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SUMMARY REPORT OF REDWOOD NATIONAL PARK'S INVOLVEMENT
TO CONTAIN SEDIMENT ERODED FROM THE U.S. HIGHWAY 101 BYPASS PROJECT
FOLLOWING THE OCTOBER 20, 1989 STORM

by

Gregory J. Bundros

June 13, 1990

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TO CONTAINMENT SEDIMENT ERODED FROM THE U.S. HIGHWAY 101 BYPASS PROJECT
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The following is a summary of efforts and costs to contain materials eroded from the Redwood Park U.S. Highway 101 Bypass project as a result of the storm which began on October 20, 1989. With the California Department of Parks and Recreation (DPR) as lead agency, this cooperative effort involved several California state agencies and Redwood National Park. State agencies included Fish and Game (DFG), the Conservation Corps (CCC), and Departments of Corrections (CDC), Forestry (CDF), and Transportation (Caltrans).

In summary, state labor crews built 27 sediment containment structures, developing a total storage capacity of 3100 yds³. Redwood National Park assisted with the layout and design of these structures, and helped supervise construction. The total cost for this effort was \$439,107. Of this total, Redwood National Park spent \$20,774 for personnel (1237 person-hours) and government vehicle use. Work began on October 28, 1989, and was mostly completed by the end of December. Redwood National Park's involvement waned in early December.

Background

Towards the end of the 1989 construction season, major earth moving along the Bypass project had been occurring between stations 620-720. This area is located immediately upslope from Prairie Creek State Park and Redwood National Park and represents the headwater regions to the Boyes, Big Tree, and Brown Creek drainages which are tributary streams to Prairie Creek. Geologically, this region is underlain by a very wet unit of the Gold Bluffs formation which contains mostly clay, silt, and sand with low rock fragments. This material is easily eroded by concentrated runoff. Over-steepened fills constructed with this material are prone to mass failure.

In past years, Caltrans had required the contractor to cease all earth moving and complete winterization of the project by October 15th. This year, however, in an attempt to complete the earth moving phase of this project, Caltrans ignored decisions and recommendations from other agencies and allowed the contractor to work beyond the October 15th deadline. The contractor focused on earth moving and did nothing to winterize this section of the project. Rains began on October 20th and produced 3.7 inches of rainfall measured at Orick (5.2 inches at Prairie Creek) over the next six days. Because of material properties found in this section of the project, and the fact that the project had not been winterized, this relatively small and common rainfall caused severe erosion, producing some of the highest turbidity levels ever observed in Prairie Creek and its tributary streams for this size of event.

Severe erosion occurred because this section of the project had not been winterized. There were no outboard berms to contain runoff to the alignment's surface, no inboard ditches to collect and safely direct runoff, and no temporary relief culverts to breakup and convey concentrated runoff into stable areas. Runoff from the alignment's surface was simply uncontrolled. Runoff discharged onto several steep, stream valley fillslopes initiating severe gully erosion and shallow debris-mudflows. Streamflow below the Boyes Creek viaduct breached a temporary diversion and severely eroded a stream valley fillslope creating mudflows and gullies which deposited sediment directly into streams. Widespread

gully erosion occurred on most of the alignment's surface.

By October 26, 1989, the alignment's surface was a quagmire, barely passible with a 4x4 vehicle. A significant break in the weather was needed to enable winterization of the project and control erosion. Perceived as an emergency, Prairie Creek State Park and Redwood National Park superintendents offered their assistance to Caltrans to implement sediment containment measures aimed at protecting the park resources located immediately downstream from the Bypass project. In a memo addressed to both state and national parks dated October 26, 1989, Caltrans officially requested assistance to construct sediment retention structures at the base of fills in the various streams affected by the Bypass project and this storm event. The parks, along with CCC, CDC, CDF and DFG responded immediately.

While the CCC and DPR organized labor crews, tools, and materials, the Klamath District maintenance staff along with Redwood National Park and California Department of Fish and Game physical sciences staff identified locations for sediment containment structures. The intent was to build structures with greater integrity and storage capacity than silt fences which are commonly used on the Bypass project to contain sediment. Work began on October 28, 1989 and was mostly completed by the end of December.

Objectives and Justification for Action

The primary objectives for sediment containment efforts were to contain Bypass-generated sediment as close as possible to the Bypass project, and prevent sediment already introduced into tributary streams from entering Prairie Creek. These objectives were justified by the following:

- 1) The entire area between stations 620 and 720 of the Bypass project had not been winterized prior to the October 20th storm and, because the Bypass surface was a quagmire, it was doubtful that winterization could ever occur without a significant break in the weather.
- 2) Had the Bypass project been properly winterized and in compliance with the 1603 Agreement, most of the erosion would not have occurred and virtually all of the sediment generated from this relatively common storm would have been contained to the project site.
- 3) The soils exposed in the major excavation areas are easily eroded and transported by surface runoff which remained uncontrolled.
- 4) This single storm created erosion features in critical areas which were similar in size to features which, in past years, had not developed until much later in the winter season. The potential for severe erosion to steep, stream valley fillslopes was immense.
- 5) Silt fences typically applied throughout the highway project for sediment control, lack the structural integrity needed to contain large amounts of sediment and fail if not maintained regularly. They are also inappropriate in stream channels carrying winter flows. Because of this, structures with more integrity, strength, and compatibility with streams were necessary.

6) The Bypass project drains into the most pristine and productive salmonid habitat in the entire Redwood Creek Watershed and, perhaps, along the entire north coast of California. Degradation to salmonid habitat had already exceeded levels estimated in the Environmental Impact Statement. Sections of Prairie Creek and its tributary streams, not identified in the EIS or covered by the 1603 Agreement issued by the Department of Fish and Game, were also impacted severely by erosion from the Bypass during this storm.

Sediment Containment Efforts

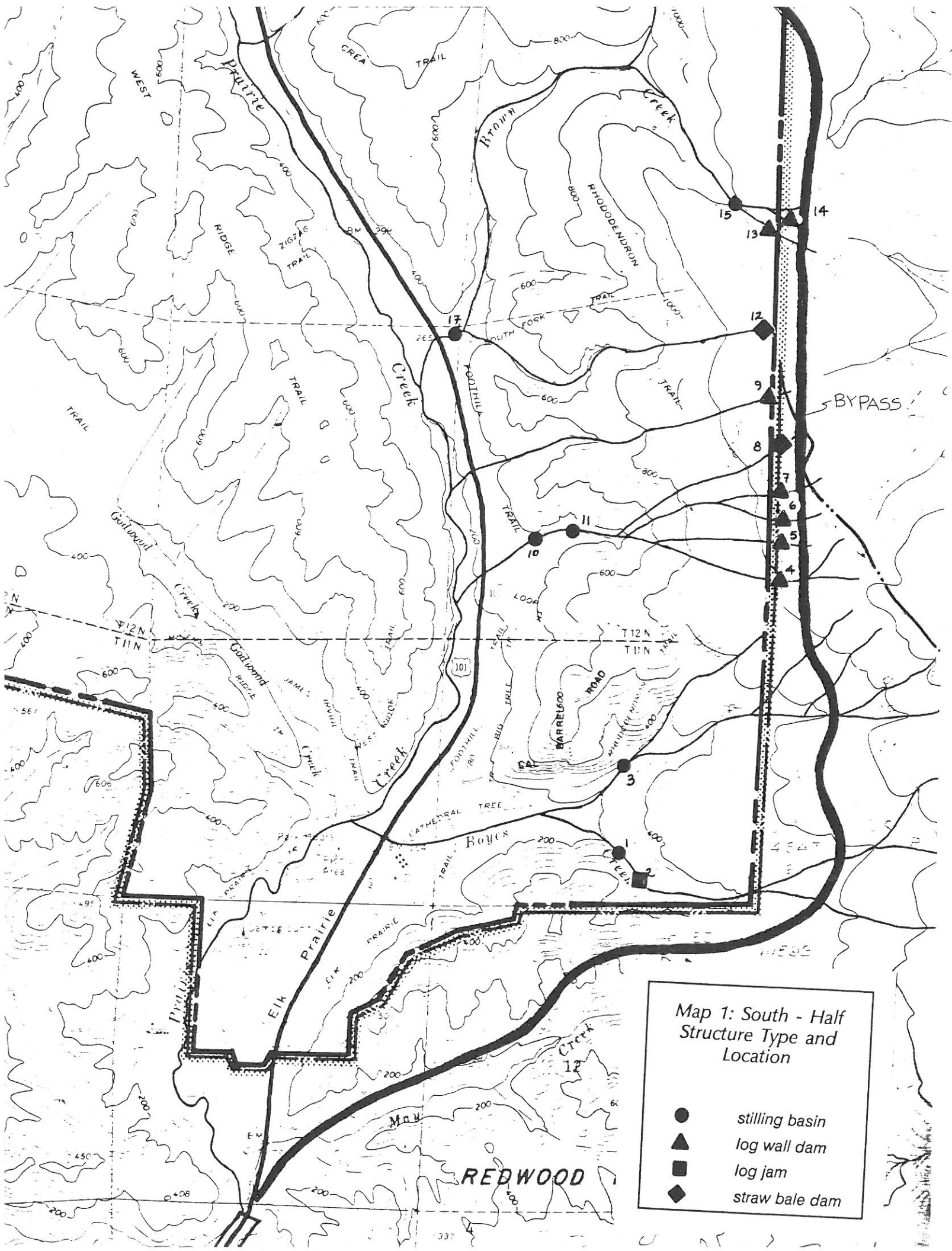
A total of 27 sediment containment structures were constructed on state lands, developing a total storage capacity of 3100 yds³. The structures were constructed by the CCC and CDC labor crews and, at the height of this effort, included 5 CCC and 2 CDC crews totalling nearly 100 workers. Rigging and materials were supplied by DPR, CCC, and Caltrans. Redwood National Park was largely responsible for the layout and design of the structures, and helped supervise construction. The total cost of this effort including CCC (\$255,553), and DPR (\$162,780) was \$439,107. Of this total, Redwood spent \$20,774 for personnel (1237 person-hours) and for government vehicle use. Redwood National Park's costs are summarized in Appendix A. Appendix B contains daily records of RNP's personnel hours.

