A METHODOLOGY STUDY TO DEVELOP EVALUATION CRITERIA FOR WILD AND SCENIC RIVERS

Report of

Irrigation Subproject

by
C. C. Warnick

Water Resources Research Institute
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ABSTRACT

This report is a subproject of an overall study to try to provide a better methodology for evaluating wild and scenic rivers for possible inclusion in a National Wild and Scenic Rivers System. The Salmon River in Idaho has been chosen as the basis for making this methodology study. The specific objectives in this subproject are concerned with evaluating potential for using Salmon River water for irrigation within the river basin and outside the river basin and to determine the impact of such potential irrigation use on the status of the river for inclusion in National Wild and Scenic River System.

An inventory of present and potential use of water for irrigation within the basin has been made and presented. An analysis has been made of various development schemes that could transfer water out of the basin for use into various other adjacent river basins. This is based on previous studies of agricultural water needs in various basins in Idaho and even other states. An unsophisticated technique for assigning a net value to the water has been proposed using data from previous feasibility studies involving specific water development projects for which it is assumed the water value would have to be at least that value to be able to identify positive benefit. Costs have not been estimated but benefit cost ratios from recent planning studies have been used to calculate a net value for the water projected for irrigation use. The study has been done by segments of the Salmon River with imposed restraints identified for use, the diversion location, and amount of water possible to be utilized. Simple identification sketches have been included to identify the conceptual diversion schemes and numerous tables summarize the details on the various alternatives.

A final analysis identifies the conflicts of the various irrigation water use potentials or alternatives with possible inclusion of segments of the river in the National Wild and Scenic River System.

A flow chart of the methodology used in the study is presented in the Appendix of the report.

INTRODUCTION

The United States Congress reacted to great interest of the public for maintaining a quality natural environment and passed on October 2, 1968 the Wild and Scenic Rivers Act, Public Law 90-542. The Act indicates the policy of the Federal Government is to have selected rivers, which with their immediate environment possess outstanding scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. The Wild and Scenic Rivers System established under the act specifies that such rivers shall be preserved in their free flowing state and shall be protected for the benefit and enjoyment of present and future generations.

The Act provides for two categories under which specific rivers will be preserved or studied for possible inclusion in the preservation status. Included in the first category are rivers authorized for immediate inclusion in the National Wild and Scenic Rivers System ("Instant Rivers"). Two of the five rivers so designated are, the Middle Fork of the Salmon River and the Middle Fork of the Clearwater River, located in Idaho. The second category includes rivers designated to be studied for possible inclusion in the System ("Study Rivers"). Five rivers in Idaho have been designated for study under the second category. They include the main stem of the Salmon River, the Bruneau River, the St. Joe River, the Priest River, and the Moyie River.

The Act specifies three classes of wild rivers: wild, scenic, and recreational. A wild river is a river free from impoundments, with shorelines essentially primitive, and with waters non-polluted. A scenic river is a river free from impoundments, with shorelines or watersheds still largely primitive and undeveloped, but which is accessible in places by roads. A recreational river is a river which is readily accessible by roads and railroads which may have undergone some impoundment or diversion in the past. Public Law 90-542 sets a ten-year time limit on classification studies after which recommendations on the disposition of study rivers are to be made to the Congress.

It is recognized that little valid methodology has been developed for evaluating what should be the status of specific rivers under the new concept as spelled out by the Act. While methodology is a means to an

end, it is none-the-less the key to developing techniques and criteria for classifying rivers for possible inclusion in a wild or scenic rivers system. In view of this, the Water Resources Research Institute of the University of Idaho, through a specially organized Scenic Rivers Study Unit, is involved in developing a methodology to evaluate wild rivers.

General Purpose and Objectives

This study has as its goal the establishment of criteria which can be used to identify and determine the economic, esthetic, scenic and other values of wild rivers. The primary emphasis of this study will be focused for the next few years on the Salmon River in Idaho. This river includes essentially all the fundamental problems concerned with such evaluations for wild rivers and represents vital part of the State of Idaho resources and geographic area.

The portion of the Salmon River designated as a study river is the segment from its mouth on the western border of Idaho to the town of North Fork. However, the Institute will include in its study that portion of the river above North Fork and the tributaries for two reasons. First, because any physical development such as impoundments, dredging, diversions, mining, and logging within the basin area above North Fork would affect the main stem of the river. Second, because an economic study has to include all of the activity in the river basin and its margins to be meaningful. The latter consideration also involves what may happen in the river area if and when the Salmon River is selected as a wild river. A wild river status would affect all levels of economic development, as well as sociological patterns, in the area.

