JOHN DAY RIVER

FISH HABITAT IMPROVEMENT IMPLEMENTATION PLAN

Project No. 84-21

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ABSTRACT

A basin habitat improvement program for wild spring chinook and summer steelhead in the John Day Basin is being implemented on private lands by the Oregon Department of Fish & Wildlife (ODFW). This implementation plan was prepared for anadromous fish habitat work on private lands by ODFW to facilitate accomplishments of the program in a cost effective manner. The plan identifies existing habitat problems, goals and objectives, solutions, priorities, estimated project costs and associated fishery benefits. The plan is a working document to identify priority work areas for implementation years April 1, 1988 - March 31, 1992. Any changes in the plan identified by ODFW will be subject to a formal review process by both ODFW and the Bonneville Power Administration (BPA), and coordinated with the sub-basin plan for the John Day River. Additional habitat work conducted in the basin beyond 1992 will be guided by information in the sub-basin plan.

The program provides for treatment of up to approximately 180 miles of stream habitat on private lands from April 1, 1988 to March 31, 1992. Limiting habitat factors in the basin are adult holding areas and rearing habitats for spring chinook, and rearing habitats for summer steelhead. Present rearing conditions are less than optimum due to low pool:riffle ratios, little instream cover or riparian vegetation, limited shading or instream diversity, and high summer temperatures. In addition, unstable eroded banks add to sedimentation problems reducing egg and juvenile survival, and reducing chances of vegetative recovery. Up and downstream passage barriers are also limiting adult and juvenile migration.

Treatment techniques include: 1) passage projects at barriers, 2) riparian fencing, and 3) instream structures to stabilize streambanks and improve rearing habitat. Type, location, timing, and intensity of implementation work is developed based on the following factors: location within the basin, present riparian and instream habitat conditions, landowner cooperation, coordination with the USFS on potential joint projects, and anticipated fish benefits.

Program benefits will include increased wild chinook and steelhead fish production, improved riparian habitat, improved water quality and quantity, and improved seasonal flow distribution.

CONTENTS

		Page
	Abstract	i
	List of Tables	iii
	List of Figures	iv
I.	Introduction	1
II.	Description of the John Day River Basin	3
III*	Fisheries Characteristics	5
IV.	Coals and Objectives	13
v.	Program Implementation	26
VI.	Implementation Schedule and Costs	27
VII.	Benefits	27
VIII.	Monitoring	30
IX.	References	31

TABLES

		Page
1.	John Day River Habitat Improvement Project, Number of sream mlas treated from 19854987	2
2.	Estimated Sport Catch of Summer Steelhead in the John Day River	8
3.	Summary of Chinook Salmon Spawning Density, John Day District, 1959-1987	9
4.	Steelhead Spawning Ground Summary	10
5.	Habitat Factors Limiting Production of Spring Chinook and Summer Steelhead in the John Day Basin	14
6.	Estimated Spawning and Rearing Distribution of Spring Chinook and Summer Steelhead in the John Day Basin	16
7.	Priority Streams for Habitat Improvement Projects in the John Day basin	20
8.	Factors Influencing Habitat, and Chinook and Steelhead Production in the John Day Basin	21
9.	Habitat Improvement Techniques and Major Constraints for Priority Streams in the John Day Basin	26
10.	Schedule of Habitat Improvements in the John Day Basin on Private Lands	28
11.	Preliminary Estimates of Fishery Benefits from Habitat Enhancement Projects in the John Day Basin	29

FIGURES

		Page
1.	John Day River Basin	4
2.	Spring Chinook Salmon Spawning Areas	6
3.	Summer Steelhead Spawning Areas	7
4.	Priority Streams in the John Day Basin	19
5.	Middle Fork John Day River Priority Reach from Big Creek to Phipps Meadow	24
6.	John Day River Mainstem Priority Reach	25

I. INTRODUCTION

The John Day River implementation plan supplements an on-going fish habitat improvement program on private land that began in 1984. Funding for this program has been provided by the Bonneville Power Administration (BPA) as part of the Northwest Power Planning Councils Fish and Wildlife Program under Program Measure 704(c) (1), Action Item 4.2. The goal of the passage, riparian, and instream work is to maintain wild gene pools and maximize production of chinook and steelhead smolts and adults to offset losses incurred by mainstem Columbia River dams. The private lands project is being implemented by the ODFW with assistance from the Soil Conservation Service (SCS) and the Grant Soil and Water Conservation District (GSWCD). Regular communication with the Malheur National Forest is also being maintained for future cooperation on stream reaches where private and USFS lands are in mixed blocks of ownership.

Since project activities on private lands were initiated in 1984, approximately $1.6 million has been spent on restoration of fish habitat on 28 stream miles, and completion of 2 passage projects that have opened up an additional 35 miles of steelhead spawning and rearing habitat (Table 1). To date, lease agreements have been signed with 11 landowners on 16 properties. Projects included installation of jetties, rock riprap, and juniper riprap to stabilize actively eroding banks and reduce stream channel erosion, as well as provide more "edge effect" for rearing juvenile salmonids. Weirs and boulders were placed instream to provide more pool area and instream cover. Checkdams and livestock crossings were located to raise the water table and promote riparian vegetation as well as pool areas for rearing juveniles. Cul-de-sac watering gaps and offsite spring developments were constructed to provide watering sites for livestock. Fencing, both electric and barbed wire, was constructed to manage cattle and allow recovery of riparian areas.

To facilitate accomplishment of project goals in the most cost effective manner, an implementation plan identifying habitat problems and solutions, project priorities and costs, and fishery benefits has been proposed. Objectives of the implementation plan are to:

1. Identify major limiting factors for wild spring chinook and summer steelhead in the John Day Basin.
2. Present strategies to modify limiting factors and increase wild salmonid production.
3. Present a priorities list and schedule for implementation of habitat projects.
4. Present implementation cost estimates for budget planning purposes.
5. Estimate fish benefits from project activities.

An attempt has been made to provide for completion of the highest priority habitat enhancement activities based on resource needs proposed for April 1, 1988 - March 31, 1992. Additional habitat Improvement work beyond March 31, 1992 will be guided by up-to-date information in the sub-basin plan. Proposed project time frames, costs and fishery benefits are provisional. Landowner cooperation on private lands is highly variable and required to meet this schedule.

Table 1. John Day River Habitat Improvement Project
Number of stream miles treated from 1985-1987

Year	Habitat Miles Protected or Passage Improvement				
	Mainstem John Day	Fox Creek	Deer Creek a/	Fivemile Creek b/	Total
1985	3	1.5	5	--	9.5
1986	6	6.5	10	--	22.5
1987	4	2	--	25	31
Total	13	10	15	25	63

a/ Five miles of stream protected by riparian fence. Passage project opened up 10 miles of spawning and rearing habitat for summer steelhead.

b/ Passage allowed access to 25 miles of spawning and rearing habitat for summer steelhead.

II. DESCRIPTION OF THE JOHN DAY BASIN

A. General Features

The John Day Basin is a semi-arid area of approximately 8100 square miles in east central Oregon and is the fourth largest drainage in the state (Figure 1). The basin includes major portions of Gilliam, Grant, and Wheeler counties and parts of Crook, Harney, Jefferson, Morrow, Sherman, Umatilla, Union, and Wasco counties.

The Mainstem John Day River flows 284 miles from its source in the Strawberry Mountains into the Columbia River just above the John Day Dam. The largest tributary, the North Fork, enters the John Day at Kimberly (RM 184) and extends 112 miles to its headwaters in the Elkhorn Mountains at elevations near 7500 feet. The Middle Fork originates just south of the headnaters of the North Fork and flows roughly parallel to it for 75 miles until they merge at RM 31 of the North Fork. The South Fork originates from Snow Mountain, elevation 7163, and drains the South side of the Aldrich Mountains.

Hydrologically, the John Day River discharge pattern is characterized by high spring flows from melting snows and rainfall with peak runoff occurring March through June and low late summer flows in August and September, largely from ground water discharge. Approximately 70% of the annual percipitation falls from November to May, mostly as snow while less than 10% falls as rain during July and August. Average annual rainfall varies from 9 to 40 inches in the basin: average annual discharge of the John Day River is approximately 1.5 million acre-feet of water. More than 2500 water rights, primarily for irrigation, exist in the Upper Mainstem and its tributaries.

Basin flora in the Upper Mainstem, Middle Fork, North Fork and South Fork subbasins where a majority of chinook and steelhead spawning and rearing occurs, is characterized dominantly by forest and rangeland. Lower plateaus and valleys have a cover of grasses, sagebrush, and junipers. Irrigated grass and alfalfa hay crops are grown on private lands along the stream bottoms.

B. Land Use Features

Forest products and livestock agriculture are the major industries in the upper subbasins. In the past, mining for gold, precious metals, and industrial minerals were major products from the North Fork, Middle Fork, and Upper Mainstem subbasins, both from placer and underground mines. Lower prices for gold and other minerals in recent years have depressed the mining economy, but small placer and hardrock mines and some mineral exploration persists on the Upper Mainstem, North Fork, and Middle Fork subbasins.

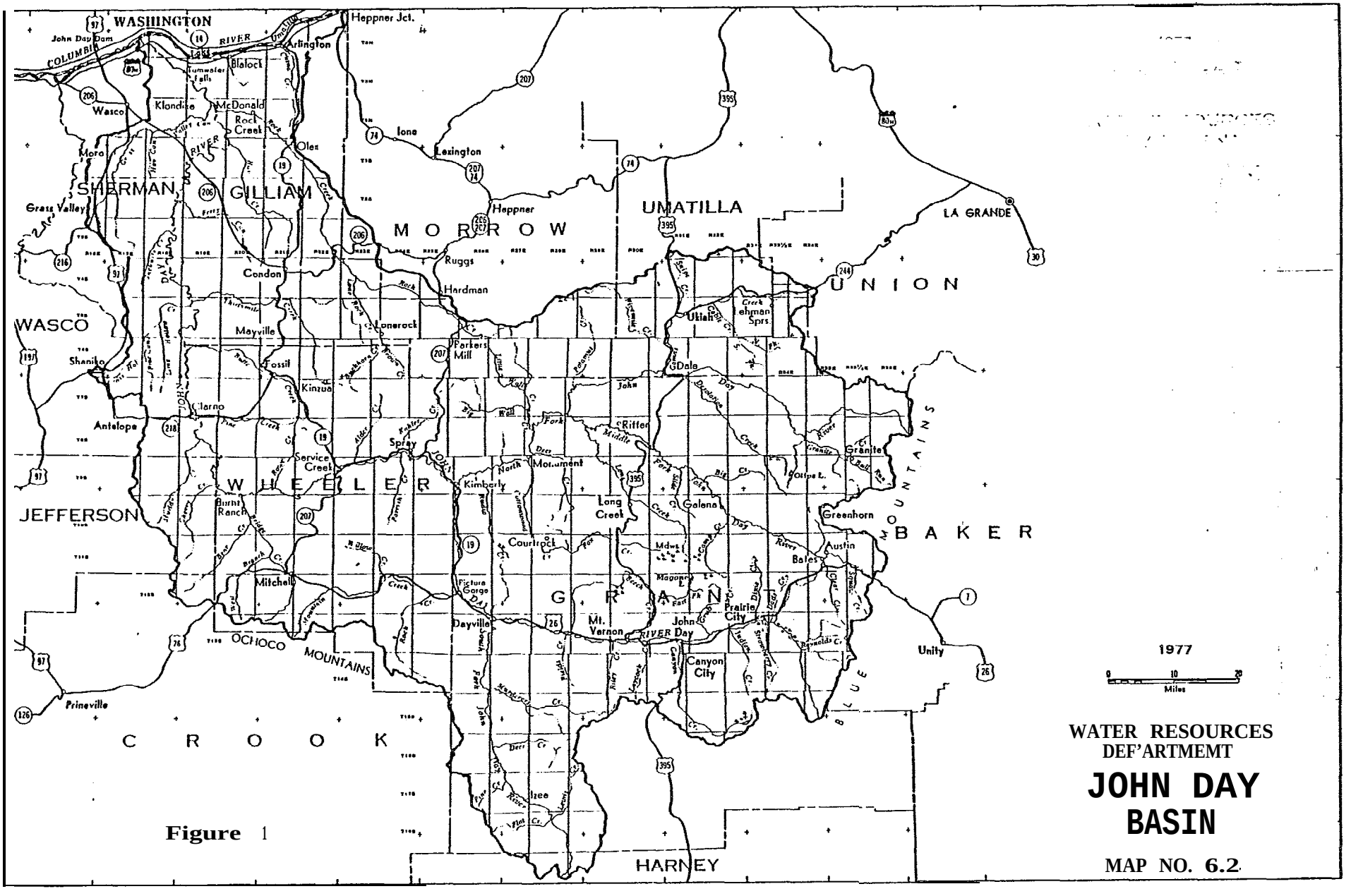
WASHINGTON
John Day Dam
COLUMBIA RIVER
Arlington
Heppner Jct.
Biglock
Klondike
McDonald
Rock Creek
Wasco
Moro
Olex
Ione
Lexington
Heppner
SHERMAN
GILLIAM
MORROW
UMATILLA
LA GRANDE
Grass Valley
Condon
Ruggs
Hardman
UNION
WASCO
Mayville
Lonerock
Parkers Mill
Shaniko
Fossil
Kinzua
Dale
Ukiah
Lehman Sprs
Antelope
Clarno
Spray
Service Creek
Ritter
Granite
WHEELER
Kimberly
Mt. Vernon
Long Creek
Galena
Greenhorn
BAKER
JEFFERSON
Burnt Ranch
Mitchell
Picture Gorge
Courtrock
Dayville
Mt. Vernon
John Day RIVER
Prairie City
Austin
Bates
Canyon City
Unity
OCHOCO MOUNTAINS
Prineville
CROOK
Izee
HARNEY
BLUE MOUNTAINS
1977
0 10 20
Miles
WATER RESOURCES DEF'ARTMEMT
JOHN DAY BASIN
MAP NO. 6.2

Figure 1

III. FISHERY CHARACTERISTICS - LIMITING FACTORS

A. Fisheries

The John Day basin supports the largest remaining, exclusively wild run of spring chinook and summer steelhead in northeast Oregon. The genetic component of these runs must be protected to maintain genetic diversity for maximum fisheries production and habitat utilization, and to reserve the genetics for future rebuilding of runs in other Columbia River tributaries. Other game fish species in the basin include resident rainbow trout (Salmo gairdneri), cutthroat trout (Salmo clarki), bull trout (Salvelinus confluentus), brook trout (Salvelinus fontinalis), mountain whitefish (Prosopium williamsoni), channel catfish (Ictalurus punctatus), bullheads (Ictalus spp.), and smallmouth bass (Micropterus dolomieui). Rough fish species include suckers (Catostomus spp.), northern squawfish (Ptychocheilus oregonensis), redside shiner (Richardsonius balteatus), dace (Rhynichtys spp.), chiselmouth (Acrocheilus alutaceus), and sculpins (Cattus spp.).