The initial response focused on preventing additional sediment from stream valley fillslopes from entering streams. Stream channels immediately below the stream valley fillslopes between stations 620-720 were inventoried first. As prescription, design, and implementation progressed, efforts moved farther downstream within the drainages to capture and contain sediment already introduced to stream channels by the October 20th storm.

Various types of sediment containment structures were built by manual labor crews. The size and type of structure was largely controlled by: worksite characteristics; availability of local materials; type and quantity of sediment to be contained; and proximity to the Bypass project. "Dry" structures were built immediately below stream valley fillslopes with the intent of capturing material eroding from these areas. At these locations, culverts draining the fills and upstream drainages were extended downstream beyond the sediment containment structures to prevent culvert discharge from re-working and transporting the captured sediment downstream. "Wet" structures (stilling basins) were constructed farther downstream to capture Bypass-generated sediment already in the streams. Maps 1 and 2 show the location of each worksite. Each worksite and structure is described in Appendix C. Technical drawings for typical structures are contained in Appendix D.

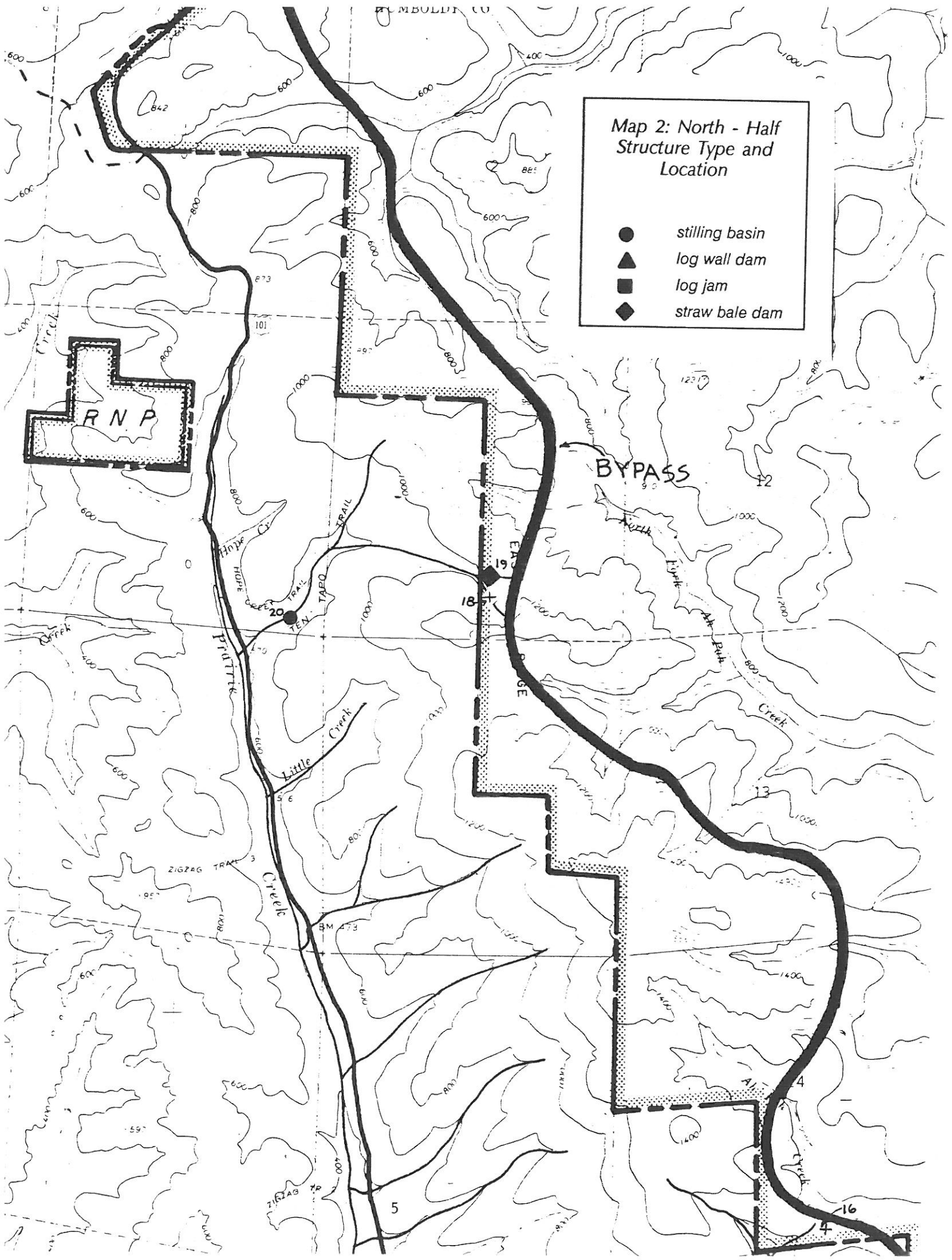
The following is a description of the four general types of sediment containment structures built during these efforts.

1) Multiple-Tier, Straw Bale Dams: constructed at the base of stream valley fillslopes where valley definition is poor, and erosion potential is moderate. They are "dry", low profile structures intended to capture material from shallow debris-mudflows and prevent this material from entering streams. They utilize straw bales which are reinforced with fence posts and wire, rebar stakes, and filter fabric.



Map 2: North - Half
Structure Type and
Location

- stilling basin
- ▲ log wall dam
- log jam
- ◆ straw bale dam



2) Log Wall Dams: constructed immediately below the base of stream valley fillslopes where erosion potentials are high. These are "dry", moderate to high profile structures intended to capture material from shallow debris-mudflows and gully erosion and prevent this material from entering streams. They utilize local, fallen trees which are stacked and anchored in a horizontal position and reinforced with steel cable, rebar, and filter fabric.

3) Log Jams: constructed downstream from the Bypass project in active, well defined stream channels. These are "wet", low profile structures which utilize local woody debris to form small log jams and storage compartments to capture the coarser fragment of Bypass-generated sediments already in the streams. Fence wire, rebar, and filter fabric are used throughout these structures

4) Log Stilling Basins: constructed downstream from the Bypass project in active, well defined streams intended to capture both fine and coarse grain sediment. These wet, moderate to high profile structures utilize fallen redwood trees which bridge the stream channel. Logs are placed in a near vertical position and anchored to the tree and stream channel to capture sediment already in the stream. Fence wire, rebar, steel cable, and filter fabric are used throughout these structures. Three stilling basins utilize log wall construction.

Conclusion

A maintenance and operation plan has been developed by Caltrans and approved by Redwood National Park and other affected agencies. The plan calls for routine winter inspection and maintenance, and removal of stored sediment during the summer months (sooner, if necessary). It also specifies the degree to which each structure will be dismantled when all affected agencies agree they are no longer needed.

Sediment containment structures have not been resurveyed to determine how much sediment has been trapped. Hopefully, personnel and funds will be available this summer to resurvey these structures to quantify their effectiveness. From a purely qualitative point of view, all structures are functioning as intended with the exception of structures #15 and #20. Both are "wet" structures that have had problems maintaining their seals and not creating the impoundment necessary for a stilling basin. These structures will be modified and repaired this summer by the CCC's.

A question we should answer soon is, at what point - when - should these structures be decommissioned? There is a growing concern amongst our staff that, by trapping and storing Bypass-generated sediment, we may be prolonging the effects of the Bypass project on Prairie Creek by not allowing this sediment to be transported through the system as it is being generated. These structures will have a limited life, perhaps 3-7 years (really anybody's guess), and can be viewed as little time bombs ready to supply slugs of sediment to the system. So much of this will depend on Caltran's ability to keep materials on the project site, and the frequency and intensity of winter storms. Structures are definitely trapping and storing sediment. Whether the quantity stored (along with potential quantity) and the particle size distribution of the material is critical to Prairie Creek must be determined to assist with this management related decision.

