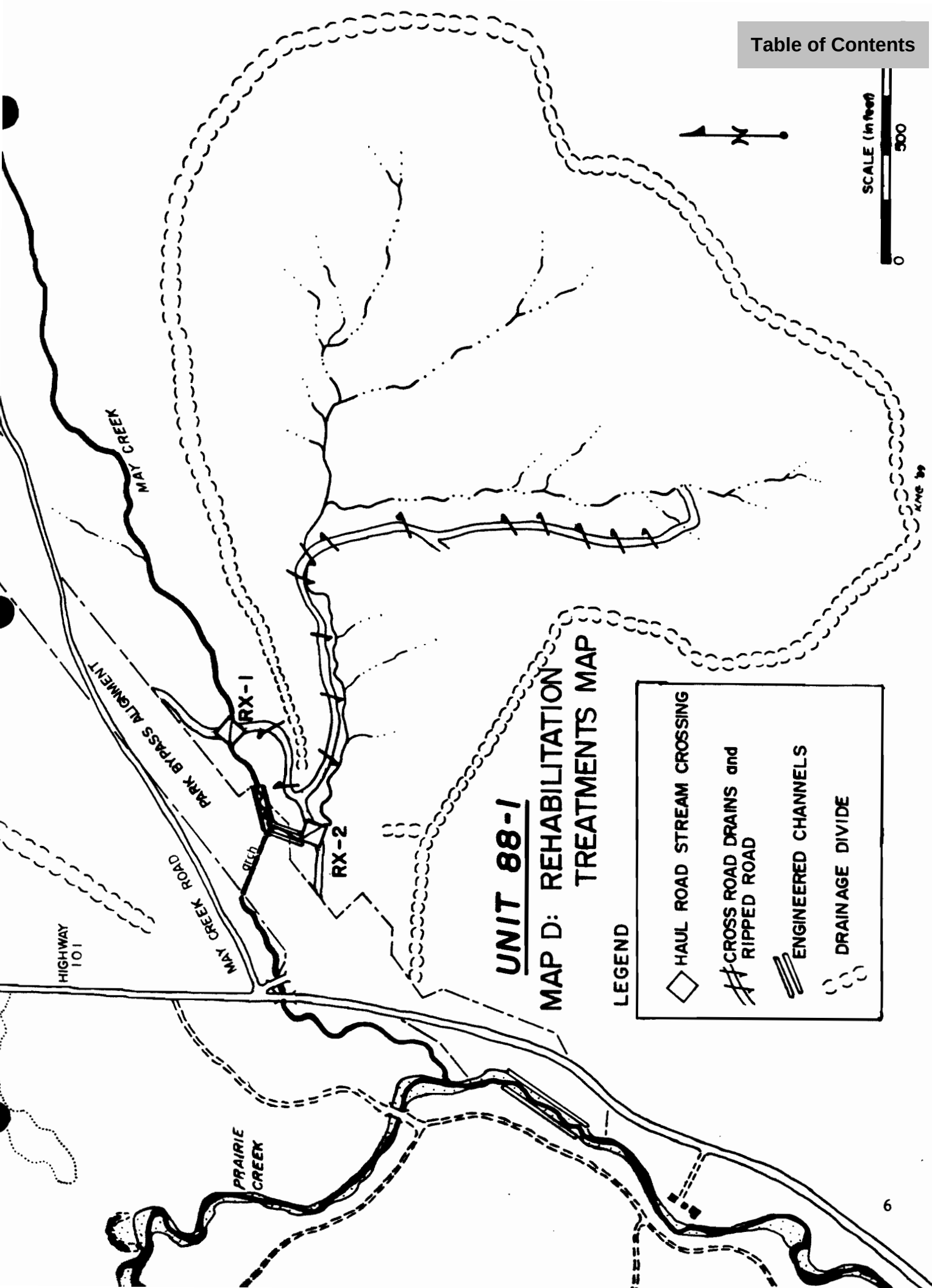
Equipment utilized to accomplish this work consisted of a Caterpillar D8 bulldozer and a FiatAllis FE40L hydraulic excavator for the primary treatments. A Case 220 excavator, Peterbilt dump truck, and a wheeled Trojan front-end loader were used in transporting and placing rock for the secondary treatments (Table 2).

