

SUMMARY REPORT

**EROSION CONTROL WORK PERFORMED ON
UPPER DEVILS CREEK REHABILITATION UNIT**

85-1

**By
Gregory Bundros
Michael Sandeck
David Burns**

December 1985

TABLE OF CONTENTS

Introduction	1
Timber Harvest and Erosion Features	3
Erosion Control Rehabilitation Work	8
Discussion	18

LIST OF MAPS AND TABLES

	Page
MAP A. LOCATION AND TOPOGRAPHY.....	2
TABLE 1. SUMMARY COSTS OF EROSION CONTROL WORK.....	4
MAP B. LOGGING HISTORY.....	5
TABLE 2. SUMMARY OF AVERAGE HEAVY EQUIPMENT COSTS.....	9
MAP C. EROSION TREATMENTS.....	11-13
PLATE 1.....	11
PLATE 2.....	12
PLATE 3.....	13
TABLE 3. HAUL ROAD CROSSING COSTS.....	14
TABLE 4. SUMMARY OF AVERAGE LABOR COSTS.....	17
APPENDIX A. BREAKDOWN OF EQUIPMENT COSTS ¹	
APPENDIX B. DRAINAGE AREAS AND PEAK DISCHARGES	

¹Appendixes are on file at the South Operation Center.

Introduction

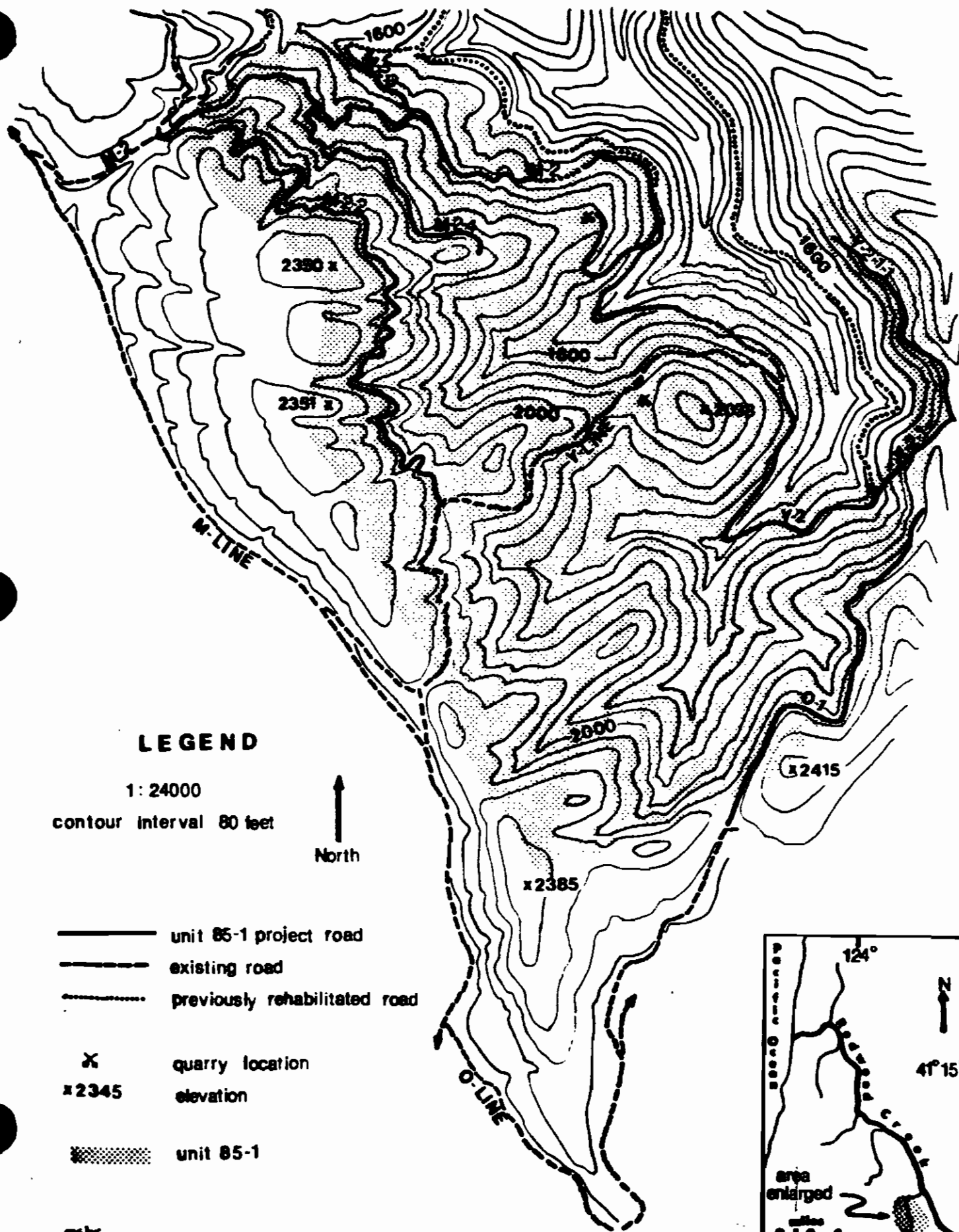
Rehabilitation Unit 85-1 is located in the Devils Creek basin, about 12 miles southeast from Orick, California (see map A). Devils Creek is the southernmost tributary to Redwood Creek within the 1978 park expansion area. Its watershed drains approximately 4450 acres and is considered one of the relatively few, low relief, redwood dominated tributaries to Redwood Creek.

The rehabilitation unit encompasses some 2090 acres and contains 10.4 miles of logging haul roads, located in the middle to upper hillslopes of the basin. Because of its large size, the unit's morphology, structure, and soil type varies considerably across the unit. On this unit, total relief approaches 1000 feet, with elevations ranging from approximately 1400 to 2400 feet.