APPENDIX A:

SUMMARY OF REDWOOD NATIONAL PARK COSTS
OCTOBER 23 THROUGH DECEMBER 13, 1989

SUMMARY OF REDWOOD NATIONAL PARK COSTS
OCTOBER 23 THROUGH DECEMBER 13, 1989

Personnel Costs, Regular Time¹

Greg Bundros 220 hrs. @ \$16.16/hr. =	\$3555.20
Louise Johnson 160 hrs. @ \$15.83/hr.=	2532.80
Darci Short 160 hrs. @ \$15.52/hr.=	2483.20
Ron Sonnevill 209 hrs. @ \$15.00/hr.=	3135.00
Randy Klein 50 hrs. @ \$15.40/hr.=	770.00
Vickie Ozaki 26 hrs.@ \$15.35/hr.=	399.10
Carie Jones 46 hrs. @ \$8.10/hr.=	372.60
Fred Booker 45 hrs. @ \$8.97/hr.=	403.65
Lyle Johnson 10 hrs. @ \$10.65/hr.=	106.50
Doug Smith 10 hrs. @ \$12.86/hr.=	128.60
Kieth Ritchie 2 hrs. @ \$11.82/hr.=	23.64
Darleen Buck 2 hrs.@ \$10.53/hr.=	21.06
Sub-Total=	<u>\$13,931.35</u>

Personnel Costs, Overtime

Greg Bundros 100.75 hrs. @ \$19.14/hr=	\$1928.35
Louise Johnson 101.5 hrs. @ \$19.66/hr.=	1995.49
Darci Short 95 hrs. @ \$19.05/hr.=	1809.75
Sub-Total=	<u>\$5733.59</u>

Vehicle Costs²

Vehicle 62-1243: 1.7 months and 846 miles	\$441.14
Vehicle 62-10923: 1.2 month and 687 miles	330.70
Vehicle 62-12433: 1.0 month and 708 miles	304.72
Vehicle I-147171: 153 miles	32.89
Sub-Total=	<u>\$1109.45</u>

GRAND TOTAL=\$20,774.39

¹All personnel hours and activities are detailed in the Appendix B.

²The General Services Administration charges Redwood National Park \$152.50/month and \$0.215/mile for the 4x4 pickups used for this Bypass work. The mileage listed above is the actual mileage recorded for each vehicle from October 23rd through December 13th and is all related to sediment containment efforts. A daily record of vehicle mileage and use is not available nor will it be constructed.

APPENDIX B:

DAILY CALENDAR OF PERSONNEL HOURS
TO CONSTRUCT SEDIMENT CONTAINMENT STRUCTURES

DAILY CALENDAR OF PERSONNEL HOURS
TO CONSTRUCT SEDIMENT CONTAINMENT STRUCTURES

OCTOBER, 1989

	SUNDAY 22	MONDAY 23	TUESDAY 24	WEDNESDAY 25	THURSDAY 26	FRIDAY 27	SATURDAY 28	TOTALS
G. Bundros	0	10	10	10	10	<u>11</u>	0	40, <u>11</u>
L. Johnson	0	0	0	0	0	<u>1</u>	2	<u>3</u>
R. Sonnevill	0	10	10	10	10	0	0	40
	29	30	31					
G. Bundros	8	10	10					20, <u>8</u>
L. Johnson	0	<u>11</u>	10					10, <u>11</u>
D. Short	0	<u>10</u>	10					10, <u>10</u>
R. Sonnevill	0	<u>10</u>	12.5					22.5

October Notes:

Both regular time and overtime hours are shown in this table with overtime hours underlined.

Bundros and Sonnevill are identifying structure sites and designing structures; Johnson and Short are becoming familiar with the structure sites and design, and begin supervising construction on the 30th.

The following vehicles were used on a full time basis during this period of time: 1985 Ford 4x4, #62-12432(Bundros); 1983 Dodge 4x4, #62-10923(Johnson); 1985 Ford 4x4, #62-12433(Short). Technical service's vehicle is not included due to lack of record.

NOVEMBER, 1989

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	TOTALS
				1	2	3	4	
G. Bundros				10	10	9	0	20, 9
L. Johnson				10	10	10	0	30
D. Short				10	10, .5	10	9.5	30, 10
R. Sonnevill				12.5	10	10	0	55
L. Johnson				5	5	0	0	10
D. Smith				5	5	0	0	10
K. Ritchie				0	2	0	0	2
D. Buck				0	2	0	0	2
	5	6	7	8	9	10	11	
G. Bundros	0	10	10	10	9.75	7	6	30, 22.75
L. Johnson	9.5	10	10	10	10	10	0	30, 29.5
D. Short	9.5	10	10	10	10	10	9.5	30, 39
R. Sonnevill	0	10	10	10	10	0	0	40
V. Ozaki	0	8	0	0	0	0	0	8
C. Jones	0	8	0	0	0	0	0	8
	12	13	14	15	16	17	18	
G. Bundros	0	10	10	10	10	10	10	40, 20
L. Johnson	0	11	10	10	10	10	10	40, 21
D. Short	9	9	10	10	10	10	0	40, 18
R. Sonnevill	0	5	5	5	5	0	0	20
V. Ozaki	0	8	0	0	0	0	0	8
C. Jones	0	8	0	0	0	0	0	8
F. Booker	0	0	5	0	0	0	0	5

NOVEMBER, 1989 (Cont'd)

	19	20	21	22	23	24	25	
G. Bundros	10	10	10	10	0	0	10	30, 20
L. Johnson	10	11	10	10	0	0	8	20, 29
D. Short	0	0	10	10	0	0	0	20
R. Sonnevill	0	0	10	10	0	0	0	20
R. Klein	0	10	0	0	0	0	0	10
V. Ozaki	0	10	0	0	0	0	0	10
C. Jones	0	10	0	0	0	0	0	10
	26	27	28	29	30			
G. Bundros	10	10	10	10	10			40, 10
L. Johnson	0	8	10	10	10			30, 8
D. Short	9	9	10	10	10			30, 18
R. Sonnevill	0	10	10	0	0			20
R. Klein	0	10	10	10	0			30
C. Jones	0	10	10	0	0			20
F. Booker	0	10	10	10	0			30

November Notes:

Both overtime and regular time are shown in this table with overtime underlined.

Bundros and Sonnevill are coordinating Redwood National Park's involvement, meeting with Caltrans, Water Quality, and Fish and Game, and supervising construction; Johnson and Short are supervising construction. Klein, Ozaki, Jones, and Booker are surveying sediment basins for storage capacities. RNP labor crews (Johnson, Smith, Ritchie, and Buck) delivered straw to structure sites at stations 672, 683, and 695 on November 1-2, 1989.

The following vehicles were used on a full time basis during this period of time: 1985 Ford 4x4, #62-12432(Bundros); 1983 Dodge 4x4, #62-10923(Johnson); 1985 Ford 4x4, #62-12433(Short). The labor crew delivered 80 bales of RNP purchased straw with its 1980 GMC 2 1/2 ton, #I-147171.

DECEMBER, 1989

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	TOTALS
G. Bundros						<u>1</u>	<u>2</u>	
	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>0,3.5</u>
G. Bundros	0	10	10	0	0	0	0	20
D. Short	0	0	5	0	0	0	0	5
R. Sonnevill	0	10	4	0	0	0	0	14
R. Klein	0	10	0	0	0	0	0	10
F. Booker	0	10	0	0	0	0	0	10
	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	
G. Bundros	0	5	10	0	0	0	0	15

December Notes:

Both regular and overtime hours are shown in this table with overtime hours underlined.

RNP's involvement wanes by December 1. Bundros, Sonnevill, and Klein finalize Lower Big Tree structure design. Bundros compiles RNP's personnel costs, meets with Caltrans and other agencies, performs a final review of structures with Short, and prepares and submits a volume report for each structure to Caltrans. Sonnevill and Klein are supervising the Lower Brown Creek site construction.

APPENDIX C:
SITE SPECIFIC STRUCTURES

Site Specific Structures

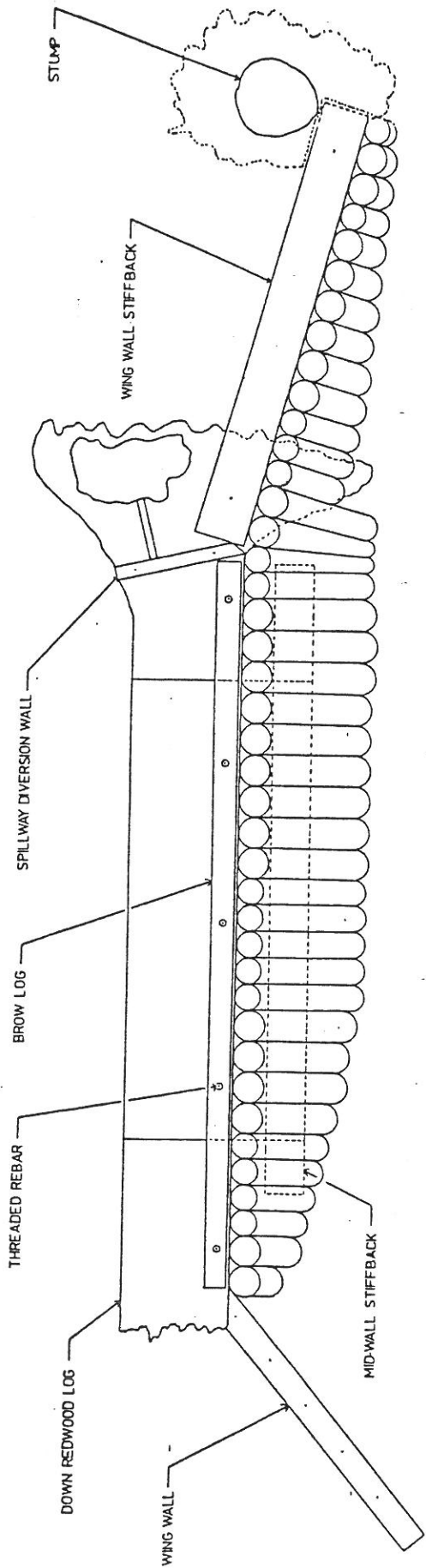
The following list describes each sediment containment structure. Site identification numbers include station numbers in parenthesis which are referenced to the Bypass project. The reader is referred to Maps 1 and 2 which locate each structure site. Obtained from the State Parks System, technical drawings for typical structures can be found in Appendix D.

