

SUMMARY REPORT
OF WORK PERFORMED ON
REHABILITATION UNIT, SITE 80-3
BRIDGE CREEK

by
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INTRODUCTION

This report documents the work performed on Rehabilitation Unit, Site 80-3. The report is presented in three parts:

Part I. Narrative

Part II. Heavy Equipment Application and Cost Breakdown

Part III. Labor Intensive Work and Cost Breakdown

Part I provides a brief description of the unit and a chronology of road construction and timber harvest. It goes on to describe erosional processes and sediment source areas, and discusses site specific prescriptions.

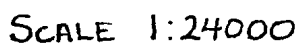
Part II documents the heavy equipment phase for this project. It discusses equipment application, identifies storage units for excavated and end-hauled material, and provides a cost breakdown for this phase.

Part III describes the labor intensive phase but lists only physical erosion control treatments and provides a cost breakdown for this work. Vegetal treatments and costs will be documented by the vegetation management staff upon completion of their work.

The original boundary of the rehabilitation unit included the hillslopes immediately above and below the M-6-2 Road, from the terminal portion of the road to Drainage #1 (see Figure 1, page 2). Because of an active and unstable road segment surrounding a stream crossing on the M-6-1 Road, it was decided to expand the unit boundary to include the M-6-1 and hillslopes up to the M-Line. The decision to expand the unit's boundary was made towards the latter part of May, and time allowed for only a cursory inventory of erosional features in the expanded area. Detailed mapping (1 inch = 100 feet) was completed for only the originally proposed unit, using an enlarged aerial photograph as a base map. The expanded area was mapped by compass at a scale of 1 inch = 125 feet. All maps are in completed form and stored in the map case located in Technical Service's trailer in downtown Orick.

This project was supervised by Gregory Bundros and Tery Huber. Our labor force (and great thanks to them) consisted of Wes Hoffschmidt, Bill Jung, Peter Bretnall, Roger Lemstrom, and the YCC and Redwoods United Crews.

JK



PART I. NARRATIVE

DESCRIPTION AND HISTORY OF REHABILITATION UNIT

Rehabilitation Unit Description

Rehabilitation Unit, Site 80-3 consists of approximately 680 acres. It is bordered to the west by the M-Line, to the east and south by Bridge Creek, and to the north by a second-order perennial tributary. The physiographic unit extends to the west towards Rodgers Peak and includes the hillslopes above the M-Line (see Figure 1, page 2). Two other haul roads are constructed across the hillslopes of this unit. The M-6-1 Road is a mid-slope road, approximately 2 miles long. Its counterpart, the M-6-2 Road, is approximately one mile long and is constructed much lower on the hillslope. *Total 82
acres*

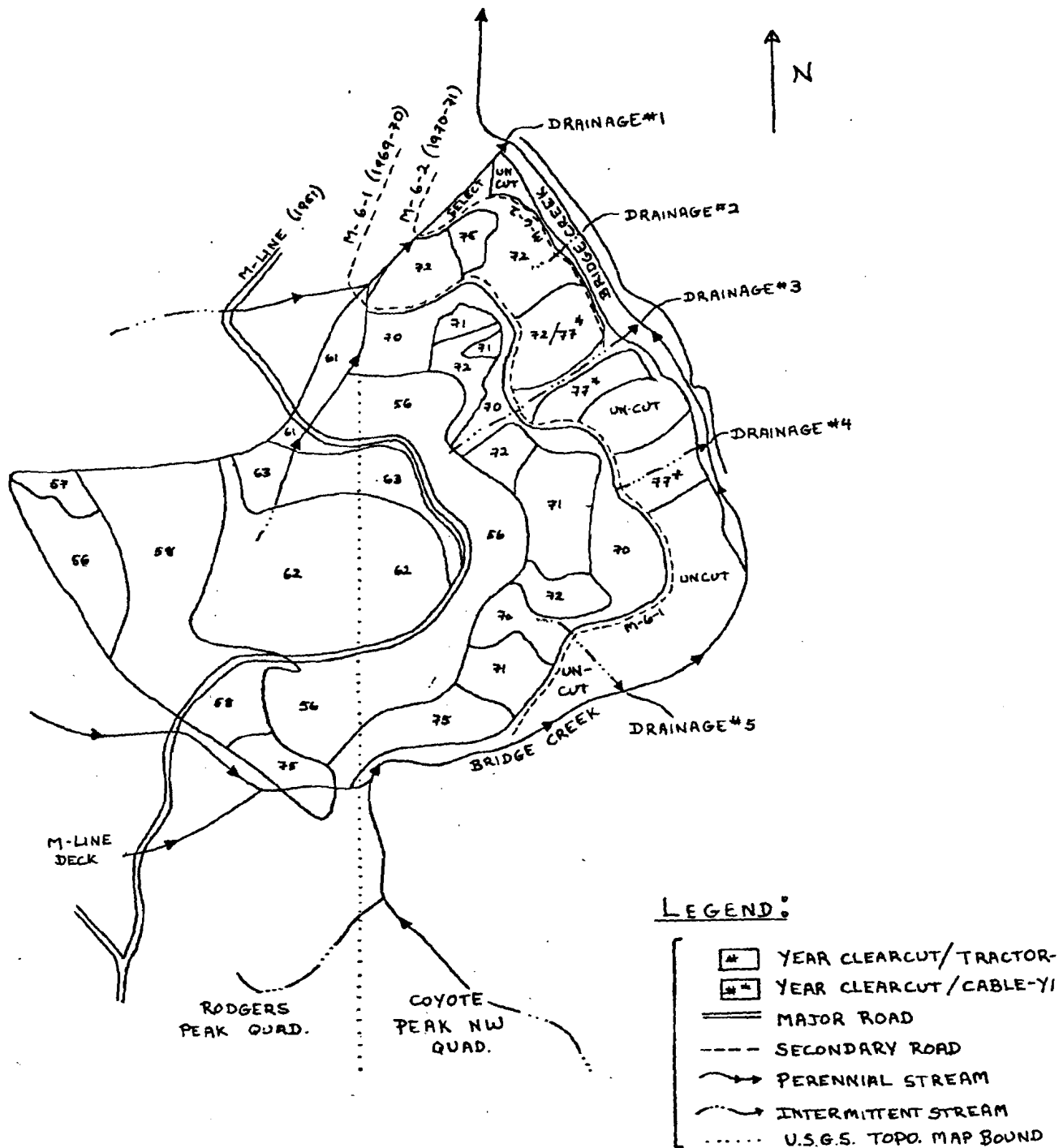
Both intermittent and perennial streams are found on this unit. Drainage #1 is a moderately to deeply incised, second-order perennial stream draining hillslopes from as far as Rodgers Peak. Once below the M-6-1 Road, its channels become deeply incised. Drainage #3 is the most incised intermittent stream with its incision beginning just downslope from the M-6-1 Road. The M-6-1 Road crosses Drainage #3 and all remaining intermittent streams at their lower swale regions. The M-6-2 Road is below the last major break-in-slope of the hillside, and crosses moderately to deeply incised drainages.

Chronology of Road Construction and Timber Harvest

As has been the case in the Redwood Creek basin, the upper hillslope areas were roaded and logged first leaving the more difficult areas - steep terrain - for later harvest. The M-Line, constructed in 1951, provided access to timber above and immediately below the road. This major haul road was constructed almost entirely as a full bench road, and used road fill only to cross stream channels. The M-6-1 Road, constructed between 1969-1970, was also a full bench road for most of its length. Road fill was used to cross stream channels and to construct road prisms across steep hillslope areas. The M-6-2 Road was constructed between 1970-1971. Its alignment was low on the hillslope, and below the last major break-in-slope leading into the main stem of Bridge Creek. Approximately 30% of the M-6-2 was constructed of fill to cross stream channels and very wet, steep, landslide-prone hillslope areas.

The total area of this physiographic unit, which includes the hillslopes above the M-Line, approximates 980 acres (see Figure 2, page 4). Of this

FIGURE 2. AGE OF CUTS ON SITE 80-3⁺



⁺ DATA SOURCE : IN-HOUSE REPORT, R.N.P.

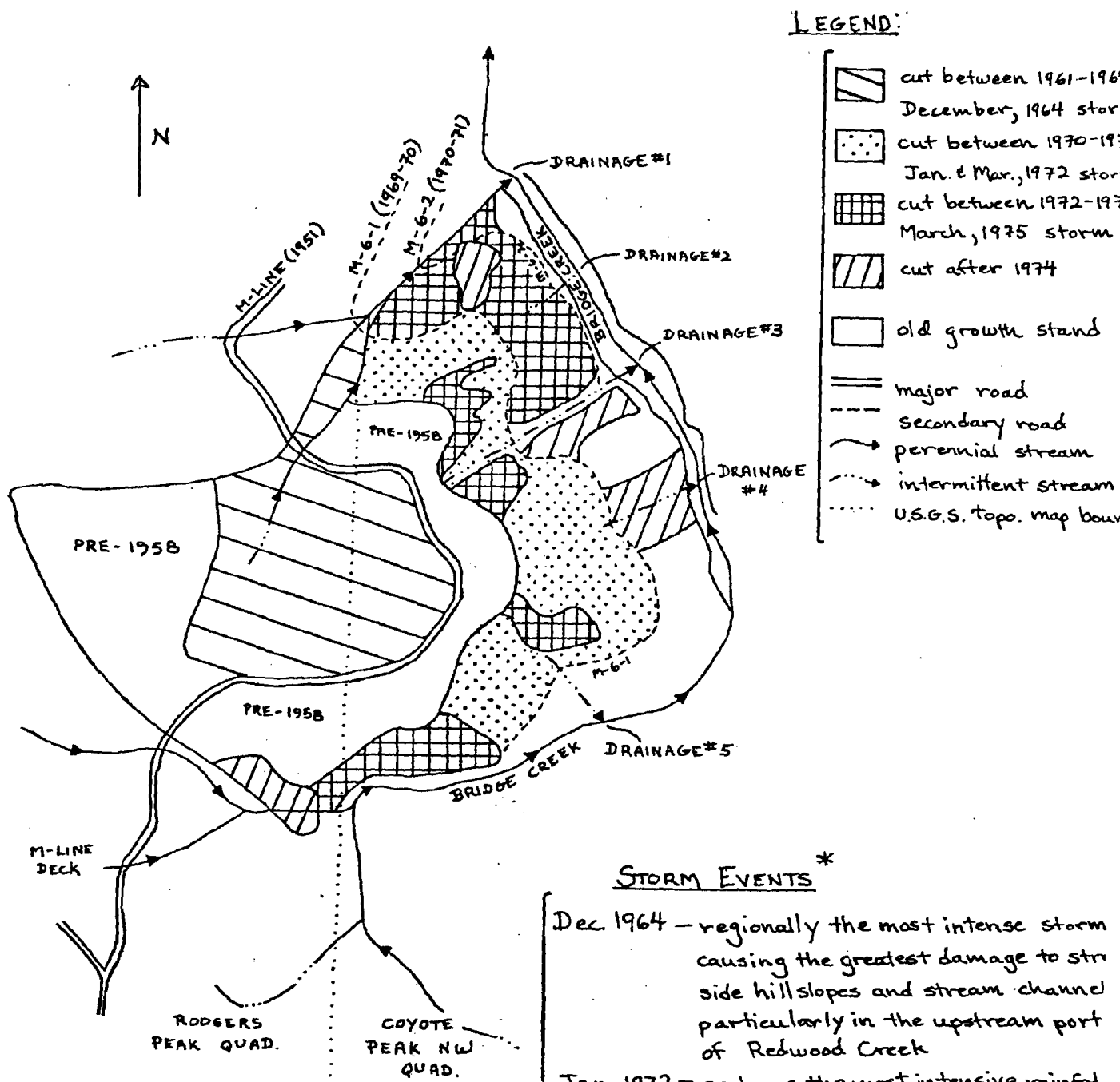
Chronology of Road Construction and Timber Harvest (cont'd.)

total acreage, approximately 50% was clearcut and tractor yarded in an eight year period between 1956-1963. Approximately 30% was clearcut and tractor yarded in a three year period between 1970-1972. The more recent clearcuts, between 1975-1977, accounted for another 10% of which 50% were tractor yarded. Only 10% of this unit remained as old growth or selectively cut stands.

Timber Harvest and Storm Events

The timing of timber harvest, large scale disturbances to hillslopes and stream channels from tractor activity, and road construction have all contributed to the development of erosional problems on this unit. Figure 3, page 6, combines the timing of timber harvest on this unit with storm events in the Redwood Creek basin. A striking feature is the amount of land logged three to four years prior to major storm events. In terms of erosional problems found on this unit, the 1964 storm was perhaps the least damaging of all recent storm events. This storm triggered culvert and road failures along the M-Line, which formed and/or initiated the hillslope gullies below the road. The greatest damage to hillslopes and especially to stream channels occurred with the 1972 and 1975 storm events. It was during this time that logging activity moved farther down the hillslope and entered stream channels.

FIGURE 3. LOGGING HISTORY AND STORM EVENTS: SITE 80-3



SCALE 1:24000

* Janda, 1978
Open File Report 78-480

EROSIONAL PROCESSES AND SEDIMENT SOURCE AREAS

Rills and Gullies

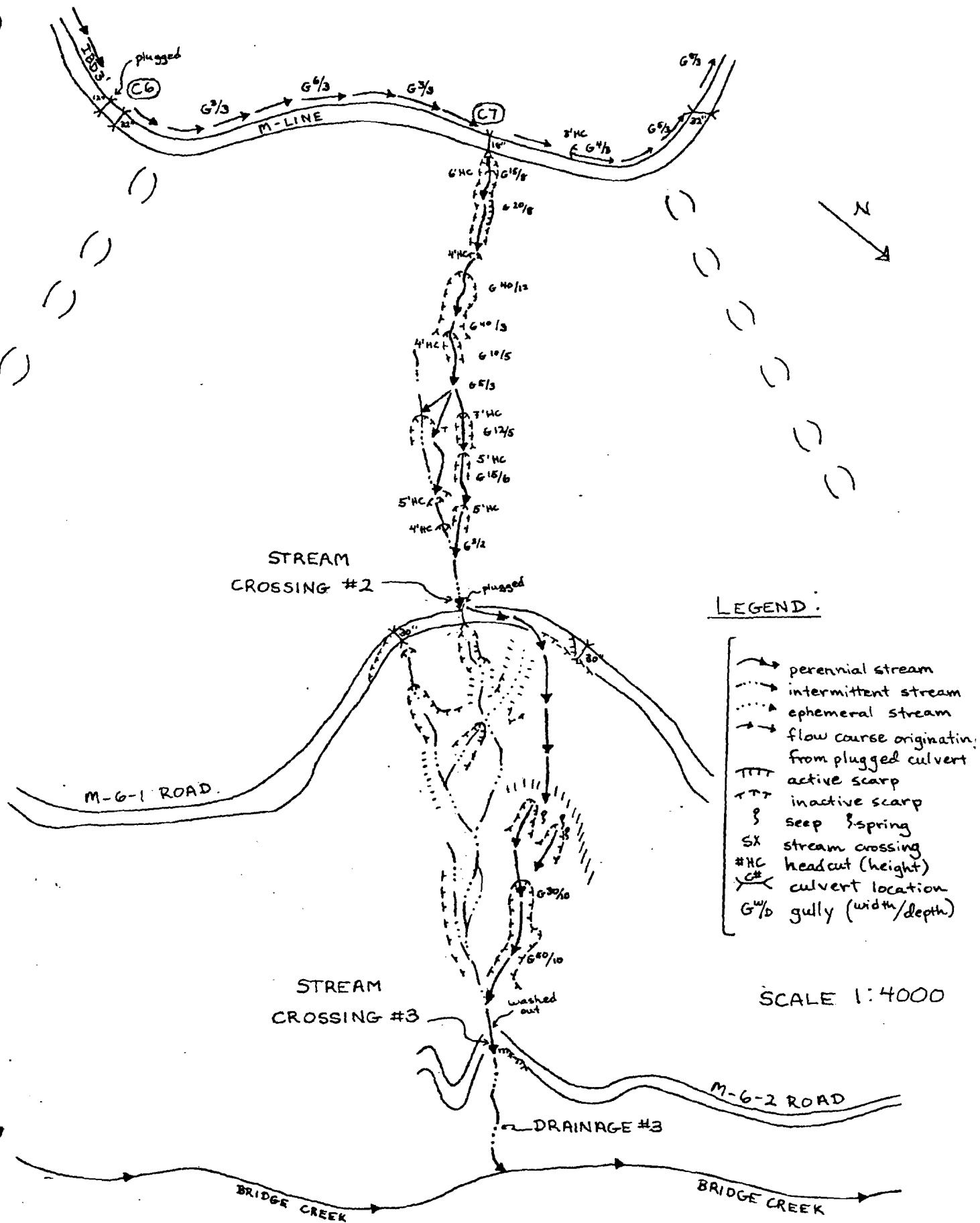
Show me a skid trail cut low on the hillslope and I'll show you a rill and/or gully. Skid trails are found throughout hillslope regions of this unit with cuts ranging from 2-4 feet deep. On lower hillslope and in swale regions, skid trail cuts intercept groundwater and convey this water with storm, surface-generated runoff downslope forming rills and gullies. Many skid trails have never been water barred, and dendritic drainage patterns of rills and small gullies have formed. Relative to other erosional features on this unit, skid trail rills and gullies have played a smaller role in contributing sediment to tributary streams.