Much of the northern, uppermost Devils Creek watershed is a partially dissected peneplain displaying well incised, often paired and opposing drainages, but otherwise shows little topographic relief. Well incised, these upper hillslope stream valleys are relic features of earlier drainage patterns and are today misfit, relative to present-day stream discharges. These upper drainage patterns contrast with the younger, fault controlled drainage patterns found in the lower basin. Much of the lower watershed falls within an inner gorge to the mainstem of Devils Creek, where hillslope gradients commonly exceed 80 percent. Midslope regions, however, are transitional. In the northern portions of this unit, steep hillslope and stream gradients are commonly found immediately below the peneplain, and become less steep throughout the midslope reach until the inner gorge regions are met. Throughout this midslope area, drainage systems display youthful channel development. Hillslope morphology varies from large, arcuate bowls, and tread and riser topography in the north, to steep, fairly uniform topography in the southern portion of this unit.

Located on the west side of the Grogan Fault, this unit is underlain by quartz-mica schist. The schist is highly variable. Large coherent, competent blocks are found throughout much of the upper hillslopes regions. In contrast, schist can be found in the lower regions of this unit which is so pulverized that it could be considered a type of colluvium. Tectonic blocks of metavolcanic origin are exposed in many midslope areas of the northern portions of this unit. Many of these areas are associated with active land slide zones, and conceivably, the Bridge Creek Linament. Of particular interest are the features which fall along a straight line in the vicinity of a suspected fault zone. These features include: earthflow zones on opposite sides of the ridgeline forming rock pit #2; closed depressions located to the south of the Y-line earthflow; and the abrupt lithologic and gradational change, located on the 0-1 Road.

MAP 'A' LOCATION AND TOPOGRAPHY

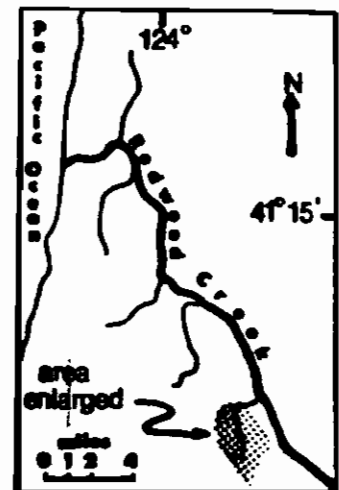


LEGEND

1: 24000
contour interval 80 feet



- unit 85-1 project road
- - - existing road
- previously rehabilitated road
- x quarry location
x2345 elevation
- ▨ unit 85-1



Soil types mimic the unit's variability. Trailhead and Fortyfour soils are common to the upper hillslope regions, while Tectah and Copper Creek soils occupy the middle to lower slope regions. As may be expected, Devils Creek soils are found in hollows, along most streams, and in mass wasting features. For a complete description of soils found on this unit, the reader is referred to the report by Popenoe, et. al., 1985, "Soils of the South Devils Creek Rehabilitation Unit".

This rehabilitation unit addressed virtually all roads remaining in Devils Creek, with the exception of the M-2-1-1 Road and approximately one mile of the Y-Line. The roads removed, preceded by their length (mile) included: 1.4, M-2; 0.5, M-2-3; 1.0, M-2-4; 2.3, M-2-2; 1.8, Y-Line; 0.9, Y-2; 0.5, Y-2-1; 0.7 Y-2-1-1; 1.3, O-1 Road. The 1320 Road was also inspected. Because of the advanced development of erosion features, and poor access, this road was not treated. Roughly 19,000 cu. yds of fill were excavated from 32 road-stream crossings. Of the 10.4 miles of road removed, 1.3 miles were outsloped while the balance was simply cross-road drained. Total rehabilitation costs, including the evaluation phase, was \$108,986. Of this total, heavy equipment and labor-intensive work accounted for 86 percent and four percent, respectively. The evaluation phases accounted for approximately 10 percent. These costs are summarized in Table 1.

Timber Harvest and Erosion Features

Timber harvest in the Devils Creek basin is well documented by aerial photographs, and may be divided into three time periods. Each harvest period utilized the latest harvesting technology available.

The first period of timber harvest began around 1930. Logs were yarded to a central staging area with "steam donkeys", and transported to the mills via railroad systems. Devils Creek was entered from the south, where Hammond Lumber Company extended their main railroad grade from Little River onto the broad ridge dividing Redwood Creek from Little River and Maple Creek. Several secondary grades branched from the mainline grade in order to access the gentle ridgetops in the Devils Creek basin (see map B). They extended out spur ridges as far as possible before grade was lost due to steepening hillslopes. Well incised streams, typical of these relatively flat areas, were crossed by trestle-supported bridges. Few roads were used in constructing the trestles. Air photos show large radial patterns emanating from main staging areas, where steam donkeys were used to winch logs up to rail lines. Logs were yarded over distances commonly exceeding 1000 feet. Much of the relatively flat ridgetop topography was clearcut in this manner. These areas were later burned for about six years until about 1941. These rail alignments followed the present-day beginning sections of the O-Line, O-1 Road, Y-Line and M-Line.

Table 1. SUMMARY COSTS OF EROSION-CONTROL REHABILITATION WORK: UNIT 85-1

Phase	Task	Hydrologist & P.S. Tech.	Laborers	Heavy Equipment Rental	YCC	RU	Total Task Costs	% Total Cost	Phase Totals	Phase %
-------	------	--------------------------	----------	------------------------	-----	----	------------------	--------------	--------------	---------