Spring chinook spawn in the mainstem John Day River above Indian Creek (Figure 2), in the North Fork above the town of Dale including Granite Creek and its tributaries, Clear and Bull Run Creeks, and in the Middle Fork above Mosquito Creek. Total chinook spawning habitat in the basin is approximately 117 miles. Summer steelhead utilize virtually all accessible tributaries in the basin (Figure Summer steelhead spawn and rear in the South Fork up to RM 28 at Southfork Falls, an impassable barrier. Total steelhead spawning habitat in the basin is approximately 1608 miles.

The John Day Basin supports locally important fisheries of summer steelhead, resident rainbow trout, and smallmouth bass. Sport catch for summer steelhead has ranged between 305-7381 fish in the years 1959-1987 (Table 2). Some spring chinook are harvested in the lower Columbia River Indian ceremonial fisheries in April and May. A John Day River sport fishery ended in 1977 due to significant declines in spawning escapement. Spring chinook are apparently not harvested in significant numbers in ocean fisheries, probably due to: 1) the majority of John Day spring chinook are not large enough to be caught with commercial fisheries gear, 2) intensive ocean commercial fisheries begin after spring chinook enter the Columbia River to spawn, and 3) possible more offshore distribution vs nearshore intensive fishing.

Approximately 500,000 hatchery steelhead fry and pre-smolts were released in the 1960's, but few likely survived (Errol Claire, pers comm). Hatchery releases ceased in 1969 and strays from other Columbia River tributaries appear to account for only 4-15% of the total sport catch.

ODFW personnel first surveyed the John Day system for spring chinook and summer steelhead in 1959. Few chinook redds were found. Gradually, over the next 14 years, redd counts in the basin increased. Since 1978, however, chinook returns have declined, until recently (Table 3). During the 1960's and early 1970's, summer steelhead counts remained fairly stable with a peak of 16 redds per mile in 1966 (Table 4). Index counts declined to a low of 1 redd per mile in 1979.

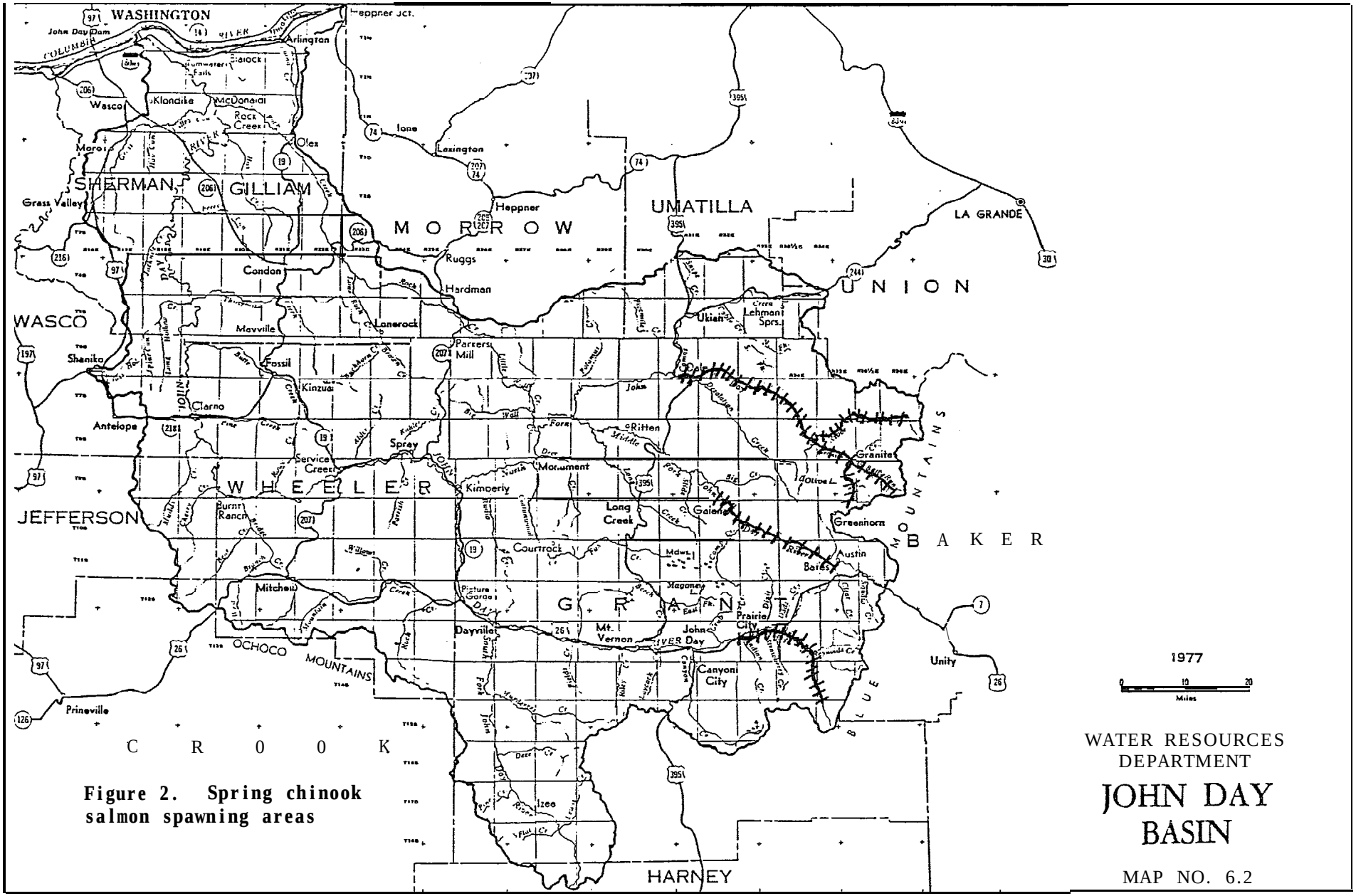

Figure 2. Spring chinook salmon spawning areas

WATER RESOURCES DEPARTMENT

JOHN DAY BASIN

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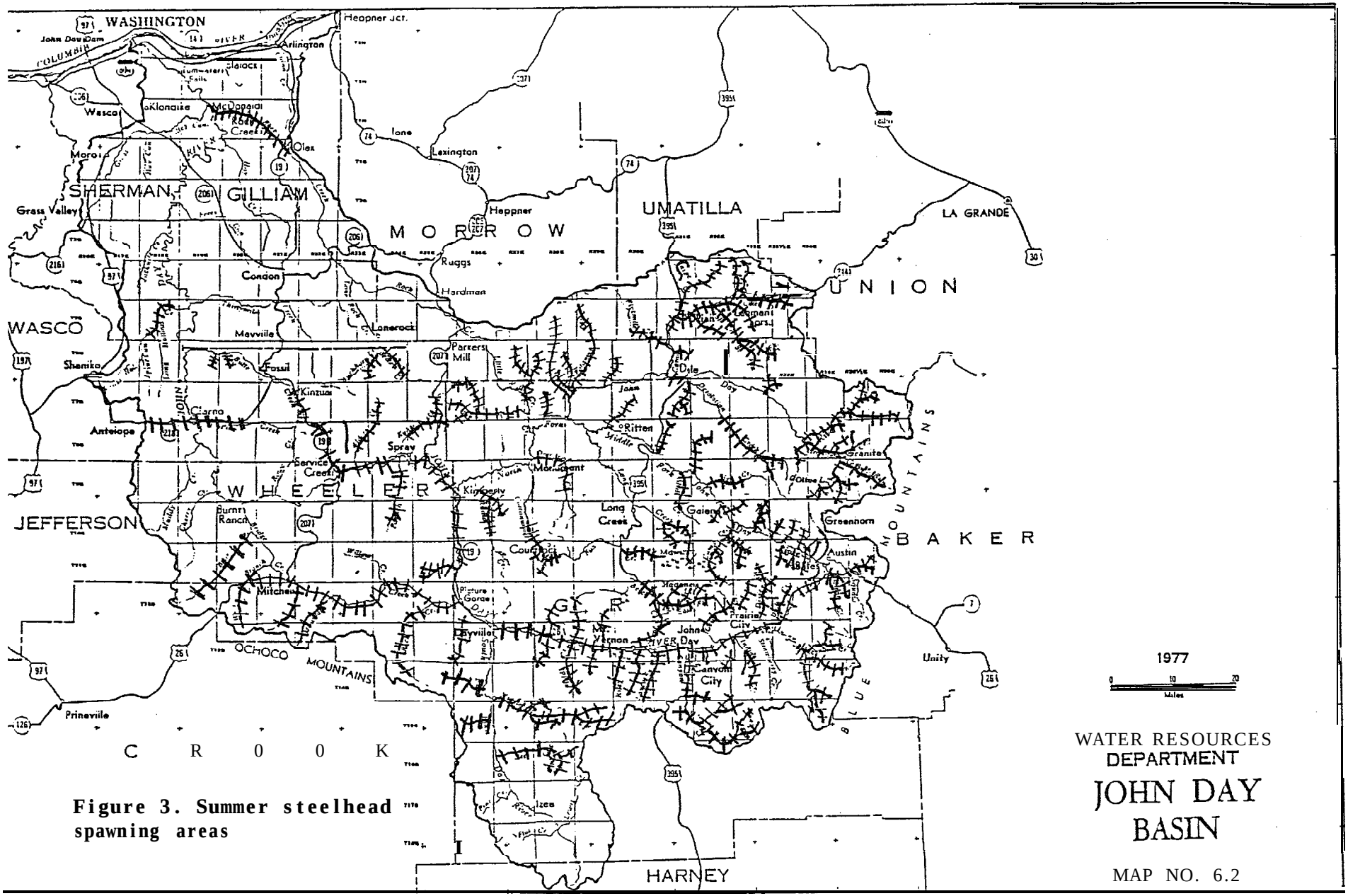

Figure 3. Summer steelhead spawning areas

WATER RESOURCES DEPARTMENT

JOHN DAY BASIN

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Table 2. Estimated sport catch of summer steelhead in the John Day River

Brood Year	Sport Catch
1959	2,694
1960	7,381
1961	4,326
1962	1,366
1963	2,930
1964	2,149
1965	2,574
1966	4,676
1967	4,568
1968	3,506
1969	2,870
1970	2,629
1971	2,381
1972	3,068
1973	3,290
1974	891
1975	2,784
1976	1,506
1977	2,919
1978	1,421
1979	305
1980	666
1981	1,721
1982	2,982
1983	990
1984	1,974
1985	2,011
1986	4,000a/
1987	5,500a/

a/ Punchcard estimates unavailable; estimates from Errol Claire (personal communication)

Table 3. Summary of Chinook Salmon Spawning Density John Day District 1959 to 1987 (redds per mile) a/

Year	Bull Run Creek	Clear Creek	Granite Creek	John Day River	Middle Fk John Day River	North Fk John Day River	Average
1959	*	4.3	6.0	0 3	0.0	*	2.5
1960	*	16.3	10.0	0.7	3.2	*	7.5
1961	*	3.3	5.3	3.0	1.1	*	3.2
1962	2.0	49.7	44.2	12.2	2.8	*	22.2
1963	7.0	29.2	26.4	0.8	0.4	*	12.7
1964	10.0	49.7	34.8	1.3	3.6	7.8	17.8
1965	7.5	16.7	24.4	5.8	3.7	8.1	11.0
1966	0.3	43.5	31.0	9.3	6.5	10.3	16.8
1967	6.0	38.5	19.4	7.4	1.7	5.5	13.0
1968	6.4	60.5	50.2	0.7	0.4	8.8	14.4
1969	15.6	13.7	16.8	9.3	4.8	20.5	13.3
1970	26.4	18.7	33.6	8.3	7.6	16.8	14.1
1971	11.6	18.8	31.2	7.0	4.1	11.8	11.5
1972	24.4	39.5	43.5	3.9**	5.1	10.5	14.2
1973	7.2	27.0	36.0	8.9	4.3	19.4	15.7
1974	7.6	8.0	25.5	2.5	8.1	7.2	8.2
1975	18.8	11.5	24.7	7.1	8.9	11.7	11.7
1976	9.2	7.0	20.2	4.6	6.6	6.2	7.5
1977	11.6	12.8	23.1	4.9	5.8	16.4	11.1
1978	12.4	6.3	19.8	4.5	10.7	5.9	8.3
1979	6.4	7.0	15.6	5.2	11.8	11.1	9.7
1980	1.2	7.0	8.5	1.2	5.8	4.3	4.3
1981	2.8	11.3	10.6	3.9	2.6	7.7	6.1
1982	5.2	10.8	12.0	3.8	6.2	5.5	6.4
1983	0.8	1.0	7.3	10.2	5.1	4.2.	5.8
1984	3.2	2.0	5.8	5.6	6.7	3.5	4.4
1985	6.4	8.2	15.1	8.9	4.0	6.1	7.5
1986	2.4	11.5	21.0	12.2	6.3	13.3	11.9
1987	5.6	14.0	12.9	19.0	28.3	20.8	20.2

* No survey

** Count low due to rain and increased river flows which delayed survey and caused poor counting conditions

a/ Data from Errol Claire, ODFW John Day District Fish Biologist

Table 4. *Steelhead Spawning Ground Summary* a/

Twenty-Eight Year Periods

Year	Number of Streams Surveyed	Miles surveyed	Steelhead	Redds	Per Mile
1959	6	14.5	30	108	7.4
1960	10	22.0	60	194	8.8
1961	8	24.5	56	166	6.8
1962	10	26.5	56	184	6.9
1963	11	30.5	47	216	7.1
1964	13	43.5	51	266	6.1
1965	19	45.0	88	344	7.6
1966	23	69.0	141	1,103	16.0
1967	25	70.0	61	905	11.6
1968*	23	74.5	19	358	4.8
1969	27	91.5	76	806	8.9
1970	21	65.0	58	530	8.1
1971	8	22.5	18	181	8.0
1972	16	53.5	41	409	7.6
1973	25	76.4	22	402	5.3
1974**	14	38.0	4	167	4.4
1975**	14	34.0	21	302	8.9
1976	21	59.8	8	308	5.2
1977	30	75.5	69	535	7.1
1978	35	102.7	21	438	4.3
1979	29	78.7	4	81	1.0
1980	34	90.1	11	305	3.4
1981	33	86.1	12	319	3.7
1982	32	71.8	34	301	4.2
1983	31	89.3	39	438	4.9
1984	29	76.7	33	299	3.9
1985	39	120.3	88	1,016	8.5
1966	42	117.6	127	1,286	10.9
1987	61	154.3	103	1,757	11.4
Totals and Averages	560	1,580.5	1,154	10,653	6.8

*Nineteen hundred and sixty eight was low water with an absence of spring runoff. Irrigation took entire stream flows on several tributaries causing steelhead spawning escapement to be nill in some areas. The poor count is reflected in redd/mile figure fur that season.