Improper culvert size and placement frequency along haul roads pose a more serious threat to gully erosion. Within this physiographic unit, hillslopes above the M-Line are drained by eight culverts, Culverts 3 through 10 (see Figure 1, page 2). Culverts 3, 6, and 10 are old, 12-inch diameter, failed culverts which were buried in the road bed, and have been replaced by 30-36 inch diameter culverts with trash racks. Culvert 4 has also plugged in the past and is likely to be a more recent addition along with Culverts 8 and 9. Severe gully erosion downslope from Culverts 5 and 7 has contributed a large amount of sediment to tributary streams, and is due to uproad culvert failures. The effects of gully erosion below culverts can be transmitted downslope to other culvert locations. For example, Culverts 6 and 7, M-Line, provide a possible scenario explaining the hillslope gully erosion found downslope of the M-6-2 Road (see Figure 4, page 8). Culvert 6 failed and sent its water to Culvert 7. The increased flow gullied a course downslope which initially paralleled Drainage #3, but merged with the stream just above the M-6-1 Road. Streamflow, exceeding culvert capacity, with high bedload concentrations and float debris plugged the culvert at Stream Crossing #2, M-6-1 Road. The plugged culvert diverted streamflow down and across the road, causing severe gully erosion to the lower hillslope. Severe gully erosion has also taken place downslope of Culvert 10, M-Line, but is more a result of stream diversion than of uproad culvert failures.

Stream Crossings

Prior to treatment, most stream crossings on the M-6-1 and M-6-2 Roads appeared stable. The exceptions were Stream Crossings #4, M-6-1, and #3, M-6-2 Road. Stream Crossing #4, an intermittent headwater channel, was actively slumping due to saturation of the road fill. Stream Crossing #3 had previously failed, depositing its fill material and organic debris just downstream from the crossing.

FIGURE 4. GULLY EROSION ORIGINATING FROM CULVERT 7



Stream Channel Degradation

All headwater regions of streams draining this unit were extensively damaged by tractor activity. From a sediment standpoint, the stream channels of Drainages #1 and #3, above the M-6-1, were the most severely impacted. Tractors crossed and closely paralleled these channels many times, and side-cast large volumes of earth, slash and logs into the streams. The stream reach below the M-6-1, in Drainage #3, was, and still is, the most actively eroding stream on this unit (see Figure 5, page 11). Its channel is heavily aggraded and contains small, yet frequent, debris jams which are storing sediment. Lateral cutting of the channel, and old and more recent stream-side slides occur along its entire reach. Undermined streamside vegetation is also common along this reach and has diverted the channel in two locations. Finally, a small sediment and debris jam, immediately downstream of Stream Crossing #3, M-6-2, would divert high flows into the left bank, undermining the toe of the fill-slope below the M-6-2 Road.

The following are streamflow observations of Drainage #3 made during the March 14, 1980 storm:

Total flow at M-6-1 = 15.5 cfs. (low turbidity)

Total flow at M-6-2 = 16.0 cfs. (very high turbidity)

Log Jams

Two log jams are located on Bridge Creek below this unit (see Figure 6, page 13). The upstream and largest jam encompasses approximately 12,000 ft² of channel, and has created a step in channel gradient of approximately 12 to 15 feet. An overflow channel has formed along its left bank and is eroding the toe of the hillslope causing streamside sliding. The downstream log jam encompasses approximately 3600 ft² of channel area, and is partly a result of Road Failure #1. Before treatment, high flows would be directed against the left bank causing streamside sliding.

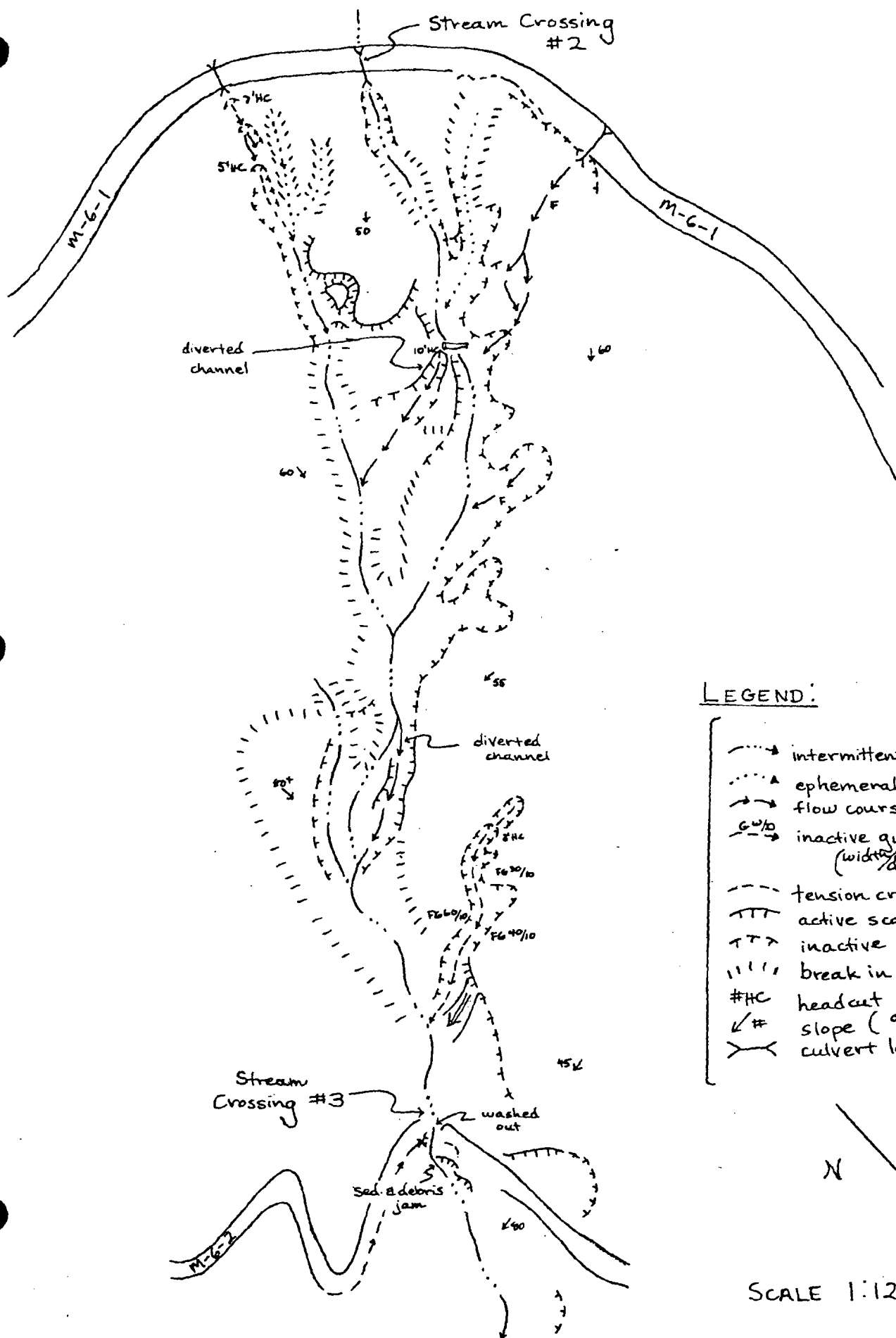
Mass Movement

Pre-logging landslides were visible on aerial photographs at the locations of Road Failures #2 and #3. Mass movement features at the locations of Road Failure #1, M-6-2, and Stream Crossing #2, M-6-1, appeared to be post-logging earthflow/landslide features. Road segments located at Road Failures #1 through #3 and around Stream Crossing #2, M-6-1, were all constructed using large volumes of fill. In addition, small log landings were constructed at Road Failures #1 and #3. Winter observations noted vertical displacements of 1 to 3 feet along the margins of Road Failure #3 and 1 foot displacements of the road segment around Stream Crossing #2, M-6-1.

Mass Movement (cont'd.)

From a sediment standpoint, Road Failure #3 and the M-6-1 Road segment on either side of Stream Crossing #2 are the most important and active mass movement features. Their failure mechanisms would only be aggravated by the moderate intensity, short duration storm events which are common to this area. The delivery of sediment to the system would be gradual. Total hillslope failures, delivering large volumes of sediment to streams, could result as a catastrophic event associated with less frequent, long duration storm events.

FIGURE 5. DRAINAGE #3 BELOW THE M-6-1 ROAD



EROSION CONTROL TREATMENTS

(see Figure 6, page 13)

Rills and Gullies on Skid Trails

Numerous rills and small gullies are found on skid trails which are cut across swales and lower hillslope areas. Most rills and gullies intercept groundwater and are fully developed; i.e., inactive features. Skid trails are also well vegetated with alder. For these reasons, the drainage patterns established by skid trail rills and small gullies which intercept groundwater were not treated and/or re-disturbed by equipment use.

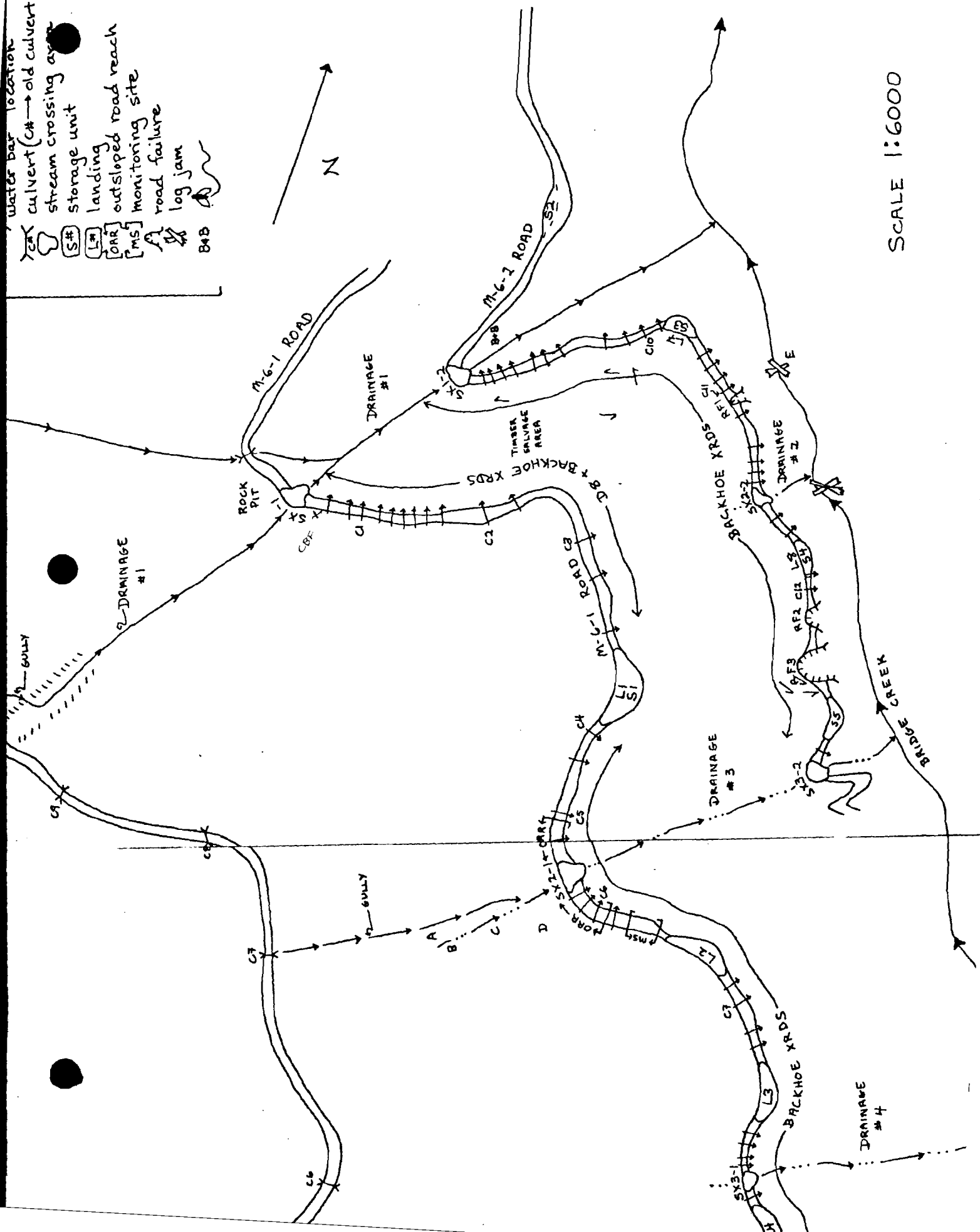
The following were labor intensive water bar treatments on surface fed skid trail rills and gullies: 1) three water bars were manually excavated on skid trails which drain onto Road Failure #3; 2) four water bars were manually excavated to disperse surface runoff on skid trails in the north-northeastern section of this unit.

Culvert Related Gullies

With the exception of a few isolated reaches, culvert fed gullies on the hillslope above the M-6-1 Road are inactive features, having downcut to either bedrock or basement material. The gullies downslope of Culverts 5 and 7, M-Line, are related to up-road culvert failures. Today, inboard ditches along the M-Line are no longer downcutting and trash racks are constructed at every culvert inlet. In addition, hillslope areas above the M-Line are revegetated with conifers. Assuming no future culvert failures, the peak flows which formed these gullies should not reoccur.