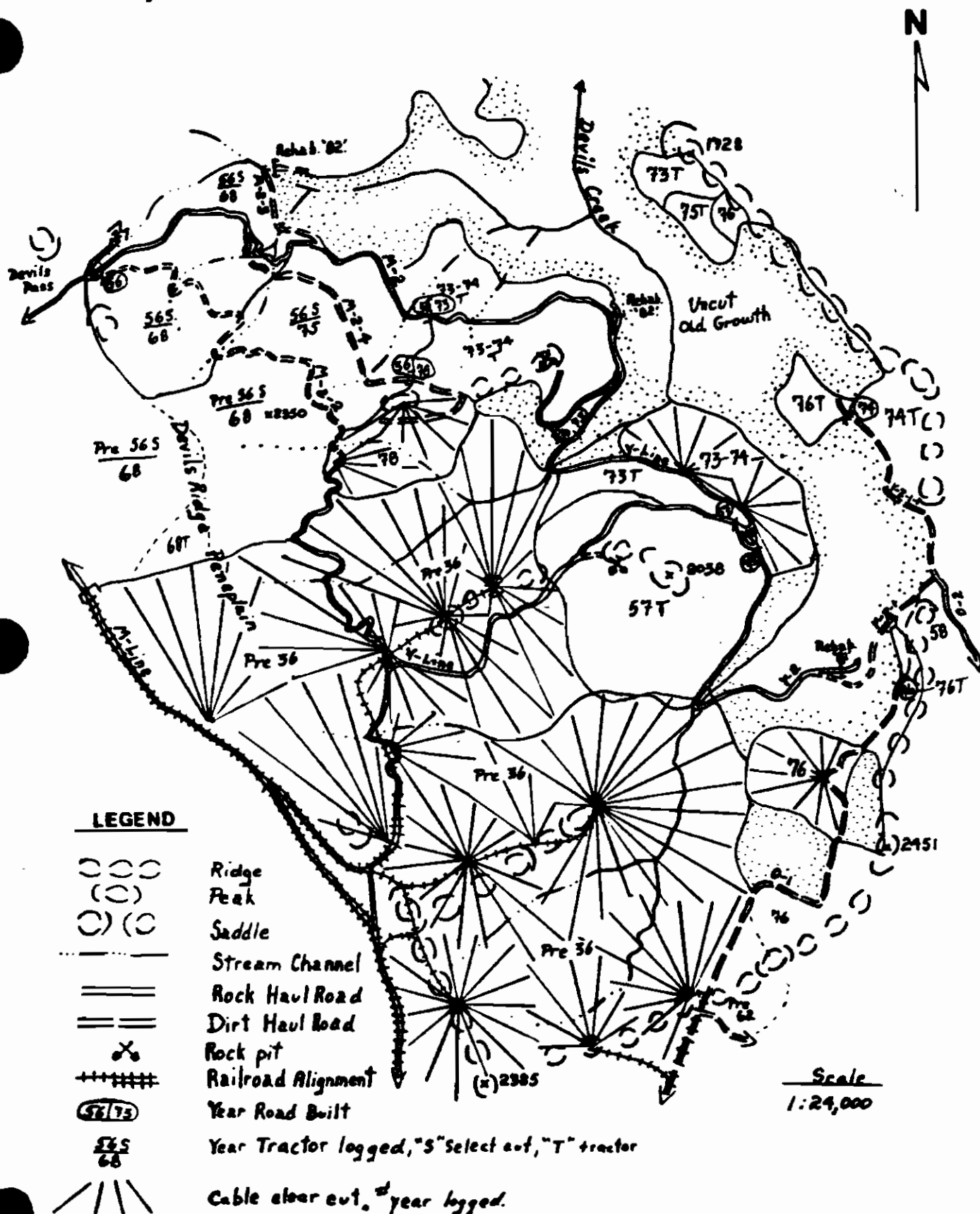
Evaluation Phase	Mapping	\$3,890	--	--	--	--	\$3,890	3.6	\$10,353	9.5
	Prescriptions, Planning & Documentation	4,720	\$893	--	--	\$850	6,463	6.0		
Heavy Equipment Phase	Primary Treatments	9,650	--	\$70,204	--	--	79,854	73	93,845	86.1
	Secondary Treatments	--	--	231	--	--	231	0.3		
	Access Cost	--	--	4,282	--	--	4,282	3.9		
	Miscellaneous Costs	--	--	9,478	--	--	9,478	8.7		
Labor Intensive Phase	Primary Treatments	--	--	--	--	--	--	--	4,788	4.4
	Secondary Treatments	180	1,105	--	\$245	460	1,990	1.8		
	Travel Time	--	561	--	194	300	1,055	1.1		
	Miscellaneous	--	893	--	--	850	1,743	1.6		

COST ANALYSIS FAILS TO INCLUDE PRICE OF STRAW & DOUBLES THE EXPENSE OF LABORERS IN FOR EVALUATION PHASE!

GRAND TOTAL = \$108,986

\$18,440 \$3,452 \$84,195 \$439 \$2,460

Map. B. LOGGING HISTORY



The erosion impacts from these earliest timber harvests were minimal, considering the large areas involved. Though timber harvest activities stripped the entire landscape of all vegetation, there was no large-scale ground disturbance. Topography was gentle; deep, well developed soils provided excellent infiltration. Stream channels, though well incised, were relic and carried little flow. Few roads crossed these stream channels. There were no diversion potentials; fill volumes were relatively small in well incised valleys. Paths where logs were dragged upslope to a staging area, accounted for most of the ground disturbance. These paths, however, diverged in a downslope direction, and failed to concentrate surface flow.

The second period of timber harvest occurred in 1956. With the advent of diesel technology and crawler tractors, steeper topography could be accessed for harvest. Much of the 1956 harvest occurred in midslope regions of the basin, and were generally seed-tree leaves. The M-2 Road entered the basin through Devils Pass and splayed into a network of roads which included the M-2-2, M-2-4 and M-2-3. Many of these roads were built without clearing the right-of-way and trees were often severed at road level. Road surfaces were not rocked. Typical of road building practices for this period, roads followed topographic contours, and utilized large fills to maintain road grade and eliminate sharp curves while crossing deeply incised stream channels. Some roads were constructed across log filled channel bottoms. Many large Douglas-fir trees were culled during the harvest and utilized in stream crossing construction as conduits for streamflow ("humboldt crossings"). In some cases, landings were built directly in the stream channels.