**Counts low due to high water in spring which smoothed out early redds and caused poor counting conditions.

a/ Data from Errol Claire, ODFW John Day District Fish Biologist

Smolt to adult survival rates for Columbia Basin spring chinook are related to passage conditions. Smolt-to-adult survival rates for Idaho spring chinook dropped from over 2% with 4 dams present to less than 1% with the addition of 3 more dams, while Deschutes spring chinook that have only 2 dams to pass have survival rates of 2-3% (Lindsay 1986). Correlation of the completion of the John Day Dam and expansion of the Dalles power house and consequent reduction in spill to spring chinook stock recruitment curves, appear to be the principal factors causing reduction in John Day spring chinook. Passage appears to be a problem with both downstream migrating smolts as well as returning adults.

Recent returns of both spring chinook and summer steelhead have indicated an upswing in survival. The 1986 surveys for chinook and steelhead averaged 11.9 and 10.9 redds per mile, respectively, while 1987 preliminary data indicates an even better return at 20.2 and 11.4 redds/mile, respectively. Reasons for this recent upswing are likely a combination of the US-Canada treaty limiting harvest for north migrating stocks off Alaska and Canada, improvements in passage on mainstem Columbia River dams, better than average water flows in recent years and higher spilling rates to assist migrating smolts, better ocean survival, etc..

B. Habitat Problems - Limiting Factors

In addition to passage problems at Columbia dams, the John Day River has been affected by a variety of man's activities that have impacted salmon and steelhead production. Placer mining in the late 1800's left many streams with little or no shade, high silt loads, and diverted flows. Later, dredging overturned the stream channels in the larger streams, changing stream courses, silting gravel, and destroying stream cover. Inactive mine sites and their settling ponds continue to release turbid flows, some known to contain toxic heavy metals.

More recently, livestock overgrazing, water withdrawals for irrigation, landowner clearing, road building, logging, and channelization created further fish habitat problems by disturbing or destroying riparian vegetation, and destabilizing streambanks and watersheds. The results are wide, shallow channels: low, warm summer flows; high turbid spring flows; high sediment loads: and decreased fish production.

Recent improvements have been made to the habitat including screening irrigation ditches, streamside fencing and instream fish habitat work, and removal of some passage barriers. Much remains to be done, however, to return the John Day to its once productive state.

Based on information from stream habitat surveys, the John Day spring chinook research study (Lindsay 1986) and the ODFW district fish biologist, factors limiting anadramous production are juvenile rearing and adult holding areas for spring chinook and juvenile rearing areas for summer steelhead. Habitat factors which affect production are 1) limited access to spawning and rearing areas due to natural or manmade passage barriers, 2) lack of riparian cover, 3) lack of habitat diversity, and 4) water withdrawals (Table 5). These factors affecting fish production are discussed:

1. Passage Barriers Falls and irrigation dams are blocking or delaying upstream passage of adults into areas of suitable spawning and rearing habitat. In addition, juvenile steelhead and spring chinook are blocked from suitable rearing habitat, particularly from some tributaries where juveniles are attracted during low summer flows.

2. Lack of Riparian Cover Healthy riparian areas represent a vital part of the watershed and provide multiple functions - nutrient cycling, shading, bank stabilization, water storage, filtration and retention cover, and wildlife values. Disturbance of riparian areas by livestock grazing, road building, logging, clearing, and channelization has caused major impacts on watersheds and associated fish and wildlife habitat. Major fisheries habitat quality problems caused by lack of good riparian areas include:

   a. increased water temperatures High summer temperatures, frequently exceeding 80 F, reduce rearing habitat, displace salmonids, increase competition from warmwater tolerant species such as dace, squawfish, and suckers, and impair growth and survival. A healthy riparian canopy reduces solar insolation during summer and insulates many streams from winter freezing, thereby affecting overwinter survival of fish and aquatic life (Bottom et al. 1985).

   b. changes in timing and rate of peak and minimum flows Reduction of riparian vegetation decreases the capacity of a stream's aquifer to retain water during high flows and its gradual release during low summer flows. This-alters stream flow discharge, and intensifies winter and spring flooding, and extreme low summer flows.

   c. decreased bank stability and adverse channel morphology changes Unstable banks with frequent cave-ins and shifting substrate destroys habitat for aquatic life and reduces productivity, increases sedimentation, reduces fish hiding and rearing cover from undercut banks and decreases a stream's ability to filter sediment and debris. Channel shape changes from narrow, deep channels to wide, shallow channels, reducing usable fish habitat.

   d. decreased abundance and diversity of aquatic organisms and food resources for salmonids Loss of riparian *cover* alters and reduces production of aquatic invertebrates through reduced detritus, increased temperatures, increased turbidity and sedimentation, and altered substrate and flow patterns. There is also a reduction of aquatic and terrestrial insects and benthic invertebrates associated with the loss of large woody debris and gravel and rubble substrate (Bottom et al. 1985).

   e. increased sedimentation Increases in fine sediment through loss of root structure and surface vegetation cause direct mortality through smothering of eggs, reduces winter survival of juvenile salmonids through embeddedness of cobble and boulder habitats, cements spawning gravels, reduces foraging efficiency of salmonids because of high turbidity, decreases aquatic food production, and decreases pool area for juvenile rearing and adult holding sites.

f. increased winter ice conditions Increased anchor and surface ice can accelerate erosion on streambanks and cause physical damage to rearing juvenile through 1) de-watering of streams from ice jams, 2) stranding of fish in de-watered side channels, 3) collapse of snow and ice causing death by suffocation or crushing, and 4) freezing of eggs or reduction of water interchange, restricting the oxygen supply to eggs.

3. Lack of Habitat Diversity Salmonids require a diversity of riffle and high quality pool areas to meet freshwater life history requirements for spawning and rearing. Disturbance of stream channels and associated riparian zones has resulted in wide, shallow channels with low pool:riffle ratios. Removal of woody debris and change in channel morphology by logging and channelization has resulted in loss of cover in the form of boulders, submerged logs, undercut banks, and overhanging vegetation necessary for juvenile salmonid resting and escape cover, and sedimentation of cobble and boulder substrates.

4. Water Withdrawls Over 4500 water rights have been issued, primarily for irrigation and mining purposes, since the 1860's. Although current water rights are approximately 76% of the annual basin discharge, there is insufficient flow on many streams to satisfy all water rights and minimum streamflows. Due to the seasonal distribution of runoff, water uses for irrigation and minimum stream flows for fisheries conflict during low summer flows. Water withdrawals compound water quality and temperature problems for salmonids, and restrict habitat utilization, particularly in the Upper Mainstem and Middle Fork subbasins, during low flow years.

IV. GOALS AND OBJECTIVES OF HABITAT IMPROVEMENT PROGRAM

The goal of the John Day Basin habitat improvement project is to restore watershed, riparian, and instream conditions to optimum, to maintain wild gene pools of spring chinook and summer steelhead runs, and maximize production.

A. Project Objectives

Project objectives to maximize fish production in order. of importance are identified below (Table 5).

1. Passage Barriers Improvement of access to spawning and rearing habitat for steelhead and chinook over natural (i.e. waterfall) and manmade (ie. irrigation dams, culverts) is a high priority objective for the John Day Basin. Passage improvement projects completed in 1987 on Deer and Fivemile Creeks, tributaries of the North Fork of the John Day improved passage at 2 waterfall barriers opening an additional 35 miles of suitable spawning and rearing habitats for summer steelhead. Other passage barriers have been identified for passage improvement on tributaries of the mainstem.

Table 5. Habitat Factors Limiting Production of Spring Chinook and Summer Steelhead in the John Day Basin

Priority	Problem	Treatment Technique
1	Access	passage improvement
2	Lack of Riparian Cover a. temperature b. water flow c. bank stabilization d. food production e. sedimentation f. winter icing	Fencing Instream structures Planting
3	Lack **of** Habitat Diversity	Fencing Instream structures
4	Water Withdrawals	- - -

2. Riparian Recovery A combination of fencing and instream structures will be implemented to enhance riparian recovery by restricting livestock grazing, stabilizing actively eroding banks, raising the water table, and increasing channel stability. Fencing along the riparian corridor is located a minimum of 20 feet from the streambank to exclude livestock and allow banks to revegetate. Riparian plantings with grass seed and shrubs are planted to accelerate vegetative recovery on severely eroded sites and restore areas disturbed by heavy equipment and construction activities. SCS personnel estimate plantings can advance riparian recovery by as much as 5 to 10 years over natural vegetative recovery in the John Day Basin. Seed mixes and shrubs are selected that provide good root structure, nitrogen-fixing capabilities for rapid establishment of cover, and large amounts of foliage for surface stabilization and cover.

   Instream structures are located to stabilize actively eroding banks, raise water tables in incised channels, and reduce stream channel erosion. Jetties, riprap, juniper riprap, weirs, boulder placements, and large woody debris are used to provide bank protection as well as fish habitat benefits. Bank protection techniques are necessary on severely eroded sites to promote vegetative recovery and protect fences from being lost during high water, prior to establishment of a stable riparian zone. Appendix A provides examples of technical specifications used in construction contracts for fencing and instream structures.

   Additional benefits of riparian recovery will be sediment retention, increased stream shading reducing temperature extremes, better retention and seasonal distribution of runoff, nutrient cycling, woody debris, nutrient cycling, etc.

3. Increase Habitat Diversity The same combination of instream structures and riparian recovery will also provide increased habitat diversity and complexity for rearing juveniles. Instream structures such as log or boulder placements provide benefits of quality pool area, and resting and rearing cover.

   Additonal habitat diversity will be provided as riparian vegetation increases and streambanks stabilize. As natural stream morphology and riparian vegetation are restored, microhabitats of large woody debris, pools, undercut banks, and overhanging vegetation will create the variety of stream depths, velocities, substrates, cover, and food sources used by salmonids.

B. Strategy for Implementation

Prioritization of habitat projects for implementation is based on the following factors:

Species of emphasis The two stocks of emphasis for habitat work in the John Day Basin are spring chinook and summer steelhead. While resident trout and other species may benefit, the project objectives are to increase production of both anadramous species through improvement of juvenile rearing and adult holding areas. Distribution of spring chinook and summer steelhead in the John Day Basin is displayed in Table 6 and shown on Figures 2 and 3.

Table 6. Estimated Spawning and Rearing Distribution of Spring Chinook and Summer Steelhead in the John Day Basin (percent 1 a/

Sub-basin	Spring Chinook	Summer Steelhead
Upper Mainstem b/	18	16
South Fork	- -	7
Middle Mainstem c/	- -	4
Middle Fork	24	30
North Fork	58	40
Lower Mainstem d/	- -	3

a/ Information from Errol Claire, ODFW District Fish Biologist

b/ Headwaters to Picture Gorge

c/ Picture Gorge to Clarno

d/ Clarno to Columbia River

- Needs of the fisheries resource - potential smolt benefits An important criterion for identifying priority stream reaches and types of treatment techniques is to locate areas that have the greatest resource need and the greatest potential benefit for increasing suitable spawning and rearing habitat for anadramous fish. The strategy of the John Day BPA habitat program on private lands is to implement projects on areas that will provide the greatest and most lasting production benefits in the shortest time frame possible under the biological and economic constraints imposed on the program.

  Cost effectiveness Projects have been and will continue to be implemented in the most cost effective manner possible. Passage projects have been identified as a highly cost effective technique to increase production by opening additional spawning and rearing habitat. Restoration of riparian areas is also cost effective due to its relatively low cost and long term benefits of reducing high summer' temperature, augmentation of low summer flows, increased habitat diversity, and stabilization of streambanks. It is a solution that mutually meets anadramous fish production needs and private landowner needs to prevent erosion. Instream structures contribute to both habitat diversity, bank stabilization, and provides immediate fish benefits to increase pool habitat and cover. Bank stabilization structures can be necessary to protect investments of fencing on severely eroded banks. ODFW will continue to implement projects in the most cost effective manner identifiable and to seek means by which ODFW can further improve cost effectiveness.

  Location within the Basin The preferred approach for implementation has been to treat streams from upstream downward, and in large contiguous sections to provide for positive, cumulative affects in downstream areas. Another factor affecting project location is the location of ongoing riparian projects (by ODFW and other agencies) within the basin or on a specific stream. As maximum benefits are realized when large reaches of streams are treated, efforts will be made to coordinate with other agencies to implement projects in close proximity to their ongoing projects.

  Landowner acceptance and cooperation Landowner acceptance and cooperation is necessary on private lands to allow for implementation of improvement activities. Factors which may affect landowner acceptance include a) disruption or interference with ranch management activities, b) uncertainty or fear of dealing with a governmental agency, c) property currently for sale, and d) landowner absenteeism. Each property requires a 15 year lease agreement that places an encumbrance on the property title and makes a partner of the landowner in cooperating to achieve mutual goals of fish and wildlife habitat restoration, riparian recovery, and soil and water conservation. With the able assistance of the SCS and GSWCD, we have received strong support of the project.

Logistic contraints Logistical constraints also affect implementation in terms of a) size of the John Day basin - managing projects at great distances apart, b) access to sites, c) agricultural practices on private lands and the ability to fit private landowner and fish habitat restoration goals together, d) instream water working schedules limited to approximately 2 months per year (which can coincide or conflict with major ranch activities), and e) technical feasibility.

C. Priority Areas

Based on the project objectives listed in section A, 12 streams are selected in the John Day basin as target areas for fish habitat projects, and prioritized for treatment (Figure 4) (Table 7). These streams are prioritized by a consideration of the biological criteria of species of emphasis, needs of the fisheries resource, the potential for-increased smolt benefits, and location within the basin. The two top priority projects are passage improvement on Rock Creek and Canyon Creek. Next in priority for habitat improvement projects are the Middle Fork of the John Day River from Phipps Meadow (RM 72) to Big Creek (RM 39), and the Mainstem from Blue Mountain Hot Springs (RM 275) to the town of John Day (RM 248). Both are major reaches for chinook spawning and rearing, and steelhead rearing. The remaining 10 streams are major steelhead spawning and rearing areas that have been degraded from logging, agricultural, and mining practices, and have a high potential for response to good management practices. Canyon Creek and Rock Creek have been listed a second time for habitat improvement projects once passage projects have been completed.

The following discussion will outline some of the fisheries potential and planning efforts on the passage projects on Rock Creek and Canyon Creek, the 2 major priority reaches, the Middle Fork and Mainstem of the John Day River, and the remaining 10 priority streams. Tables 8 and 9 outline habitat problems on the 12 priority streams and treatment techniques that will be implemented.

1. Rock Creek Passage - Passage for steelhead adults is partially restricted up to RM 25 over 5 active and 6 inactive (2 to be reactivated in 1987) irrigation dams (Schumacher 1986). At Harper's Dam at RM 25, an 8' cement dam completely restricts steelhead passage except at very high flows. No redds were found in a spawning survey conducted in 1986 above Harper's Dam. Improved passage at 4 irrigation dams would open up 50 miles of former steelhead spawning and rearing habitat.