Primary Treatments

Haul Road Stream Crossings

Road crossing one (RX-1) was located on the main-stem of May Creek with a drainage area of 890 acres at that point. Work at RX-1 entailed removing a single-layer log bridge that consisted of 9 girders and spanned 45 feet (Table 3). Two of the girders had rotted and fallen from the brow logs and most were showing advanced signs of rot. A perceived danger, aside from having the bridge collapse with someone on it, was a scenario of the bridge collapsing and creating a barrier to flow. Logs could deflect flow into stream banks or increase the possibility of accumulation of debris.

The approach involved the excavator scraping the fill from the bridge deck (about 1 ft. thick) and then knocking the girders off of the brow logs. The logs were then jockeyed into a position so the bulldozer could yard them away. An



**REHABILITATION UNIT 88-1
Lower May Creek**

TABLE 1. Rehabilitation Work Cost Summary

	<u>Worksite Quantity</u>	<u>Total Cost</u>	<u>Unit Cost</u>
<u>Heavy Equipment Costs</u>			
Primary Treatments			
Haul Road Stream Crossings	2	\$2,033	\$1.69/yd ³
Ripping/Cross Road Drains	3,800 LF.	\$ 641	\$0.10/LF.
Secondary Treatments			
Rock Armoring	1	\$1,465	\$26.64/yd ³
Miscellaneous			
	-	\$2,664	-
Total Heavy Equipment Cost		<u>\$6,805</u>	
<u>Labor Intensive Costs</u>			
Secondary Treatments			
Straw Mulch	34 bales	\$ 609	\$17.94/bale
Total Labor Intensive Cost		<u>\$ 609</u>	
<u>Project Implementation Costs</u>			
Evaluation			
Mapping	-	\$1,162	-
Prescribing	-	615	-
Surveying	-	273	-
Supervision			
Heavy Equipment	-	\$ 752	-
Labor	-	14	-
Documentation			
Photo Documentation	-	\$ 72	-
Cost Analysis and Report	-	150	-
Total Project Implementation Cost		<u>\$3,038</u>	
<u>TOTAL REHABILITATION PROJECT COST</u>		<u>\$10,453</u>	

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TABLE 2. Summary of Heavy Equipment Costs

Treatment	Worksite Quantity	Total Quantity	Total Cost \$	Average Cost per Worksite Quantity \$	Average Unit Cost \$	Unit Cost Range \$
Primary Treatments						
Haul Road Crossings	2	1,200 yd ³	2,033	1,017	1.68/yd ³	1.44-3.46 per yd ³
Rip/Cross Road Drains	3,800 ft.	14 XRD	641	-	1,300/mi.	-
Secondary Treatments						
Rock Armor Placement	1	65 yd ³	1,465	-	22.54/yd ³	-
Miscellaneous Costs	-	-	2,664	-	-	-
Total Heavy Equipment Costs			\$6,805			

TABLE 3. Haul Road Excavation Costs

Location	Excavated Volume yd ³	Total Cost \$	Unit Cost \$	Equipment Hours		Endhaul Dist. Ft.	Excavation ¹ Rate yd ³ /pc-hr
				W	X		
RX-1	150	519	3.46/yd ³	2.00	4.00	50	25
RX-2	1,100	1,514	1.44/yd ³	13.25	6.25	100	56
Total Or Average	1,250	\$2,033	1.68/yd³			94	52

Equipment Used:

W: Caterpillar D8H 46A (\$69.50/hr) with winch, 24" tracks, 12' straight-blade, 235 h.p., owned and operated by Rick Ziegler (Ziegler Logging Co.).

X: 1986 FiatAllis FE40L hydraulic excavator (\$95/hr) with 3 yd³ bucket, 36' reach, 243 h.p., operated by Chris Hake (Hake Construcion Co.).