Two labor intensive treatments were prescribed for treatment of these culvert-related gully features. First, a channel (Site A) was manually excavated to de-water the lower reach of the gully downslope from Culvert 7, M-Line, delivering gully flow to the channel of Drainage #3. Here, slash dams (i.e., crude check dams) were constructed in the diversion channel from on-site material. Secondly, a 36-inch diameter culvert with downspout was added to the M-Line in the natural stream course of Drainage #1. This re-established a natural drainage course and de-watered the active gully below Culvert 10, M-Line.

- water bar location
- culvert (CA → old culvert location)
- stream crossing area
- storage unit
- landing
- outslotted road reach
- monitoring site
- road failure
- log jam
- BAB



SCALE 1:6000

Drainage #1 Above M-6-1 Road

No treatment was necessary for this stream channel. Tractor-constructed stream crossings have washed out; crossings have downcut to original streambed material.

Drainage #3 Above M-6-1 Road

This is the headwater region for Drainage #3. Prior to logging, there was probably little incision to the channel in this reach. Today, the channel appears to be an inactive gully which has downcut through a series of skid trails as a result of increased surface runoff from surrounding hillslopes and from Culvert 7, M-Line. Bedrock and basement material are exposed throughout most of the reach, and organic debris loading is high. Stream-side areas are well vegetated with alder, young conifers, and ground cover species.

The following are labor intensive treatments prescribed to control erosion in this stream reach: 1) energy dissipation (Site B) in the form of slash was anchored to the channel and was installed in an active headcut downstream from the confluence of Site A; 2) Site D was manually excavated to increase channel capacity and to deactivate an overflow channel which feeds a gully system. Bank protection in the form of rock and debris was installed along the right bank of Site C and Site D.

Drainage #3 Below the M-6-1

This lower reach between the M-6-1 and M-6-2 Roads is a high sediment source area. Major sediment sources, however, are no longer on the streamside hillslopes but are in the stream channel itself. Channel erosion of this stored sediment is the primary source of sediment today. No treatment is prescribed at this location because it is inaccessible to equipment and the downstream reaches of the stream would be severely impacted should large volumes of stored sediment be released.

Secondary sediment sources are two channel diversions within this reach (see Figure 5, page 11). The upstream channel diversion is downcut to a grade consistent with the abandoned channel's grade. Only the left bank remains oversteepened. No treatment is prescribed for this channel diversion because even if equipment could access this area, it would be extremely difficult to retrieve and maintain the original flow course due to the depth of downcutting at the point of diversion. The second, downstream channel diversion is not treated for similar reasons.

Drainage #3 Below M-6-2

A small debris-sediment jam was located immediately downstream of Stream Crossing #3, M-6-2. The jam diverted high flows against the left bank, undermining the fill-slope above it (see Figure 7, page 16).

The following treatments were prescribed at this site: 1) key logs were removed and stored slash and sediment were excavated from the channel leaving upstream logs keyed into the banks as a base level for the upstream reach; 2) spillways were cut into these keyed-in logs to direct flow towards the center of the channel; and 3) energy dissipation was installed in the form of large slash placed at the base of keyed-in logs to prevent them from being undermined.

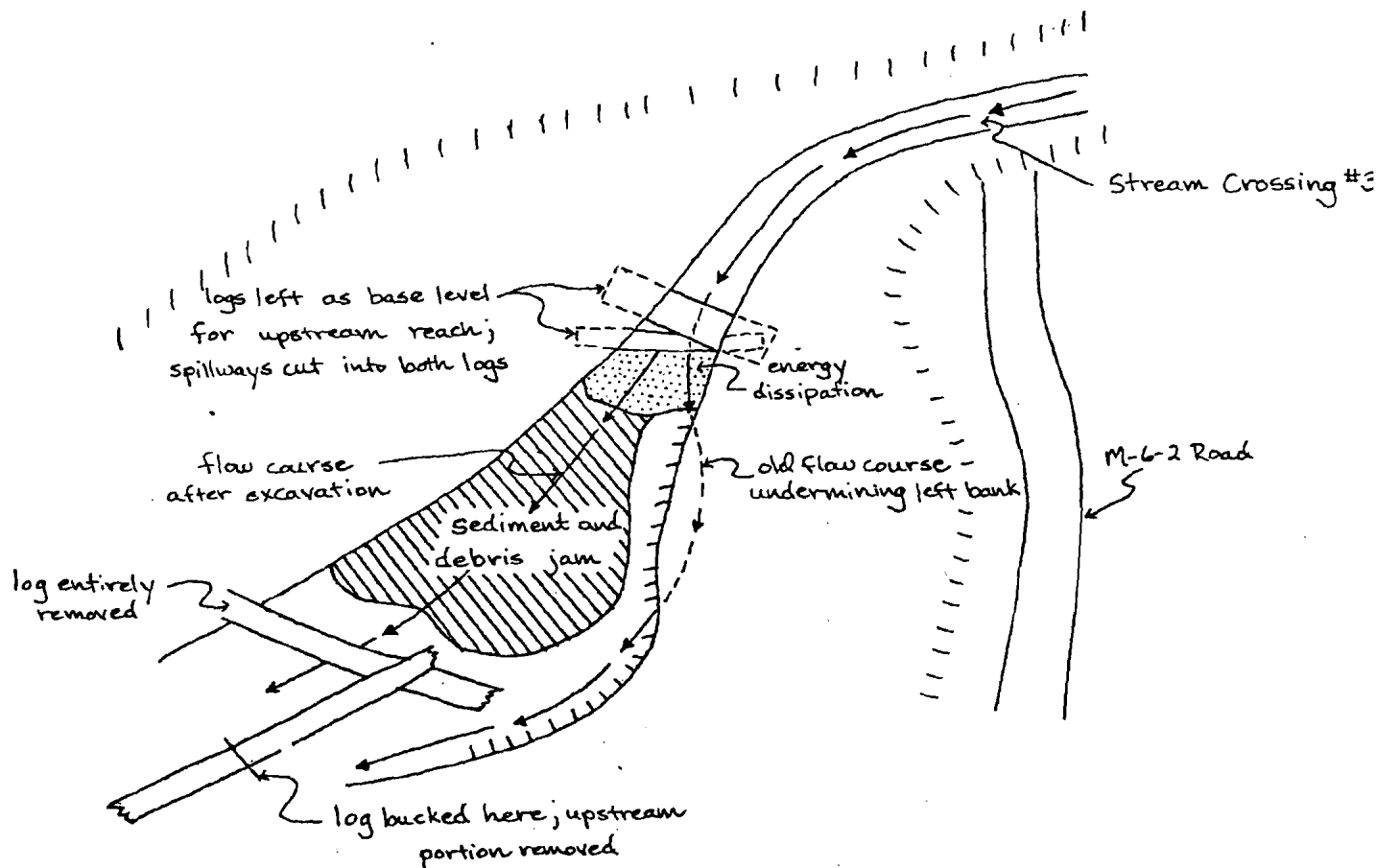
M-6-1 and M-6-2 Roads

Minimum treatments were prescribed for both the M-6-1 and M-6-2 Roads. Treatments included ripping road surfaces, excavating stream crossings (see below) and draining inboard ditch and spring areas with cross-road drains. Initially, both roads were scheduled to be ripped, however, reoccurring equipment breakdowns precluded the ripping of the M-6-2 Road. Only the M-6-1 Road was ripped. Outsloping was not prescribed as an erosion control treatment for either road. However, a 120-foot segment of the M-6-1 Road was outsloped for Technical Services to develop an experimental plot testing mulch application rates.

Stream Crossings

Erosion control treatments for stream crossings along the M-6-1 and M-6-2 Roads included excavating stream channels down to original streambed level, pulling back channel sideslopes as much as possible, armoring streambeds to prevent downcutting, and mulching and revegetating channel sideslopes. Straw and jute netting were prescribed for the left bank of Stream Crossing #3, M-6-2, where sideslopes could not be pulled back to angles $\leq 50\%$. Rock was prescribed as channel armament for all but two stream crossings. Check dams were prescribed for two headwater stream channels of Stream Crossings #3 and #4, M-6-1 Road, and for the cross-road drain location C12, M-6-2 Road. The latter location was an old culvert site, draining two gullies which intercepted groundwater and were very responsive to rainfall.

FIGURE 7. SEDIMENT AND DEBRIS JAM
BELOW STREAM CROSSING #3, M-6-2 ROAD



*

taken from field sketch, March 14, 1979

Road Reach - Stream Crossing #2, M-6-1 Road

This portion of the M-6-1 Road is constructed mostly of fill material. It crosses the hillslope at a break-in-slope, just above an area of high drainage density that is prone to accelerated soil creep and/or landsliding. The inter-valley hillslopes just downslope from the road are torn with recent and active scarps. Leaning and fallen timber is present throughout this area. As mentioned earlier, this road segment, on either side of Stream Crossing #2, slumped approximately 1 foot during the mapping season. This movement is probably a result of hillslope loading from road fill material, drainage alteration, and the loss of structural support in the hillslope caused by the lateral cutting of Drainage #3.

This road reach was treated as follows: 1) the hillslope was unloaded by excavating and end-hauling road fill material; and 2) hillslope runoff at the road was re-distributed by fully excavating and armoring cross-road drains and by utilizing abandoned natural stream channels to circumvent Stream Crossing #2 and the reach of Drainage #3 just below it.

Road Failure #1

Possibly pre-conditioned by the 1972 storm event, this road and streamside hillslope failed entirely in 1975. The sequence of events leading to this failure was not clear. The slide track and adjacent hillslopes were traveled, but not extensively, by tractors. From slide debris along the margin of the track, and cuts in the hillside immediately above the road, it appears that a small log landing was also constructed at this point. Field mapping has identified a series of old scarps which cross the hillslope, and appear inactive; however, there has been significant movement in the road since its construction in the early 1970's. Culvert 11, located just 60 feet to the north, recorded the cumulative movement of the road prism. While excavating this culvert, it was found that the lower half section had been sheared off at a coupling and had been offset by almost 5 vertical feet. In any case, the slide left an oversteepened crown scarp which was simply pulled back and outsloped. The slide track was well vegetated with alder, and no other treatment was prescribed. (see Log Jams, page 18).

Road Failures #2 and #3

This segment of the M-6-2 Road was constructed using large volumes of fill across steep (40-50%), wet slopes and neighboring inter-valley swales. Aerial photographs taken prior to the logging of this area showed both locations having an accelerated soil creep and/or landslide history. Since construction of this road, the north and south margins of Road Failure #2 have slumped 3 feet and 6 feet respectively. The north and south margins of Road Failure #3 have slumped 7 feet and 12 feet respectively. Physiographically, these road failures were separated by a ridge; however, lateral scarps extended from Road Failure #3 into Road Failure #2, linking both hillslope areas.

Road Failures #2 and #3 (cont'd.)

Similar treatments were prescribed for Road Failures #2 and #3, and included:

1. unloading the hillslopes of landing material by winching logs to a stable storage unit,
2. unloading hillslopes of road fill material by excavating and end-hauling fill to a stable storage unit (see Table 1, page 24),
3. improving hillslope drainage by:
 - a. identifying surface and groundwater source areas and excavating channels to contain these sources (see Appendix A, page 55),
 - b. constructing check dams in newly excavated channels to prevent downcutting in these saturated, slump-prone soils,
 - c. outsloping for drainage when practical,
4. mulching and revegetating these areas as soon as possible after treatment.

Landings

With the exception of Landing #6, all landings in close proximity to stream channels appeared stable. Active slumping was identified on the over-steepened south slope of Landing #6, and sidecast material was retrieved by an excavator. A general treatment prescribed to all landings was ripping and minimum outsloping to improve drainage. Two outsloping techniques (see Landings, page 23) were used; the chosen technique was dependent on whether or not the treated landing was a storage unit for end-hauled fill material. Landings #2-#4 were outsloped using the quartering technique, while end-hauled fill was used to outslope Landings #1, #7, and #8.

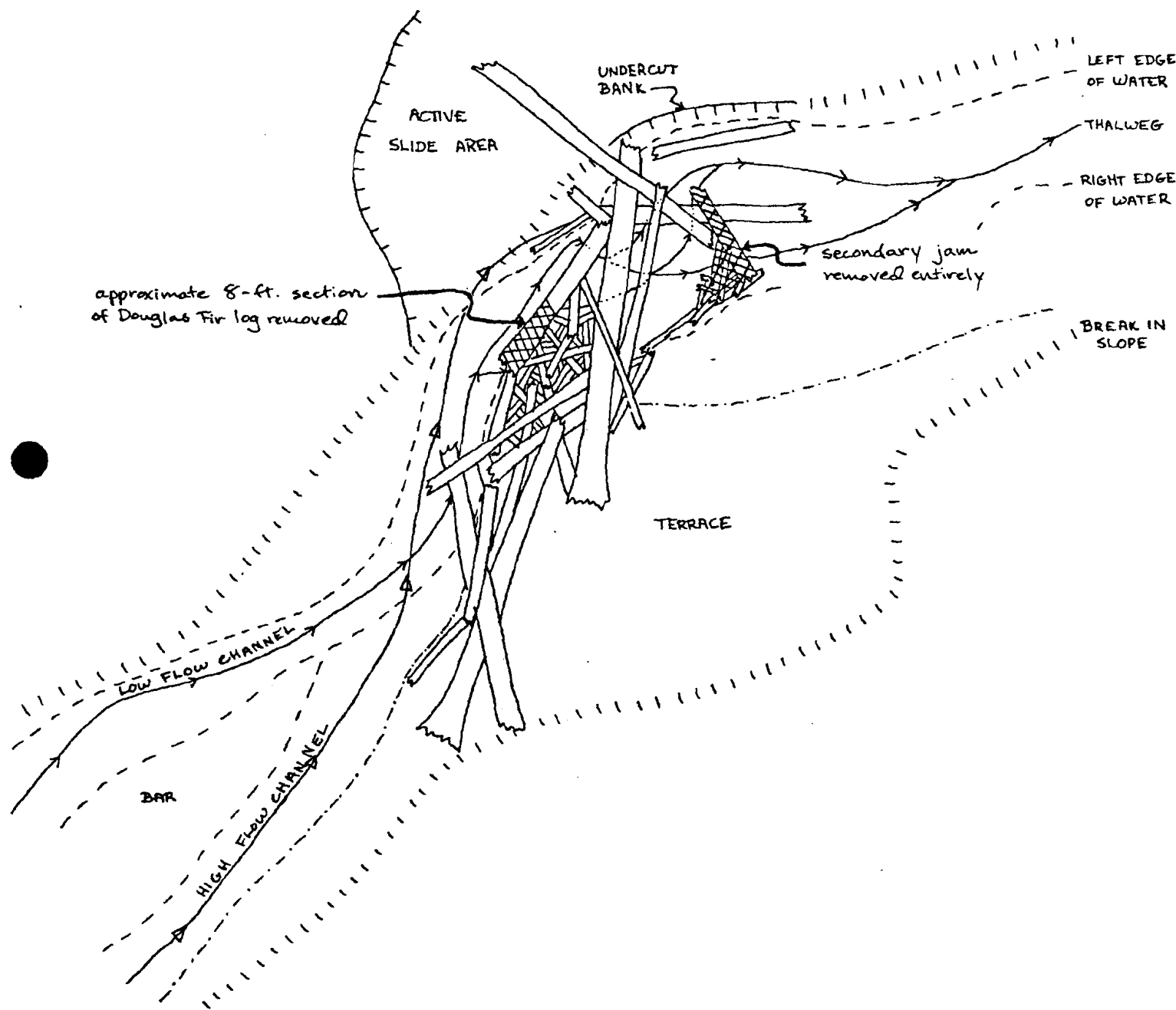
Bridge Creek Log Jams

Anyone familiar with the large upstream log jam will realize the futility of trying to remove this feature. No treatment was prescribed. The downstream log jam, downslope from Road Failure #1, was a bit more treatable. During high flow regimes, a single log spanned the channel, and directed streamflow into the left bank (see Figure 8, page 20). Just downstream, a second jam, composed of float debris and no stored sediment, also encouraged streamflow into the left bank. The result was active streamside sliding into Bridge Creek.