Due to the tractor yarding methods, erosion impacts from this harvest period were more severe than that of previous logging. Channels were often choked with fill and debris from skid trail, haul road, and landing construction. Many of these channels, however, were high enough in the watershed that most of the material remained in storage despite several large runoff events that occurred since harvest. Piping and gullying appears to have been the main erosional processes in these middle to upper hillslope areas. Lower in the watershed, however, much of the instream fill eroded and was transported by large flows, causing culverts to plug and fill volumes to erode. For example, a landing constructed across the northernmost fork of Devils Creek, at the end of the M-2-3 Road was severely eroded during the 1964 storm.

The final period of timber harvest in Devils Creek began in the early 1970's. It was characterized by extensive road building and rock pit development. Additionally, with the advent of the Forest Practice Act, 1973, the size of clearcut units could no longer be the large, coherent units they had been in the past. Instead, smaller areas, widely dispersed throughout the watershed, were harvested. All of the existing roads were rebuilt and many additional miles of road were added to the

existing system in order to access these units. Some of these roads were built within the inner gorge of Devils Creek; most roads extended through uncut old growth areas. Road surfaces were rocked to extend their usefulness into the rainy season.

The new road system allowed alternative access routes to various parts of the basin. With the development of two rock pits, this road system allowed road building and timber harvest to occur simultaneously. During this period, the M-2 Road ("M-2 east") was extended to connect with the Y-Line system. The M-2 Road was rocked extensively and improved with culverts. The M-2-3 Road was reopened, and provided a continuous loop to the Y-Line. The M-2-2 and M-2-4 were reopened and, along with the cutting of new timber units, adjacent 1956 harvest areas were relogged. New road construction also included the : Y-Line; Y-2; Y-2-1; Y-2-1-1; and 0-1 roads.

The erosion features associated with this period of timber harvest included: 1) the failure of road-stream crossings; 2) gullyng of new and reconstructed skid trail crossings; and 3) mass wasting features associated with roads and landing. Nearly all road crossings on the M-2, M-2-3, and M-2-4 roads had failed, at least once, in response to the major storm events in 1972 and 1975. Some culverts plugged (RX 1,2,9,11), allowing streamflow to overtop and erode these crossing fills. Other crossings never contained culverts and either washed-out (RX 3,6) or diverted streamflow (RX 4,5) down the road, eroding the road prism elsewhere. Road-stream crossings constructed under more stringent guidelines; i.e., post 1973, do not appear to have eroded as severely.

A total of 47 skid trail crossings were identified on this unit. At the time of mapping, most had eroded beyond cost-effective treatment. Eight of these crossing, however, were identified as points of potential stream diversion.

Mass wasting features associated with timber harvest activities included debris torrents, earthflows, and translational slides from roads fills and landings. A suspected fault zone connects two, naturally occurring earthflow regions located on opposite sides of the ridge forming rock pit #2. On the north side of the ridge, the M-2 (eastern end) had been constructed across the head of an earthflow in 1974. The hillslope below this road had also been tractor yarded at this time. By 1975, differential slumping had occurred at three locations along this road (Sta. 42, 47 and 52). Major displacement, however, occurred in 1982. Two landings with road benches (@ Sta. 42 and 52) failed, triggering a debris torrent at each location. At station 47, compound slumping offset the road bench by 14 feet.

On the south side of the same ridge, and above the present-day location of the Y-Line, an earthflow failed just prior to road construction in 1970. In 1973, the Y-Line was extended across the toe of this feature, and downed timber was yarded by tractors

from the earthflow. Toe removal, resulting from road construction, most likely had a de-stabilizing effect, causing repeated burial of the road during subsequent storm events.

Along the Y-2 Road, a translational slide originating in road fill occurred along a 600-foot long road bench, just east of the mainstem road crossing. To the north of the mainstem crossing, road fill torrented from a headwater swale, scouring the hillslope below. At the end of the Y-2-1-1 Road, a large debris torrent developed as a result of a landing failure. Though most road segments described herein had been reconstructed by timber companies up until the 1978 park expansion, a high potential for repeated failure remained. Additionally, incipient failures of road benches and landings were also identified along most roads within this unit. The interested reader is referred to the detailed geomorphic mapping for a complete description of the erosion potential within this unit.

Erosion Control Rehabilitation Work

The Upper Devils Creek Unit contains 2090 acres. Approximately 845 acres were mapped in detail, requiring 38 person-days to complete. Prescription, planning, and documentation required 43 person-days to complete. Heavy equipment work was performed from July 9 through September 17, 1985, and was supervised by Gregory Bundros, David Burns, and Michael Sandeck.

Erosion control treatments were performed on erosion features capable of delivering sediment directly to streams, and, in some cases, on potential debris avalanche features which threatened stands of old growth redwoods. Examples of these treatments included: 1) excavating road and skid trail stream crossings; 2) outsloping unstable roads and landings; and 3) excavating road fill from headwater depressions. A summary of average heavy equipment costs for all treatments is presented in Table 2. All worksites and treatments are located on Map C.

Road stream crossings were excavated to remove road fills as potential sediment sources and to reconstruct, as much as possible, the original pre-road hydraulics and geometry of streams channels and valleys. In the majority of cases, the excavations exposed and followed the original stream channels and gradients. Secondary treatments, in the form of channel armor, were not performed. Original debris and rock armor, exposed during the excavations, were left undisturbed to help stabilize these channels. Table 3 summarizes haul road crossing excavation costs.

A total of 47 skid trail crossings were identified on this unit. With the exception of the hillslopes above the 0-1 Road, all other hillslope areas and skid trail crossings had experienced the 1972 and 1975 flood events. As a result, most skid trail crossings had already eroded beyond cost-effective treatment.