2. Canyon Creek Passage - Canyon Creek has good water quality, flow, and temperature characteristics for steelhead spawning and rearing throughout much of its length. A 60" diameter culvert approximately 160' in length, located at the mouth of the creek limits adult steelhead passage in low flow years, and juvenile chinook and steelhead rearing during low summer flows. The landowner approached ODFW to remove the culvert, and a draft easement has been written for the project.

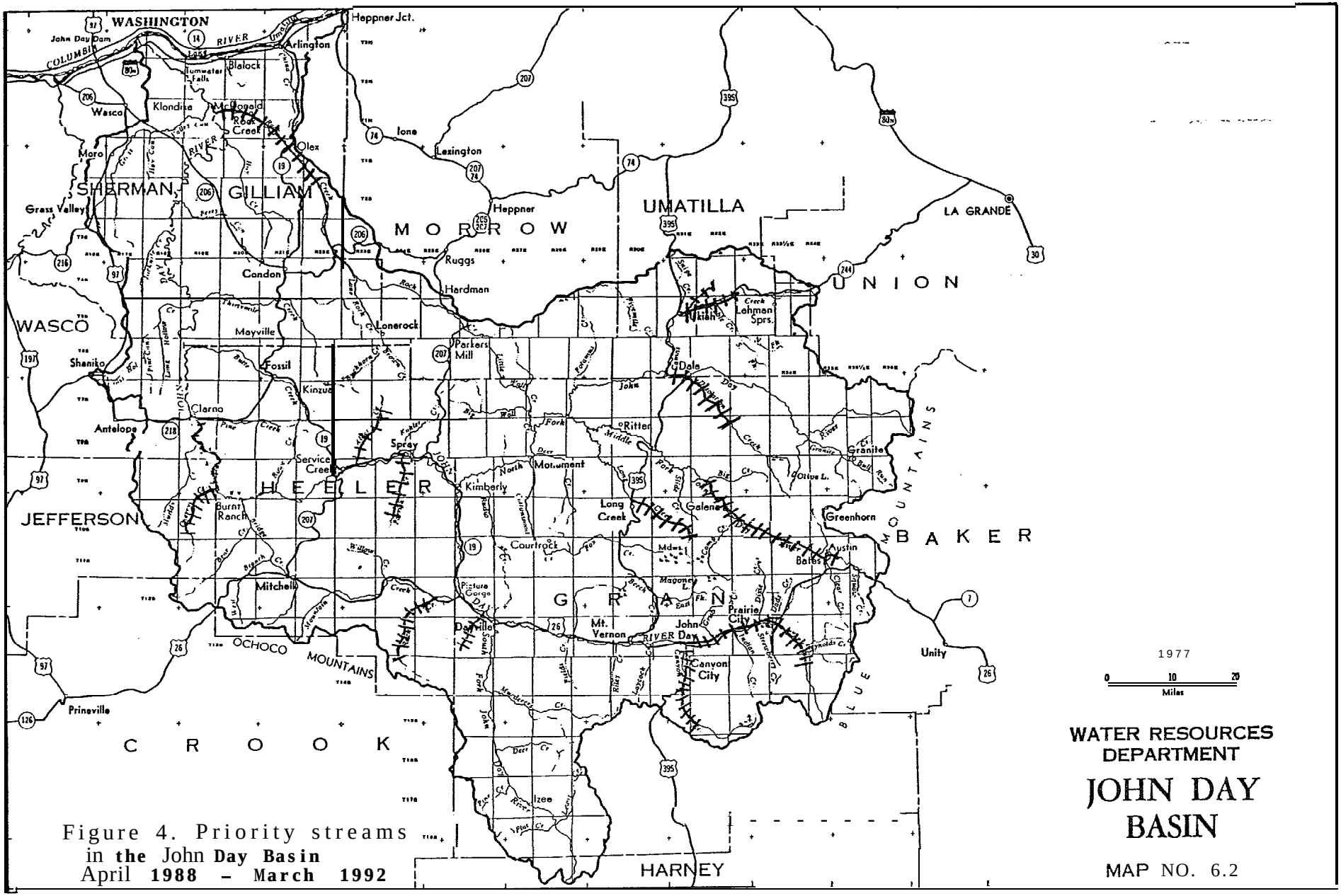

Figure 4. Priority streams in the John Day Basin April 1988 – March 1992

Table 7. Priority Streams for Habitat Improvement Projects in the John Day Basin a/

Priority	Stream Reach	Miles (private)	Location
1	Rock Creek	passage	RM 25 to mouth, 4 passage projects
1	**Canyon Creek**	passage	mouth
2	Middle Fork	20	Phipps Meadow to Big Creek
3	Mainstem	14	Blue Mountain Hot Springs to John Day
4	**Canyon Creek** (Mainstem)	8	USFS boundary to Hwy 395
4	Desolation Creek (North Fork)	11	Park Creek to mouth
4	Camas/Owens Creek (North Fork)	24	Camas- corners to Owens Owens-below USFS boundary
4	Cherry Creek (Mainstem)	9	Cherry Creek Dam (RM 9) to mouth
4	Parrish Creek (Mainstem)	7	Tamarack Creek to mouth
4	**Long** Creek (Middle Fork)	8	USFS boundary to Hwy 395
4	Cottonwood Creek (Mainstem)	7	USFS boundary to Hwy 26
4	**Rock** Creek (Mainstem)	53	Hwy 207 to Olex
4	**Alder Creek** (Mainstem)	9	Winlock to Hwy 19
4	**Rock-Mountain** Creek (Mainstem)	10	Lake Creek to mouth
	Total	180	

a/ 1988 projects include commitments to landowners for habitat improvement work on Fox Creek.

Table 8. Factors Influencing Habitat, and Chinook Salmon and Steelhead Production in the John Day Basin a/

Stream Reach	Habitat Status a/	Existing Problems
Middle Fork	**poor-fair** (private) fair-good (USFS)	temperature, riparian, streambank degradation, pool/riffle, cover, flow, channelization, sediment
Mainstem	fair	riparian, sediment, streambank,cover degradation, pool/riffle, flow, channelization
Canyon Creek b/	fair	passage, riparian, habitat, diversity
Desolation Creek	fair	streambank degradation, gradient, riparian, pool/riffle
Camas/Owens Creek	poor-f air	streambank degradation, gradient, temperature, flow, riparian, cover channelization, sediment, pool/riffle
Cherry Creek	poor	streambank degradation, sediment, temperature, riparian, passage, cover
Parrish Creek	poor-f air	streambank degradation, flow, sediment, temperature, riparian, cover, pool/riffle
Long Creek	fair	flow, temperature, sediment, streambank degradation, cover
Cottonwood Creek	poor-f air	streambank degradation, riparian, channelization, flow, habitat diversity
Rock Creek b/	fair	passage, riparian streambank degradation, flow, sediment, incised channel, temperature
Alder Creek	poor-f air	riparian, streambank degradation, gradient, flow, temperature, sediment
Rock-Mountain Creek	fair	riparian, streambank degradation, sediment, temperature
Fox Creek c/	poor-f air	**riparian,** streambank degradation, sediment, temperature

a/ Information from Basin Plan (Errol Claire, Rick Rieber, personal communication)

b/ passage projects with highest priority

c/ Fox Creek habitat improvement project will be completed in 1988

Table 9. Habitat Improvement Techniques and Major Constraints for Priority Streams in the John Day Basin

Stream	Techniques	Constraints/Coordination
Middle Fork	Fencing/Structures	Landowner Cooperation, Coordination with USFS, Cost
Mainstern	Fencing/Structures	Landowner Cooperation, Cost
Canyon Creek a/	Passage/Fencing/Structures	Landowner Cooperation, Small Ownerships, Town Swimming
Desolation Creek	Fencing/Structures	Landowner Cooperation, Coordinate with USFS
Camas/Owens Creek	Fencing/Structures	Landowner Cooperation
Cherry Creek	Fencing/Structures	Landowner Cooperation, Coordinate with BLM
Parrish Creek	Fencing/Structures	Landowner Cooperation
Long Creek	Fencing/Structures	Landowner Cooperation
Cottonwood Creek	Fencing/Structures	Landowner Cooperation, Coordinate with BLM
Rock Creek a/	Passage/Fencing	Landowner Cooperation, Logistics, Maintenance
Alder Creek	Fencing	Landowner Cooperation
Rock-Mountain Creek	Fencing	Landowner Cooperation

a/ Passage projects are highest priority: proposed for implementation in 1988

3. Middle Fork - The Middle Fork subbasin produces approximately 24% of the total spring chinook (1987 - approximately 1600 spawners) and 30% of the total summer steelhead (1987 - approximately 8000 spawners) populations in the John Day Basin. In addition, it has a resident trout population that provides 2000 - 3000 angling days per year. It has been identified as the highest priority stream in the basin for habitat improvement projects due to its great potential for increased production and the present severity of habitat conditions. Low flow, high summer temperatures, severe bank erosion and sedimentation restrict juvenile rearing.

   Approximately 32 miles of spawning and rearing habitat on mixed blocks of private and USFS land ownership are targeted for habitat projects (Figure 5) ODFW plans to coordinate extensively with USFS personnel to provide a comprehensive approach to conducting projects. This will be done by coordinating work as best as possible in contiguous blocks of stream reaches: sharing material sources (log and rock); coordinating on time frames, priorities, and implementation.

4. Mainstem John Day River - The upper mainstem John Day basin produces approximately 18% and 16% of the spring chinook and summer steelhead populations, respectively. It has been identified as the second highest priority work area for habitat improvement projects due to its great potential for increased production for both spring chinook and summer steelhead. Approximately 13 miles of habitat improvement projects have been implemented between the town of John Day and Blue Mountain Hot Springs between 1985 - 1987 and have already exhibited impressive vegetative, riparian, and channel morphology recovery (Figure 6). Approximately 15 miles of mainstem river remain, that have great potential for habitat improvement.

   Costs on large systems such as the Mainstem and Middle Fork have cost as high as $50,000/mile including fish habitat, bank stabilization, and fencing costs. With experience since 1985, the ODFW private lands program has been working on lowering costs by advertising more effectively to a wider array of contractors: breaking contracts into smaller, more manageable sized contracts that local business can compete effectively with reduced bonding requirements and lower prices: and using other techniques to reduce costs. Also, the direction of the program has been to place greater emphasis on less expensive riparian restoration techniques and lesser emphasis on instream structural improvements, which have more immediate benefits but higher costs.

5. Priority Steelhead Streams - The remaining 10 streams identified in the priority list (Table 7) are tributaries of the Upper Mainstem, Middle Fork, and North Fork of the John Day River. They are major steelhead producing streams that generally have good numbers of steelhead redd counts. Production is limited, however, by lack of juvenile rearing as a result of habitat, riparian, and water quality degradation by past and present land use practices. Similar to the Middle Fork, some of the tributaries are in mixed blocks of ownership with the U.S. Forest Service and Bureau of Land Management (BLM). While streams are listed

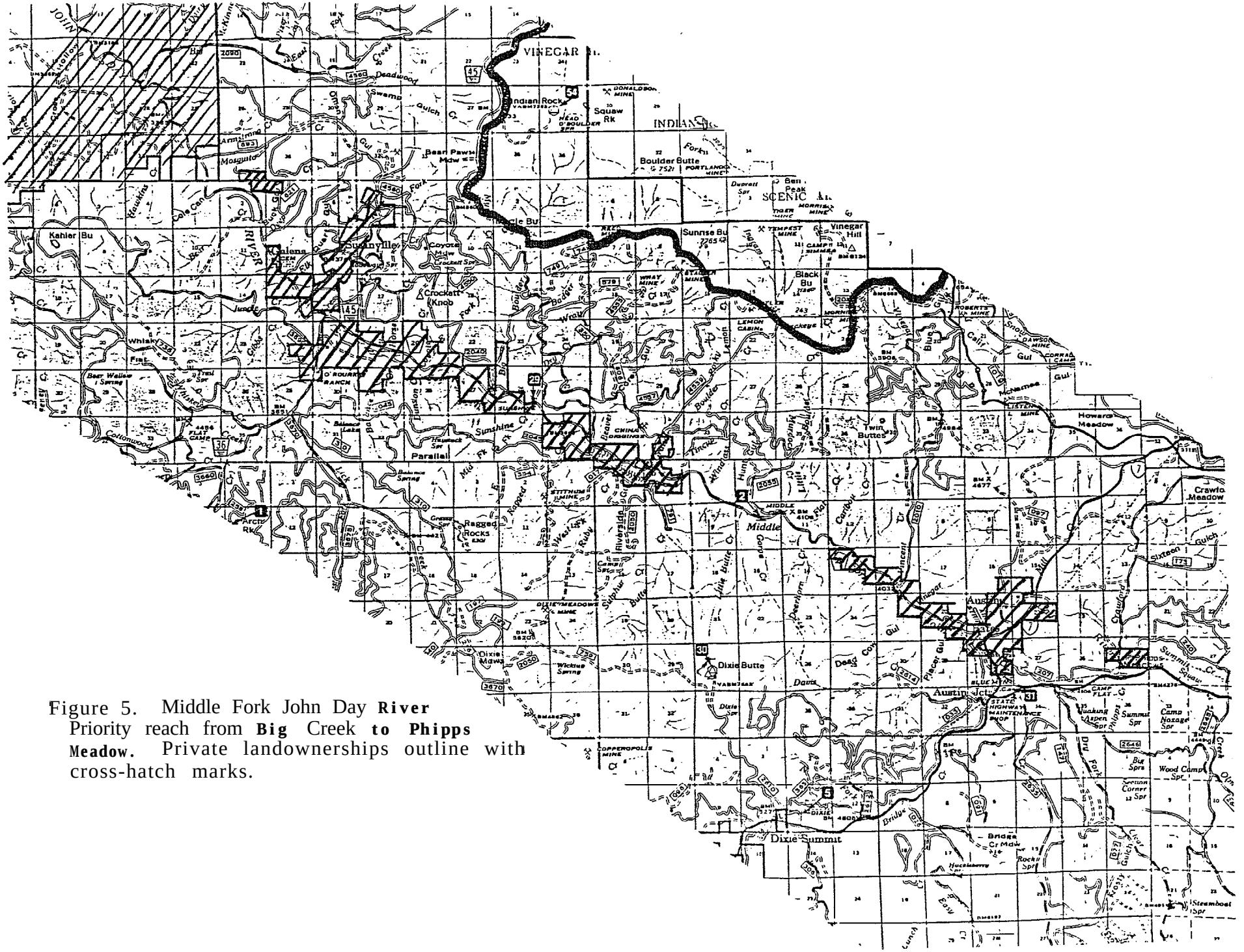

Figure 5. Middle Fork John Day **River** Priority reach from **Big** Creek **to Phipps Meadow.** Private landownerships outline with cross-hatch marks.