Bridge Creek Log Jams (cont'd.)

Treatments prescribed to control streamside erosion at the downstream log jam site include: 1) the removal of an 8-foot section of the Douglas-fir log which encouraged streamflow towards the left bank; and 2) removal of the entire float debris jam.

FIGURE 8. MORPHOLOGIC MAP OF BRIDGE CREEK LOG JAM - SITE E



* taken from field survey map by John Pitlick, July 1980

PART II. HEAVY EQUIPMENT APPLICATION AND COST BREAKDOWN

EQUIPMENT LIST

Contractor	Equipment (operator included)	Cost/Hour
Carl Kjer and Sons	22B Bucyrus Erie crane with clamshell and dragline buckets	\$85.00
Keith Parker and Son	Case 580 B extendahoe	\$32.40
	CAT 955 track- mounted loader with 4:1 bucket and winch	\$37.80
	Case 680-extendahoe and CAT 955 track-mounted loader combination	\$56.00
	10 cu. yd. dump truck (#1)	\$32.74*
	10 cu. yd. dump truck (#2)	\$32.74*
Marvin McGaughey	International TD 15 crawler tractor with winch	\$40.00
Dutra Trucking	CAT D8 crawler tractor with winch, hydraulic 6-way blade and ripping teeth	\$75.00
Ted's Construction	Case 880 hydraulic excavator	\$69.50

* paid engine time only

EQUIPMENT APPLICATION

Stream Crossing Excavations

Two types of stream crossings were found on this rehabilitation unit. The first type contained large volumes of fill which were end-hauled because of inadequate storage at the excavation site. The second type of stream crossing contained relatively small volumes of fill and ample storage was available. Table 1 (see page 24) lists the storage units for end-hauled excavations. End-hauled stream crossings entailed the use of a crane to excavate fill material and load dump trucks, two trucks to transport material from the excavation site to the storage unit, and a tractor or loader at the dump site to work the spoil pile. Most storage units, especially those on the M-6-2 Road, were small and required the constant attention of a tractor or loader to maintain a driveable surface for dump trucks. Stream Crossing #2 on the M-6-1 Road and all stream crossings on the M-6-2 Road utilized this end-hauling process. Stream Crossings #2 and #3 were excavated with a 680 backhoe and 955 loader. Stream Crossing #4 on the M-6-1 Road was completed with only a hydraulic excavator.

In an attempt to minimize sediment introduced to streams during stream crossing excavations and to maintain dry working conditions, streamflow was diverted prior to the excavation of both perennial Stream Crossings #1 on the M-6-1 and M-6-2 Roads. A temporary diversion dam was constructed just upstream from the road at both locations and the streamflow was gravity fed through an 8-inch diameter plastic pipe, buried above and adjacent to the prospective channel excavation. Once the stream crossing excavation and rocking were complete, the diversion dam and pipe were removed, releasing streamflow into the new channel.

Rock Preparation

The rock source for this rehabilitation unit and for Site 80-6 was the rock pit located on the M-6-1 Road (see Figure 6, page 13). A 955 loader was used to quarry and sort approximately 300 cu. yds. of rock. Dump trucks, also loaded by the 955, transported rock to all stream crossings which were slated for rocking. This phase of rock development and transport was completed before other pieces of equipment were delivered to the unit. At first, the rock pit appeared to have an adequate supply of rock already developed. Therefore, our initial approach required the loader to gather and sort rock while two dump trucks were out delivering the rock to specified areas. In reality, the pit did not have enough developed rock. The

Rock Preparation (cont'd.)

dump trucks were shut down one day to allow the loader (assisted by a backhoe) to quarry, sort, and stockpile rock. Towards the completion of this project, a D8 ripper tractor spent approximately two hours in the pit preparing a supply for future projects.

Rocking of Stream Crossings

Rock was placed into the excavated stream channels with a 680 backhoe at Stream Crossings #1 and #2 on the M-6-1 Road. At Stream Crossing #1, M-6-2 Road, a crane with clamshell bucket assisted the backhoe by lowering large rock into the excavated channel and placing the rock within reach of the backhoe for final placement. All rock placed by equipment was placed in a check dam fashion with the larger diameter rock (18 inches - 24 inches) along the channel banks. Smaller diameter rocks (6 inches - 10 inches) were spread between all rock check dams.

Storage Units

Material excavated from stream crossings, road failures, and from outcropping the M-6-1 Road (see Figure 6, page 13) was end-hauled to the storage units designated below.

TABLE 1. END-HAULING STORAGE UNITS

Excavation Site	Storage Unit (S#)
M-6-1:	
Stream Crossing #2	S1
Monitoring Site	S1
Outsloped Road Reach	S1
M-6-2:	
Stream Crossing #1	S2
Stream Crossing #2	S3
Stream Crossing #3	S5
Road Failure #2	S4
Road Failure #3	S3, S4

Road Treatment

The prescribed treatments for both the M-6-1 and M-6-2 Roads included the removal of all culverts, the ripping (decompacting) of road surfaces, and the development of cross-road drains. All road culverts were excavated, transported, and loaded into dump trucks by the 680 backhoe, and were removed when they were encountered in the road treatment process. Culverts could not be removed en masse because most were still carrying water at the time of equipment operation and end-hauling was used extensively.

A D8 ripper tractor was hired to rip all roads on both this rehabilitation unit and on Site 80-6. The tractor repeatedly broke down on both units and was not always available when needed. As a result, only the M-6-1 Road was ripped. The average ripping depth was 24 inches.

Three techniques were used to excavate cross-road drains on the M-6-1 and M-6-2 Roads...and so, the story unfolds. Initially, a Case 880 hydraulic excavator was hired along with a 955 loader to excavate culverts, cross-road drains and smaller stream crossings, and to place rock in all crossings. The excavator's operator was found to be irresponsible, and the rental agreement for the excavator was terminated. In its short period of employment, the unassisted excavator placed 10 cross-road drains on the M-6-1 Road--alas, the first cross-road drain technique! (see Figure 6, page 13). Once the excavator was terminated, a new rental agreement was signed with the loader operator which included a 680 backhoe. One operator would operate either piece of equipment as needed. The second cross-road drain technique utilized this new equipment combination to excavate 68 cross-road drains. The third technique utilized the D8 ripper tractor to perform the preliminary excavation on 14 cross-road drains on the M-6-1 Road. The tractor excavated the bulk of road material, leaving only the inflow and outflow of each drain for the backhoe to complete.

Landings

To improve surface drainage, all landings on the rehabilitation unit were outsloped using one of two methods. The first method involved a "quartering" process in which 1) a D8 tractor ripped and bladed material from the outer edge of the landing toward the cutbank, 2) an excavator or backhoe retrieved the small berm left along the outer margin and 3) a 955 loader shaped and graded the final outsloped region. The second method utilized a tractor to blade and outslope fill material end-hauled to the landing. Landings #2-#6 were outsloped using the first method, while the second method was applied to Landings #1, #7, and #8.

Road Failures #2 and #3

Road Failure #2 was simply excavated by a dragline crane and the removed material was end-hauled to Storage Unit 4 by dump trucks. As in all end-hauling applications on this unit, a TD15 tractor was kept at the dump site to grade the spoil and maintain a driveable surface for dump trucks. The tractor was brought to the excavation site on occasion to winch logs exposed during the excavation.

Road Failure #3 was an exercise in road construction and removal. In order to gain access to the slide and to Stream Crossing #3, the original road had to be reconstructed across the landslide (RF3). The 955 loader with a 4:1 bucket was used instead of a dozing tractor. The loader was chosen because it could remove road fill from stable road reaches, scoop the fill in its bucket, and transport the fill to where it was needed. The landslide was not cut into in order to obtain fill. Once the road was reconstructed to the southernmost margin of the slide, the TD15 was used to doze stable road fill to the loader. Together, they placed a 12-inch culvert, developed an inboard ditch to drain the wet hillslope and graded the road surface for dump truck traffic. Concurrent with road work, a labor crew felled all alder on the 3/4-acre slide in order to improve visibility for the dragline crane, and to improve safety conditions for the TD15 which was to operate on the slide, above the road. Stretching a long "hay line" across the slide that was attached to the TD15 winch, labor crews tossed the downed alder onto the hay line, wrapped it into a large bundle and winched the bundle from the slope. Once the alder was removed, the TD15 and labor crew began winching landing debris from the lower slopes of the slide. The TD15 constructed a second road accessing this area. This second road, cut from fill material on the slide, also provided access for the crane to excavate material which was out of its reach from the first road.

An original approach to the treatment of Road Failure #3 utilized the crane to remove all fill material including both roads from the upper road. The TD15 would then doze the upper slide block down, grading the hillslope uniformly. To borrow an old cliché, "Hindsight is always better than foresight." After the crane removed all fill and both roads from the slide, it was realized that the upper slide block was too wet and unstable for the TD15 to operate safely. A third road had to be constructed higher on the landslide than the original road and required some of the material already end-hauled to be brought back for road fill. Once again, the crane was brought in to remove the remaining slide block. Channels to drain spring areas were then excavated by a 580B backhoe, with the assistance of the TD15 to position the backhoe on the landslide.

COST SUMMARY - HEAVY EQUIPMENT WORK

Includes all heavy equipment costs for this phase of rehabilitation in Bridge Creek: Site 80-3, M-6-1 and M-6-2 Roads.

Rock Development	\$ 1745.47
Culvert Removal	\$ 2530.36
Timber Salvage	\$ 708.44
Ripping of Roads: M-6-1	\$ 1012.50
Shaping of Landings: M-6-1	\$ 3698.00
Cross-Road Drains	\$ 3623.25
Stream Crossing Excavations	\$21922.79
Rock Placement in Stream Crossings	\$ 1451.70
Road Failures	\$24500.11
Road Reach, M-6-1 Road	\$ 6916.58
Monitoring Site Excavation	\$ 2442.72
Miscellaneous Costs	<u>\$ 6331.39</u>
Total	<u>\$76883.31</u>

TABLE 2. EQUIPMENT WORK ITEMS AND UNIT COST

Item	Quantity	Cost	Unit Cost
Rock Development	170 cu.yds.	\$ 1745.47	\$ 10.27/cu.yd.
Ripping of Roads	1.8 miles	\$ 1012.50	\$ 562.50/mile
Landings:			
outsloped	3 landings	\$ 2504.50	\$ 834.83/landing
retrieved and outsloped	1 landing	\$ 1193.50	\$1193.50/landing
Cross-Road Drains:			
excavator	10 drains	\$ 868.75	\$ 86.87/drain
955 & 680 combo	68 drains	\$ 2016.00	\$ 29.65/drain
680 & D8	14 drains	\$ 523.50	\$ 37.39/drain
Stream Crossing Excavations:			
end-hauled	5950 cu.yds.	\$19365.54	\$ 3.25/cu.yd.
not end-hauled	875 cu.yds.	\$ 2557.25	\$ 2.92/cu.yd.
Rock Placement:			
955 & 680 combo	75 cu.yds.	\$ 504.00	\$ 6.72/cu.yd.
680 & crane	60 cu.yds.	\$ 947.70	\$ 15.79/cu.yd.
Road Failures: (end-hauled)			
R.F.#2	1190 cu.yds.	\$ 3154.80	\$ 2.65/cu.yd.
R.F.#3	4510 cu.yds.	\$21261.31	\$ 4.71/cu.yd.
Road Reaches: (end-hauled)	3800 cu.yds.	\$ 9359.30	\$ 2.46/cu.yd.

DAILY EQUIPMENT HOURS ON WORK SITES

Introduction to Table 3

The cost breakdown which follows is derived from information contained in Table 3. The table, assembled from field notes, identifies daily work sites and the time spent at each work site for every piece of equipment. The volume of fill excavated by the crane each day is also listed, and can be found in the center of the crane's column. Finally, equipment worked 10-hour days without formal breaks, and were paid for 1/2-hour lunch periods.

Abbreviations and Symbols Used in Table 3

- a number preceeding a letter(s) - number of hours worked
- a number following a letter(s) - specific work site
- a number following a dash - road location (M-6-1 or M-6-2)
- R - relocation time
- SP - paid standby (1/2 equipment cost)
- S - standby (full time)
- SX - stream crossing
- RSX - rock placement at crossing
- XRD - cross-road drain
- RXRD - rock placement at cross-road drain
- RF - road failure site
- L - landing
- ORR - outsloped road reach
- ms - monitoring site
- d.s. - dump site
- ERA - equipment rental agreement
- Rock - quarrying and/or transportation of rock
- c.a. - cleared alder
- ⌢ - removed culvert
- ⌢ T - transported culvert
- w.l. - winched logs
- log T - transported logs

TABLE 3. DAILY EQUI

Date (1980)	955	955 & 680	Dump #1	Dump #2
July 7	Open M-6-1 4 Open M-6-2 5 1R	-	-	-
July 8	Rock 80-3 10	-	Rock 80-3	-
July 9	Rock 80-3 5 80-6	-	-	-
July 10	Rock 80-6	-	Rock 80-6	Rock 80-6
July 11	Rock 80-6	-	Rock 80-6	X T 80-3 1 Rock 80-6
July 14	Rock 80-3 7 80-6	-	Rock 80-3 5½ 80-6	-
July 15	RF3; road 5½ L6-H.E. assist 5	-	-	-
July 16	L6 7½ 2½R	-	SX3-2 6 3S	-
July 17	SX3-2 5	-	SX3-2 10	-
July 18	SX3-2 5	-	SX3-2 10	-
July 21	ERA now includes 680 →	SX3-2 3 RF3 3 4R	-	-
July 22	-	SX4-1 2½ XRD-1 6½ 1R	-	-
July 23	-	XRD-1 8½ X 1½	RF3 8 2S	RF3 8 2S
July 24	-	XRD-1 1 L4 8 1R	RF3 8½ 1½S	RF3 8½ 1½S
July 25	-	L4 3 SX3-1 6 1R	RF3 8½ 1½S	RF3 8½ 1½
July 28	-	SX3-1 10	RF3 10	RF3 10
July 29	-	Sick	RF3 10	80-6
July 30	-	Sick	RF3 10	RF3 10
July 31	-	Sick	-	-
Aug. 1	-	SX3-1 7 XRD-1 3	RF3 8½ 1½S	-

NT HOURS ON WORK SITES

Crane			TD15		Excavator		D8	580B
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	rock 80-3 80-6
-	-	-	-	-	-	-	-	-
-	-	-	RF3; c.a.	7 2R	-	-	L6 rip M-6-1	4½ 3½ 1R
-	-	-	RF3; c.a. w.l.	7 3	-	-	L4 L3, L2 rip M-6-1	2 3½, 2 2½
-	-	-	RF3; road w.l.	4 6	L6	2½ 3½R	L2	2
SX3-2	150	6½ 3½S	RF3; w.l. SX3-2; d.s.	7½ 2½	L6	5½	-	-
SX3-2	370	8½ 1½S	SX3-2; d.s.	2½	XRD-1	9½ 1R	-	-
SX3-2	700	1½, 7½R	-	-	XRD-1 SX4-1	5½, 1½R	-	-
RF3	-	8 2S	RF3; w.l.	8½	-	-	-	-
RF3	-	9 1S	RF3; road w.l.	3 3, 4S	-	-	-	-
RF3	600	8 2S	RF3; d.s.	5 5S	-	-	-	-
RF3	460	8½	RF3; d.s.	5 5S	-	-	-	-
RF3	580	8½ 1½S	RF3; d.s.	5 5S	-	-	-	-
RF3	640	10	RF3; d.s.	5 5S	-	-	-	-
RF3	420	10	RF3; d.s.	5 5S	-	-	-	-
RF3	520	10	RF3; d.s.	5 5S	-	-	-	-
RF3	-	10 SP	RF3; slide road	5 5	-	-	-	-
RF3	320	8½ 1½S	RF3; d.s. road	8½ 1½	-	-	-	-