The purpose of the methodology study is to develop information pertinent to decision-making and planning as it pertains to the selection, use and management of wild and scenic river systems. The methodology study has four broad objectives:

1. Inventory present quantities and qualities of natural resources in the river basin area, and estimate future quantities and qualities of these resources, establishing their values in both situations.
2. Identify, describe, and quantify, where possible, benefits from scenic beauty, personal enrichment,

and other esthetic experiences derived from the river.

3. Develop a series of models to evaluate or determine the resource use pattern consistent with a wild river system, and the resource use pattern which would exist under various levels of development in the river basin area.
4. Present recommendations for alternative uses of resources for the entire river basin area, restrictions if classification is applicable, and economic and social ramifications of each of the alternatives considered.

The plan for the methodology study divides the research work into a series of subprojects, each covering an important economic activity related to the river. These subprojects consist of the following fifteen resource and service functions:

1. Forest and range resources
2. Minerals
3. Outdoor recreation
4. Commercial fisheries
5. Irrigation
6. Water for municipal & industrial use
7. Water quality control
8. Hydroelectric power
9. Flood control
10. Navigation
11. Transportation and access
12. History
13. Agriculture
14. Hunting
15. Anthropology

Upon completion of the subprojects, a series of economic models will be developed which will make best-at-the-time estimation of costs and benefits for each of the resources included in the subprojects, and also permit direct comparison of costs and benefits of alternative resource uses. This technique will then be extended to make estimates of future uses and values. Forecasts of future uses will be extended to the years 2000 and 2020 in keeping with the projections of the Columbia-North Pacific Comprehensive Framework Study (1).

Two general evaluations of the river resource base can be made. First, the current and projected levels of economic activity based on status quo. Second, a determination of the benefits foregone as a result of maintaining the river in its natural free flowing state. Efforts throughout the study will be to try to identify and quantify the esthetic and personal

enhancement values for which has been expressed a strong national desire to protect and conserve.

Specific Subproject Purpose and Objectives

The specific objectives of the subproject for evaluation of water for irrigation use are:

1. To determine present and potential use of water for irrigation use within the Salmon Basin.
2. To determine present and potential use of water for irrigation outside of the Salmon River Basin giving consideration for the physical, hydrological and land use possibilities and to attempt to assign values to these present and potential uses.
3. To determine the impact such irrigation use would have on the Salmon River either in total or in segments of various degrees of development or use for irrigation.

Principal Sources of Information

The sources of information for this study have included basically four types of information. First, basic statistical information such as hydrological data characterized by such published material as Water Supply Papers of the U. S. Geological Survey or the Idaho Water Resources Inventory of 1968. Second, published project or planning reports of government agencies such as the U. S. Bureau of Reclamation, U. S. Corps of Engineers, U. S. Soil Conservation Service, Idaho Water Resource Board, and Idaho Department of Water Administration characterized by such reports as Snake Plain Recharge Project, Idaho Special Report, Region 1, U. S. Bureau of Reclamation, June, 1962 (2), House Document 403, 87th Congress, 2nd Session, 1958 (3). Third, unpublished studies by agencies, or private individuals. A typical example is a reconnaissance survey of storage possibilities on French Creek Basin by Professor J. J. Peebles (4). Fourth, published reports of consulting engineers or companies that have made water use studies characterized by such reports as "Western State Water Augmentation Concept" by L. G. Smith, copyright, 1968 (5).

Insofar as possible a complete documentation of references has been included but it is impossible to identify all letter and written data that comprises the study. References are at the end of the report.

BRIEF HISTORY OF IRRIGATION IN THE BASIN

The earliest irrigation in the basin dates back to pioneering efforts of early Mormon settlers in the vicinity of Fort Lemhi in 1855. Although this community was abandoned in 1858 the original ditch taking water from Pattee Creek is still in use. In 1862 a John McGarvey and son were reported to have operated fish traps and raised vegetables in the vicinity of Salmon, Idaho. This activity apparently expanded considerably in 1866 when gold was discovered in the Leesburg basin (6).

These early irrigation uses were direct flow diversion and were limited in many cases to the flood stage of the streams. With the advent of efficient pumps additional land has been developed by direct pumping from the river. There are many small tracts irrigated along the flood plains of the river.

Crops are chiefly hay and pasture that are grown to support the livestock industry in the basin.