Site	Drainage	Description
1 (580+00)	S. Fk. Boyes	1 log stilling basin 80 ft. wide, 7 ft. high; total storage capacity = 280 yd ³ .
2 (580+00)	S. Fk. Boyes	1 log jam 50 ft. wide, 5 ft. high; total storage capacity = 112 yds ³ .
3 (614+00)	N. Fk. Boyes	1 log stilling basin 50 ft. wide, 8 ft. high; utilizes milled redwood slabs and 10"x10" beams; storage capacity = 185 yds ³ .
4 (650+00)	Big Tree	1 log wall dam 30 ft. wide, 12 ft. high; highway culverts extended downstream from structure; storage capacity = 240 yds ³ .
5 (657+50)	Big Tree	1 log wall dam 40 ft. wide, 7 ft. high; highway culverts extended downstream from structure; storage capacity = 55 yds ³ .
6 (659+00)	Big Tree	2 log wall dams ranging from 40-50 ft. wide, 7-8 ft. high; highway culverts extended downstream from structures; total storage capacity = 65 yds ³ .
7 (664+50)	Big Tree	2 log wall dams 40 ft. wide, 6-10 ft. high; highway culverts extended downstream from structures; total storage capacity = 100 yds ³ .
8 (672+00)	Big Tree	1 straw bale dam 50 ft. wide, 4 tiers high; storage capacity = 23 yds ³ .
9 (683+00)	Big Tree	1 log stilling basin 40 ft. wide, 9 ft. high; storage capacity = 80 yds ³ .
10 (128.20) Hwy 101	Big Tree	1 gabion/straw stilling basin 50 ft. wide, 7 ft. high; site utilizes old trail crossing and broad valley; storage capacity not available at this time.
11 (128.20) Hwy 101	Big Tree	1 log jam 50 ft. wide, 4 ft. high; storage capacity not available at this time.
12 (695+00)	S. Fk. Brown	3 straw bale dams 40 ft. wide, 3-4 tiers high; total capacity = 76 yds ³ .

Site	Drainage	Description
12 (695+00)	S. Fk. Brown	3 straw bale dams 40 ft. wide, 3-4 tiers high; total capacity = 76 yds ³ .
13 (711+00)	N. Fk. Brown	4 log jams ranging from 20-60 ft. wide, 2-7 ft. high; total storage capacity = 119 yds ³ .
14 (714+00)	S. Fk. Brown	1 log jam 35 ft. wide, 5 ft. high; storage capacity = 11 yds ³ .
15 (718+00)	S. Fk. Brown	1 log stilling basin 80 ft. wide, 16 ft. high; capacity = 1015 yds ³ .
16 (770+00)	N. Fk. Brown	A manual excavation to contain highway runoff on skid trail which routes runoff to nearby drainage.
17 (129.00) Hwy 101	Brown Creek	2 log wall stilling basins 30 ft. wide, 2-3 ft. high; both structures allow fish passage; total storage capacity = 86 yds ³ .
18 (930+00)	Ten Tapo	Manual excavation of material stored behind failed silt fence in stream; constructed silt fences to contain excavated material; manual excavation of waterbars on skid trail.
19 (933+00)	Ten Tapo	2 straw bale dams 30 ft. wide, 2-3 tiers high; total capacity = 36 yds ³ .
20 (132.36) Hwy 101	Ten Tapo	1 log wall stilling basin 50 ft. wide, 4 ft. high; capacity = 445 yds ³ .

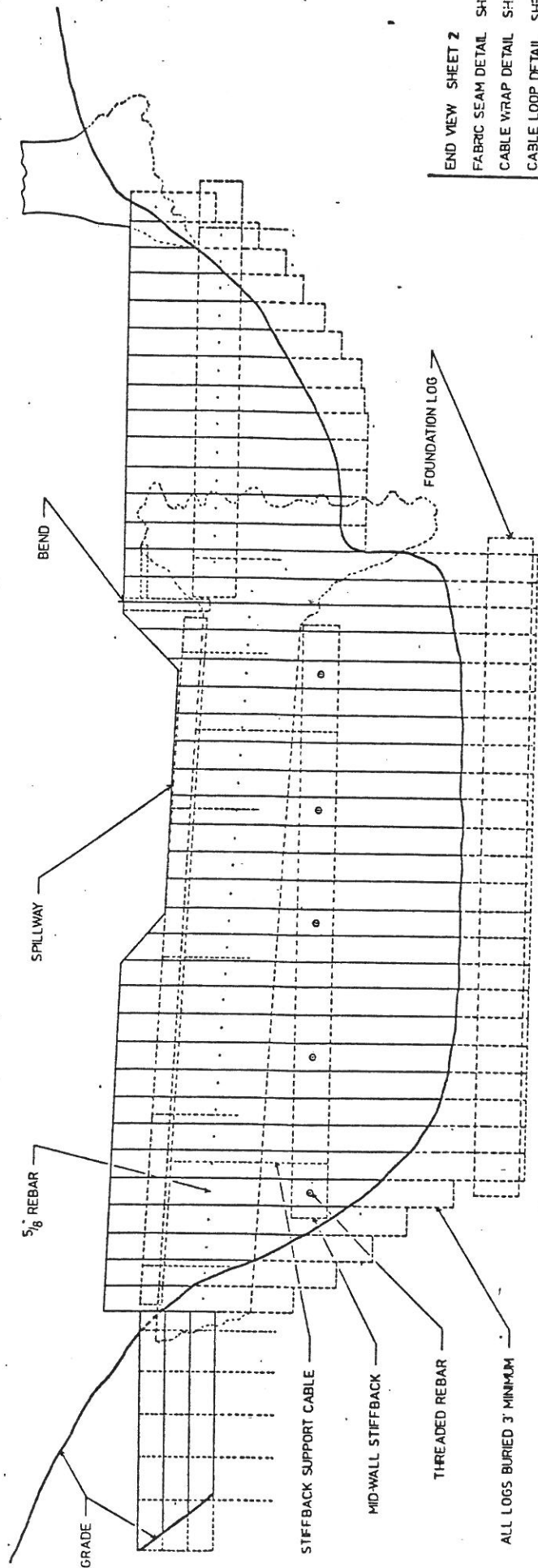
In addition to these structures, manual labor crews excavated Bypass-generated sediment from stream banks and bars in the Big Tree drainage utilizing shovels and buckets. The amount of sediment removed is unknown.