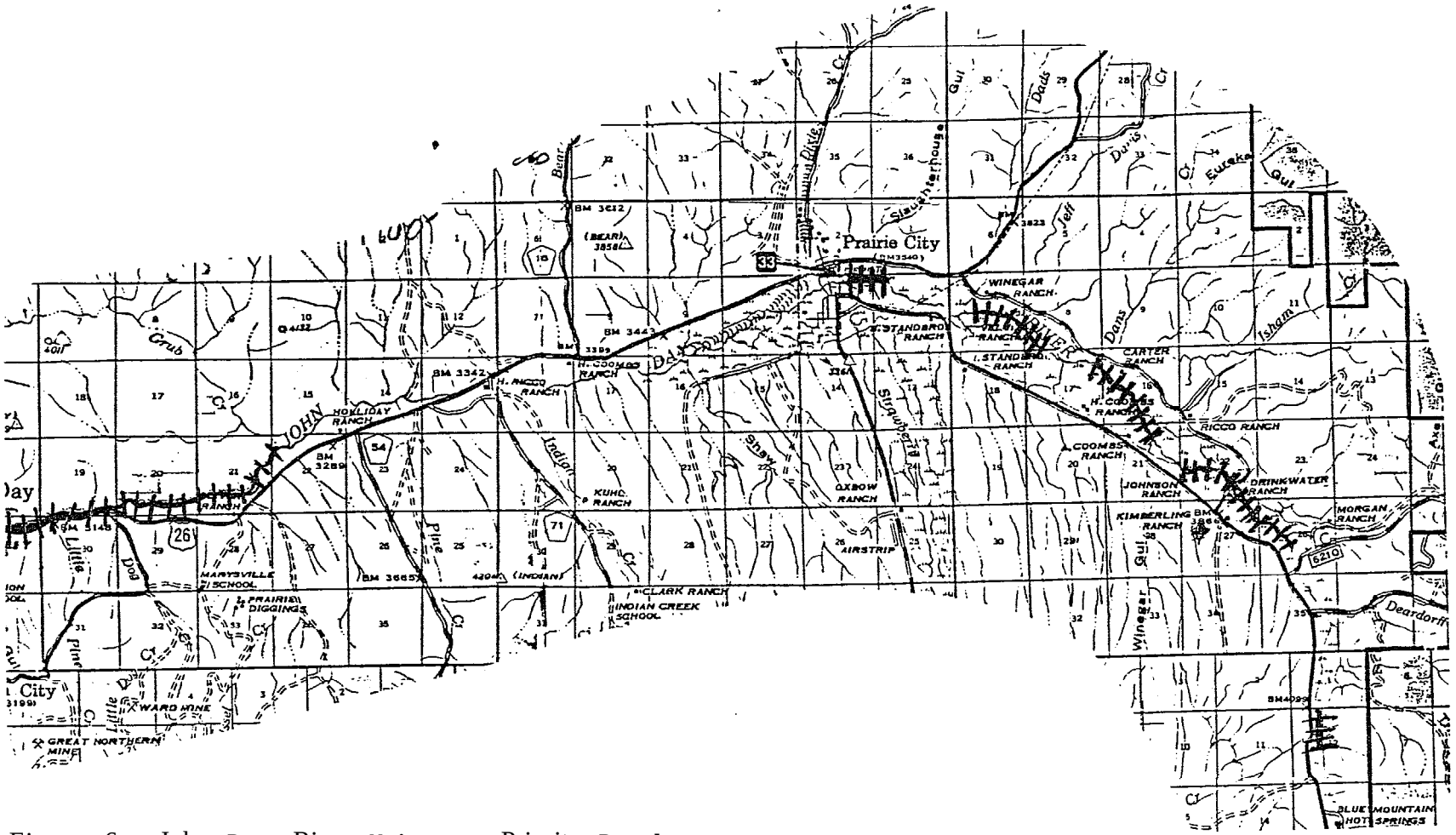

Figure 6. John **Day** River **Mainstem** Priority **Reach**
Highlighted sections are where **habitat** work **was completed 1985-1987**

in this plan in general order of priority, an opportunity would be taken to implement a greater length of stream with habitat projects done in coordination with another agency. Any changes in the proposed implementation schedule, however, will involve a formal review process between ODFW and BPA.

Using this framework for setting area priorities, habitat inventory data will be used to identify specific needs of each reach.

V. PROGRAM IMPLEMENTATION

A. Program Policy on Implementation

Over 900 miles of streams were originally identified as anadramous fish streams in the John Day Basin which have the highest priority for habitat improvement (James 1984). Over 500 miles are on private land. The 12 streams identified in this implementation plan were further refined as priority areas to target habitat improvement projects in the next 4 years (Figure 4) . Habitat projects implemented after March 31, 1992 will be guided by information from the sub-basin plan.

While approximately 180 miles of stream area have been identifited within the 12 priority streams, actual completed work will vary from 40 to 80 miles of work completed between April 1, 1988 - March 31, 1992. Based on previous work completed for 1985 through 1987 and the realistic constraints of working with landowners and logistics, expected implementation will range from 10 to 20 miles of habitat improvement per year. The additional areas on priority streams are contingency areas that will provide alternative sites if initial lease agreement goals are not met.

B. Program Constraints

In addition to biological criteria, realtistic constraints of landowner acceptance and cooperation, and logistics are recognized as factors limiting program implementation on private lands. Based on past experience on private lands, landowner acceptance in the John Day Basin has been highly variable. While it is a biological priority to implement habitat work on upper reaches and work downstream, and to work on streams with the greatest potential benefit with both species of emphasis, actual implementation in a given budget period is highly dependent on landowner acceptance for the target areas. Table 10 shows an approximate schedule for implementation on private lands in the John Day Basin for April 1, 1988 through March 31, 1992, given the combined criteria of biological priorities and program constraints.

In addition, commitments have been made to landowners to complete projects in 1988, that complement work completed from 1985 through 1987 (Table 7):

Fox Creek - Approximately 10 miles of habitat improvement work has been completed on major spawning and rearing areas for summer steelhead on Fox Creek, a major tributary of the North Fork, from 1985 - 1987. Lease agreements and addendums have been signed or are pending signatures with 3 landowners on 3 additional properties on Fox Creek. These properties will complement existing habitat work and add an additional 6 - 8 miles of stream enhancement into the programs. The Fox Creek fish habitat improvement project provides an excellent example of implementing work on a large contiguous reach of a steelhead stream, with 16 miles of stream restoration.

VI. IMPLEMENTATION SCHEDULE AND COSTS

Table 10 shows an approximate schedule for implementation and costs of projects in the John Day Basin on private lands. These projects are subject to landowner acceptance and cooperation, logistics, and access to stream sites. Other streams in the priority list may be substituted or interchanged with this schedule, with BPA approval, given opportunities that may arise with other land management agencies, such as the Malheur National Forest. Costs are also subject to modification, as stream surveys are completed that identify specific habitat problems.

VII. BENEFITS

A. Fisheries

Tabie 10. Schedule of Habitat Improvements in the John Day Basin on Private Lands, April 1, 1988 - March 31, 1992 a/

Streams	FY Year	Stream Miles	Smolt Benefits CHS	Smolt Benefits STS	Fence b/	Planting d/	Instream Structures b/	Water Develop b/	Passage	Total cost c/
Fox	88	6	3900	--	14	--	--	5	--	146,180
Canyon		20	6500	--	--	--	--	--	1	22,686
Rock		50	16,250	--	--	--	--	--	4	157,086
Middle Fk		2	1300	5860	3	2	2	--	--	101,683
Mainstern		2	1300	5860	3	--	2	--	--	84,126
Middle Fk	89	3	1950	8790	8	2	2	4	--	141,000
Mainstem		2	1300	5860	4	--	1	4	--	90,000
Canyon		2	1300	--	4	--	1	2	--	50,000
Desolation		11	7150	--	22	--	2	6	--	231,000
Middle Fk	90	5	3250	14,650	10	2	2	5	--	200,000
Camas/Owens		5	3250	--	10	--	2	5	--	160,000
Cherry		-4	2600	--	a	--	2	5	--	150,000
Middle Fk	91	5	3250	14,650	10	2	2	5	--	200,000
Parrish		5	3250	--	10	--	2	5	--	160,500
Long		6	3900	--	12	--	2	6	--	160,000

a/ All work and costs contingent on landowner approval, logistics and access to stream sites

b/ Miles of fence to build, streambank to plant, or stream to be treated with structures

c/ Costs based on administration costs plus the following:
1) fencing = $5000/mile (one lineal mile)
2) planting = $l000/mile
3) instream structures = $20,000/mile large streams
= $10,000/mile small streams

d/ Smolt capacities with enhancement (numbers of smolts)

Table 11. Preliminary Estimates of Fishery Benefits from Habitat Enhancement Projects in the John Day Basin

B. Other Benefits

In addition to increased fish production, habitat improvement projects will increase other benefits for water quality and quantity, reduced sedimentation, re-establishment of riparian vegetation, and increased use by wildlife species.

The combination of instream structures and restoration of riparian vegetation will restore streambanks to a healthy, productive condition. Vegetative root structure stabilizes banks, while surface vegetation filters overland flows, trapping sediment and debris. Woody debris falling into the stream creates pools and reduces water velocity. Vegetation and instream structure also raise the water table and retain water, creating a less severe seasonal distribution of water flow. Riparian vegetation also shades the stream and cools water temperatures for aquatic life. Leaf litter and terrestrial insects falling into the stream improves nutrient cycling. Riparian zones are essential for wildlife species and provide essential habitat for approximately 288 of 363 total wildlife species, for water, food, cover, migration corridors, etc. (Thomas et al. 1979).

VIII. MONITORING

Monitoring procedures have been and will continue to be an integral part of the John Day Basin habitat improvement program. Baseline information is collected through:

A. Physical stream measurements to document vegetative and stream morphology changes. Two types of surveys include:

1. physical inventory walk-through surveys measuring pool:riffle ratio, stream side vegetation, cover, substrate, and pool quality

2. transects using compass and rod measuring stream depth, width, channel configuration, overhanging banks, and stream shading

B. Photopoints to document vegetative changes in riparian recovery and stream morphology.

C. Stream temperature ‘and solar insolation on selected stream reaches to document temperature regimes and changes in response to canopy cover.

D. Steelhead redd surveys on tributaries receiving passage projects.

E. Bird surveys on selected stream reaches to document overall ecological changes with changes in vegetative recovery.

Once baseline information has been collected and used to assess fish habitat problems, and fencing and instream projects have been implemented, subsequent surveys are conducted at regular intervals to document changes. While intensive biological surveys will not be done as part of this program to document changes in fish populations, projects done on Camp Creek, Deer Creek, and Clear Creek indicate a positive response in fish populations to treatments.

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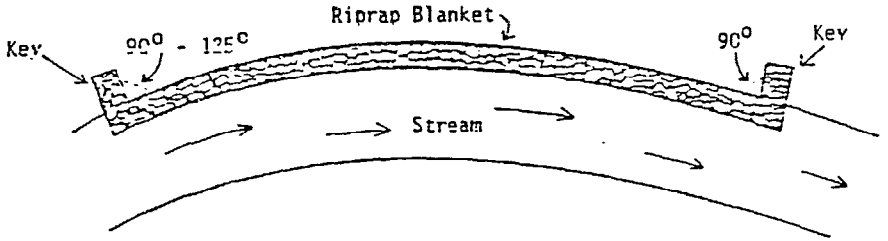
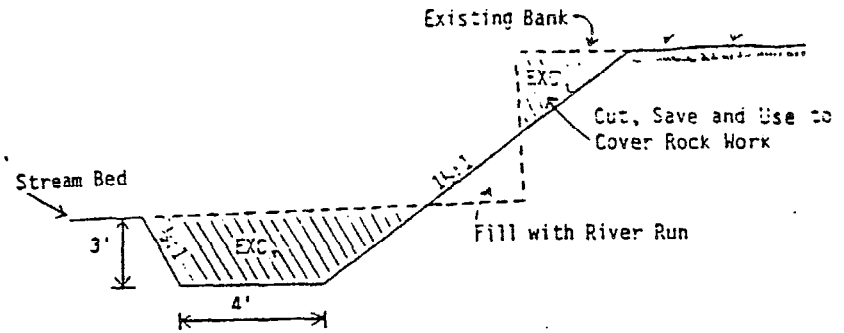
Appendix A - Technical Specifications

RIPRAP BLANKET TYPICALS

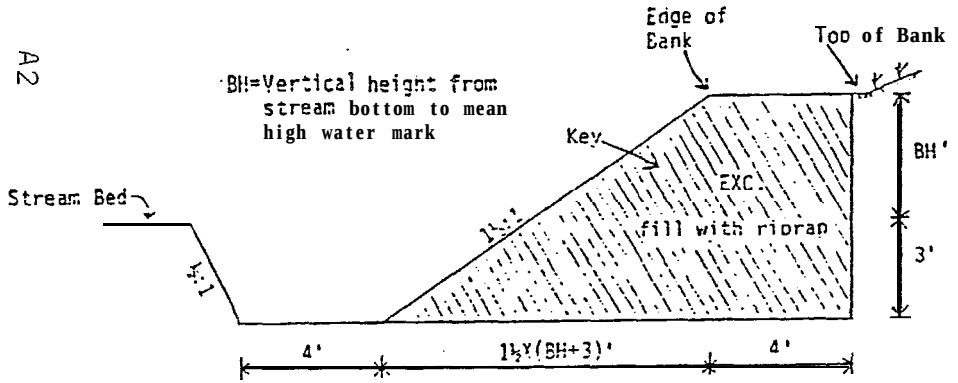


Plan View

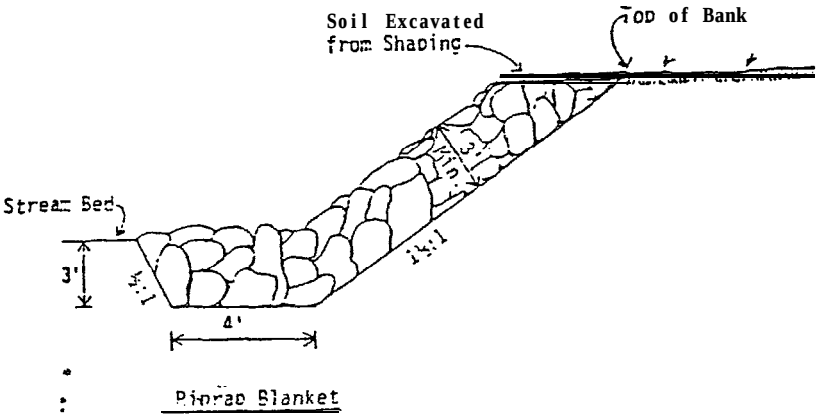


Shaping

Bank *and* Toe Trench Excavation



Key



Riprap Blanket

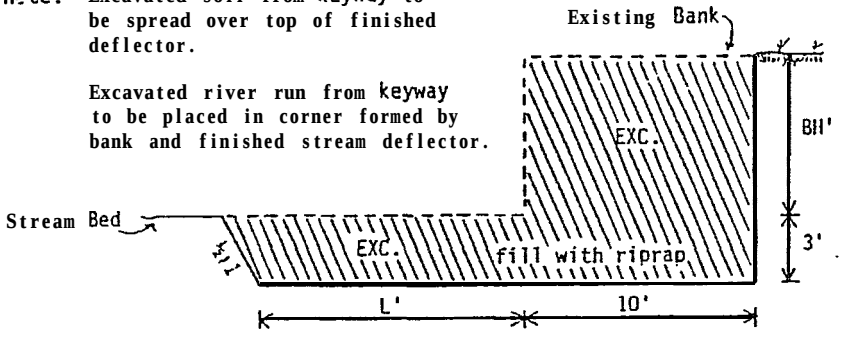
A2

NOT DRAWN TO SCALE

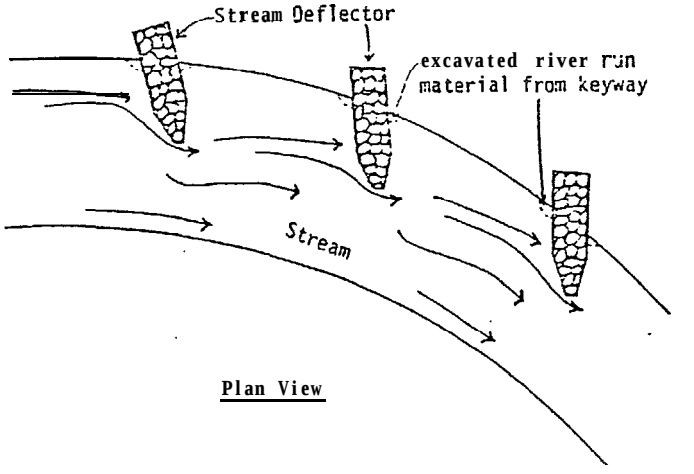
STREAM DEFLECTOR TYPICALS

Note: Excavated soil from keyway to be spread over top of finished deflector.