Table 1 gives data on present irrigation in the Salmon River Basin by counties, and Table 2 is presented to give an indication of the relative change in irrigation development since reasonable statistics on irrigated land use has been maintained. In Lemhi County, records show that irrigated acreage was as follows:

1919 - 66,905 acres
1929 - 61,278
1939 - 73,821
1949 - 76,697
1959 - 79,211
1969 - 79,500

TABLE 1. Present Irrigation in Salmon River Basin, Idaho

COUNTY	ACRES IRRIGATED	WATER SOURCE	
		Surface	Ground
Adams	11,400	11,400	0
Blaine	700	700	0
Custer	48,100	48,100	0
Idaho	1,500	1,500	0
Lemhi	79,500	78,600	900

Source of Information: Idaho Water Resource Board, "Potentially Irrigable Lands in Idaho - 1970."

TABLE 2. Relative Change in Irrigated Acreage in Salmon River Basin

YEAR	ACRES OF IRRIGATED LAND IN USE IN RESPECTIVE BASIN					
	Total	Salmon River			Lemhi River	Pahsimeroi River
		Below French Creek	French Creek to Salmon	Above Salmon		
1959	128,000	15,000	14,000	34,000	47,000	18,000
1949	124,684	14,355	10,321	34,515	46,814	18,679
1939	112,874	16,790	10,059	26,268	47,269	12,488

Source of Information: U.S. Census of Agriculture, Irrigation of Agricultural Lands.

In U. S. Geological Water Supply Paper 657, Hoyt (7) indicates that in 1935 the estimated acreage devoted to irrigation was 90,000 to 100,000 acres and water rights records as of 1928 showed 87,500 acres having recorded irrigation rights in the basin. This information would indicate that irrigation development has essentially reached a stabilized level. Figure 1 gives a sketch map of where the principal irrigated areas are located in the State and the basin and Figure 2 gives a detailed map of the eastern part of the basins' irrigation areas. This is also the location of most of the potential irrigated land areas.

A separate subproject report on history as it has an impact on the possible inclusion of the Salmon River as a wild river is being prepared. A more detailed larger-scale map that illustrates graphically the presently irrigated and potentially irrigable land area is reported in the map prepared by the Idaho Water Resource Board (8).

NEEDS FOR IRRIGATION WITHIN BASIN

Over the past four decades different estimates have been made for the irrigation needs or potentially irrigable acres in the Salmon River Basin. It is interesting that in an estimate dated 1935 in U. S. Geological Survey Water Supply Paper 657 by Hoyt (7) the potential irrigable area in the entire Snake River drainage was indicated to be 1,291,000 acres. No mention was made of a potential in the Salmon River even though other tributary basins within Snake River system were separately itemized. The only figure that might even be construed to be a figure of potential is a miscellaneous listing of 10,000 acres.