APPENDIX D:
TECHNICAL DRAWINGS



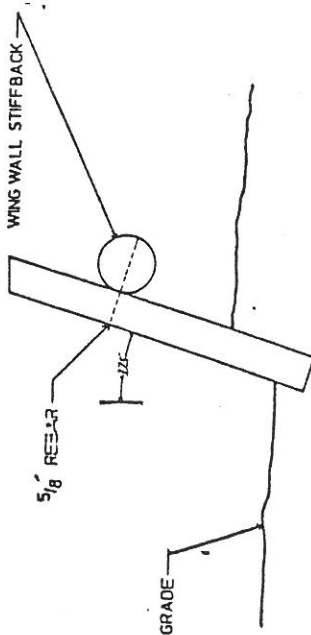
REBAR PROJECTIONS NOT SHOWN PLAN VIEW
FOUNDATION LOG NOT SHOWN PLAN VIEW

d-1

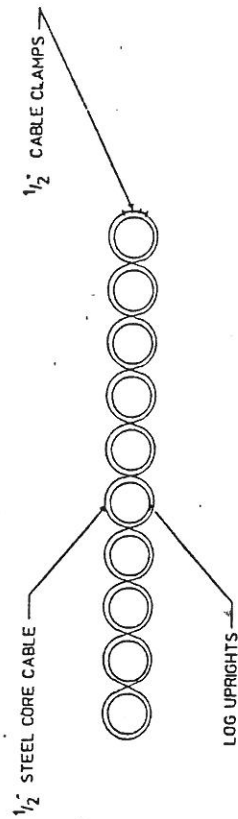
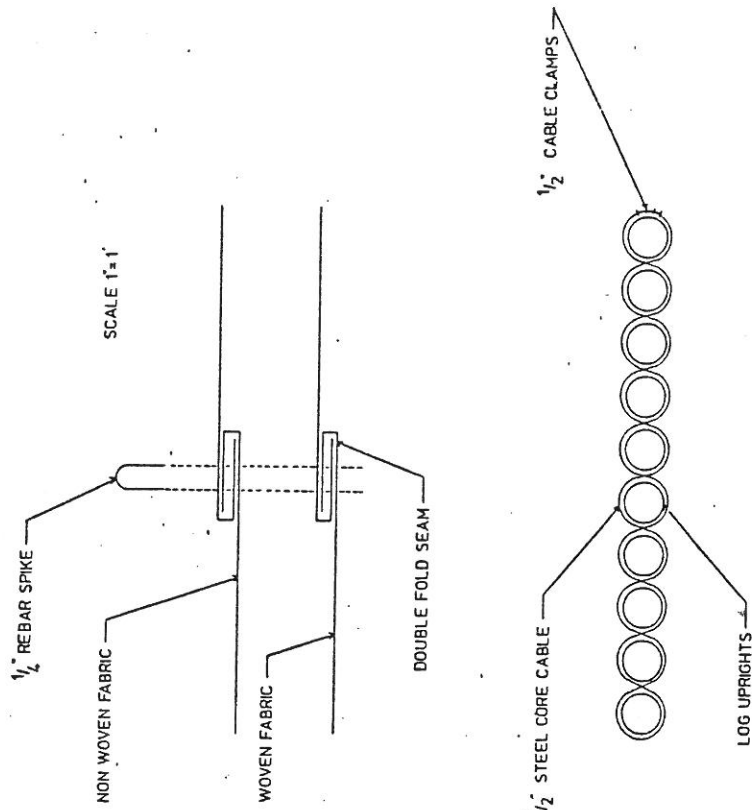
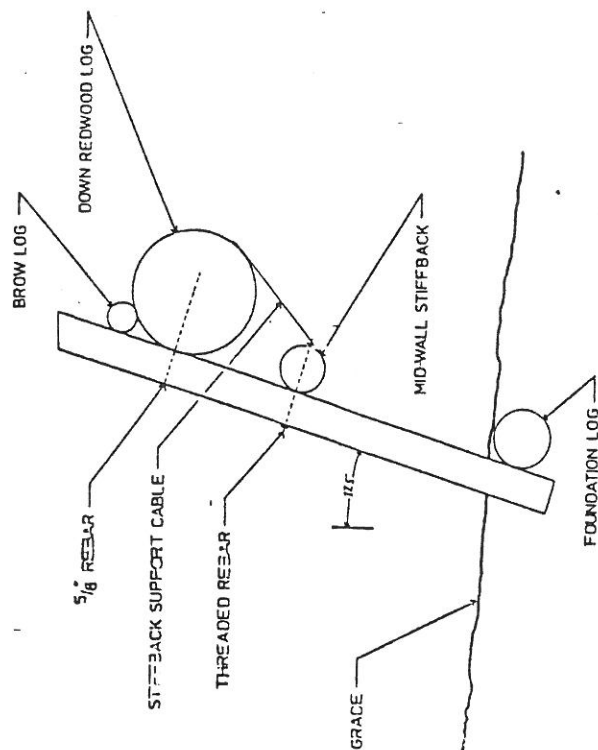


END VIEW SHEET 2
FABRIC SEAM DETAIL SHEET 2
CABLE WRAP DETAIL SHEET 2
CABLE LOOP DETAIL SHEET 3
CABLE OVERLAY DETAIL SHEET 3
CABLE LAYOUT SHEET 3

WING WALL END VIEW



MAIN WALL END VIEW

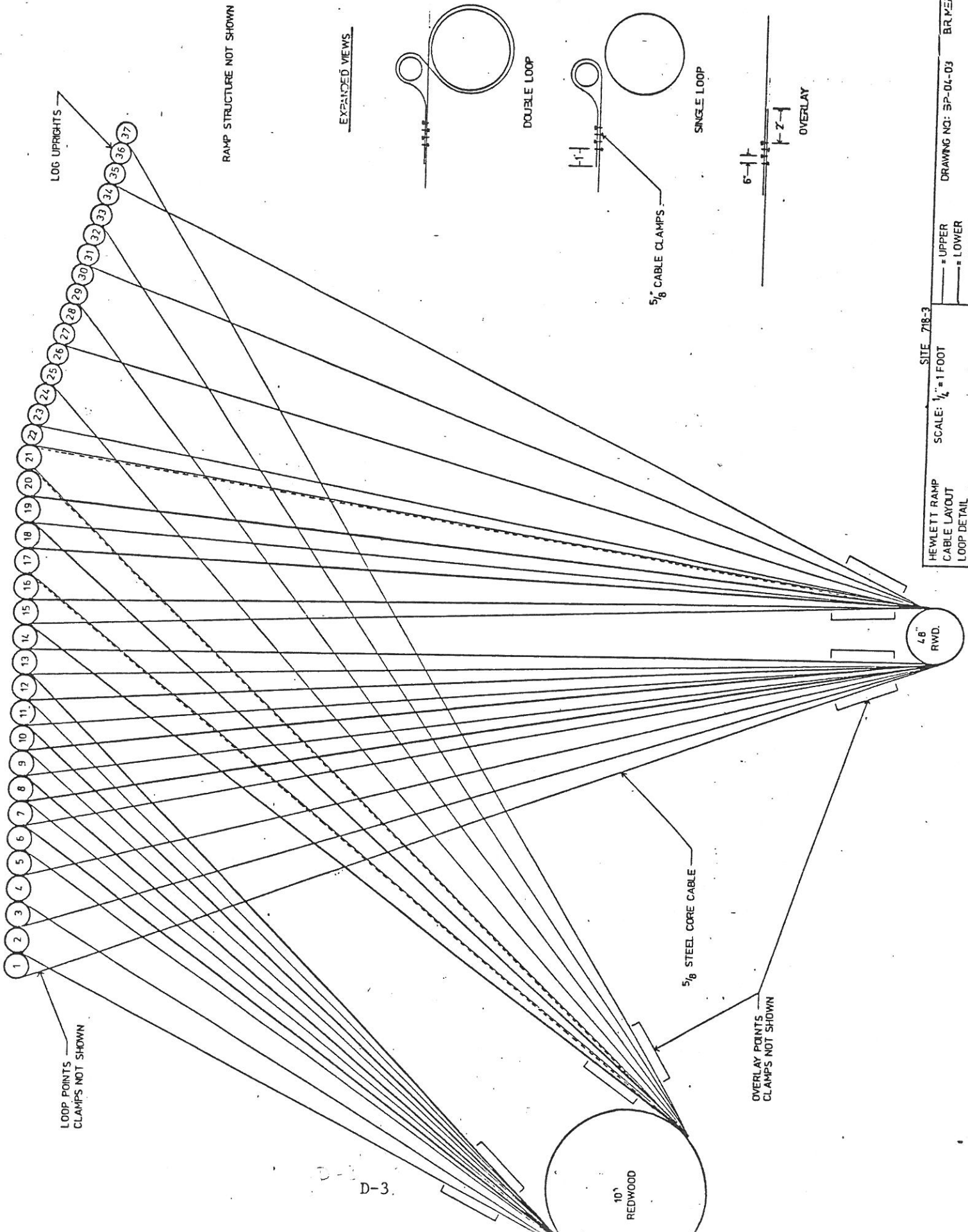


BR VERRILL 1/75

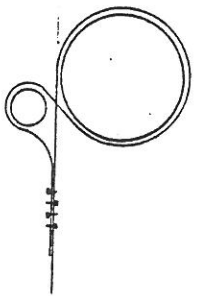
HEWLETT RAMP SITE 718.3
END VIEWS
FABRIC SEAM DETAIL
CABLE WRAP DETAIL

SCALE: 1/2"=1' DRAWING NO: BP-04-02

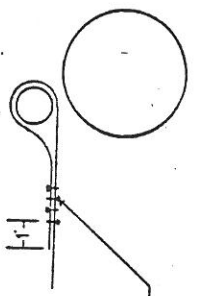
SHEET 2 OF 3



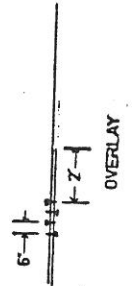
EXPANDED VIEWS



DOUBLE LOOP



SINGLE LOOP



OVERLAY

5/8" CABLE CLAMPS

6'-1"