Table 2. SUMMARY OF AVERAGE HEAVY EQUIPMENT COSTS: UNIT 85-1

Treatment	# of Work-Sites	Total Quantity	Total Cost	Avg. Cost Worksite	Avg. Cost Quantity	Range Cost/Quantity
<u>Access Costs</u>						
Open roads	--	--	\$225	--	--	--
Travel (major relocations on unit)			1945	--	--	--
Move-in/move-out			2112			
TOTAL ACCESS =			<u>\$4282</u>			
<u>Miscellaneous Costs</u>						
Standby with operator (excavator breakdown)		--	\$292	--	--	--
Standby without operator (excavator breakdown)		--	3393	--	--	--
Administration/breaks		--	4597	--	--	--
Oververt detail		--	1196	--	--	--
TOTAL MISCELLANEOUS =			<u>\$9478</u>			
TOTAL HEAVY EQUIPMENT COST =			~~<u>\$84,195</u>~~			
			<u>84204</u>			

MAP C. EROSION TREATMENT

Plate 1.

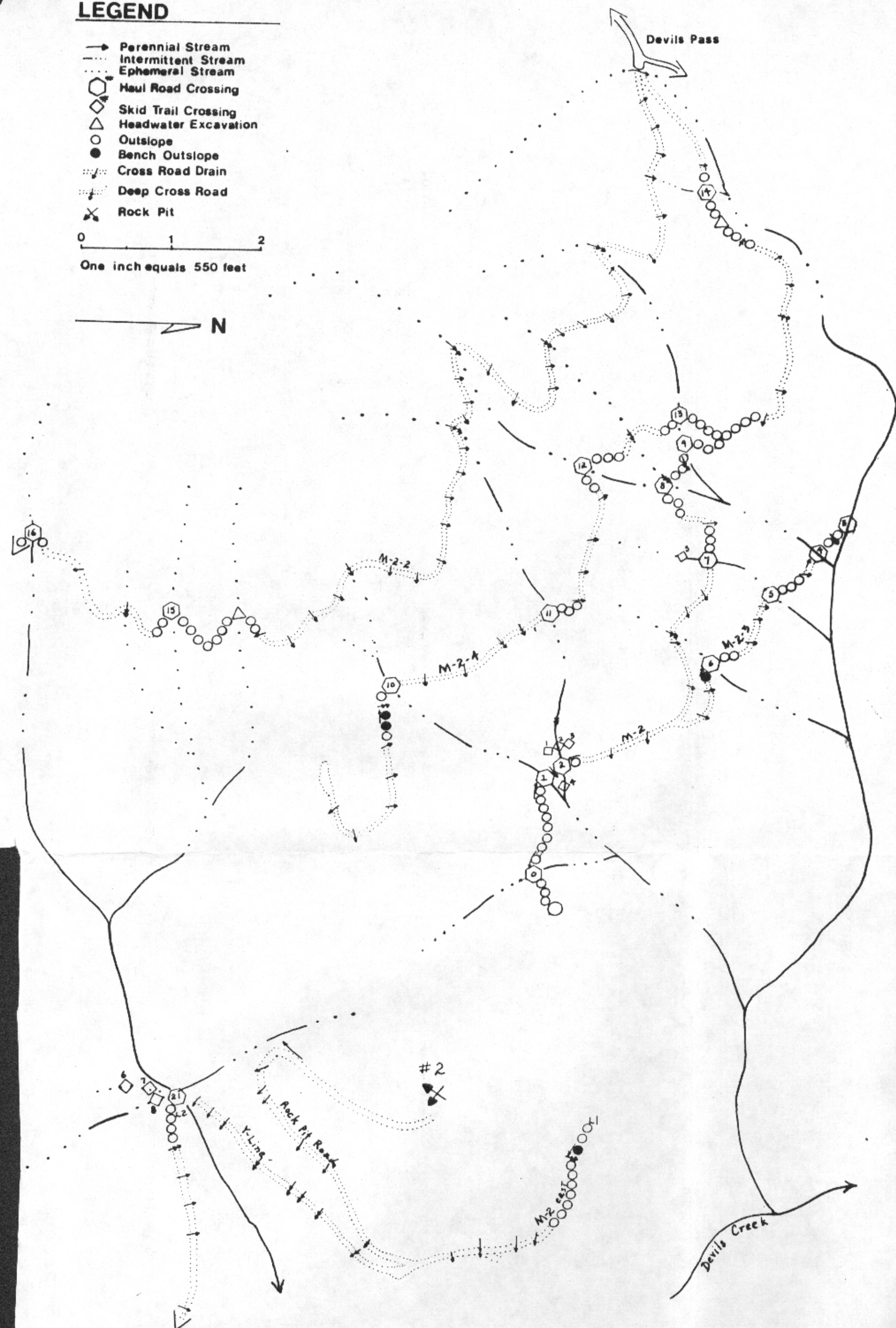
LEGEND

- Perennial Stream
- Intermittent Stream
- ... Ephemeral Stream
- Haul Road Crossing
- ◇ Skid Trail Crossing
- △ Headwater Excavation
- Outslope
- Bench Outslope
- Cross Road Drain
- Deep Cross Road
- ✕ Rock Pit