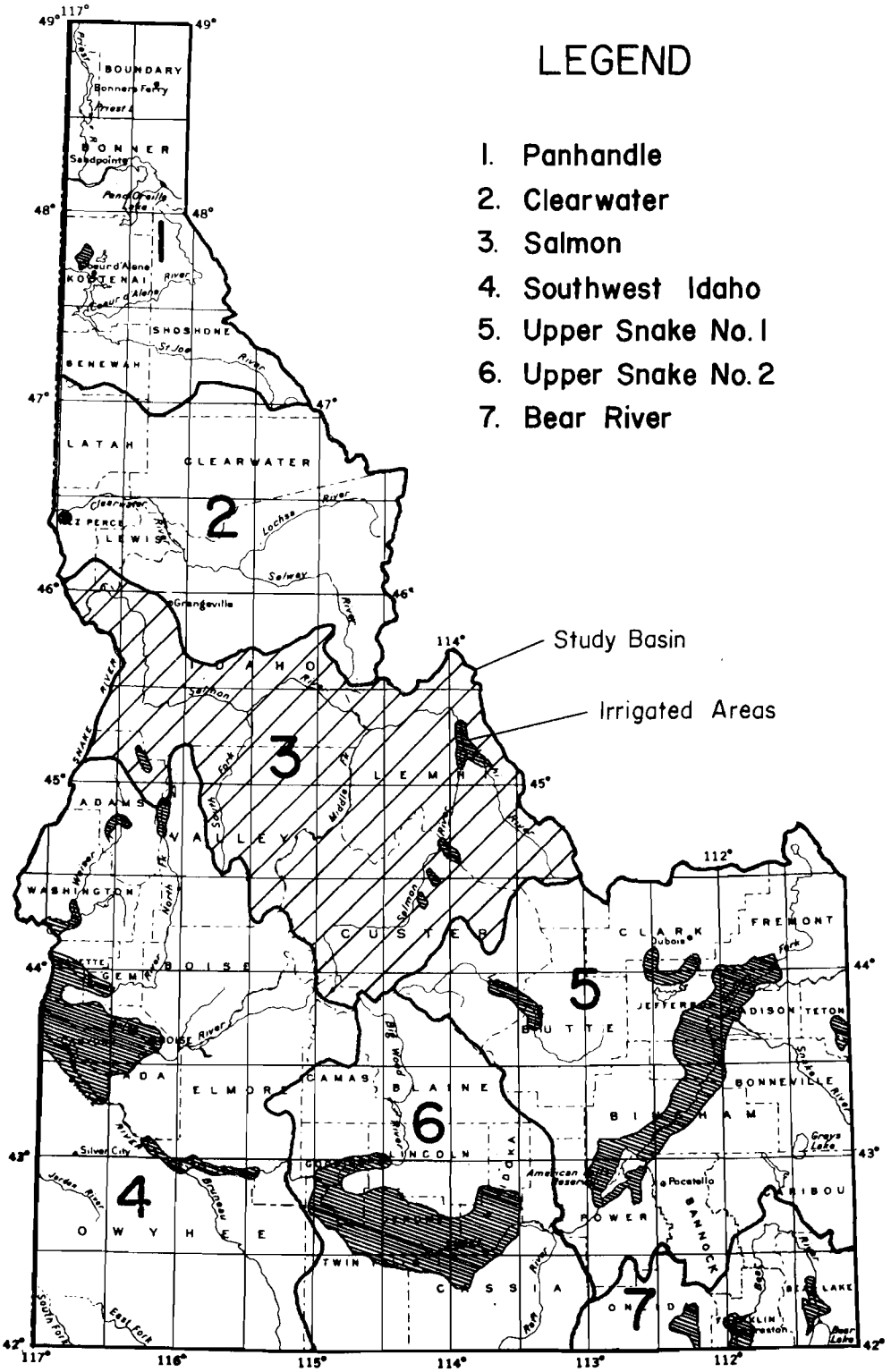
The 1958 report of the U. S. Bureau of Reclamations' Columbia River Report (9), House Document 473 shows a then estimated need of supplemental water on 21,890 acres of inadequately irrigated land and a potential for new irrigated lands in the basin of 10,720 acres. These data were obtained by summarizing the information on page 164 of that report.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

IDAHO

TOPOGRAPHIC DIVISION
PACIFIC AREA
MENLO PARK, CALIFORNIA

Fig. 1. Sketch Map of Irrigated Areas of Idaho and Basin Subdivisions.