SITE 718-3

SCALE: 1/4" = 1 FOOT

DRAWING NO: SP-01-03

BR MERRILL 12-89

SHEET 3 OF 3

HEWLETT RAMP
CABLE LAYOUT
LOOP DETAIL
OVERLAY DETAIL

— = UPPER
— = LOWER
— = UPPER/LOWER

D-3

10" REDWOOD

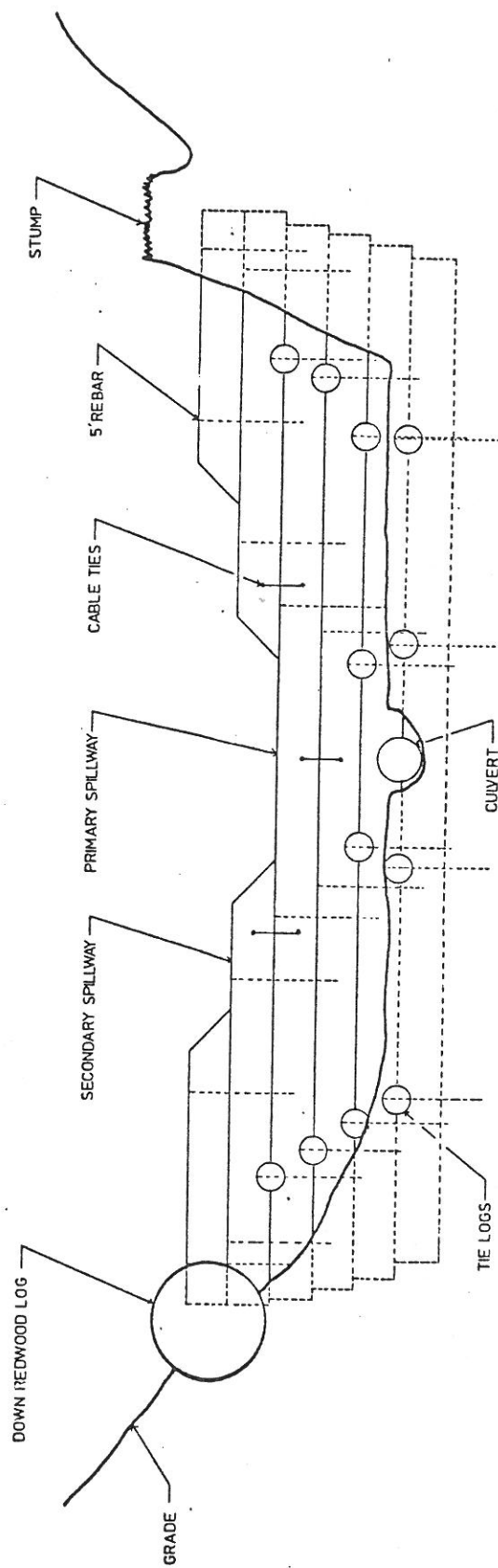
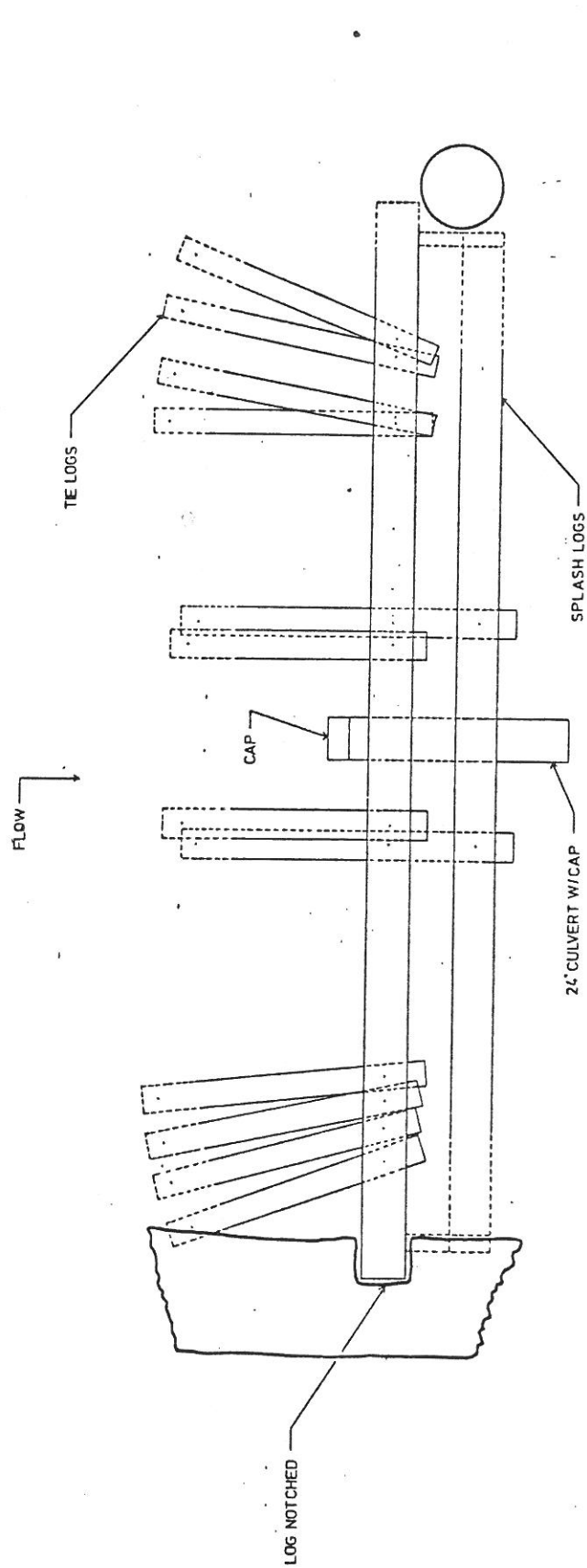
46" RWD.