Excavated river run from keyway to be placed in corner formed by bank and finished stream deflector.



Kevwag Excavation

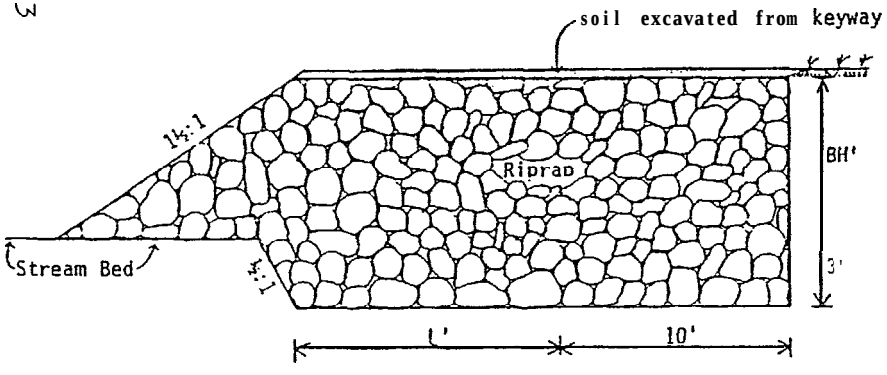


Plan View

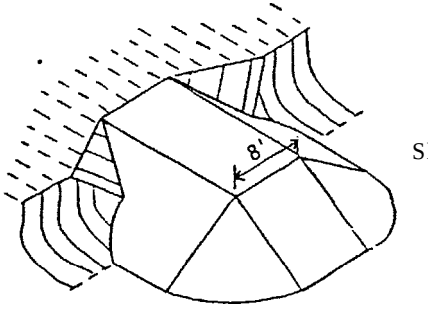
BH=Vertical height from stream bottom to mean high water mark

L =Deflector length to be determined by COR to achieve the desired hydraulic effect.

A3



Riorao Stream Deflector & Keyway

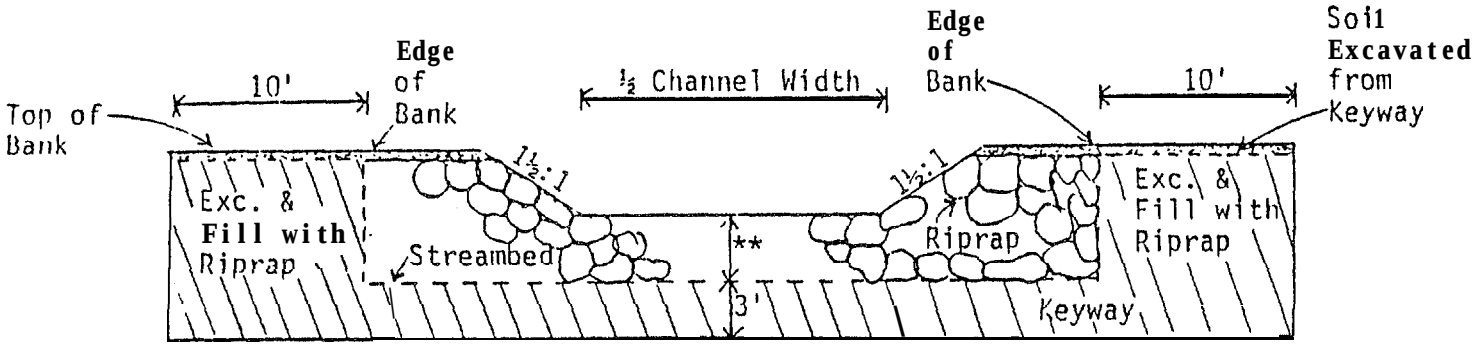


Slooes = 1½:1

Isometric View

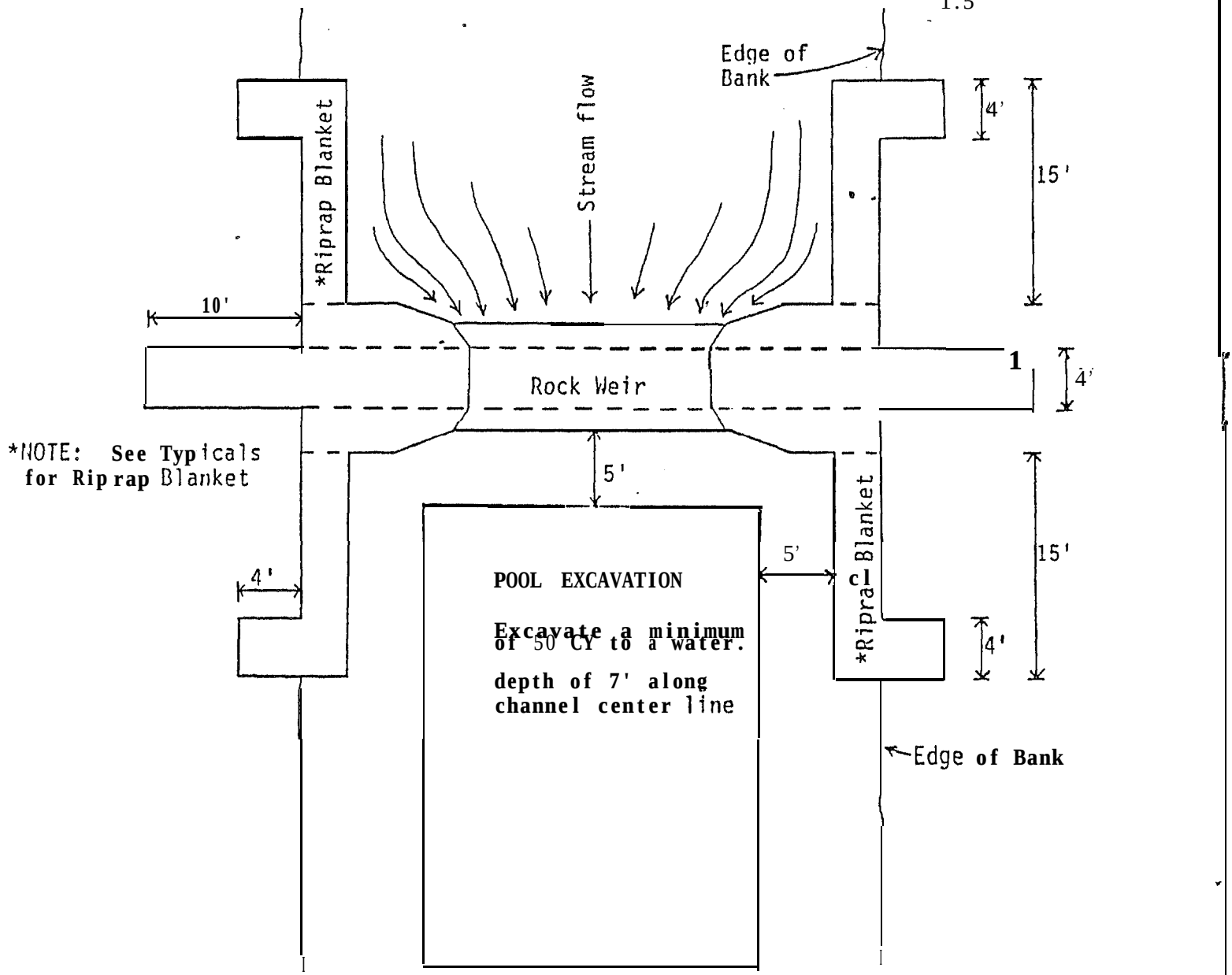
NOT DRAWN TO SCALE

ROCK WEIR TYPICALS



X-Section View
Rock Weir

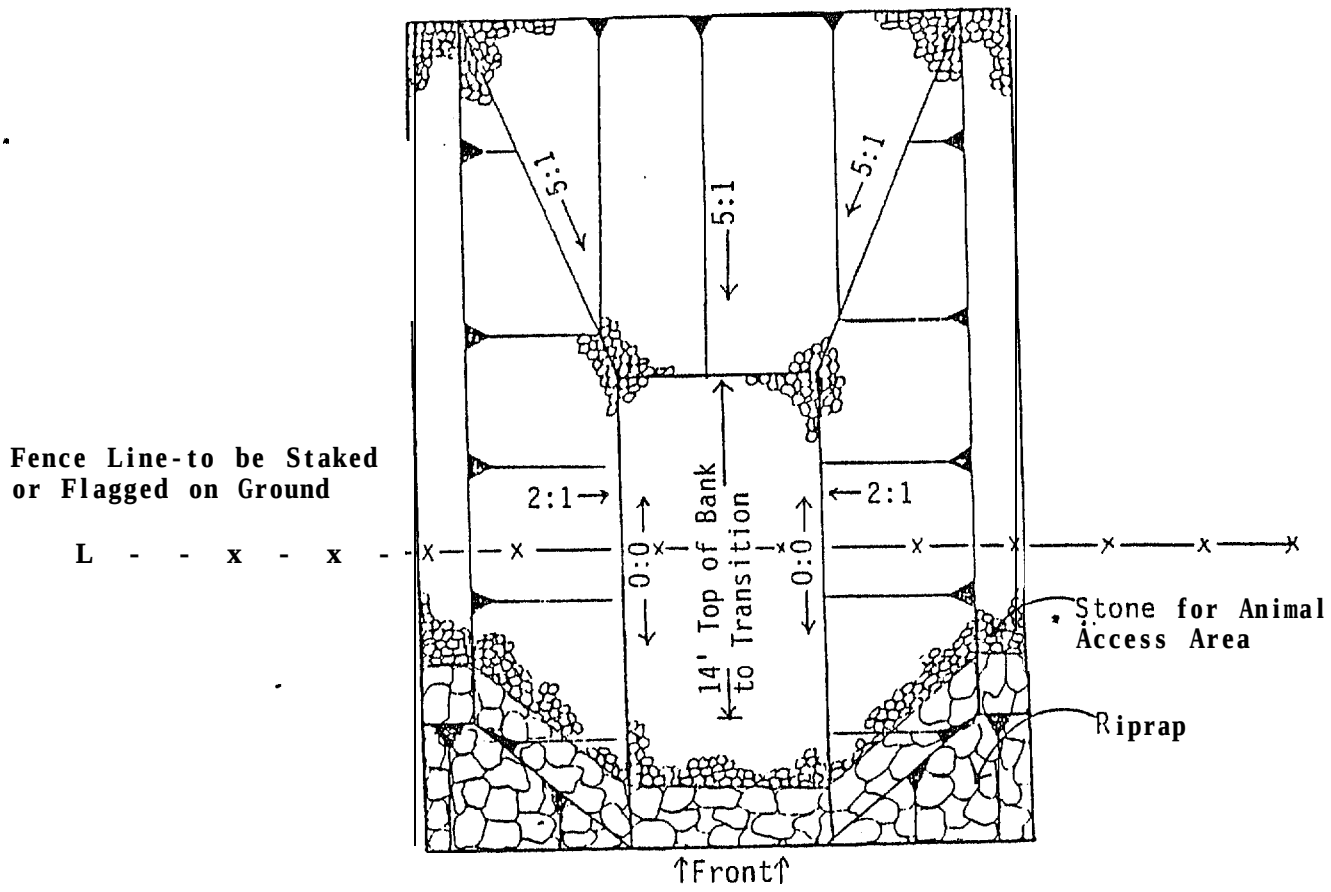
**Weir Height = Stream depth + a minimum of 1.5'