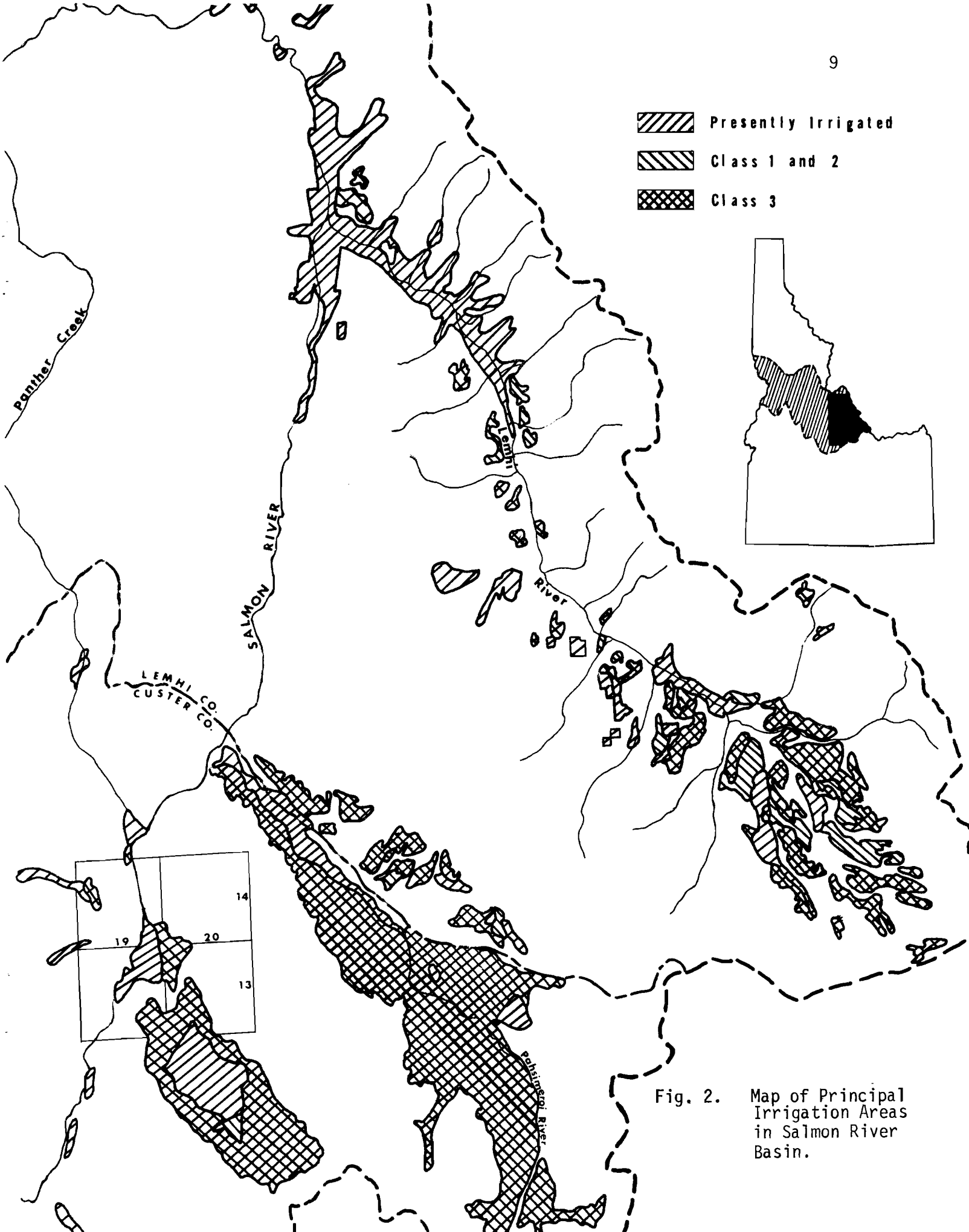


Fig. 2. Map of Principal Irrigation Areas in Salmon River Basin.

The review report of the U. S. Army Corps of Engineers entitled "Columbia River and Tributaries Northwestern United States" (10), sent forth by the Chief of Engineers on 28 June 1949 and later published in 1950 as House Document No. 531, reports potential irrigation in the Salmon River Basin as 12,300 acres of land requiring a supplemental supply and 9,100 acres of new land. This is reported in Table 29, page 1631 of House Document No. 531.

The Columbia-North Pacific Framework Study (1) indicates the rather gross or overall figures for the basin and subdivides the information as shown in Table 3.

The Idaho Water Resource Board studies (11) show the potentially irrigable areas in the basin as indicated in Table 4.

Different criteria for estimating the water needs for such land can be used. The work of Dr. Corey and R. J. Sutter (12) would indicate the diversion needs for in basin use to be about 130,000 acre feet per year. This amount is relatively small and will probably be supplied in part by return flow so that the net depletion of the stream will be much less. Likewise the development would no doubt extend over many years before such a consumptive use amount would be reached.

CONCEPTUAL PLANS FOR IRRIGATION USE OF WATER

Plans Within Salmon River Basin

The irrigation development within the basin appears to have reached a stabilized level and although limited efforts of planning have been indicated, there is practically no new projects that appear to be in the offing. The Challis Project is typical of several suggested small projects that the U. S. Bureau of Reclamation has made studies of to establish possible irrigation use within the basin. Projects by name

Table 3. Land Areas Having Potential for Irrigation Water Use.

Basin	Acreage (Acres)
Main Stem Salmon	32,510
Pahsimeroi	22,500
Lemhi	8,500
Middle Fork Salmon	2,160
TOTAL	65,670

Table 4. Potential Irrigation Lands Within Salmon River Basin by Land Classes

County	Class 1	Class 2	Class 3	Total
		Acreage (Acres)		
Adams	0	2,000	0	2,000
Blaine	0	2,700	1,600	4,300
Custer	1,300	3,900	154,100	159,300
Idaho	0	18,079	19,995	38,074
Lemhi	0	23,200	53,800	77,000
Lewis	0	0	9,100	9,100
Valley	0	6,800	1,900	8,700
TOTAL	1,300	56,679	240,495	298,474

that have been suggested are Challis project, Pahsimeroi project, Lemhi project, Leadore project, Yearian project, and Agency project. The Challis project did reach the feasibility level of planning and was presented as a report to the Secretary of the Interior in March, 1964 (13). However, lack of real interest and probably the small scale of the project has left it as just a plan. Thus, in-basin use of water for irrigation is almost at a standstill until greater alternative economic benefits can be achieved.