¹ The excavation rate reflects only the time spent by a piece of equipment actually moving material.

estimated 150 yd³ of material was excavated from the side slopes once the brow logs were removed. It was necessary to loop around to the other side of RX-1 via the Bypass alignment to complete both sides of the crossing and travel time consequently accounts for 16% of the cost (perennial streams cannot be waded by equipment).

RX-2 was a Humboldt Crossing that spanned the tributary drainage immediately upstream of the inlet to the engineered channel. The crossing had a large sink hole where fill had collapsed into the stream below. The potential for catastrophic failure, in this case massive gullying, was a scenario easy to envision. If the Humboldt functioned poorly during a storm event (drainage area is 258 acres) and backed-up water overtopped the fill, a large amount of material could be quickly introduced to May Creek. With the threat of erosion clearly present, it is interesting to speculate on the degree of pre-construction planning of the engineered portion of the channel downstream (discussed further under *Rock Armor*).

Close to 1130 yd³ was removed from RX-2 and pushed with a bulldozer to adjacent terrace surfaces (Table 3). The bulldozer worked alone, removing much of the fill before the excavator arrived to finish the channel. Logs and other large organic debris were expected to be abundant throughout the excavation, yet became so only near the designed channel grade. The inlet to the concrete arch was constructed at an elevation higher than the natural stream course, in effect raising the local base level, so the excavation probably only uncovered the tops of the logs that lie in the original channel.

Ripping/Cross Road Drains

While the vegetation has recovered well over most of this site, it has recovered poorly along the haul road corridors. These road segments were ripped utilizing the hydraulic excavator (Table 4). The decision to use an excavator rather than a bulldozer with ripper teeth was based on the extra cost of moving in a ripper for a short period of time. All other bulldozer work required one equipped with a winch.

In this situation, the excavator actually worked quite well for ripping. The excavator basically scraped the bucket back and forth across the road surface while simultaneously opening and closing the bucket. On each "clomp" or "grab" the excavator bucket was able to loosen the top 1-2 feet of road bed. The short nature of the road segment, narrow road width, and the ability to construct the cross-road drains at the same time added to the success. Also, the road had been surfaced with a thin veneer of river-run gravel which made decompacting easier than if the road base had been constructed with thick layer of crushed rock.

Secondary Treatments

Rock Armor

Initially, there was no rock armor planned for the Lower May Creek Unit at either RX-1 or RX-2. Rock armoring was not planned for RX-1 since the crossing needed little recontouring as the existing channel was stable under the former bridge. No rock armoring was planned for RX-2 because of these anticipated conditions: 1) low discharge velocities due to low stream channel gradient (.009), and 2) a stable base level which would discourage downcutting. The estimated fifty-year flood discharge (Q_{50}) is 55 cfs (Campbell and Sidle, 1984) and the channel width was sized accordingly.

Site-specific characteristics and anticipated conditions during or after

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TABLE 4. Ripping and Cross Road Drain Costs

Treatment	Worksite Quantity	Total Cost \$	Average Cost per Worksite \$	Average Unit Cost \$	Unit Cost Range \$	Equip Hrs X
Ripping	3,800 ft.	380	0.10/ft.	543/mi.	.08-.24/ft.	4.0
Cross Road Drains	14 XRD	261	18.66/XRD	0.75/ft.	.71-.95/ft.	2.75
Total Rip/Drain Costs		\$642				

Equipment Used:

X: FiatAllis FE40L¹ (a/a)

¹Hydraulic excavators are not normally used for ripping. It was used here to avoid the extra costs of moving in a ripper Cat. The short nature of the road reach and the large size of the machine seemed to warrant a try with the excavator.