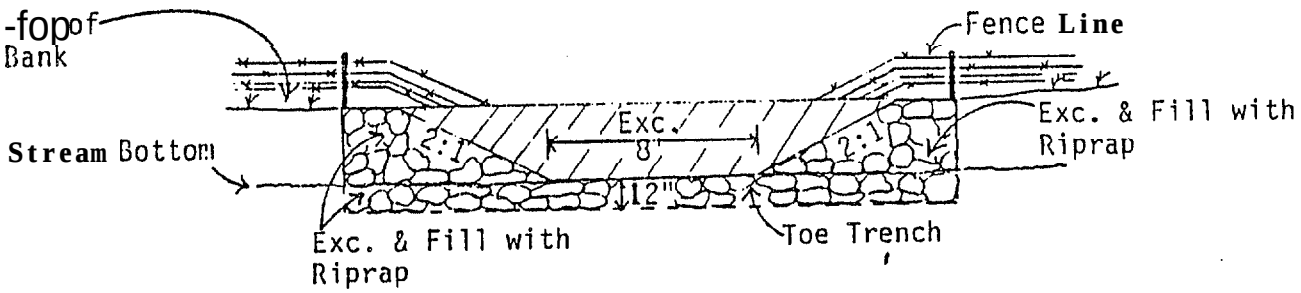
Plan View

NOT DRAWN TO SCALE

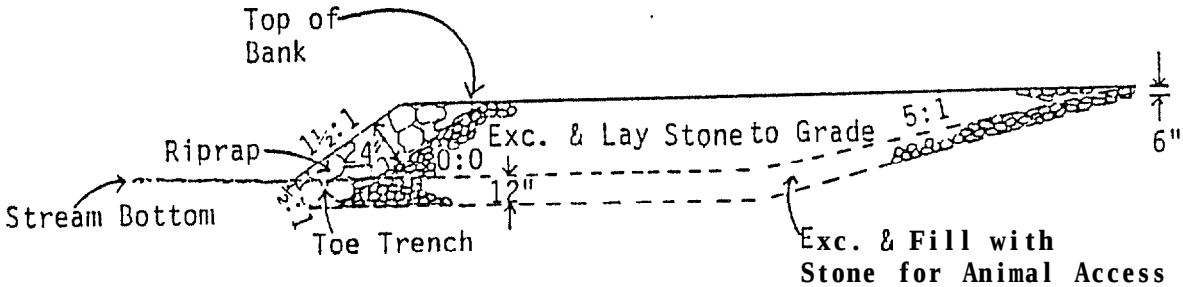
WATER GAP TYPICALS



Plan View



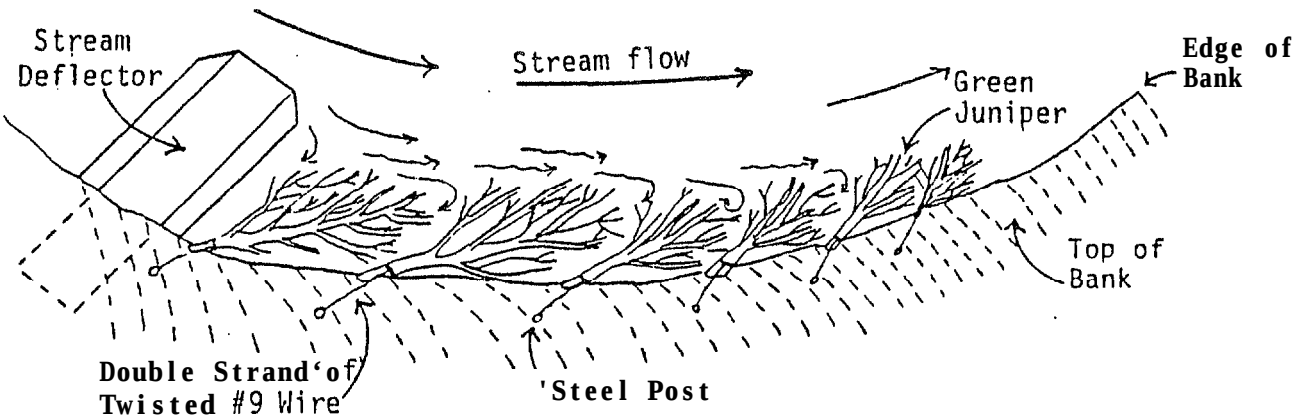
Front View

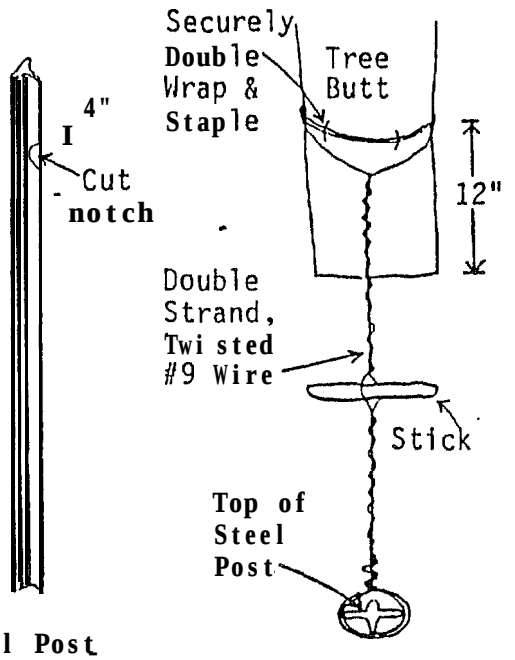


Side View

NOT DRAWN TO SCALE

JUNIPER RIPRAP TYPICAL



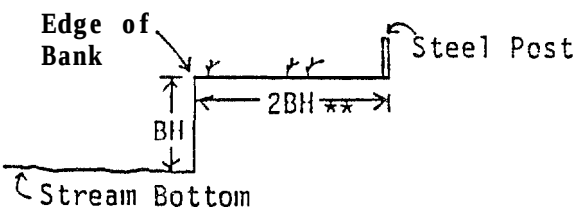


Steel Post
3' Min. Length
1.33 lb./ft.

Hiring

NOTES

1. **Place juniper trees in a shingled, overlapping pattern, tightly packed, beginning downstream. Use green, full limbed trees.**
   Min. Size: Butt Dia. 6", Length *
   Max. Size: Butt Dia. 18", Length *
2. **Double wrap and staple #9 smooth wire around butt end of tree and double wrap opposite end of #9 wire around steel post in cut 'notch. Twist #9 wire until tree Is tight against bank.**
3. **Drive steel posts a min. of 2BH back from edge of bank in undisturbed soil. Drive flush with ground. Place 'notch away from stream.**
4. **Location of juniper riprap shall be staked or flagged.**

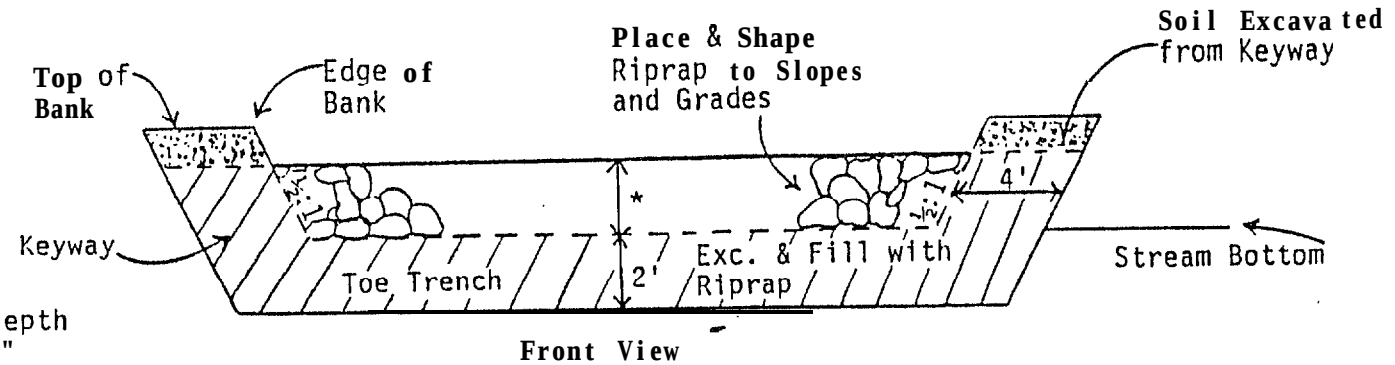


***TREE LENGTH shall be adequate to allow 1' - 3' of the butt end to rest on the bank while deflecting stream current 6' - 8' away from the bank.**

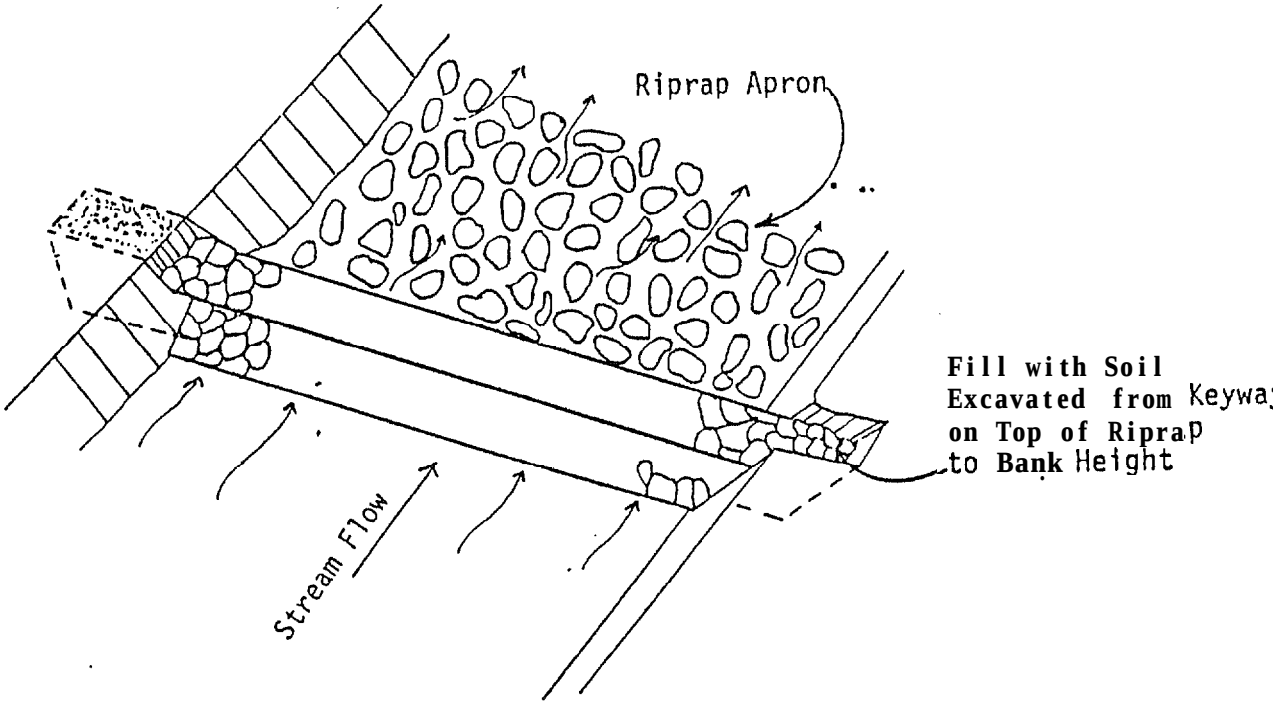
****Not to exceed 16'**

NOT DRAWN TO SCALE

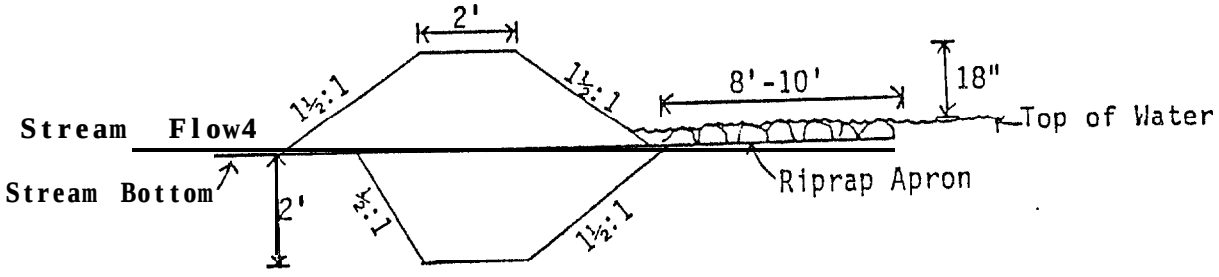
CHECK DAN TYPICALS



Front View



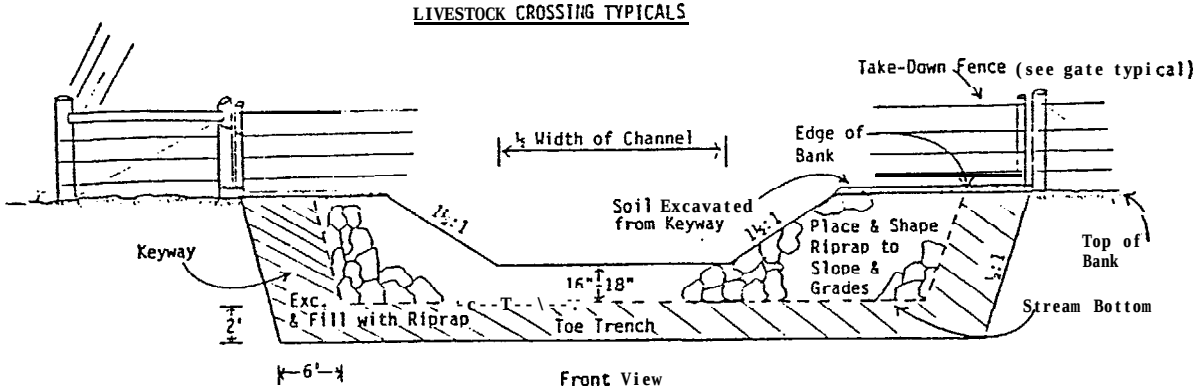
Isometric View



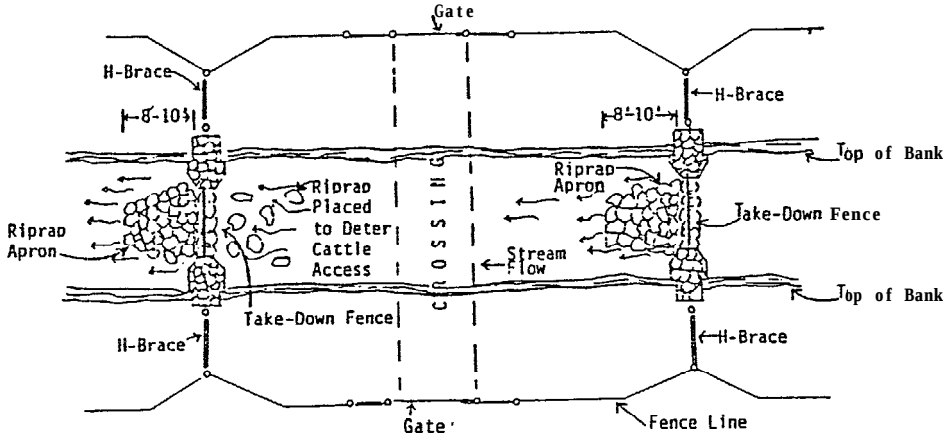
Side View

NOT DRAWN TO SCALE

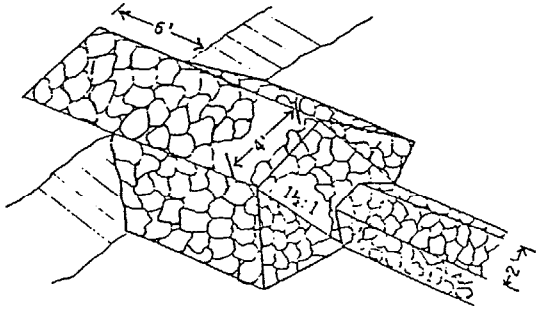
LIVESTOCK CROSSING TYPICALS



Front View



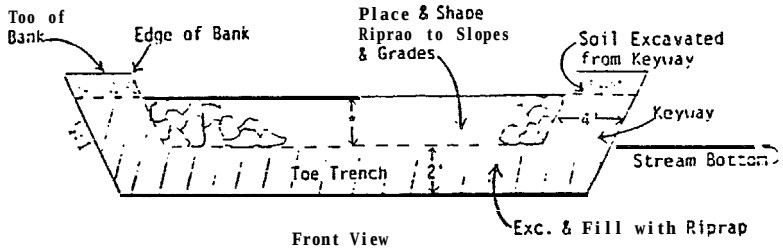
Plan View



Isometric View

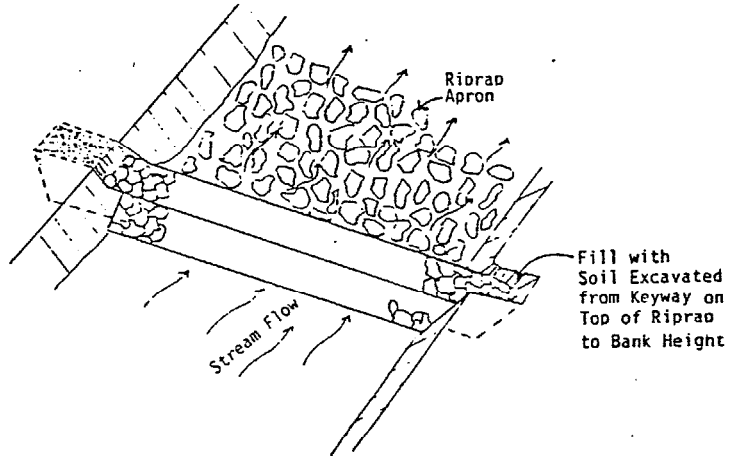
NOT DRAW TO SCALE

CHECK DAM TYPICALS

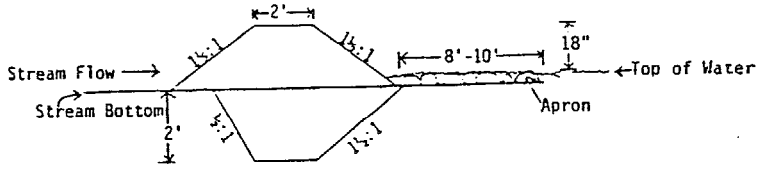


Front View

● t(ater Depth Plus 18"