Plans Outside the Salmon Basin

In reviewing the literature and trying to develop some order of magnitude of potential use for irrigation use outside the basin, many schemes and studies came to the attention of the writer. In order to best present this information, a comprehensive table was developed to organize the information on various conceptual schemes that have been investigated. The degree of detail on the various studies varies greatly and therefore, it becomes very hard to make valid comparisons. However, the table and subsequent treatment of the information represents a first attempt. Table 5 contains this summary of information on schemes for use of Salmon River for irrigation and other uses. Sketch maps Figures 3 - 19) have been developed to illustrate the schemes and give a graphic representation of the conceptual ideas.

Subheads to the various pages or sections of the table identify the type of information reported. The 58 columns of Table 5 report the breakdown of detailed information. The columns identify the respective schemes, the corresponding identification sketch map, and the literature source from which the information was obtained to facilitate finding pertinent data for comparison purposes.

It is the writers firm belief that there are other ideas "pigeon-holed" away and many have not come forth because of a rather definite deferral of development of this river for consumptive use of the water. This deferral exists primarily because of the desire to protect the anadromous fish run that the river system supports and the fact that any out-of-basin diversions would be very difficult to achieve due to the topography.

Table 5. Summary Information on Conceptual Schemes Proposed for Utilizing Salmon River Water for Irrigation Outside the Salmon River Basin

A. PLAN IDENTIFICATION

Scheme No.	Figure No.	Name of Plan or Scheme	Author/Authors	Agency/Company	Earliest Date Mentioned	Reference Source
1	2	3	4	5	6	7
1	3	Modified Snake-Colorado Dunn Plan	Dunn	Private Consultant	1965	(14)
2	4	Riggins-Snake Diversion	Warnick/others	Private/others	1920-1970	(-)
3	5,6	Little Salmon Diversion	Warnick	Private	1969,70	(-)
4	7	French Creek Diversion	J. J. Peebles	U of I	1969	(3)
5	8	Payette Diversion to Baron Creek	U.S.B.R.	U.S.B.R.	1937	(15)
6	9	Payette Diversion to Warm Springs Creek	U.S.B.R.	U.S.B.R.	Not known	(15)
7	10	Payette Diversions to Gold Creek	U.S.B.R.	U.S.B.R.	1936	(15)
8	11	Denver Plan	U.S.B.R.	U.S.B.R.	Probably 1940	(15)
9	12	Boise Diversion Plan II	U.S.B.R.	U.S.B.R.	" 1940	(15)
10	13	Boise Diversion Plan III	U.S.B.R.	U.S.B.R.	" 1940	(15)
11	13	Boise Diversion Plan IV	U.S.B.R.	U.S.B.R.	" 1940	(15)
12	14	North Fork Boise Diversion to Ballentyne Creek	U.S.B.R.	U.S.B.R.	" 1932	(15)

Scheme No.	Figure No.	Name of Plan or Scheme	Author/Authors	Agency/Company	Earliest Date Mentioned	Reference Source
1	2	3	4	5	6	7
13	15	Clayton Diversion to Chilly Sinks	U.S.B.R.	U.S.B.R.	Not known	(15)
14	16	Salmon Diversion to Big Wood River	U.S.B.R.	U.S.B.R.	Not known	(15)
15	17	Yellowstone-Snake-Green Project	Stetson	Private Consultant	1964	(16)
16	18	Western States Water Augmentation Concept (Smith Plan)	L. G. Smith	Private Consultant	1968 edition	(4)
17	19	Snake River-Lake Mead Diversions	S. B. Nelson	City of Los Angeles	1963	(17)

Table 5. Summary Information on Conceptual Schemes Proposed for Utilizing Salmon River Water for Irrigation Outside the Salmon River Basin