TABLE 5. Secondary Treatment Costs

Heavy Equipment

	Worksite Length	Volume Placed	Total Cost	Unit Cost/yd ³	Unit Cost/ft.	Equipment Hours		
						X	L	D
Rock Armor Placement	80 ft.	65 yd ³	1,465	26.64/yd ³	18.31/ft	9.5	7.25	3.5

Labor Intensive

	Number of Bales	Person Hours	Cost \$
Straw Mulch ¹			
Materials ²	34	--	106
Distribution & Spread	34	35	504

Total Secondary Treatment Costs \$2,075

Equipment Used:

X: Case 220 (\$120/hr), 2.75 yd³ bucket, 295 h.p., 38' reach. Operated by Wendell Larkin.
 L: Trojan wheeled front-end loader (\$23.51/hr), 2 yd³ bucket. Operated by Tom Dore (RNP).
 D: Peterbilt dump truck (\$44.30/hr), 10 yd³ rock-box. Owned and operated by Frank Vyscocl.

¹ All straw distribution and spreading was accomplished by RNP Resources Management Labor Crew.

² Straw purchase price was \$3.13/bale.

rehabilitation treatments may warrant rock armoring or other erosion control structures for any individual site. However, these types of secondary treatments are usually only considered where the natural boundary conditions are not expected to be found or to be stable. Most of the erosion control work in RNP consists of identifying and re-establishing the natural conditions. A clear contrast to this approach is the engineered channel of May Creek leading into the arch. Here, the natural boundary conditions were obliterated and new boundaries were created.

The engineered channels were planned to do two things. First, they were designed to direct flow of the two streams into the arch. Second, they were also designed to replace lost aquatic habitat by employing these additional elements: a) organic steps created by placing logs across the stream and keying them in to the banks, and b) a channel bottom backfilled with clean, "spawning-sized" gravels. The stream banks were lined with rock rip-rap as well. Thus, the channel reach is both stable and contains key fishery elements. This work was designed by the California Department of Fish and Game (CDFG) and implemented by the Department of Transportation (CalTrans).

After the Lower May Creek Unit was completed, Fish and Game Enforcement Staff reviewing the site noted and made comments to RNP Administration on the newly exhumed stream valley at RX-2. They cited possible erosion from the unprotected stream banks as a primary concern. However, an apparent anxiety may have revolved around justifying the type of engineered channel they designed to others (i.e. CalTrans) who might see both approaches side by side. Ostensibly, CalTrans might wonder why CDFG required them to create an expensive channel reach when other resource managers use a much less intensive approach. Probably to avoid confrontations, RNP Administration made the decision to re-enter RX-2 and place rock armor.

Several draft options by RNP Rehabilitation and Geological Services Staff were presented to CDFG Fisheries Biologists and were discussed on-site. The design chosen was an extension of the rip-rap of the CDFG channel up the stream to better tie-in with the defined stream banks of RX-2. The final design entailed placing about 65 yd³ of rock (0.5 to 2.5 ft. dia.) on each bank along the lower 40 feet of the channel. Toe trenches were excavated two feet deep and the rock was layered about two to three feet thick and four to five feet up each bank. Keys were created at the upstream end by excavating five to six foot long trenches and "stuffing" them with rock.

Implementation of this work was made difficult (i.e. expensive) by several factors: 1) reopening a completed crossing required constructing a road, 2) using a Park Service front-end loader not up to desired specifications (which eventually broke down), 3) handling of the rock required extra time to clean sand from it that had been spread on the bypass alignment (dump site for the rock), and 4) finding equipment and operators for one-day jobs; bids were either non-existent or quite high.

The initial approach used a front-end loader to transport rock from the dump site on the Bypass alignment 200 feet down the access road to where the excavator was placing the rock. About half way through the work, the loader broke down and this required that the excavator transport the rock from the dump site to the rocking site as well. This was a time consuming process since the excavator could only carry about 2 yd³ of rock and moved more slowly than the loader (see Table 5).

Overall, the rock armoring has produced a more stable channel system and has reduced the risk of scour behind the original CDFG rip-rap. However, cost-effectiveness is likely to be minimal since, based on the low energy environment that exists at RX-2, that risk was quite small to begin with.