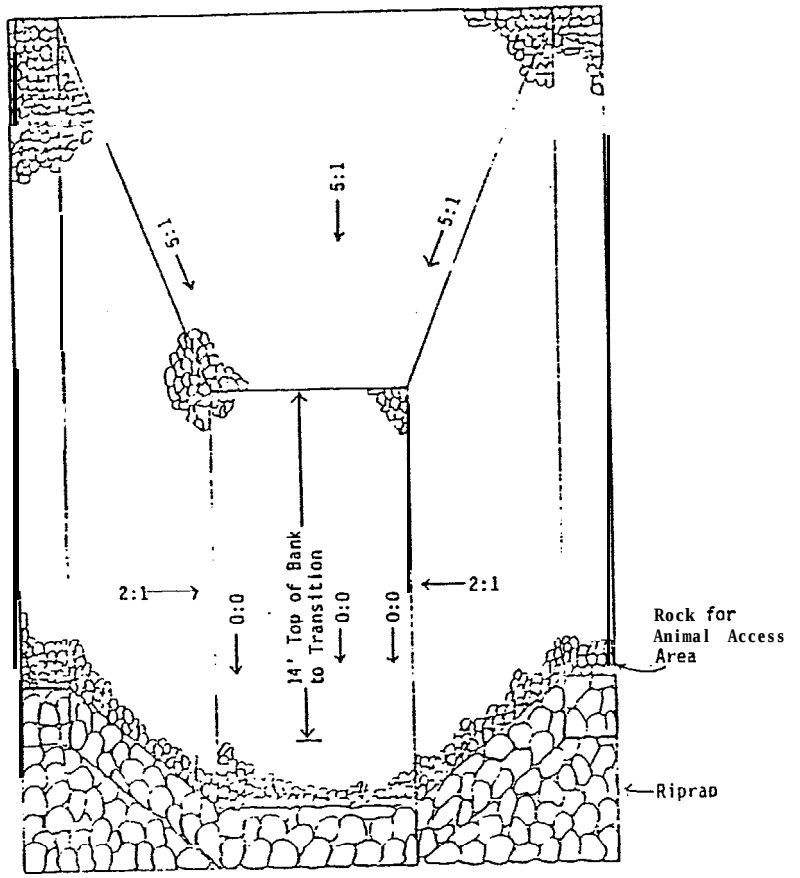
Isometric View



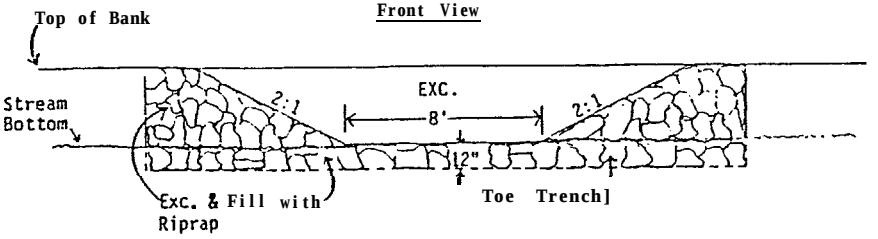
Side View

HATER GAP TYPICALS

Plan View

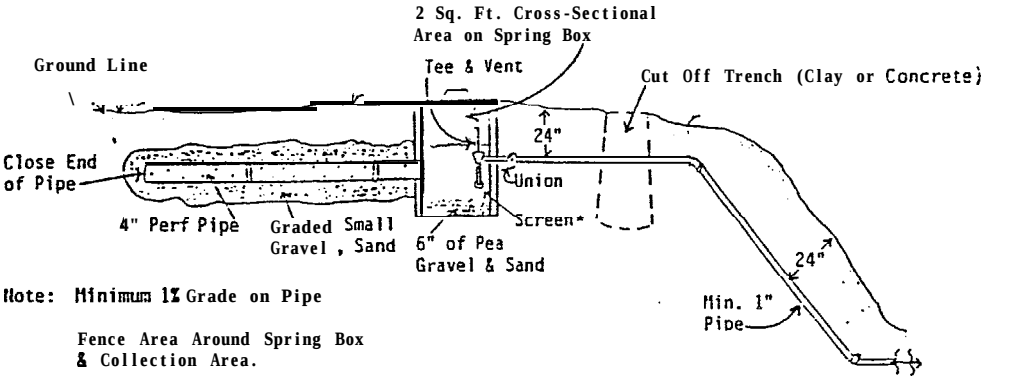


Front View



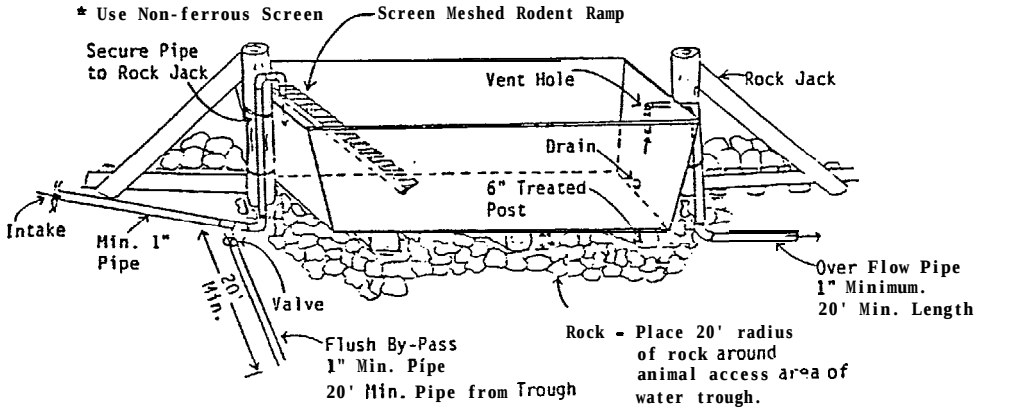
NOT DRAWN TO SCALE

SPRING DEVELOPMENT TYPICALS



Note: Minimum 1% Grade on Pipe

Fence Area Around Spring Box & Collection Area.



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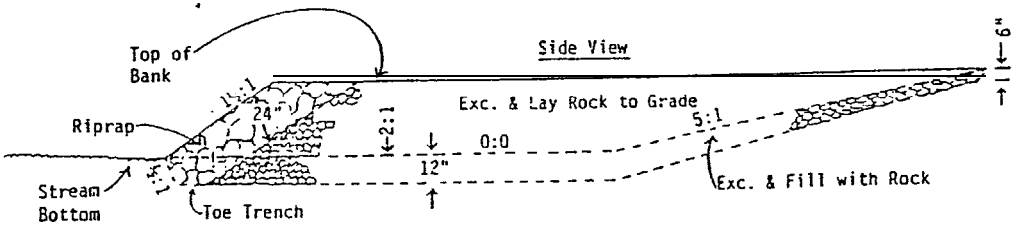
Side View



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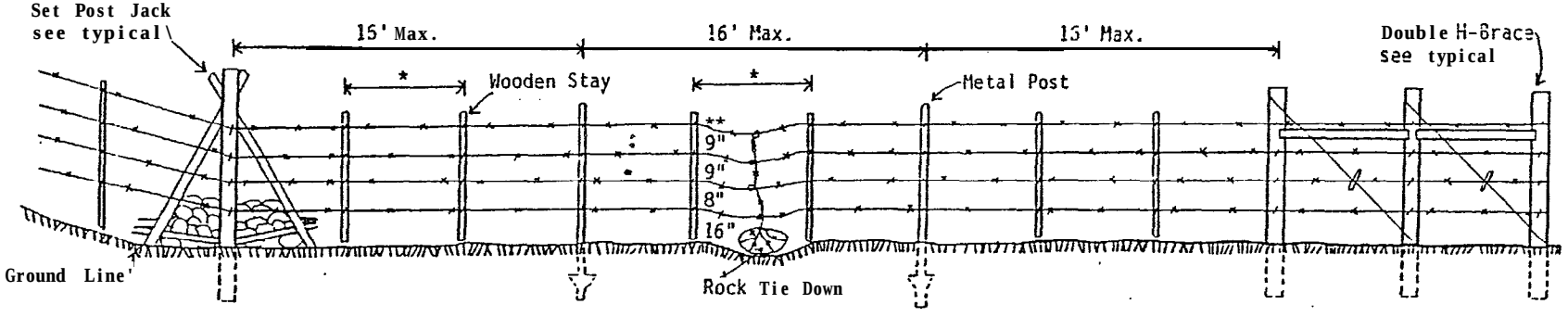
FENCING TYPICAL



*stays to be evenly placed between posts

**wire spacing may vary by landowner - confirm by COR

number of wire5 may vary by landowner

ALTERNATIVE FENCING TYPICALS

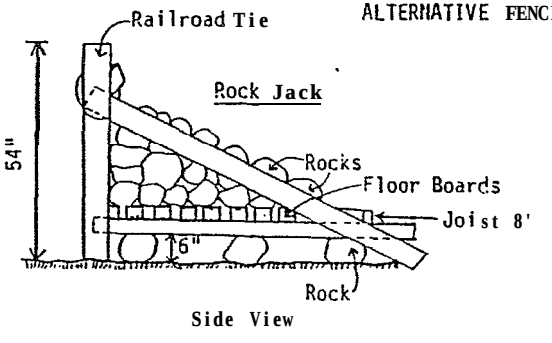
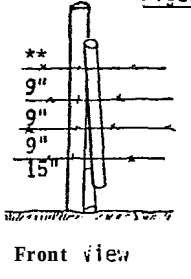
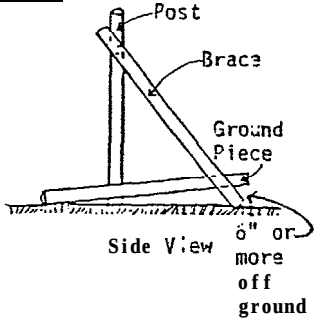
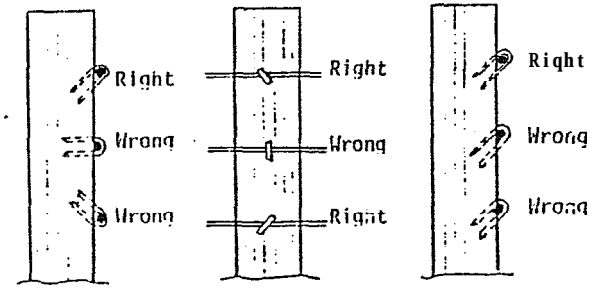


Figure Four



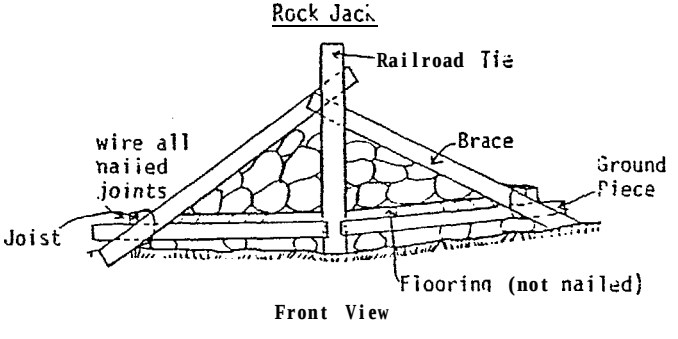




Drive staples at an angle.

Do not drive staples parallel in side of posts.

Leave wire loose in staples except fence ends and stays.



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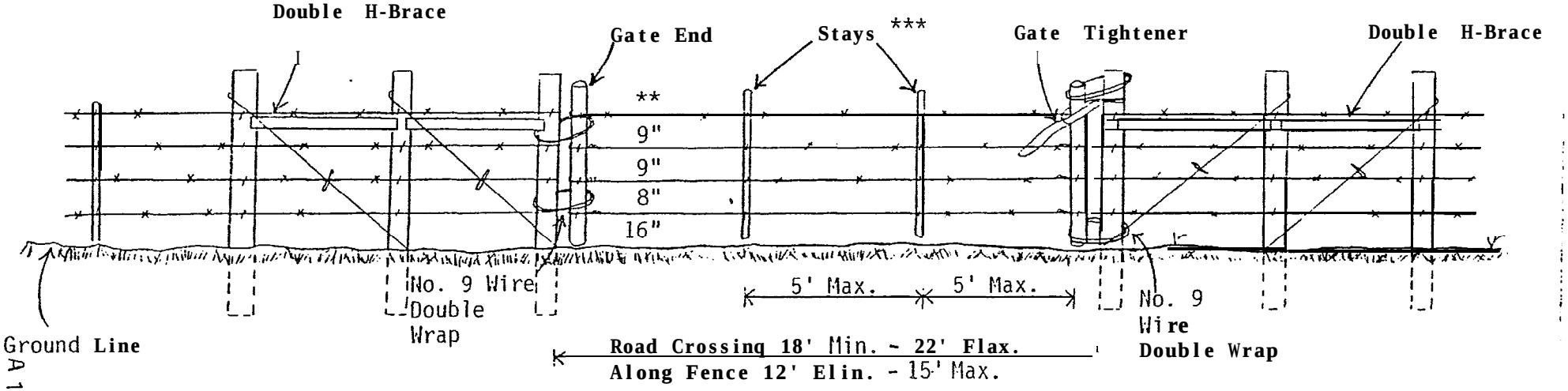
GATE TYPICAL



A 12

** Wire Spacing & Number of Wires May Vary by Landowner - Confirm by COR

***Gate Stays on Fence Line Shall be Wood

NOT DRAWN TO SCALE