TABLE 3. DAILY EQU

Date (1980)	955	955 & 680	Dump #1	Dump #2
Aug. 11	-	2 >X< 3; 1 1/2 R XRD-1 1/2 L2 6 1/2	RF2 10 1/2	-
Aug. 12	-	3 >X< 7 XRD 1 Rock 2	SX2-2 3 1/2	SX2-2 3
Aug. 13	-	SX2-2 7 SX1-2 3	SX2-2 5 >X< T 2 SX1-2 3	SX2-2 5 >X< T 2 SX1-2 3
Aug. 14	-	SX2-2 2 XRD-2 6 1/2 RF1 1 1/2	SX1-2 10	SX1-2 10
Aug. 15	-	XRD-2 4 SX1-2; >X< 6	SX1-2 4, 4S >X< T 2	SX1-2 4, 4 >X< T 2
Aug. 18	-	SX1-2 6 RSX1-2 4	SX1-2 5 5 SP	SX1-2 5 5 S
Aug. 19	-	RSX1-2 5 SX1-2; d.s. 2 L2 2, 1R	SX1-2 4 materials 3	SX1-2 4
Aug. 20	-	>X< T 1 3 >X< 3 ms 5, 1S	>X< T 1 ms 8, 1S	ms 8, 1
Aug. 21	-	ORR; XRD 1 1/2, 1 1/2 S ORR; d.s. 7	ms 5 ORR 4, 1S	ms 5 ORR 4, 1
Aug. 22	-	>X< 2 ORR; d.s. 6, 2S	ORR 10	ORR 10
Aug. 25	-	XRD-1 1 SX2-1; w. l. 1 ORR; d.s. 8	ORR 6 1/2 SX2-1 3 1/2	ORR 6 1/2 SX2-1 3 1/2
Aug. 26	-	SX2-1; >X< 1 d.s. 9	SX2-1 9, 1S	SX2-1 9
Aug. 27	-	XRD-1 1 1/2 Rock 1 1/2 SX2-1; d.s. 7	SX2-1 5, 1/2 S ORR 4 1/2	SX2-1 5 ORR 4 1/2
Aug. 28	-	RSX2-1 4, 1S ORR; XRD 5	ORR 4, 3 1/2 S	ORR 4
Aug. 29	-	>X< 5 1/2 log T 2, 2 1/2 S	>X< T 2 1/2 logs T 3 1/2	>X< T 2 1/2 log T 3 1/2
Sept. 2	-	ORR; RXRD 2 >X< 2 XRD-1 6	-	-
Sept. 3	-	XRD-1 4 SX1-1 4, 2S	-	-

EQUIPMENT HOURS ON WORK SITES (CONT.)

	Crane	TD15	Excavator	D8
	RF2 650 9½ 1S	RF2; d.s. 5 5S	-	-
3½	SX2-2 320 3½	Storage 4; w.l. 9 SX2-2; d.s. 1	-	-
5 2 3	SX2-2 600 5,1½S SX1-2 300 3,½S	RF3; d.s. 4 SX2-2; d.s. 2½	-	-
10	SX1-2 610 10	RF3; d.s. 3 SX2-2; d.s. 2 SX1-2; d.s. 5	-	-
4,4S 2	SX1-2 400 4,4S >< 2	SX1-2; d.s. 5 5S	-	-
5 5 SP	SX1-2 400 6 RSX1-2 4	SX1-2; d.s. 1 log salvage 6½,1R	-	-
4	SX1-2 400 4 1R	-	-	-
8,1S	ms 800 8 1S	-	-	-
5 4,1S	ms 500 5 ORR 400 4,1R	-	-	-
10	ORR 800 8½ 1½S	-	-	-
6½ 3½	ORR 500 6½ SX2-1 300 3,½R	-	-	-
9,1S	SX2-1 410 9,1S	-	-	-
5,½S 4½	SX2-1 400 5,½R ORR 400 4½	-	-	-
4,3½S	ORR 400 7½	-	-	-
2½ 2	-	-	-	-
	-	-	-	SX2-1, ORR 3 rip 5,1R XRD 2½
	-	-	-	rip 2½ SX1-1 1

COST BREAKDOWN

Rock

Includes quarry and transportation costs for rock used at stream crossing excavations.

TABLE 4. ROCK DEVELOPMENT COSTS

Equipment	Hours	Cost/Hour	Cost
955	22	\$40.00	\$ 880.00
955 & 680	3½	\$56.00	\$ 196.00
580 B	5	\$32.40	\$ 162.00
Dump trucks	15½	\$32.74	<u>\$ 507.47</u>
Rock Volume $\approx$ 170 cu. yds.		Total Cost	<u>\$1745.47</u>

Culvert Removal

Includes the excavation and removal of culverts (excluding culverts at stream crossings) and transportation to the G-Line Deck.

TABLE 5. CULVERT REMOVAL COSTS

Equipment	Hours	Cost/Hour	Cost
955 & 680	37	\$56.00	\$2072.00
Dump trucks	14	\$32.74	<u>\$ 458.36</u>
Total Cost			<u>\$2530.36</u>

Timber Salvage

Includes the yarding, loading and transportation of approximately 7,200 board-feet of redwood logs and their transportation to the G-Line Deck (see Figure 6, page 13).

TABLE 6. REDWOOD SALVAGE COSTS

Equipment	Hours	Cost/Hour	Cost
TD 15	6½	\$40.00	\$ 260.00
955 & 680	4½	\$56.00	\$ 252.00
Dump trucks	6	\$32.74	<u>\$ 196.44</u>
Total Cost			<u>\$ 708.44</u>

Ripping of Road: M-6-1 Road

Includes the ripping (decompaction) of approximately 1.8 miles of road surface to an average depth of 24 inches.

TABLE 7. ROAD RIPPING COSTS

Equipment	Hours	Cost/Hour	Cost
D8	13½	\$75.00	\$1012.50
Total Cost			<u>\$1012.50</u>

Shaping of Landings: M-6-1 Road

Includes the outslping of four landings using the quartering process (see page 23). Sideslope debris was retrieved only at Landing #6 using a hydraulic excavator.

TABLE 8A. LANDING #2

Equipment	Hours	Cost/Hour	Cost
D8	4	\$75.00	\$ 300.00
955 & 680	8½	\$56.00	<u>\$ 476.00</u>
Sub-total			<u>\$ 776.00</u>

TABLE 8B. LANDING #3

Equipment	Hours	Cost/Hour	Cost
D8	3½	\$75.00	\$ 262.50
955 & 680	12½	\$56.00	<u>\$ 700.00</u>
Sub-total			<u>\$ 962.50</u>

TABLE 8C. LANDING #4

Equipment	Hours	Cost/Hour	Cost
D8	2	\$75.00	\$ 150.00
955 & 680	11	\$56.00	<u>\$ 616.00</u>
Sub-total			<u>\$ 766.00</u>

TABLE 8D. LANDING #6

Equipment	Hours	Cost/Hour	Cost
D8	4½	\$75.00	\$ 337.50
Excavator	8	\$69.50	\$ 556.00
955	7½	\$40.00	<u>\$ 300.00</u>
Sub-total			<u>\$1193.50</u>

Total Landing Cost = \$3698.00

Cross-Road Drain Excavation

Includes the placement of cross-road drains using 1) an excavator alone, 2) a 955 loader and backhoe combination without D8 preparation, and 3) a 955 loader and backhoe combination following preliminary drain excavation by a D8 tractor (see Figure 6, page 13).

TABLE 9A. CROSS-ROAD DRAIN PLACEMENT WITHOUT PREPARATION

Equipment	Hours	Cost/Hour	Cost
Excavator (10 drains)	12½	\$69.50	\$ 868.75
955 & 680 (68 drains)	36	\$56.00	<u>\$2016.00</u>
		Sub-total	<u>\$2884.75</u>

TABLE 9B. CROSS-ROAD DRAIN PLACEMENT WITH D8 PREPARATION

Equipment	Hours	Cost/Hour	Cost
955 & 680	.6	\$56.00	\$ 336.00
D8	2½	\$75.00	<u>\$ 187.50</u>
		Sub-total	<u>\$ 523.50</u>
Total Drains = 14		Total Cross-Road Drain Cost	<u>\$3407.25</u>

Stream Crossing Excavations

Includes excavation and disposal of fill material from seven stream crossings on the M-6-1 and M-6-2 Roads.

TABLE 10A. STREAM CROSSING #1:M-6-1

Equipment	Hours	Cost/Hour	Cost
955 & 680	12	\$56.00	\$ 672.00
D8	1	\$75.00	<u>\$ 75.00</u>
Excavated fill $\approx$ 300 cu. yds.		Sub-total	<u>\$ 747.00</u>

TABLE 10B. STREAM CROSSING #2:M-6-1

Equipment	Hours	Cost/Hour	Cost
Crane	18	\$85.00	\$1530.00
Dump trucks	38	\$32.74	\$1244.12
955 & 680	18	\$56.00	\$1008.00
D8	1½	\$75.00	<u>\$ 112.50</u>
Excavated fill $\approx$ 1110 cu. yds.		Sub-total	<u>\$3894.62</u>

TABLE 10C. STREAM CROSSING #3:M-6-1

Equipment	Hours	Cost/Hour	Cost
955 & 680	23	\$56.00	\$1288.00
Excavated fill $\approx$ 375 cu. yds.		Sub-total	<u>\$1288.00</u>

TABLE 10D. STREAM CROSSING #4:M-6-1

Equipment	Hours	Cost/Hour	Cost
Excavator	5½	\$69.50	\$ 382.25
955 & 680	2½	\$56.00	<u>\$ 140.00</u>
Excavated fill $\approx$ 200 cu. yds.		Sub-total	<u>\$ 522.25</u>

TABLE 10E. STREAM CROSSING #1:M-6-2

Equipment	Hours	Cost/Hour	Cost
Crane	33½	\$85.00	\$2847.50
Dump trucks	60	\$32.74	\$1964.40
TD 15	16	\$40.00	\$ 640.00
955 & 680	17	\$56.00	<u>\$ 952.00</u>
Excavated fill $\approx$ 1810 cu. yds.		Sub-total	<u>\$6403.90</u>

TABLE 10F. STREAM CROSSING #2:M-6-2

Equipment	Hours	Cost/Hour	Cost
Crane	28½	\$85.00	\$2422.50
Dump trucks	34	\$32.74	\$1113.16
TD 15	23½	\$40.00	\$ 940.00
955 & 680	9	\$56.00	\$ 504.00
580 B	1	\$32.40	\$ 32.40
Excavated fill ≈ 1810 cu. yds.		Sub-total	<u>\$5012.06</u>

TABLE 10G. STREAM CROSSING #3:M-6-2

Equipment	Hours	Cost/Hour	Cost
Crane	27½	\$85.00	\$2337.50
Dump trucks	29	\$32.74	\$ 949.46
TD 15	5	\$40.00	\$ 200.00
955 & 680	3	\$56.00	\$ 168.00
955	10	\$40.00	<u>\$ 400.00</u>
Excavated fill ≈ 1220 cu. yds.		Sub-total	<u>\$4054.96</u>
Total Stream Crossing Cost			<u><u>\$21,922.79</u></u>

Rock Placement in Stream Crossings

Includes only the placement of rock into excavated stream channels.

TABLE 11A. STREAM CROSSING #1:M-6-1

Equipment	Hours	Cost/Hour	Cost
955 & 680	4	\$56.00	\$ 224.00
Rock Volume≈30 cu. yds. (rock on site)		Sub-total	<u>\$ 224.00</u>

TABLE 11B. STREAM CROSSING #2:M-6-1

Equipment	Hours	Cost/Hour	Cost
955 & 680	5	\$56.00	\$ 280.00
Rock Volume≈45 cu. yds.		Sub-total	<u>\$ 280.00</u>

TABLE 11C. STREAM CROSSING #1:M-6-2

Equipment	Hours	Cost/Hours	Cost
Crane	4	\$85.00	\$ 340.00
Dump trucks	10*	\$10.37	\$ 103.70
955 & 680	9	\$56.00	<u>\$ 504.00</u>
Rock Volume≈60 cu. yds.		Sub-total	<u>\$ 947.70</u>
		Total Rocking Cost	<u><u>\$1451.70</u></u>

*paid standby time

Road Failures: M-6-2 Road

Represents only the outsloping (pulling back) of the headcut which resulted from Road Failure #1. It includes access road construction, winching of landing debris, and the excavation, transportation and storage of fill material from Road Failures #2 and #3.

TABLE 12A. TREATMENT COSTS:ROAD FAILURE #1

Equipment	Hours	Cost/Hour	Cost
955 & 680	1½	\$56.00	<u>\$ 84.00</u>
Excavated fill	≈300 cu. yds.	Sub-total	<u>\$ 84.00</u>

TABLE 12B. TREATMENT COSTS:ROAD FAILURE #2

Equipment	Hours	Cost/Hour	Cost
Crane	20	\$85.00	\$1700.00
Dump trucks	20	\$32.74	\$ 654.80
TD 15	20	\$40.00	<u>\$ 800.00</u>
Excavated fill	≈1190 cu. yds.	Sub-total	<u>\$3154.80</u>

TABLE 12C. TREATMENT COSTS:ROAD FAILURE #3

Equipment	Hours	Cost/Hour	Cost
Crane	106½	\$85.00	\$9052.50
Crane	10	\$35.64	\$ 356.40
Dump trucks	146½	\$32.74	\$4796.41
TD 15	156	\$40.00	\$6240.00
955 & 680	3	\$56.00	\$ 168.00
580 B	20	\$32.40	<u>\$ 648.00</u>
Excavated fill=4510 cu. yds.		Sub-total	<u>\$21261.31</u>
Total Road Failure Cost			<u><u>\$24500.11</u></u>

Road Reach-Stream Crossing #2, M-6-1 Road

Includes the excavation, transportation and storage of sidecast material retrieved from a failing segment of the M-6-1 Road (see Figure 6, page 13).

TABLE 13. OUTSLOPED ROAD REACH

Equipment	Hours	Cost/Hour	Cost
Crane	32½	\$85.00	\$2762.50
Dump trucks	67	\$32.74	\$2193.58
955 & 680	33	\$56.00	\$1848.00
D8	1½	\$75.00	<u>\$ 112.50</u>
Excavated material ≈ 2500 cu. yds.		Total Cost	<u>\$6916.58</u>

Monitoring Site Excavation

Includes the retrieval and transportation of sidecast material from a 120-foot reach of the M-6-1 Road prepared as a monitoring site for Technical Services.