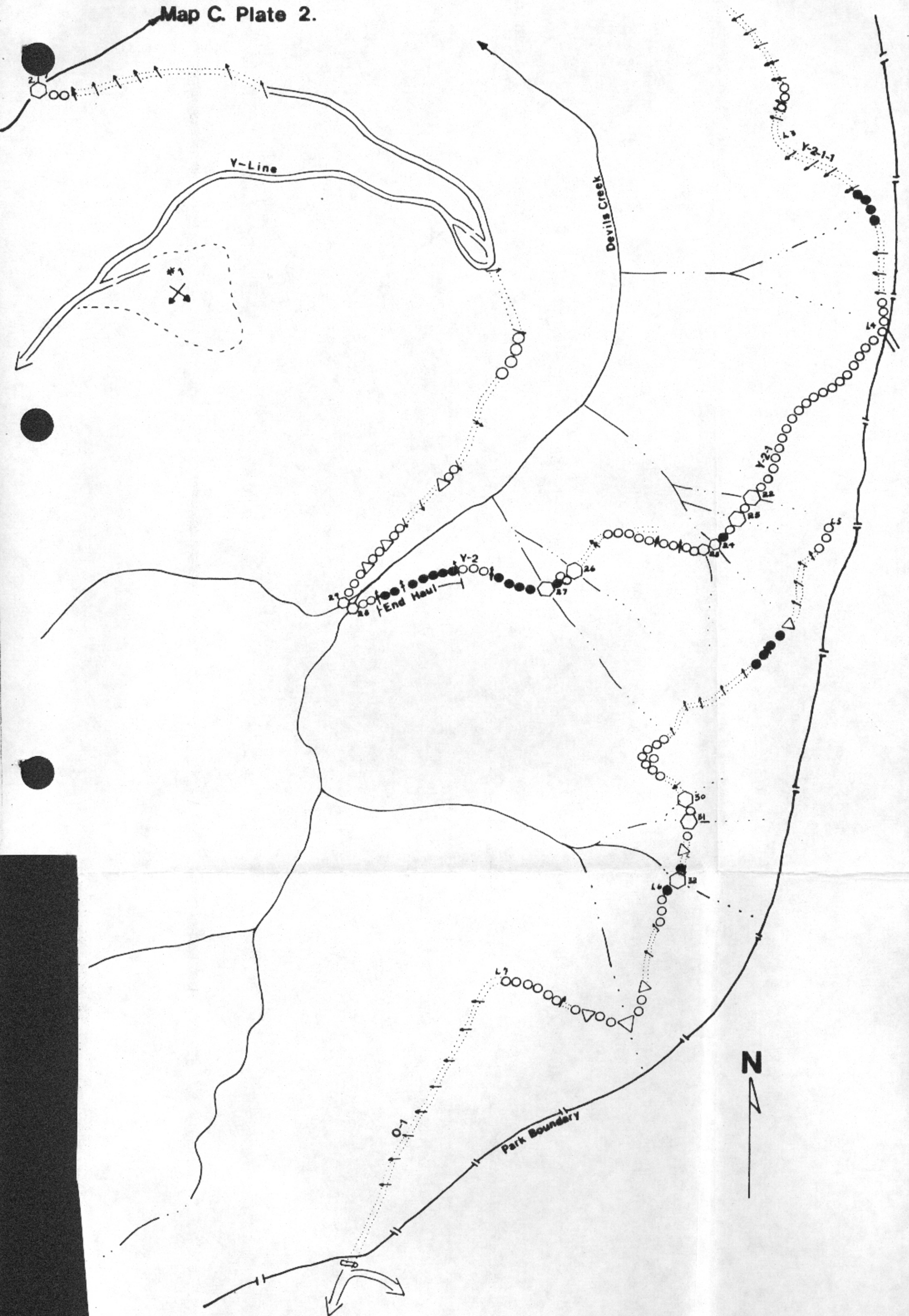
0 1 2

One inch equals 550 feet

N



Map C. Plate 2.



Map C. Plate 3.