B. LOCATION INFORMATION ON DIVERSION

Scheme No.	Stream Diversion Point/Points	Non-Depletion Point on Main Stem Salmon River	Non-Stage Effect on Salmon River
1	8	9	10
1	Mouth Salmon River, Mile 0	Mouth, Salmon River	Mouth, Salmon River
2	Riggins	Riggins	Riggins
3	Riggins	Riggins	Riggins
4	French Creek, Mile 104.8	French Creek, Mile 104.8	Head waters of Crevice Dam or French Creek, Mile 104.8
5	Salmon River below Stanley	Salmon River above Stanley	Valley Creek above Stanley
6	Bear Valley & Marsh Creek	Middle Fork Salmon River, Mile 198.8	Middle Fork of Salmon at Marsh Creek & Bear Valley Creek
7	South Fork, Salmon River near Knox, Idaho	South Fork Salmon River	South Fork of Salmon River
8	Bear Valley Creek & Marsh Creek & Red Fish Lake	Above Valley Creek & Red Fish Lake	Red Fish Lake
9	Bear Valley Creek, Marsh Creek and Salmon River	Middle Fork Salmon River Mile 190.8	Bear Valley Creek and Valley Creek upstream of Stanley Creek
10	Bear Valley Creek, Salmon River near Stanley and below mouth of Valley Creek	Salmon River near Stanley at Valley Creek	Valley Creek above Stanley Creek

Scheme No.	Stream Diversion Point/Points	Non-Depletion Point on Main Stem Salmon River	Non-Stage Effect on Salmon River
1	8	9	10
11	Bear Valley Creek, Marsh Creek & Salmon River near Stanley	Salmon River near Stanley & Red Fish Lake	Valley Creek upstream of Stanley Creek
12	Bear Valley Creek, Marsh Creek & Salmon River, near Stanley	Salmon River near Stanley & Red Fish Lake & Little Red Fish Lake	Valley Creek upstream of Stanley Creek
13	Salmon River (East Fork Salmon River - Road Creek)	Salmon River above Clayton at East Fork	Salmon River above Clayton about 10 miles Robinson Bar Ranch
14	Bear Valley Creek, Marsh Creek & Salmon River at Redfish Lake	Salmon River near Stanley at Valley Creek	Valley Creek on Salmon River
15	Snake River (Hoback River)	Not applicable	Not applicable
16	Salmon River near North Fork	Salmon River at North Fork	Salmon River at North Fork
17	Snake River (Thousand Springs)	Not applicable	Not applicable

Table 5. Summary Information on Conceptual Schemes Proposed for Utilizing Salmon River Water for Irrigation Outside the Salmon River Basin

C. LOCATION INFORMATION ON DIVERSION (DETAIL)

Scheme No.	Subbasin/s	County/s	Section	Township	Range	Latitude	Longitude	Stream Order
1	11	12	13	14	15	16	17	18
1	Salmon	Idaho	Pump back along Snake River from below mouth of Salmon River					1st
2	Salmon	Idaho	22	T24N	R1E			1st
3	Little Salmon	Idaho	22	T24N	R1E	45°27'	116°22'	1st
4	Salmon at French Creek	Idaho	13	T24N	R3E	45°26'	116°02'	1st
5	Salmon River at Stanley	Custer	34	T11N	R13E	44°14'	115°20'	1st
6	Middle Fork Salmon River	Valley (Bear V. Cr) Custer (Marsh Cr)	27 29	T13N T13N	R10E R11E	44°26'	115°17'	3rd
7	South Fork Salmon	Valley County	3	T15N	R6E	44°40'	115°42'	4th
8	M. Fork Salmon & Main Salmon River	Valley (Bear V. Cr) Custer (Marsh Cr) (Valley Cr) (Red Fish Lake)	27 30 25 21	T13N T12N T11N T9N	R10E R12E R12E R13E	44°26' 44°21' 44°16' 44°05'	115°117' 115°06' 115°00' 114°57'	3rd 3rd 3rd 4th
9	M. Fork Salmon Main Salmon River	Valley (Bear V.Cr) Custer (M Salmon & Stanley)	14 34	T13N T11N	R10E R13E	44°28' 44°14'	115°15' 114°55'	3rd 1st