TABLE 14. MONITORING SITE EXCAVATION COSTS

Equipment	Hours	Cost/Hour	Cost
Crane	14	\$85.00	\$1190.00
Dump trucks	28	\$32.74	\$ 916.74
955 & 680	6	\$56.00	<u>\$ 336.00</u>
Excavated material ≈ 1300 cu. yds.		Total Cost	<u>\$2442.72</u>

Miscellaneous Costs

1. Opening Roads.

Time was spent reconstructing portions of the M-6-1 and M-6-2 Roads to gain access for heavy equipment.

TABLE 15A. ROAD OPENING COSTS

Equipment	Hours	Cost/Hour	Cost
955	14	\$40.00	\$ 560.00
TD 15	4	\$40.00	<u>\$ 160.00</u>
		Sub-total	<u>\$ 720.00</u>

2. Material Shuttle.

A dump truck was used to transport dragline and/or clamshell buckets to various locations on the rehabilitation unit.

TABLE 15B. BUCKET SHUTTLE COSTS

Equipment	Hours	Cost/Hour	Cost
Dump truck	3½	\$32.74	\$ 114.59
		Sub-total	<u>\$ 114.59</u>

3. Hydraulic Excavator Assistance.

A 955 loader was used to remount a dislodged track on the excavator.

TABLE 15C. EXCAVATOR RESCUE COSTS

Equipment	Hours	Cost/Hour	Cost
955	5	\$40.00	\$ 200.00
		Sub-total	<u>\$ 200.00</u>

4. Equipment Move-in/out Costs.

TABLE 15D. EQUIPMENT TRANSPORTATION COSTS

Equipment	Trips (or Hours)	Cost/Trip (or Hour)	Cost
955	2 hr.	\$ 40.00/hr.	\$ 80.00
955 & 680	4 hr.	\$ 56.00/hr.	\$ 224.00
Crane	2½ trips	\$300.00/trip	\$ 750.00
TD 15	2 trips	\$300.00/trip	\$ 600.00
D8	2 trips	\$300.00/trip	\$ 600.00
Excavator	2 trips	\$300.00/trip	<u>\$ 600.00</u>
Sub-total			<u>\$2854.00</u>

5. Equipment Relocation Costs.

Includes relocating equipment to different work sites on the rehabilitation unit.

TABLE 15E. EQUIPMENT RELOCATION COSTS

Equipment	Hours	Cost/Hour	Cost
Excavator*	6	\$69.50	\$ 417.00
955 & 680	11	\$56.00	\$ 616.00
955	3½	\$40.00	\$ 140.00
Crane	4½	\$85.00	\$ 382.50
TD 15	5	\$40.00	\$ 200.00
D8	1½	\$75.00	\$ 112.50
580 B	2	\$32.40	<u>\$ 64.80</u>
Sub-total			<u>\$1932.80</u>

*Slower than a turtle
on crutches.

6. Retrieval of Logs.

Logs winched from Road Failure #3 were initially decked on the outer margin of Storage Unit #4. Once end-hauling and shaping of the fill material were complete, these logs were winched to a more stable location.

TABLE 15F. LOG RETRIEVAL COSTS

Equipment	Hours	Cost/Hour	Cost
TD 15	9	\$40.00	\$ 360.00
		Sub-total	<u>\$ 360.00</u>

7. Rock Pit.

The M-6-1 rock pit was developed for future use.

TABLE 15G. ROCK DEVELOPMENT COSTS

Equipment	Hours	Cost/Hour	Cost
D8	2	\$75.00	\$ 150.00
		Sub-total	<u>\$ 150.00</u>
		Total Miscellaneous Costs	<u>\$6331.39</u>

DISCUSSION

Table 2 (see page 27) lists the unit costs for different tasks performed by heavy equipment. Most items and unit costs appear reasonable and are self-explanatory. The discussion will focus on only a few items.

The unit cost to develop and transport rock from the rock pit to the excavation sites was high. Initially the rock pit appeared to contain an adequate quantity of rock that needed only to be gathered and loaded. Unfortunately, this was not the case. The existing rock supply was not adequate. As the amount of rock needed for both Site 80-3 and 80-6 was not large, the 955 loader was used to quarry and sort more rock. This approach was successful, but not cost-effective.

In the future, rock supplies should be quarried and sorted, and made ready for loading well in advance of the equipment phase for rehabilitation. Rock development can be most effectively accomplished by a formally advertised, fixed-price contract to obtain an adequate rock supply with proper size distribution. In addition, by having rock supplies prepared well in advance, an orderly approach to loading and distributing rock to neighboring rehabilitation units can be developed and implemented much earlier in the season.

Cross-road drains were excavated using three different methods. The 955 and 680 combo (95% of the work performed by the 680) showed the lowest unit cost per drain. The sample size for the other two methods, however, was too small for accurate representation and the total volumes excavated by each method were not considered. If volumes excavated from each drain were measured, the backhoe-D8 method would have provided the lowest unit cost. The D8 tractor first ripped a segment of road, then dozed the majority of the volume from a cross-road drain location. The backhoe followed and excavated only the inflow and outflow portions of the drain.

Scheduling a D8 ripper tractor to decompact road surfaces was, and may continue to be, a sequencing problem. Road surfaces cannot be ripped until all end-hauling is complete, and some road segments may become isolated between deep, end-hauled excavations if a D8 ripper is not available when needed. On a rehabilitation unit where the only work for a D8 is to rip roads and landings, standby costs can amount to \$350 per day. In the future, it may be possible to obtain a rental agreement for a low boy and D8 ripper keeping both on call. By doing so, the D8 would be shared between different rehabilitation units and called when needed. The D8 could rip road surfaces, quarter landings, and perform 80% of a cross-road drain excavation.

With the exception of Road Failure #3, the limiting factor to large excavations that required fill to be end-hauled was the size of the dump site. Dump sites (storage units) on the M-6-2 Road were small and required the constant attention of a TD15 tractor to maintain a driveable surface and dump area for the dump trucks. For most excavations on the M-6-2 Road, the crane operated at only 3/4th its capacity because of the dump truck's turn-around time to and from dump sites.

Road Failure #3 was a unique excavation and the high unit cost was a result of unforeseeable circumstances. Soils on the upper slide block were too wet for the TD15 tractor to operate, so a third road was constructed to provide access to the remaining slide material. In order to prevent cutting into the landslide, already excavated and end-hauled slide material was re-loaded and hauled back to the slide for road fill. Had the hillslope conditions been realized earlier, the crane could have excavated the slide mass from only two roads rather than three.

Finally, the sequencing (sharing) of equipment between two rehabilitation units was attempted this year. The original equipment plan called for a crane, D8 ripper tractor, and two dump trucks to be shared between Site 80-3 and Site 80-6. The plan was not entirely successful as the D8 experienced repeated mechanical breakdowns and the crane was held on Site 80-3 longer than anticipated, which, in turn, offset the equipment schedule for Site 80-6. Dump trucks were successfully sequenced between both rehabilitation units. Cranes, like all excavators, were pace setters in the equipment work. Many equipment operations revolved around and provided support to the crane. Assuming a plentiful supply of large excavators; i.e., cranes and hydraulic excavators, each rehabilitation unit should have its own pace setter to perform excavations. Dump trucks and D8 ripper tractors should be sequenced between rehabilitation units as much as possible.

PART III. LABOR INTENSIVE WORK

COST SUMMARY

Costs include transportation time to and from rehabilitation unit and to individual work sites, tool maintenance, and instruction from Supervising Hydrologist and/or Physical Science Technician. Pay rates listed in the following tables are: GS-5, \$5.41/hour; WG-3, \$7.03/hour; GS-9, \$8.18/hour.

Check Dam Construction	\$3,401.05	C	
Rocking of Channels	\$ 531.61	C	
Straw and Jute Netting	\$ 135.90	S	
Trail Construction	\$ 160.41	S	
Seed and Straw Application-Selected Sites	\$ 302.52	S	
Gully Diversion	\$ 656.54	C	1°
Energy Dissipation below Gully Headcuts	\$ 196.84	C	1°
Water Bar Construction	\$ 126.54	S	1°
Log Jam Treatment	\$ 210.90	C	1°
Total Cost	<u>\$5,722.31</u>		

Primary Treatment
Channel 1064.28
Surface 126.54
Total 1190.82

TABLE 16. UNIT COSTS FOR LABOR-INTENSIVE WORK

Item	Quantity	Cost	Unit Cost
Check Dam Construction	126	\$3401.05	\$ 26.99/ea.
Rocking of Channels*	906 ft. ²	\$ 531.61	\$.59/ft. ²
Straw and Jute Netting (includes Trail Construction)	3320 ft. ²	\$ 296.31	\$.10/ft. ²
Seed and Straw Application- Selected Sites	.74 acre	\$ 302.52	\$ 408.81/acre
Energy Dissipation below Gully Headcuts *	70 ft. ²	\$ 196.84	\$ 2.81/ft. ²
Water Bar Construction	140 cu. ft.	\$ 126.54	\$.90/cu. ft.

*The area specified refers to the channel area treated. Channels were rocked with one layer of rock averaging 8 inches - 10 inches in diameter. Energy dissipation below headcuts averaged 12 inches in height.

COST BREAKDOWN

Check Dam Construction

Includes transportation and preparation of material, tool maintenance and check dam installation. Check dam material was stored within 100 feet of each work site. Costs do not include the milling of redwood boards.

TABLE 17. CHECK DAM CONSTRUCTION

Site	No. of Dams	Person-Hours	Cost/Hour	Cost	Sub-totals
RF3	115 (15 YCC)	406 (106 YCC)	\$7.03 (0 YCC)	\$2854.18	\$2854.18
C3-2	8	32½	\$7.03	\$ 228.48	\$ 228.48
SX4-1	8	14	\$8.18	\$ 114.52	\$ 142.64
		4	\$7.03	\$ 28.12	
SX3-1	6	25	\$7.03	\$ 175.75	\$ 175.75
Number of dams = 137				Total Cost	<u>\$3401.05</u>

Rocking of Channels

Includes the transportation and placement of rock (3 inches - 18 inches diameter) in stream channels and cross-road drains. With the exception of SX3-1 and SX4-1, rock was available within 50 feet of each work site.

TABLE 18. ROCKING OF CHANNELS

Site	Area, ft ²	Person-Hours	Cost/Hour	Cost	Sub-totals
SX4-1	125	2	\$7.03	\$14.06	\$30.42
		2	\$8.18	\$16.36	
SX3-1	106	6	\$5.41	\$32.46	\$32.46
*SX2-1	166	11	\$7.03	\$77.33	\$104.33
		5	\$5.41	\$27.05	
*SX1-1	36	6	\$7.03	\$14.06	\$14.06
C3-2	52	2	\$7.03	\$14.06	\$30.42
		2	\$8.18	\$16.36	
SX2-2	330	40	\$7.03	\$281.20	\$281.20
XRD-2	91	5½	\$7.03	\$ 38.67	\$38.67
Total Area Rocked = 906 ft ²				Total Cost	<u>\$531.61</u>

*preliminary rocking completed by backhoe during equipment phase of work.

Straw and Jute Netting

Straw and jute netting were applied to the sideslopes of SX3-2. All materials were within 200 feet of this work site. Straw application rate approximates 6,000 lbs./acre.

TABLE 19. STRAW AND JUTE NETTING

Site	Person-Hours	Cost/Hour	Cost
SX3-2	10	\$5.41	\$ 54.10
	10	\$8.18	<u>\$ 81.80</u>
Total Area=1600 ft. ²		Total Cost	<u><u>\$ 135.90</u></u>

Trail Construction

To minimize visitor and worker impacts during wet soil conditions, two trail segments were constructed using straw and jute netting. All materials were within 100 feet of each work site. Straw application rate approximates 4,000 lbs./acre.

TABLE 20. TRAIL CONSTRUCTION COSTS

Site	Area, ft. ²	Person-Hours	Cost/Hour	Cost	Total Cost
SX3-2	600	9	\$7.03	\$63.27	\$63.27
RF3	1120	5	\$8.18	\$40.90	\$97.14
		8	\$7.03	\$56.24	<u> </u>
Total Trail Length=430 ft.				Total Cost	<u><u>\$160.41</u></u>
Total Area =1720 ft. ²					

Fertilizer, Seed, and Straw Application-Selected Sites

Fertilizer, seed and straw were applied to selected sites by our labor crew. Fertilizer was applied only on RF3. Application rates were as follows: fertilizer, 80 lbs./acre; grass-alder mix, 50 lbs./acre; straw, 4,000 lbs./acre.

TABLE 21. SEED AND STRAW APPLICATION-SELECTED SITES

Site	Area, acre	Person-Hours	Cost/Hour	Cost	Sub-totals
RF 3	.60	30YCC	Ø	Ø	\$208.55
		20	\$7.03	\$140.60	
		5	\$8.18	\$ 40.90	
		5	\$5.41	\$ 27.05	
SX2-2	.07	4½	\$7.03	\$ 31.64	\$ 48.00
		2	\$8.18	\$ 16.36	
SX1-2	.07	5	\$7.03	\$ 35.15	\$ 45.97
		2	\$5.41	\$ 10.82	
Total Area Treated= .74 acre				Total Cost	<u>\$302.52</u>

Gully Diversion-Site A

A 55-foot long channel was manually excavated to capture the flow from a gully originating from Culvert #7, M-Line, directing it into the channel of Drainage #3. Slash dams were installed in the channel bottom and at the confluence of the excavated channel and stream.

TABLE 22. GULLY DIVERSION-SITE A

Person-Hours	Cost/Hour	Cost	Sub-total
78	\$7.03	\$548.34	\$ 656.54
20	\$5.41	\$108.20	
Volume≈480 cu. ft.		Total Cost	<u>\$ 656.54</u>

Energy Dissipation below Gully Headcuts-Sites B&D

Includes the costs of cutting and anchoring slash material at the base of active headcuts.

TABLE 23. ENERGY DISSIPATION COSTS

Site	Area, ft. ²	Person-Hours	Cost/Hour	Cost
B	40	19	\$7.03	\$133.57
D	30	9	\$7.03	<u>\$ 63.27</u>
Total Area Treated≈ 70 ft. ²			Total Cost	<u>\$196.84</u>

Water Bar Construction

Includes travel, tool maintenance, and excavation costs of 7 water bars.

TABLE 24. WATER BAR CONSTRUCTION

Volume, cu. ft.	Person-hours	Cost/Hour	Cost
140	18	\$7.03	\$126.54
Total Cost			<u>\$126.54</u>

Log Jam Treatment - Site E

An 8-foot section of the key log in this jam was removed. A small secondary jam, immediately downstream from the main jam, was entirely removed. Costs include transportation time to and from rehabilitation unit.

TABLE 25. LOG JAM TREATMENT

Person-Hours	Cost/Hour	Cost
30	\$7.03	\$210.90
Total Cost		<u>\$210.90</u>

DISCUSSION

The labor-intensive erosion control work for this project was originally scheduled to be performed under a formally advertised, fixed-price labor contract. However, the equipment phase for this project continued longer than planned, extending into the rainy season. In addition, approximately 50% of the work prescribed for the contract entailed the construction of check dams on Road Failure #3 - a very unstable, saturation-prone area, incapable of being worked on during wet soil conditions. After taking into consideration the costs to prepare, let, and administer this small contract, along with the points mentioned above, it was decided to perform this work in-house with two park laborers and the project's supervising staff. Labor work was performed from August 13, 1980 to October 21, 1980, with the most critical site, Road Failure #3, completed on September 11, 1980. This time period represents 32 working days with a crew of 2-4 workers.