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TABLE 6. Miscellaneous Costs

Task	Task Cost \$	Equipment Hours hr					% of Total Heavy Equipment Cost
		X1	W	X2	L	D	
Breaks	176	1.0	1.0	-	0.5	-	2.6
Paid Down Time	48	0.5	-	-	-	-	0.7
Brushing/Access	295	-	4.25	-	-	-	4.3
Travel	124	1.0	0.25	-	0.5	-	1.8
Discussions	164	0.75	1.25	-	0.25	-	2.4
Fueling	41	0.25	0.25	-	-	-	0.6
Waiting	35	-	0.5	-	-	-	0.5
Move In/Out	1782	(\$483)	(\$462)	(\$679)	(\$47)	(\$111)	26.2
Total Misc. Costs	\$2,665						39.1

Equipment:

X1: FiatAllis FE40L excavator

W: D8H (w/ winch) bulldozer

X2: Case 220 excavator

L: Trojan loader

D: Peterbilt dump truck

Straw Mulch

The rehabilitation unit was treated with mulch only on exposed ground surfaces next to stream channels to inhibit sheetwash and provide cover for the seedbed (Table 5). The decompacted road surfaces were not treated since a closed tree canopy exists for virtually the entire length and harsh summer conditions are not expected. The straw was applied soon after the crossings were completed and, since RX-2 was reopened, it was necessary to spread straw twice at that location.

DISCUSSION

Overall, the heavy equipment rehabilitation work was quite satisfactory. With two experienced operators the work went smoothly. The excavator operator is experienced in watershed rehab at RNP and while this was the first such job for the Cat operator, he is skilled in operating his machine and learned quickly any particulars of rehab specifications.

The uncertainty of how far work might progress on the 101 Bypass alignment prompted the startup of this work. There are other similar road segments in the May and Boyes Creeks area that will need rehabilitation work and it would have been more cost-effective to do them all at once to lower start-up costs. Start-up costs are somewhat high for this site as equipment was mobilized twice (Table 6).

The rock armoring at RX-2 may have been avoided had communication with CDFG and CalTrans been better. During the site review, RNP Staff made several comments concerning the visual impact of RX-2 from the Bypass alignment. Ironically, the clearing of vegetation was thought to be the most impactful and little attention was paid to the channel itself, probably since it was recognized that it was such a low energy environment. Inviting a CDFG representative to the site review or presenting them with a detailed plan sheet might have prevented the misunderstandings.

REFERENCES

- Campbell, A.J. and R.C. Sidle, 1984, Prediction of peak flows on small watersheds in Oregon for use in culvert design; Water Resources Bulletin, v. 20, no. 1, pp 9-14.
- Harden, D.R., H.M. Kelsey, S.D. Morrison, and T.A. Stephens, 1982, Geologic Map of the Redwood Creek Drainage Basin, Humboldt County, California; U.S.G.S. Water Resources Investigations 81-496, Menlo Park, Calif., Map (1:62500) and legend.
- Popenoe, J.H., 1988, Soils of the Highway 101 Bypass Watershed Rehabilitation Unit 88-1, unpublished report, USDI-Redwood National Park, 14 p.

APPENDIX

All field mapping, prescription notes, survey data and volume calculations, stream discharge calculations, and photo-point descriptions are on file at:

Redwood National Park
South Operations Center
219 Hilton Road
P.O. Box 7
Orick, CA 95555



Unit: 88-1 PP1A 10-15-88 RX-2 Upstr Pre-Rock, Post HE DLS 35mm



Unit: 88-1 PP1A 10-17-88 RX-2 Post Rock, DLS &LEJ 35mm



Unit: 88-1 PP3 10-15-88 RX-2 dstr Pre Rock, Post HE, DLS 35mm



Unit: 88-1 PP3 10-17-88 RX-2 d-str Post Rock DLS & LEJ 35mm



Unit: 88-1 Misc. Bypass 10-31-88 DLS 35mm



Unit: 88-1 Misc Bypass 10-31-88 DLS 35mm



Unit: 88-1 Misc Bypass 1-3-89 DLS 35mm