5/8" STEEL CORE CABLE

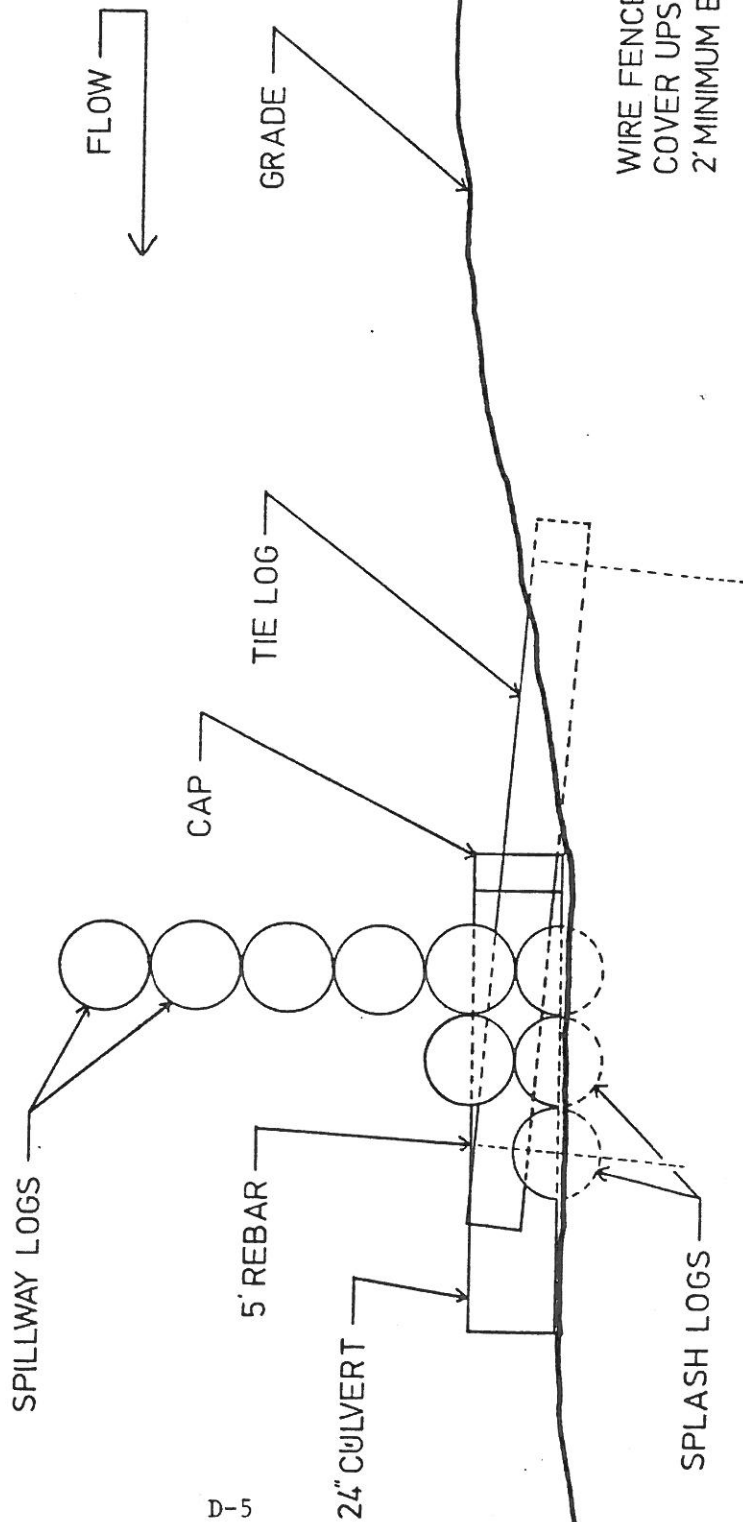
OVERLAY POINTS
CLAMPS NOT SHOWN

LOOP POINTS
CLAMPS NOT SHOWN

RAMP STRUCTURE NOT SHOWN

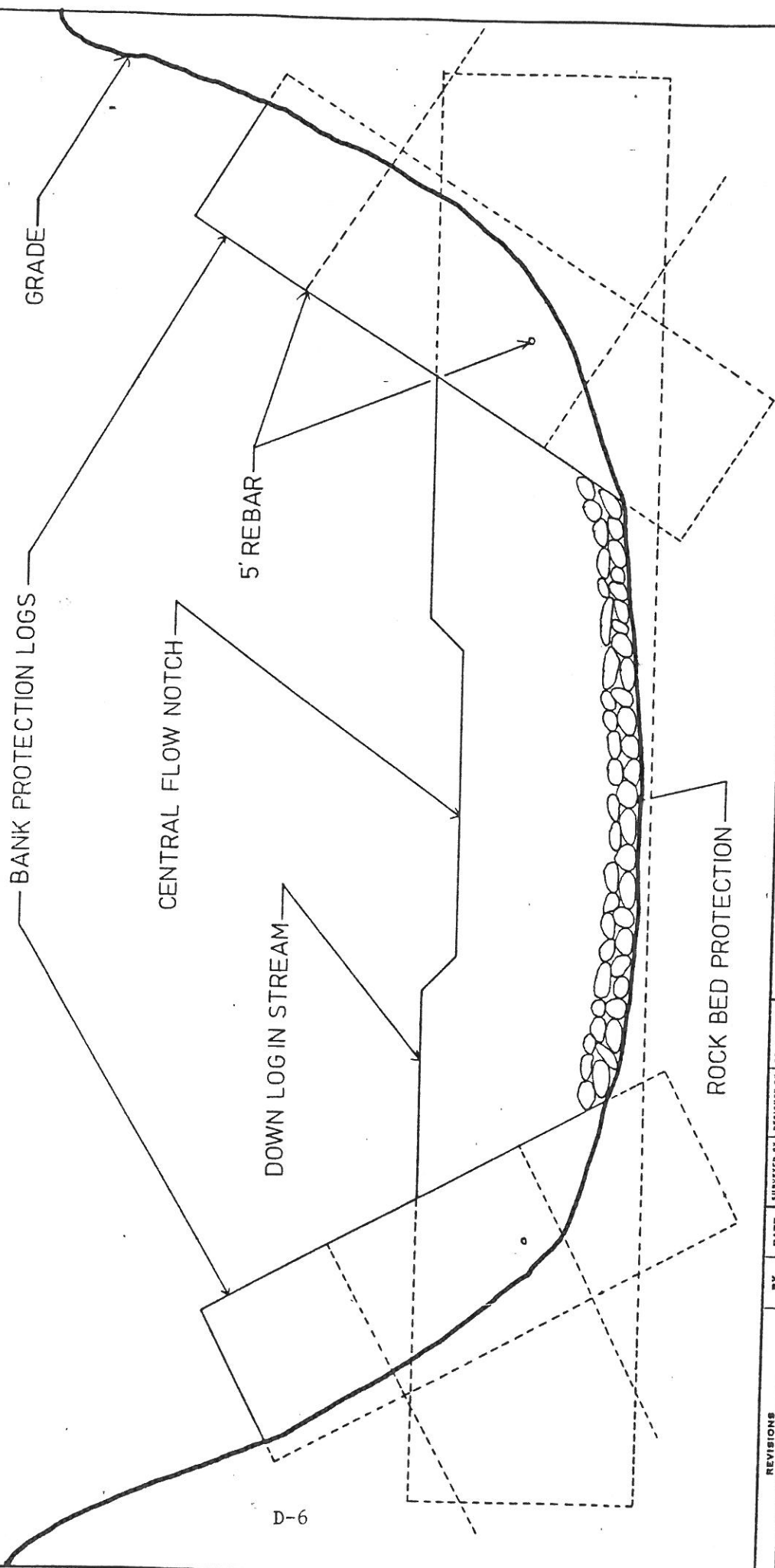


TEN TAPO
LOG RETAINING
FRONT VIEW
PLAN VIEW



WIRE FENCE AND FABRIC NOT SHOWN
COVER UPSTREAM SIDE
2' MINIMUM BURIAL ON ALL EDGES

REVISIONS		BY	DATE	SURVEYED BY		DESIGNED BY	REVIEWED BY	STATE OF CALIFORNIA DIVISION OF BEACHES AND PARKS DEPARTMENT OF PARKS AND RECREATION		TEN TAPO LOG RETAINING WALL COMPOSITE SIDE VIEW		DRAWING NO. BP-05-02	SHEET 2
		B.M.	12-89	DATE		DATE	DATE	APPROVED		DISTRICT		SCALE 1/4" = 1'	OF 2
				DATE		DATE	DATE	DEPUTY CHIEF, DIVISION OF BEACHES AND PARKS		DISTRICT		1/1	2



D-6

REVISIONS		BY	DATE	SURVEYED BY	DESIGNED BY	REVIEWED BY	STATE OF CALIFORNIA		TYPICAL LOG JAM CHECK DAM LOW PROFILE FRONT VIEW		DRAWING NO.	SHEET
							DIVISION OF BEACHES AND PARKS DEPARTMENT OF PARKS AND RECREATION				BP-03-01	
		BM.	12-89	DATE	DATE	DATE	APPROVED				1/2" SCALE	OF
				DATE	DATE	DATE	DEPUTY CHIEF, DIVISION OF BEACHES AND PARKS				DISTRICT	2
				DATE	DATE	DATE					///	

D-7

FLOW →

CENTRAL FLOW NOTCH

5' REBAR

SHALLOW KEYS FOR LOGS

REVISIONS

BY DATE
BM 12-89

SURVEYED BY DATE
DESIGNED BY DATE
TRACED BY DATE
CHECKED BY DATE

REVIEWED BY DATE
REVIEWED BY DATE
REVIEWED BY DATE

STATE OF CALIFORNIA
DIVISION OF BEACHES AND PARKS
DEPARTMENT OF PARKS AND RECREATION

APPROVED DEPUTY CHIEF, DIVISION OF BEACHES AND PARKS
DATE

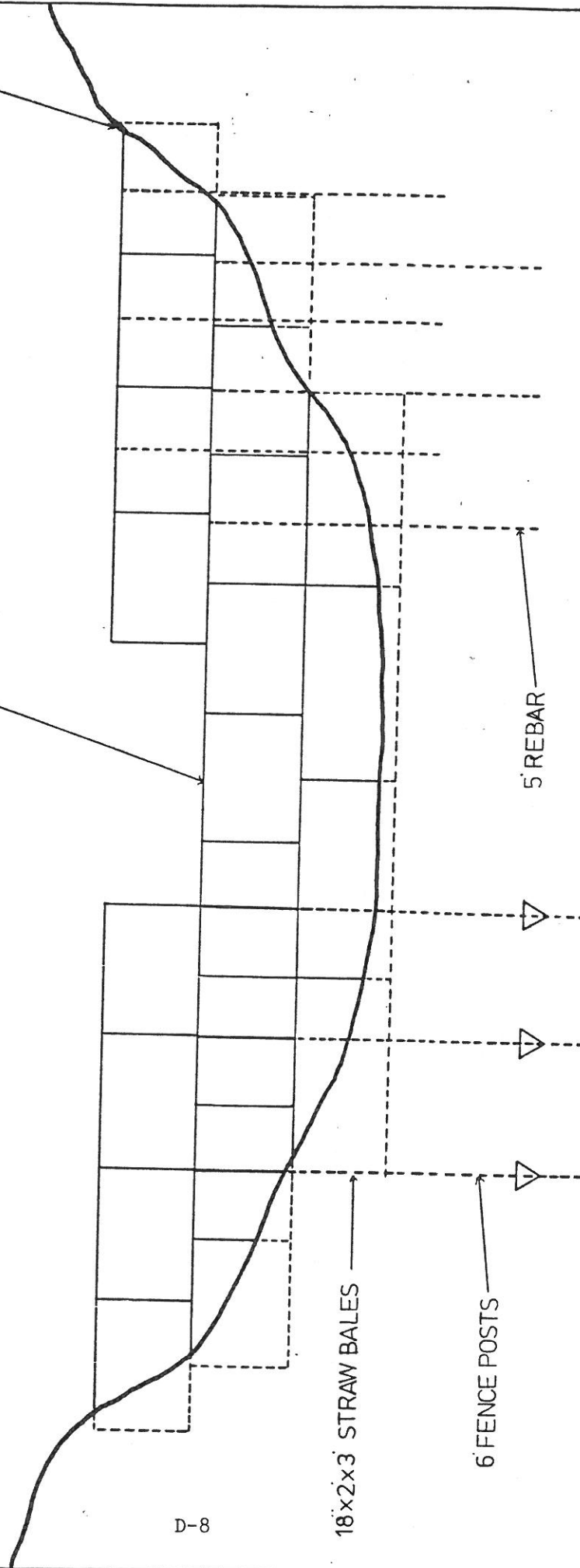
TYPICAL LOG JAM CHECK DAM
LOW PROFILE
PLAN VIEW

DRAWING NO. BP-03-02
SHEET 2 OF 2
SCALE 1/2" = 1'
DISTRICT III

SEE END VIEW FOR FABRIC LAYOUT

SPILLWAY WIDTH DETERMINED
BY FLOW

BALES KEYED INTO BED AND BANK



STATE OF CALIFORNIA
DIVISION OF BEACHES AND PARKS
DEPARTMENT OF PARKS AND RECREATION

TYPICAL STRAW BALE DAM
THREE TIER FRONT VIEW

DRAWING NO.
BP-01-1
SCALE
1/2" = 1'
DISTRICT
III

SHEET
1
OF
2

REVISIONS			
BY	DATE	SURVEYED BY	DESIGNED BY
BM.	12-89	DATE	DATE
		TRACED BY	DRAWN BY
		DATE	DATE
		CHECKED BY	CHECKED BY
		DATE	DATE
		REVIEWED BY	REVIEWED BY
		DATE	DATE
		APPROVED	DATE
		DEPUTY CHIEF, DIVISION OF BEACHES AND PARKS	