13

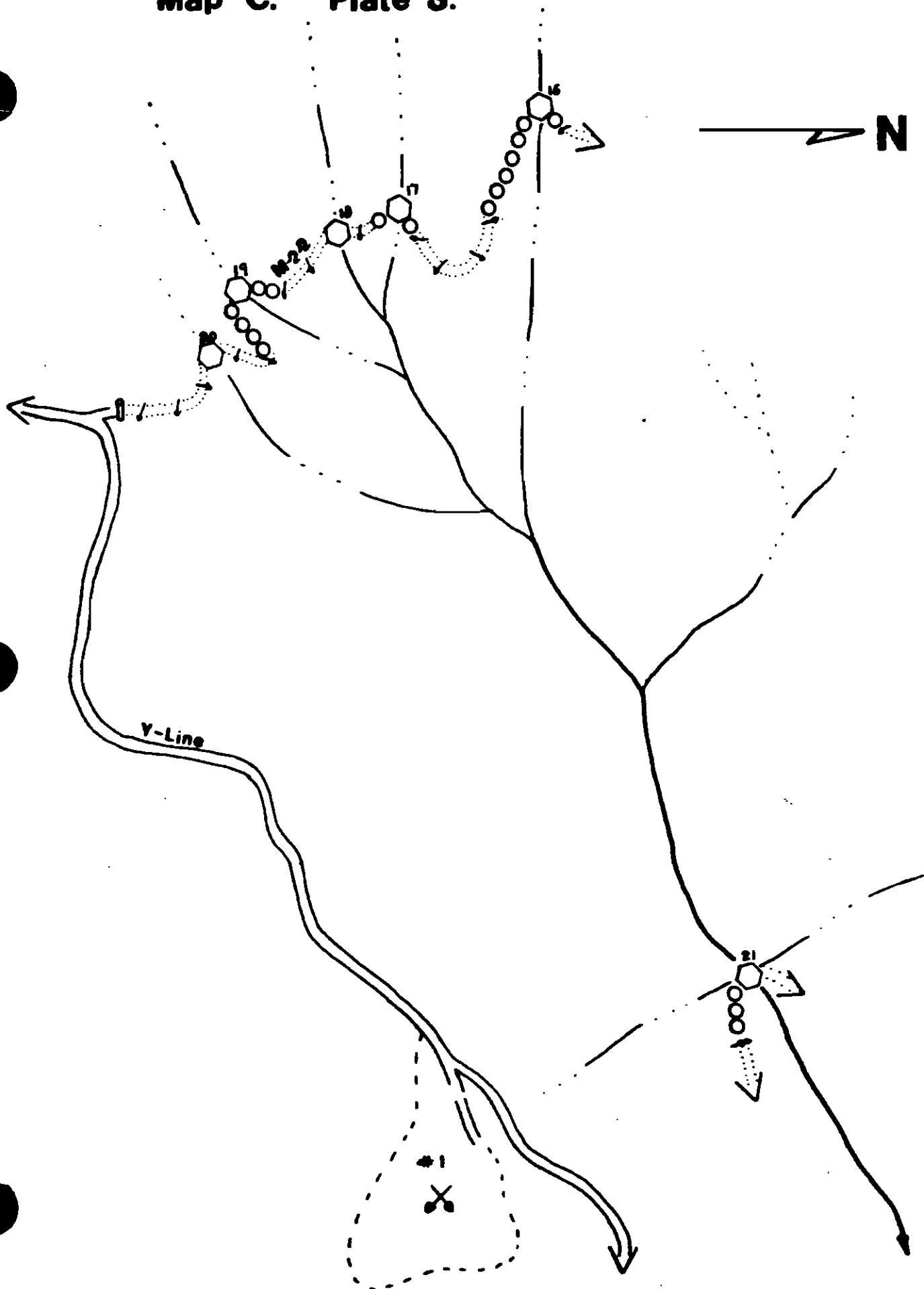


Table 3. HAUL AND CROSSING COSTS: UNIT 85-1

Type of Worksite	# of Sites	Range Volume of Fill	Equip.	Range Hours	Avg. Cost Worksite	Range Cost	Avg. Cost yd ³	Range Cost/yd ³
Small	10	≤ 200 yd ³	D8	0 - 1 1/2	\$122	\$39 - 230	\$1.68	\$1.15 - 2.64
			D7	0 - 1 1/2				
			HE	1/4 - 1 3/4				
Medium	11	200 - 500	D8	0 - 3 1/2	590	312 - 1549	1.69	0.96 - 3.52
			D7	0 - 7 1/2				
			HE	1 1/2 - 8 3/4				
Large	9	500 - 1500	D8	2 1/2 - 16	1429	672 - 3558	1.66	1.02 - 4.66
			D7	1 3/4 - 23				
			HE	3 1/2 - 19 1/2				
Extra Large	3	>1500	D8	2 1/2 - 18	3089	2455 - 4544	1.55	1.29 - 1.93
			D7	13 - 23 1/4				
			HE	13 - 17				

Because of this, only eight skid trail crossings were treated. They contained relatively small volumes (30-70 cu. yds.), but displayed diversion potentials to streamflow. Skid trail excavations averaged \$1.98/cu. yd.

Another treatment associated with streams, removed road fills from stream headwaters at 10 locations. These features were treated because they displayed debris torrent potentials capable of delivering sediment directly to active streams, or threatened undisturbed stands of old growth redwood. Referred to as headwater excavations, the excavated volumes ranged from 100-500 cu. yds.

One active debris torrent was treated on this unit (Sta. 42). Partially treated during the 1982 rehabilitation effort, the debris torrent head continued to retreat, delivering road and skid trail fill directly to a second-order, intermittent stream. The treatment performed this year completely outsloped the debris torrent head, removing approximately 800 cu. yds. at a unit cost of \$3.12/cu. yd.

Unstable road segments and landings were outsloped when in close proximity to streams. Along wet road segments to be outsloped, bench outsloping was performed to preserve the inboard ditch and collect discharged ground-water. Cross-road drains were then constructed across the bench to drain these inboard ditches onto the most stable areas. In the majority of cases, road and landing outslope treatments utilized local areas for storing fill. One segment of the Y-2 Road, however, required the excavated material to be truck endhauled to a dry and stable storage site. For road segments with known volumes, a total of 8715 cu. yds. were excavated from 0.8 mile of road, at a unit cost averaging \$1.33/cu. yd. The endhauled outslope treatment removed an additional 1900 cu. yds. at a unit cost of \$3.14/cu. yd. Additionally, a total of 4700 cu. yds. were excavated from seven landings at a unit cost averaging \$1.31/cu. yd.

Stable road segments were used as fill storage sites or cross-road drained. Where warranted, some cross-road drains were excavated deeply into the road prism, removing as much as 150 cu. yds. for a single drain. Ripping was not prescribed for any of the roads on this unit. The M-2-3, M-2-4, Y-2-1, Y-2-1-1, and 0-1 roads had never been rocked. Horse trails had been proposed for the M-2-2 (unrocked) and Y-Line (heavily rocked). Ripping these roads would have been counter productive to trail construction and maintenance. The M-2 Road had been heavily rocked. Ripping would have been a desirable road treatment to aid revegetation on this road. From the stand point of cost and logistics, however, this treatment was not prescribed. Instead, fill generated from other treatments on the M-2 Road was spread over as much of the road as possible.

Labor crews performed only secondary treatments. Secondary treatments consisted entirely of spreading straw mulch at most

road-stream crossings and selected work sites. Table 4 summarizes this labor-intensive treatment and cost.

Equipment Application

The heavy equipment used on this unit were well suited for the work. We were extremely fortunate to have had two operators, experienced with our work, return for another season. The third piece of equipment was operated by a talented individual who, within a short period of time, quickly learned the intent and methodology of our work. We sincerely appreciate their efforts and the quality of work they performed. Table 5 lists the owner/operators and the type of equipment used on this unit.

Table 5. Equipment and Operators

<u>Owner-operators</u>	<u>Equipment</u>	<u>Rate</u>
Paul Johnson	Cat D8 w/winch	\$75.00
Gary Giannndrea	Cat D7G w/winch	80.00
Larry Lambert	JD690 excavator	78.50
Wes Green	10 cu. yds. dump truck	41.50
Dave Trutalli	10 cu. yds. dump truck	41.50
Greg Brownlow	10 cu. yds. dump truck	41.50

Many of the road crossings were flowing at the time of treatment. Fortunately, road conditions at most active streams allowed streamflow to be temporarily diverted down inboard ditches while the crossings were being excavated. This technique kept the work sites dry while performing the excavations. The unit costs for road crossing excavations varied considerably, ranging from \$0.96 - \$4.66/cu. yd., and averaging \$1.77/cu. yd. A total of 18,600 cu. yds. were excavated from 32 road crossings.