Table 16 lists unit costs for labor work items performed, excluding costs for specific jobs. No quantitative comparison is made between these unit costs and unit costs from past labor contracts since the latter is not public information. However, from a qualitative standpoint, the unit costs do appear comparable. The total labor cost amounts to \$5722.31, and includes transportation time (cost) to and from the rehabilitation unit, walk-in time to individual work sites, tool maintenance, and instruction time. Assuming only two workers, daily transportation costs amount to \$28.12 (4 person-hours per day) or approximately \$900.00 of the total labor cost.

The quality of labor work performed was satisfactory to good. In general, quality was a function of the worker's attitude and the extent of supervision. Productivity, or output, varied with the motivation of each individual. Both, at times, were lacking and caused an additional 40-50 person-hours to be spent on improving check dams already installed on Road Failure #3 that were not packed or spaced properly.

Check dam construction is perhaps the most expensive and critical labor application. Without a thorough understanding of operating principles and failure mechanisms, check dams cannot be installed correctly. Therefore, it is imperative that all laborers, not only crew leaders, who construct check dams in the future, be trained in the proper installation of check dams by a professional from our staff.

APPENDIX A-SPRING LOCATIONS ON LANDSLIDE, ROAD FAILURE #3

Spring locations on the landslide were mapped by compass and tape prior to equipment work for the purpose of relocating springs after heavy equipment work. Once the earth-moving phase was complete, springs were again located by compass and tape, and drainage channels were excavated through the most safe and practical course to intercept the springs. Table 26 compiles field measurement notes and Figure 9 is a planimetric map showing spring locations and the excavated channels.

TABLE 26. FIELD MEASUREMENT NOTES FOR SPRING LOCATIONS: ROAD FAILURE #3

Line	Distance (ft)	Bearing (degree)**
Upper slide region:		
AB*	52	N20E
AC	48	N60E
AD	47	N85E
AE	62	S75E
AF	72	S70E
AG	85	S60E (stump)
Road cut bank:		
A'B'	62	N25W
A'C'	76	N25W
A'D'	100	N25W (RP)
D'E'	104	N5W
D'F'	132	N15W
D'G'	158	N15W

*Redwood log, Point A, used as takeoff point.

**Compass set with 19° declination.

REVEGETATION PROJECT

Rehabilitation Projects 80-3/80-6

Redwood National Park

Prepared by

Roy W. Martin

Symbols Used in Tables

Symbol	Trees & Shrubs Planted - Common Name (Scientific Name)
A _c	ALDER, containerized (<u>Alnus oregona=A. rubra</u>)
A _t	ALDER, transplant (<u>Alnus oregona=A. rubra</u>)
S	REDWOOD (<u>Sequoia sempervirens</u>)
P	DOUGLAS FIR (<u>Pseudotsuga menziesii</u>)
B	BACCHARIS (<u>Baccharis pilularis v. consanguinea</u>)
W	WHIPPLEA (<u>Whipplea modesta</u>)

Symbol	Other Symbols-Meaning
WB-XRD	WATER BAR-CROSS ROAD DRAIN

SEED MIX TYPES FOR M-7 and M-6 ROADS

Mix	Seed Type	% by Weight
W	Alder	3.2
	Fawn Tall Fescue	48.4
	Highland Colonial Bentgrass	<u>48.4</u>
		100.0
X	Alder	2.0
	Fawn Tall Fescue	49.0
	Highland Colonial Bentgrass	<u>49.0</u>
		100.0
Y	Alder	100 (1 lb. mixed with sawdust for spreading purposes)
Z	WET MIX:	
	Alder	2.7
	Fawn Tall Fescue	34.7
	Creeping Red Fescue	12.0
	Mt. Barker Subclover	28.8
	Lana Vetch	<u>21.8</u>
		100.0

OPERATION DATES FOR M-6-1 and M-6-2 ROADS

Activity	Total	Operation Dates (Late 1980 - Early 1981)
Strawing		8-14; 10-2 to 10-9
Fertilizing		8-13 to 8-14
Seeding	10.3 Acres	8-7; 8-13 to 8-14; 10-22
Planting		11-18 to 1-14; 2-4; 2-11

Tree Planting on M-6-1 & M-6-2 Roads

Type	Number
Containerized Alder	31,209
Redwood	10,660
Douglas Fir	<u>670</u>
Grand Total	42,539

None listed in site specific info. on road pages

	Acreage (Acres)	Seed Mix Type lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spac
		w 31 lbs.	150 lbs.	
Landing #1	0.66			
WB-XRD #1	0.01			A _C /47/2 ft.
WB-XRD #2	0.02			A _C /94/2 ft.
WB-XRD #3	0.01			A _C /46/2 ft.
WB-XRD #4	0.03			A _C /140/2 ft.
WB-XRD #5	0.01			A _C /46/2 ft.
WB-XRD #6	0.02			A _C /94/2 ft.
WB-XRD #7	0.02	x 51 lbs.		A _C /94/2 ft.
WB-XRD #8	0.01			A _C /47/2 ft.
WB-XRD #9	0.01			A _C /46/2 ft.
WB-XRD #10	0.02			A _C /94/2 ft.
WB-XRD #11	0.01			A _C /47/2 ft.
WB-XRD #12	0.01			A _C /47/2 ft.
WB-XRD #13	0.01			A _C /47/2 ft.
Stream Crossing #1	0.09			A _C /360/1 ft. S/40/1 ft.
WB-XRD #14	0.01			A _C /170/2 ft. S/20/2 ft.
WB-XRD #15	0.01			A _C /355/2 ft. S/48/2 ft.
WB-XRD #16	0.02			A _C /460/2 ft. S/58/2 ft.
WB-XRD #17	0.01			A _C /190/2 ft. S/20/2 ft.
WB-XRD #18	0.01			A _C /140/2 ft. S/20/2 ft.
WB-XRD #19	*			Not Planted
WB-XRD #20	0.02			A _C /220/2 ft. S/20/2 ft.
WB-XRD #21	0.01			A _C /110/2 ft. S/20/2 ft.
WB-XRD #22	0.01			A _C /47/2 ft.
WB-XRD #23	0.01			A _C /287/2 ft. S/40/2 ft.

*Less than 0.01 acres

	Acreage (Acres)	Seed Mix Type lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spac
		x 51 lbs.	150 lbs.	A _c /250/2 ft. S/20/2 ft. A _c /330/2 ft. S/40/2 ft. A _c /380/2 ft. S/40/2 ft. A _c /154/2 ft. S/15/2 ft. A _c /147/2 ft. S/18/2 ft. A _c /260/2 ft. S/16/2 ft. A _c /160/2 ft. S/10/2 ft. A _c /118/2 ft. S/7/2 ft. A _c /230/2 ft. S/20/2 ft. A _c /91/2 ft. S/10/2 ft. A _c /160/2 ft. S/20/2 ft. A _c /104/2 ft. S/11/2 ft. A _c /230/2 ft. S/30/2 ft. A _c /170/2 ft. S/20/2 ft. A _c /150/2 ft. S/20/2 ft.
WB-XRD #24	0.01			
WB-XRD #25	0.02			
WB-XRD #26	0.06			
WB-XRD #27	0.01			
WB-XRD #28	0.01			
WB-XRD #29	0.01			
WB-XRD #30	0.01			
WB-XRD #31	0.01			
WB-XRD #32	0.01			
WB-XRD #33	0.01			
WB-XRD #34	0.01			
WB-XRD #35	0.01			
WB-XRD #36	0.01			
WB-XRD #37	0.02			
WB-XRD #38	0.02			
Landing #2	0.43			
WB-XRD #39	0.02			
Outslope #1 & Stream Channel	0.08			
WB-XRD #40	0.01			
WB-XRD #41	0.02			
Small Slope				
WB-XRD #42	0.02			
WB-XRD #43	0.01			
WB-XRD #44	*			
Landing #3	0.45			
WB-XRD #45	0.02			
		none	none	Planted as part of Outslope #1 A _c /307/2 ft. S/29/2 ft. A _c /39/2 ft. S/4/2 ft. A _c /59/2 ft. S/6/2 ft. A _c /200/2 ft. S/30/2 ft. A _c /180/2 ft. S/20/2 ft. A _c /42/2 ft. S/8/2 ft. Not Planted
		Y		A _c /200/2 ft. S/22/2 ft.

	Acreage (Acres)	Seed Mix Type lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spacing
		Y	none	
WB-XRD #46	0.03	↓		A _c /430/2 ft.
WB-XRD #47	0.05			S/50/2 ft.
WB-XRD #48	0.01	to first		A _c /541/2 ft.
		none 1/3		S/60/2 ft.
Landing #4	0.33	of		A _c /61/2 ft.
WB-XRD #49	0.01	landing		
WB-XRD #50	*	↓		A _c /220/2 ft.
(2 sections				S/20/2 ft.
Outslope #2 1 measured ,	0.12	x 51 lbs.		Planted as part of
includes 1 stream channel)				Outslope #2
WB-XRD #51	0.01	none		A _c /2000/2 ft.
(2 sections		x 51 lbs.		S/290/2 ft.
Outslope #3 1 measured ,	0.16	↓		Planted as part of
includes 2 stream channels				Outslope #2
Outslope #4, includes 1	0.07	↓		A _c /1180/2 ft.
stream channel		none		S/150/2 ft.
WB-XRD #52	0.02			A _c /880/2 ft.
WB-XRD #53	0.02			S/60/2 ft.
WB-XRD #54	0.03			
Landing #5 (2 sections)	0.78			A _c /210/2 ft.
WB-XRD #55	0.01			A _c /94/2 ft.
WB-XRD #56	0.01			A _c /520/2 ft.
WB-XRD #57	0.01			S/30/2 ft.
WB-XRD #58	0.01			
WB-XRD #59	0.01			A _c /240/2 ft.
WB-XRD #60	0.01			Not Planted
WB-XRD #61	0.01			A _c /330/2 ft.
WB-XRD #62	0.01			A _c /200/2 ft.
WB-XRD #63	0.01			A _c /210/2 ft.
WB-XRD #64	0.01			A _c /41/2 ft.
				A _c /60/2 ft.
				A _c /90/2 ft.
				A _c /80/2 ft.
				A _c /205.2 ft.

	Acreage (Acres)	Seed Mix Type lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spacing
WB-XRD #65	0.01	none ↓	none ↓	A _C /60/2 ft.
WB-XRD #66	0.01			A _C /205/2 ft.
WB-XRD #67	0.01			A _C /250/2 ft.
Stream Crossing #2	0.04	x 51 lbs.		A _C /640/1 ft.
Road Surface	3.12			
Road Surface and Landings	5.77			A _C /2940/5-8 ft. P/670/5-8 ft. S/5938/5-8 ft.
Total Work Area	7.28	5.86 seeded		

M-6-2

	Acreage (Acres)	Seed Mix Type lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Space
		w 31 lbs.	182 lbs.	
		↓		
Outslope #1	0.20		none	A _C /1174/1 ft.
WB-XRD #1	0.02			A _C /46/3 ft.
				A _C /4090/3 ft.
Landslide	0.98	w 62 lbs.	122 lbs.	S/350/10 ft.
Outslope #2	0.17	x 51 lbs.	none	A _C /1020/1 ft.
		↓	↓	
WB-XRD #2	0.03			A _C /150/3 ft.
WB-XRD #3	*			A _C /10/3 ft.
Landing #1	0.23			
WB-XRD #4	*			A _C /20/3 ft.
WB-XRD #5	*			A _C /20/3 ft.
Stream Crossing #1	0.26			A _C /1200/1-2 ft.
WB-XRD #6	0.01			A _C /100/2 ft.
WB-XRD #7	0.01			A _C /88/3 ft.
WB-XRD #8	0.01			A _C /100/2 ft.
WB-XRD #9	0.02			A _C /84/3 ft.
WB-XRD #10	0.01			A _C /50/2 ft.
Outslope #3	0.10			A _C /660/2-3 ft.
WB-XRD #11	0.01			A _C /80/2 ft.
WB-XRD #12	0.01			A _C /30/2 ft.
WB-XRD #13	0.01			A _C /48/2 ft.
WB-XRD #14	0.01			A _C /26/2 ft.
Landing #2	0.52			
WB-XRD #15	0.01			A _C /50/2 ft.
WB-XRD #16	0.02	↓	↓	A _C /100/2 ft.

*Less than 0.01 acres

	Acreage (Acres)	Seed Mix Type lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spac
		x 51 lbs.	none	
WB-XRD #17	0.02			A _c /75/2 ft.
WB-XRD #18	0.01			A _c /60/2 ft.
WB-XRD #19	0.01			A _c /58/2 ft.
WB-XRD #20	0.01			A _c /20/2 ft.
WB-XRD #21	0.01			A _c /48/2 ft.
WB-XRD #22	0.01			A _c /73/2 ft.
WB-XRD #23	0.01			A _c /20/2 ft.
WB-XRD #24	0.02			A _c /75/2 ft.
WB-XRD #25	0.01			A _c /25/2 ft.
Stream Crossing #2	0.26			A _c /1573/1 ft.
Road Surface	1.40			A _c /190/5-8 ft. S/2910/5-8 ft.
Road Surface and Landings	2.15			
Total Work Area	4.42	4.42 seeded		
Fill Area for Material From Work Site				A _c /1000/2 ft. S/100/random spacing interspersed with Alder

OPERATION DATES FOR M-7 ROADS

Activity	Total	Operation Dates (Late 1980-Early 1981)
M-7-5-2, M-7-5-1½, M-7-5-1,		
M-7-5-½, M-7 (M-7-5-B) &		
M-7-5-A, M-7-5		
Strawing		9-24 to 10-1; 10-14 to 10-16
Fertilizing	Acres	9-15; 9-24
Seeding		10-21 to 10-22
Planting		1-1 to 1-7; 2-4; 2-11

TREE PLANTING ON NOSE OF BRIDGE CREEK
(M-7-5-2, M-7-5-1½, M-7-5-1
M-7-5-½, M-7 [M-7-5-B]
& M-7-5-A, M-7-5)

Type	Number
Containerized Alder	24,716
Transplanted Alder	673
Total Alder	25,839
Redwood	6,690
Douglas Fir	5,560
Whipplea	442
Baccharis	442
Grand Total	38,973

M-7-5

	Acreage (Acres)	Seed Mix lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spacing
Crossing situated between M-7-5-1 and M-7-5-1 1/2				B/300/2 ft. W/300/2 ft.