12' WIDE FABRIC COVERING ALL BALES
OVERLAP 3' ON TOP

13 GA. WIRE TIES

← FLOW

6' FENCE POSTS

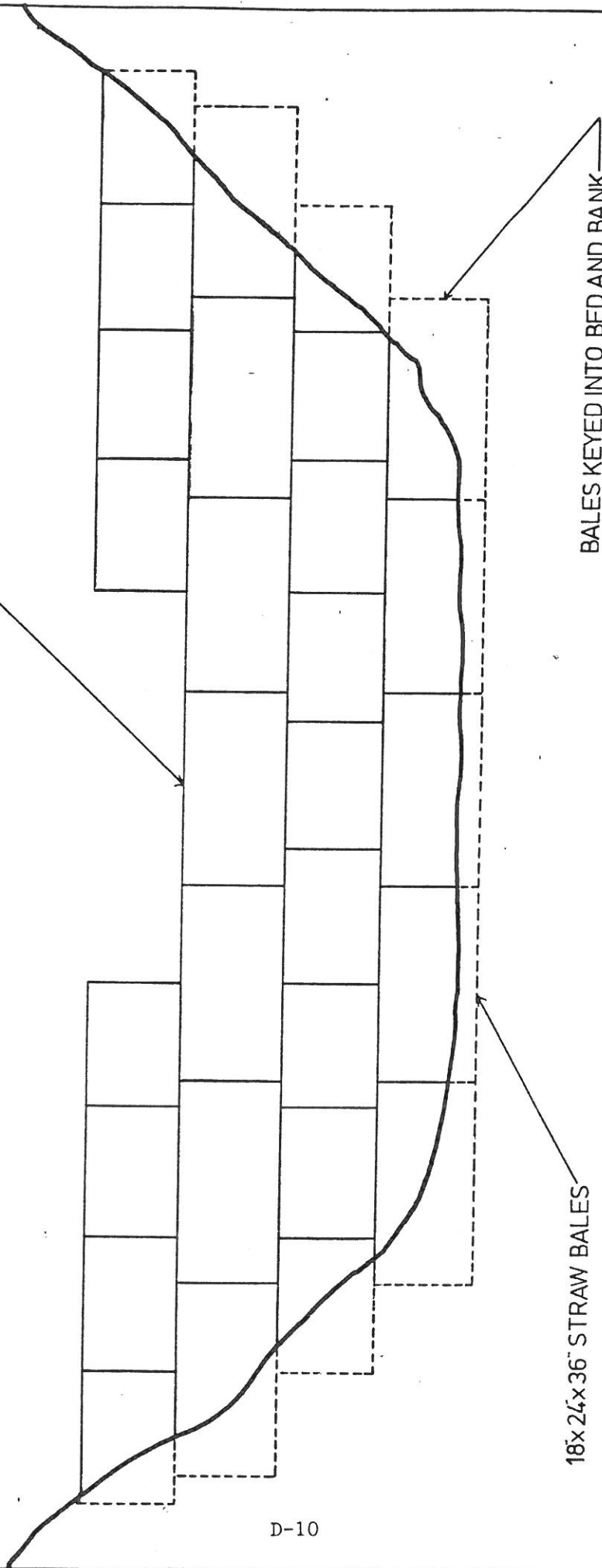
FABRIC BURIED 2' MIN. ALL SIDES

5 REBAR FROM 2nd TIER UP

REVISIONS		BY	DATE	SURVEYED BY		DESIGNED BY	REVIEWED BY	STATE OF CALIFORNIA DIVISION OF BEACHES AND PARKS DEPARTMENT OF PARKS AND RECREATION		TYPICAL STRAW BALE DAM THREE TIER END VIEW		DRAWING NO. BP-01-2	SHEET 2 OF 2	
		BM.	12-89	DATE	DATE	DATE	DATE	APPROVED				SCALE 1/2" = 1'		
				DATE	DATE	DATE	DATE	DEPUTY CHIEF, DIVISION OF BEACHES AND PARKS				DISTRICT ///		

- SEE SHEET 2 FOR FABRIC DETAIL
- SEE SHEET 3 FOR REBAR DETAIL

SPILLWAY WIDTH DETERMINED BY FLOW



18x24x36" STRAW BALES

REVISIONS		BY	DATE	DESIGNED BY		DATE	REVIEWED BY		DATE	STATE OF CALIFORNIA DIVISION OF BEACHES AND PARKS DEPARTMENT OF PARKS AND RECREATION		TYPICAL STRAW BALE DAM FOUR TIER FRONT VIEW		DRAWING NO. BP-02-01	SHEET 1
		B.M.	12-89	DRAWN BY		DATE	REVIEWED BY		DATE	APPROVED		DISTRICT III		SCALE 1/2" = 1'	OF 3
				CHECKED BY		DATE	REVIEWED BY		DATE	DEPUTY CHIEF, DIVISION OF BEACHES AND PARKS					

13 GAUGE WIRE TIES

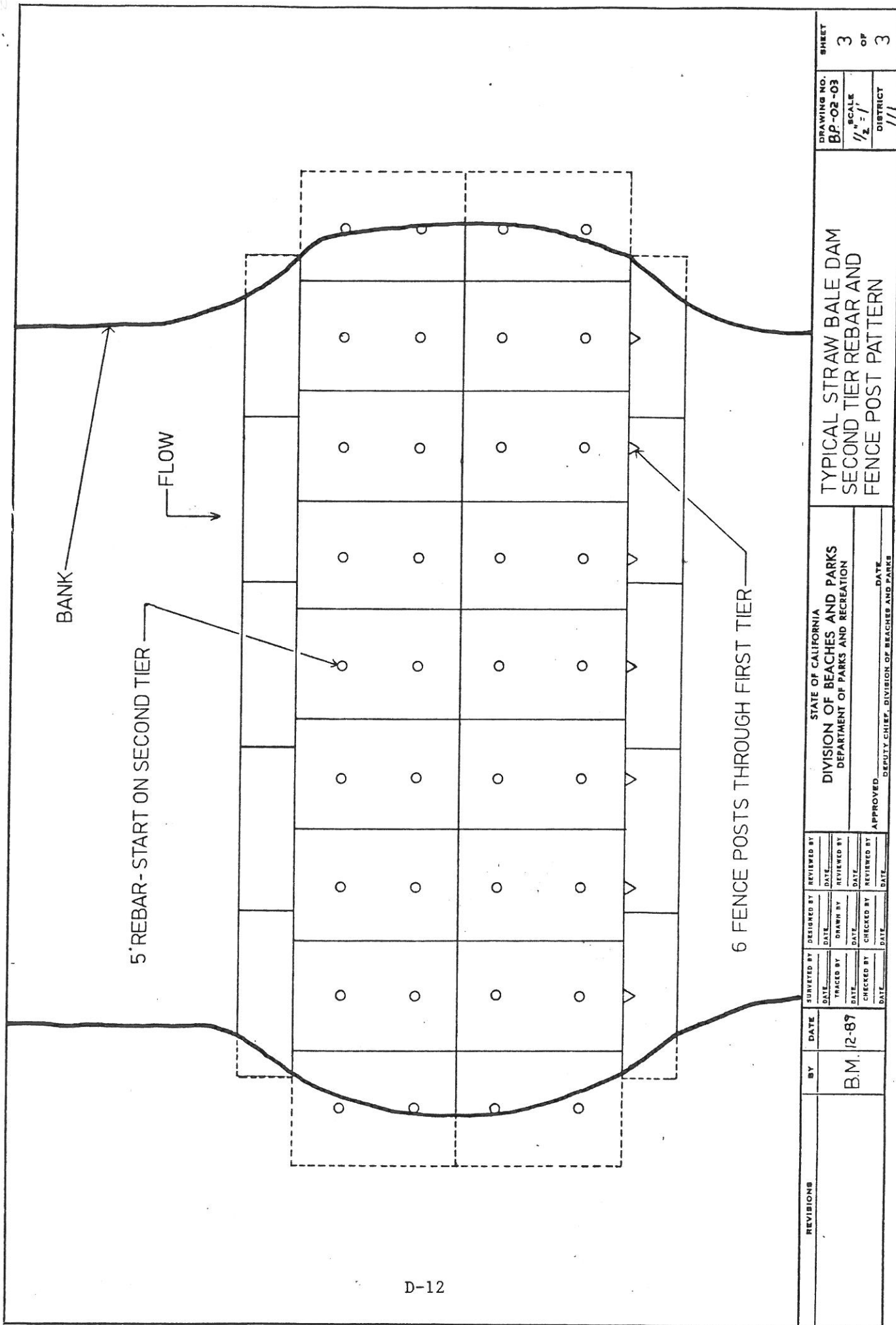
12 WIDE FABRIC COVERING ALL BALES
OVERLAP 3 ON TOP

← FLOW

GRADE

FABRIC BURIED 2' MINIMUM ALL SIDES

REVISIONS	BY	DATE	SURVEYED BY	DESIGNED BY	REVIEWED BY	STATE OF CALIFORNIA DIVISION OF BEACHES AND PARKS DEPARTMENT OF PARKS AND RECREATION		TYPICAL STRAW BALE DAM FOUR TIER END VIEW		DRAWING NO. BP-02-02	SHEET 2
			DATE	DATE	DATE	APPROVED				SCALE 1/2" = 1'	OF 3
			DATE	DATE	DATE	DEPUTY CHIEF, DIVISION OF BEACHES AND PARKS				DISTRICT III	
			DATE	DATE	DATE						



DRAWING NO.	SHEET
BP-02-03	3
SCALE	OF
1/2" = 1'	3
DISTRICT	///

STATE OF CALIFORNIA
DIVISION OF BEACHES AND PARKS
DEPARTMENT OF PARKS AND RECREATION
APPROVED
DEPUTY CHIEF, DIVISION OF BEACHES AND PARKS
DATE

DESIGNED BY	REVIEWED BY
DATE	DATE
DRAWN BY	REVIEWED BY
DATE	DATE
CHECKED BY	REVIEWED BY
DATE	DATE

BY	DATE
B.M.	12-87

REVISIONS