The higher unit costs for road crossing excavations were associated with: 1) high concentrations of logs and root wads buried in the crossing fill; 2) uncontrolled streamflow across the excavation; and 3) saturated fill encountered during an excavation. The later two usually prevented full utilization of tractors and required a greater volume to be handled by the hydraulic excavator. An exception to the three elements listed above, was the highest unit cost (\$4.66/cu. yd.) at RX 21. This road crossing had been constructed with large clast, metavolcanics from the Y-Line rock pits as fill. This excavation was atypical of road crossing excavations, as the equipment could barely dislodge the fill (boulders).

Roads and landings were outsloped utilizing tractors and the hydraulic excavator. Unit costs for these treatments varied depending upon how much of the treatment could be completed utilizing only a tractor. In general, the more completed by tractor, the lower was the unit cost. Along wide road benches with moderately steep fillslopes, tractors could easily complete 60%, or more, of the prescribed excavation. A standard outslope averaged \$0.99/cu. yd. when performed primarily by tractors.

Table 4. SUMMARY OF AVERAGE LABOR COSTS: UNIT 85-1

Treatment	Type of Labor	Total Person Hours	Avg. Cost Per Hour	Total Cost	Quantity	Avg. Cost Quantity
<u>Primary Treatments</u> - None						
<u>Secondary Treatments</u>						
Distribute straw	RNP	70	\$8.50	\$595	540 bales	\$1.10/bale*
Spread straw	RNP	60	8.50	510	540 bales	\$3.35/bale
	R.U.	92	5.00	460		
	YCC	73	3.35	245		
TOTAL SECONDARY TREATMENTS = \$1810						
<u>Travel Costs</u>						
	RNP	66	8.50	561	—	—
	R.U.	60	5.00	300		
	YCC	58	3.35	194		
TOTAL TRAVEL COST = \$1055						
<u>Miscellaneous Costs</u>						
Brush removal	RNP	105	8.50	893	--	—
	R.U.	170	5.00	850		
TOTAL MISCELLANEOUS = \$1743						
TOTAL LABOR COST = \$4608						

* Each straw bale cost \$2.90. Therefore, the unit cost for straw, distribution, and application was \$7.35/bale.

Narrow roads with steep (greater than 70%) fillslopes precluded extensive use of tractors. Especially true of a D8-sized tractor, original ground must be cut through to gain access to the fill along the outer edge of the road bench. Since this is not a desirable practice, the hydraulic excavator performed the majority of outsloping along narrow road benches. A standard outslope performed primarily by the hydraulic excavator averaged \$1.20/cu. yd.

On this unit, only one road segment required dump trucks to endhaul road fill. A relatively simple approach was taken. With one exception, the hydraulic excavator could reach the prescribed depth of excavation from the existing road level. It performed the entire excavation and dumped directly into the trucks. When road fill was beyond the reach of the excavator, the D7 constructed a lower trail for the excavator and dump trucks. A total of 460 feet of road were outsloped utilizing this truck endhaul method. Roughly 1900 cu. yds. of road fill were excavated and endhauled at a unit cost of \$3.14/cu. yd.

Discussion

In general, the unit costs to complete the variety of treatments performed on this rehabilitation unit appear reasonable. They reflect a treatment's degree of difficulty and efficient (or inefficient) equipment application and sequencing. The one exception, however, is the construction cost for standard cross-road drains. As can be seen from Table 2, the unit cost for standard drains is identical to the unit cost for deep cross-road drains. In reality, this could not be the case since greater volumes were excavated from deep drains. Additionally, deep cross-road drains often required both hydraulic excavator and tractor to construct. In contrast, standard drains were constructed almost exclusively with only the D7. The unit cost for a standard drain should have been \$20-\$25 as it generally requires 10-15 minutes for a tractor to travel between drain locations and construct a single drain. Errors in equipment notes or the lack of resolution in time-keeping probably account for this discrepancy.

Less than ideal excavations were performed at RX 7 and RX 12. At RX 7, the excavation proceeded through original ground, removing more material than was necessary. What had appeared to be a road filled headwater depression was, in reality, a full bench above a headwater depression of this stream. At RX 12, an inordinate amount of fill had been sidecast into this stream valley during road and skid trail construction. The excavation at this crossing lowered the outboard edge of the road more than 30 feet and never reached the original channel, nor established a secure baselevel for this stream. The original channel was eventually intercepted midway through the excavation. Because this valley is a relic feature, its size is not representative of anticipated stream discharges. RX 12 should experience only minor

adjustments during extreme runoff events.

Equipment standby costs were somewhat high, exceeding \$3700. The majority of this cost occurred because the hydraulic excavator experienced a major breakdown. Parts were not readily available, and the machine was down for two weeks. Equipment rental agreements require equipment to be repaired or replaced within 48 hours, or that equipment can be terminated. In this situation, however, there was no other hydraulic excavator available for hire, so it could not be terminated. Hydraulic excavators are always in short supply and the same machines return to the park each year to perform our work. As these machines get older, major breakdowns are more likely to occur. Given the limited supply of excavators, this same event will most likely recur on future equipment rental rehabilitation units.

In December of 2000 I walked the Y-2 Road from the Y-line junction to the Y-2-1, then up the Y-2-1 Road to the junction with the connector to the O-2 Road at the park boundary. Following are observations I made:

The only major crossings on this reach of road were crossings 28 and 29. They were holding up relatively well. They seem to have been excavated almost fully, with the exception of one or two hundred yards of material left between the two channels. A recent 10 yd³ failure on the right bank of crossing 29 indicates that this material is still susceptible to mass movements. The stream gradients are relatively low, and a large, catastrophic failure of this material seems unlikely.

A significant gully (up to 3' wide and 5' deep) is active in the EOS reach just east of crossing 28.

Gullying is also occurring from drainage of the inboard ditch in the EOS reach just west of crossing 27.

Crossing 22 is experiencing downcutting ~ up to 3' on the outboard edge .

Revegetation is quite good along those reaches that were treated, including the minimally outsloped sections. A very thick stand of firs up to 5' in height, averaging 2', occurs along these sections. The untreated sections of road are dominated by sparse alders and ferns.

Phil Freiberg

