	Acreage (Acres)	Seed Mix lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spacing
Outslope #1	0.02	none	none	
WB-XRD #1	0.02			
WB-XRD #2	0.01			
WB-XRD #3	0.01			
WB-XRD #4-6	*			
WB-XRD #7	0.01			
WB-XRD #8	0.01			
Road Surface	0.19			
Total Work Area	0.28			
TOTAL	0.55 acres			

*Less than 0.01 acres

	Acreage (Acres)	Seed Mix lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spacing
WB-XRD #1-3	*	None		Ac/1300/1 ft.
Stream Crossing #1	0.11	z 38 lbs		
WB-XRD #4	0.02	None ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓		P/258/8 ft. S/258/8 ft.
WB-XRD #5	0.01			
WB-XRD #6	0.02			
WB-XRD #7	0.03			
WB-XRD #8	0.01			
WB-XRD #9	0.01			
WB-XRD #10	0.01			
WB-XRD #11	0.01			
WB-XRD #12	0.02			
WB-XRD #13	0.01			
Road Surface	0.66			
Total Work Area	0.92			

*Less than 0.01 acres

	Acreage (Acres)	Seed Mix lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spacing
		None	250 lbs	
Landing #1	0.27			
WB-XRD #1	0.01			
WB-XRD #2	*			
WB-XRD #3	0.01		↓	
Stream Crossing #1	0.28		None	Ac/3000/1 ft. At/64/8 per check dam
Stream Crossing #2	0.17			Ac/2700/1 ft.
WB-XRD #4	0.01			
WB-XRD #5 (skid road #1, heading upslope)	0.01			
WB-XRD #6 (skid road #1, heading upslope)	0.01			
WB-XRD #7 (skid road #1, heading upslope)	0.01			
WB-XRD #8 (skid road #1, heading upslope)	0.01			
WB-XRD #9 (skid road #1, heading upslope)	0.01			
Stream Crossing #3 (skid road #1)	0.10			Ac/1200/1 ft.
Landing #2 (main road)	0.42			
Stream Crossing #4	0.07			
WB-XRD #10	0.04			
WB-XRD #11	0.02			
WB-XRD #12	0.02			
WB-XRD #13	0.01			
WB-XRD #14	0.01			
WB-XRD #15	0.01			
WB-XRD #16	0.02			
WB-XRD #17	0.02			
WB-XRD #18	0.01			
WB-XRD #19	0.01			

*Less than 0.01 acres

	Acreage (Acres)	Seed Mix lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spacing
		None	None	
WB-XRD #20	0.01			
WB-XRD #21	0.01			
WB-XRD #22	0.02			
WB-XRD #23	0.03			
WB-XRD #24	0.03			Ac/1400/1 ft.
Stream Crossing #5	0.15			Ac/1350/1 ft.
Stream Crossing #6	0.09			Ac/2350/1 ft.
Stream Crossing #7	0.24			
WB-XRD #25-26	*			
WB-XRD #27	0.02			
WB-XRD #28	0.01			
WB-XRD #29	*			
WB-XRD #30	0.01			
WB-XRD #31-33	*			
WB-XRD #34	0.03			
Landing #3	0.41			
Principal Road Surface	2.14			Ac/150/5 ft. (Alternate A S/150/5 ft. and S ₂ 5 ft offset)
Skid Road #1 (upslope)	0.10			
Skid Road #2 (downslope)	0.17			Ac/300/8 ft. P/1272/8 ft. S/2062/8 ft.
Principal Road Surface & Landings	3.24			
Total Work Area	4.75			Ac/380/1 ft.
7 Cross Road Drains (not identified)				

*Less than 0.01 acres

Two Skid Roads, M-7-5-1

	Acreage (Acres)	Seed Mix lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spacing
Skid Road #1 (Upslope from M-7-5-1)			None	
Stream Crossing #1	0.06	z 38 lbs ↓	None ↓	A _C /260/2 ft.
Stream Crossing #2	0.10			A _C /360/2 ft. A _t /112/
Road Surface	0.23			A _C /300/5 ft. (Alternate P/300/5 ft. and P with ft. offset
Total Area	0.39			
Skid Road #2 (Downslope from M-7-5-1)				
Stream Crossing #1	0.03	z 38 lbs ↓	None ↓	A _C /150/2 ft. A _t /72/8 per check dam
Road Surface	0.06			A _C /100/3 ft. (Alternate S/100/3 ft. A _C and S)
Total Area	0.09			
Total Area, Both Skid Roads	0.48			
	1.04 acres			

	Acreage (Acres)	Seed Mix lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No.	
Contract Work Site 1.				A _t	96
Contract Work Site 2				A _t	8
Contract Work Site 3				A _t	8
Contract Work Site 5				A _t	105
Contract Work Site 6				A _t	8
Contract Work Site 9				A _t	8
Contract Work Site 10				A _t	8
Contract Work Site 11				A _t	8
Contract Work Site 12				A _t	8
Contract Work Site 13				A _t	8
Contract Work Site 15				A _t	8
Contract Work Site 16				A _t	8
Contract Work Site 17				A _t	8

M-7-5-1 1/2

	Acreage (Acres)	Seed Mix Type lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spacing
		z 38 lbs.	250 lbs.	
WB-XRD #1	0.05			A _c /1400/1-2 ft.
Stream Crossing #1 (On Skid Road #1)	0.13			A _c /32/8 per checkdam
WB-XRD #2	0.01			A _c /2000/1-2 ft.
WB-XRD #3	0.01			
WB-XRD #4	0.01			
Landing #1	0.20			
WB-XRD #5	*			
WB-XRD #6	0.01			
WB-XRD #7	0.01			
WB-XRD #8-9	*			
WB-XRD #10-11 (On Skid Road #2)	*	none		
Stream Crossing #2 (On Skid Road #2)	0.05	z 38 lbs.		A _c /675/2 ft.
WB-XRD #12	0.01			
WB-XRD #13	0.01			
WB-XRD #14	0.01			
WB-XRD #15	0.02			
Stream Crossing #3	0.11			A _c /1700/1-2 ft.
WB-XRD #16	0.01			A _c /104/8 per checkdam
WB-XRD #17	*			
WB-XRD #18	0.01			
WB-XRD #19	0.01			
WB-XRD #20	*			
WB-XRD #21	0.01			
Landing #2	0.36			
WB-XRD #22	0.01			

*Less than 0.01 acres

	Acreage (Acres)	Seed Mix Type lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spaci
		z 38 lbs.	250 lbs.	
WB-XRD #23	0.01			
WB-XRD #24	0.01			
WB-XRD #25	*			
WB-XRD #26	0.02			
Stream Crossing #4	0.08			A _c /675/2 ft.
**Landing #3 (Outsloped inpart)	0.55			A _c /260/ P/260/5 ft. mix of S/260/ $\frac{1}{3}$ ~~12~~ each
WB-XRD #27	0.01			
WB-XRD #28-44	*			
Principal Road Surface	2.11			
Skid Road #1	0.03			A _c /30/2 ft. S _c /30/3 ft.
Skid Road #2	0.17			
**Principal Road Surface & Landings	2.67			A _c /1000/8 ft. S _c /1408/8 ft. P/1048/8 ft.
Total Work Area	4.04	3.99 seeded		
6 Cross Road Drains (Not Identified)				A _c /334/1 ft.
*Less than 0.01 acres				
**Note: Landing #3 was treated individually in terms of tree planting				

	Acreage (Acres)	Seed Mix Type lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spacin
		z 38 lbs.	250 lbs.	W/70/2 ft. B/70/2 ft. Ac/70/2 ft. W/72/2 ft. B/72/2 ft. Ac/72/2 ft.
Stream Crossing #1	0.05			
Stream Crossing #2	0.04			
WB-XRD #1	0.01			
WB-XRD #2	*			
WB-XRD #3	0.01			
WB-XRD #4	*			
WB-XRD #5	0.01			
WB-XRD #6	0.01			
WB-XRD #7	*			
WB-XRD #8	0.01			
WB-XRD #9-12	*			
Landing #1	0.32			
WB-XRD #13-14	*			
WB-XRD #15	0.03			
Landing #2	0.15			
WB-XRD #16	0.02			
WB-XRD #17	0.02			
WB-XRD #18	0.02			
WB-XRD #19	0.03			
WB-XRD #20	0.02			
WB-XRD #21	0.02			
WB-XRD #22	0.01			
WB-XRD #23	0.01			
WB-XRD #24	0.01			
WB-XRD #25	0.05			

	Acreage (Acres)	Seed Mix lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spacing
		z 38 lbs.	250 lbs.	
WB-XRD #26	0.02			
WB-XRD #27	0.01			
WB-XRD #28-45	*			
WB-XRD #46	0.02			
WB-XRD #47	0.01			
WB-XRD #48	0.03			
WB-XRD #49	0.03			
WB-XRD #50	0.01			
WB-XRD #51	0.01			
WB-XRD #52-55	*			
Landing #3	0.67			
WB-XRD #56	*			
WB-XRD #57	0.01			
WB-XRD #58	0.01			
WB-XRD #59	0.01			
WB-XRD #60	0.02			
WB-XRD #61	0.01			
WB-XRD #62	*			
WB-XRD #63	0.02			
WB-XRD #64-65	*			
WB-XRD #66	0.01			
WB-XRD #67	*			
WB-XRD #68	0.01			
WB-XRD #69	0.02			
WB-XRD #70	0.01			
*Less than 0.01 acres				

	Acreage (Acres)	Seed Mix lbs/acre	Broadcast Fertilizer lbs/acre	Trees Type/Total No./Spacing
		z 38 lbs.	250 lbs.	
WB-XRD #71-72	*			
WB-XRD #73	0.01			
WB-XRD #74-79	*			
Landing #4	0.18			
WB-XRD #80-96	*			
Road Surface	4.85			
Road Surface & Landings	6.17			
Total Work Area	6.85	6.85 <i>seeded</i>		A /1200/8 ft. P/2422/5 ft. S/2422/5 ft.

* less than 0.01 acres.

REDWOODS UNITED Labor: Cost Breakdown

Activity	Days	Person-hrs	Wages	Indirect*	Total
Nose of Bridge Creek					
Strawing	8	491	3000.30	1308.56	4308.86
Seeding	1½	120	526.35	245.36	771.71
Tree Planting	<u>1</u>	<u>60</u>	<u>271.50</u>	<u>163.57</u>	<u>435.07</u>
Total	10½	671	3798.15	1717.49	5515.64
Bridge Creek (M-6-1 and M-6-2)					
Strawing	5	300	1357.50	817.85	2175.35
Seeding	<u>¼</u>	<u>40</u>	<u>175.45</u>	<u>81.79</u>	<u>257.24</u>
Total	5½	340	1532.95	899.64	2432.59
Grand Total	16	1,011	\$5,331.10	\$2,617.13	\$7,948.23

*Indirect=Transportation, Safety and Training, and Administration Expenses

In-House Labor: Cost Breakdown

Activity	Days	Person-hrs	Wages
Bridge Creek (M-6-1 & M-6-2)			
Tree Planting	29	1,068	\$8086.60

02 x 7'7" 2#
 02 x 7'5" 1#

Volume Estimates

80-3 XING 1

Feet represented x X-SECT. Area = ft³

X-SECT. # 1	2'2 1/2	21	x 2.47 = 52 ft ³
# 2	0'2 1'7 1/2	23	x 227.94 = 5243 ft ³
# 3	1'6 9/2 2 1/2	38	x 556.60 = 21151 ft ³
# 4	1'6 1/2	net fill	

Total

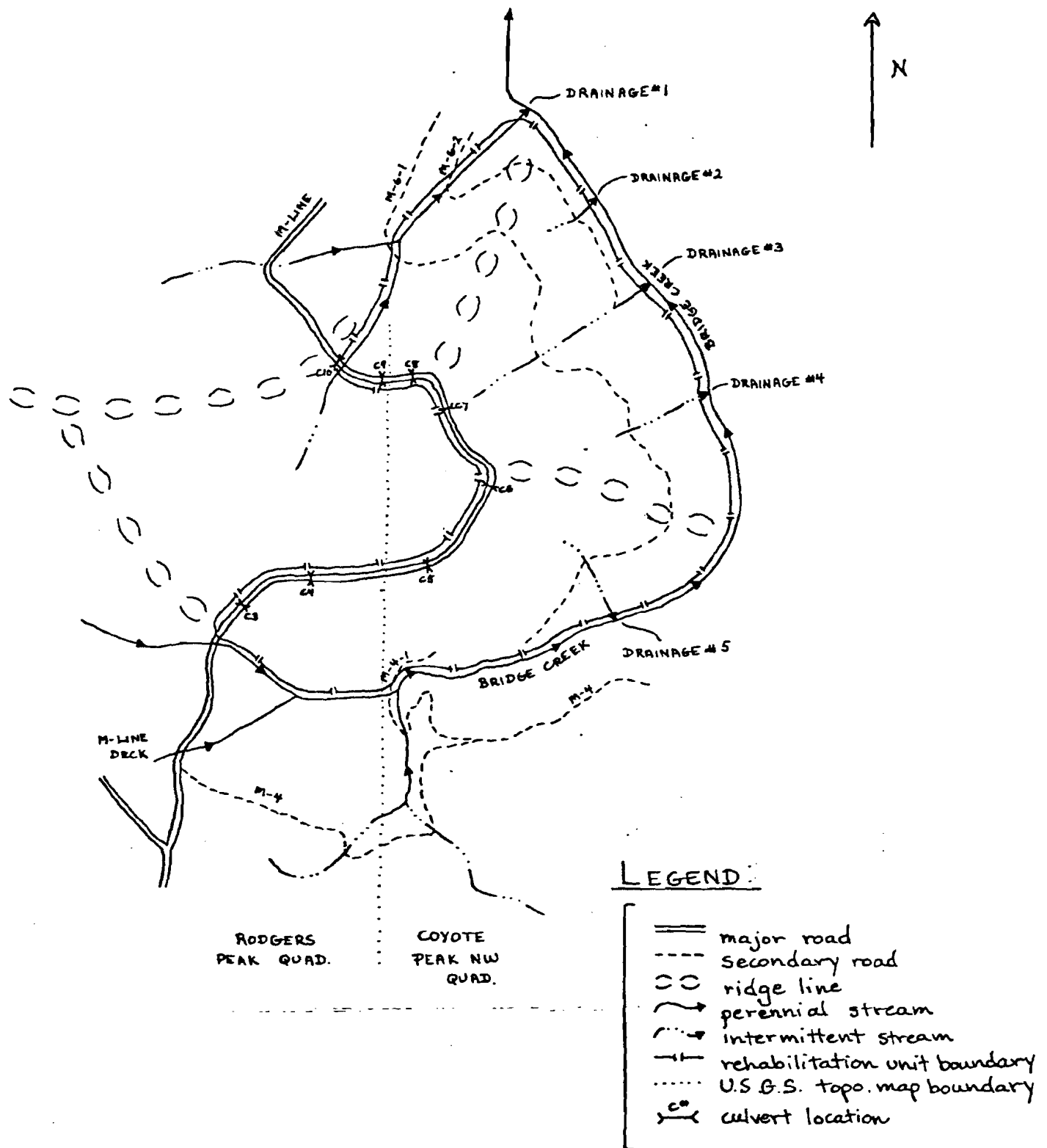
-211
 1'22
 1'2
 9'5

26446 ft³ = 979 yd³

80-6 SX3 :

X-SECT # 1	22'	x 11.517' = 253. ft ³
# 2	31'	x 10.252' = 318 ft ³
Total	571 ft ³ = 21 yd ³	

FIGURE 1. PHYSIOGRAPHIC UNIT : SITE 80-3





Unit: 80-3 Date: 7/24/1980, PP14A, SOC, (MSS)



Unit: 80-3 Date: 10/28/1982, PP14A, SOC



Unit: 80-3 Date: 11/3/1981, PP14A, SOC, (GB+TH)



Unit: 80-3 Date: 7/2/1980, PP19B, SOC, (MSS)



Unit: 80-3 Date: 9/22/1980, PP19B, SOC, (MSS)



Unit: 80-3 Date: 12/17/1980, PP19B, SOC, (MSS)



Unit: 80-3 Date: 11/3/1981, PP19B, SOC, (GB+TH)



Unit: 80-3 Date: 4/23/1980, PP20.5, SOC



Unit: 80-3 Date: 7/2/1980, PP20.5, SOC, (MSS)



Unit: 80-3 Date: 9/22/1980, PP20.5, SOC, (MSS)



Unit: 80-3 Date: 10/27/1982, PP20.5, SOC



Unit: 80-3 Date: 11/3/1981, PP22A, SOC, (GB+TH)