Scheme No.	Subbasin/s	County/s	Section	Township	Range	Latitude	Longitude	Stream Order
1	11	12	13	14	15	16	17	18
10	M. Fork Salmon R and Main Salmon River	Valley (Bear V. Cr) Custer (Marsh Cr) (Valley Cr of Salmon River at Stanley)	27 29,30 25	T13N T12N T11N	R10E R12E R12E	44°26' 44°21' 44°16'	115°17' 115°06' 115°00'	3rd 3rd 3rd
11	M. Fork Salmon & Main Salmon	Valley (Bear V. Cr) Custer (Marsh Cr) (Valley Cr of Salmon R at Stanley)	27 29,30 25	T13N T12N T11N	R10E R12E R12E	44°26' 44°21' 44°16'	115°17' 115°06' 115°00'	3rd 3rd 3rd
12	Main Salmon R	Custer (Salmon R Redfish L)	18 20	T9N T9N	R14E R13E	44°08' 44°06'	114°51' 114°58'	1st 3rd
13	Main Salmon R	Custer	17	T10N	R19E	44°11'	114°14'	1st
14	Main Salmon R	Valley (Bear V. Cr) Custer (Marsh Cr) (Valley Cr, Upper Salmon R)	27 29,30 25 18	T13N T12N T11N T9N	R10E R12E R12E R14E	44°26' 44°21' 44°16' 44°06'	115°17' 115°06' 115°00' 114°51'	3rd 3rd 3rd 3rd
15	Yellowstone River Hoback River	Park County, Montana Teton County, Wyoming	- -	- -	- -	- -	- -	1st 3rd
16	Main Salmon R	Lemhi	-	-	-	-	-	1st
17	Main Snake R	Twin Falls	-	-	-	-	-	1st

Table 5. Summary Information on Conceptual Schemes Proposed for Utilizing Salmon River Water for I-rigation Outside the Salmon River Basin.

D. LOCATION INFORMATION ON DISCHARGE POINT/S

Scheme No.	River System	County/s or State	Section	Township	Range	Lattitude	Longitude	Intent of Project Conveyance
1	19	20	21	22	23	24	25	26
1	Snake River (Outside Snake)	Southern Idaho Oregon, etc.	-	-	-	-	-	To Oregon, & Southern California, Arizona, Nevada
2	Snake	Idaho	-	T22N	R3W	-	-	To Southern Idaho & Southwest U.S.
3	Payette	Valley	36	T18N	R2E	44°51'	116°08'	To Payette for trade water
4	Payette	Idaho	6	T21N	R4E	45°12'	116°01'	To Payette River & Boise R. Drainage for trade water
5	Payette	Boise	12	T9N	R11E	44°07'	115°07'	To Payette River & Boise R S.W.I.D. Project
6	Payette	Boise	7	T11N	R10E	44°17'	115°08'	To Payette River
7	Payette	Valley Co.	6	T15N	R5E	44°40'	115°52'	To Payette R. (Gold Fork Creek
8	Boise R	Camas	9	T9N	R13E	43°46'	115°55'	To Boise R. S.W.I.D. Project or Eq.

Scheme No.	River System	County/s or State	Section	Township	Range	Latitude	Longitude	Intent of Project Conveyance
1	19	20	21	22	23	24	25	26
9	Payette R/Boise	Boise	33	T8N	R12E	44°00'	115°04'	To Payette R. thence
10	Payette R/Boise	Boise	33	T8N	R12E	44°00'	115°04'	To Boise River
11	Boise R	Camas	9	T9N	R13E	43°46'	115°55'	To Boise R. S.W.I.D. Project or Eq
12	Payette R/Boise	Boise	33	T8N	R12E	44°00'	115°04'	To Boise R
13	Big Lost River	Custer	35	T10N	R21E	44°08'	113°55'	Snake River plain
14	Big Smoky Cr South Fork of Boise R. Soldier Creek Big Wood River	Camas Camas	11	T3N	R13E	-	-	To South Idaho Counties
15	Snake River	Fremont, Idaho	-	-	-	-	-	To Green and Colorado System
16	Missouri Sys.	Montana	-	-	-	-	-	To Centennial Reservoir Augmentation of Western States
17	Colorado Sys.	Nevada	-	-	-	-	-	To Southern California

Table 5. Summary Information on Conceptual Schemes Proposed for Utilizing Salmon River Water for Irrigation Outside the Salmon River Basin

E. CONVEYANCE IRRIGATION

Scheme No.	Type of Conveyance and Mileage Estimate			Natural Channel	Conveyance Capacity Needed Total maximum	Uniform Rate	Non-Uniform Rate
	New Open Channel	Closed Conduit Surface	Closed Conduit Tunnel				
1	27	28	29	30	31	32	33
1	Aqueducts Total 1016 mi		30 (total 33.9 mi	Yes-Snake R.	Not given but 5 million A.F./year	No	Yes
2	No detail		23 mi Tunnel 11.8 mi Tunnel	Yes Yes	Not estimated 2,500 cfs	No	Yes
3	No detail	3 sections 42 mi	4.5 mi	Yes-Payette R.		No	Yes
4	No detail	8 mi		Yes-Payette R.		No	Yes
5	No detail		8.6 mi 9' dia.	Yes-Baron Cr.	600 cfs	No	Yes
6	No detail		(3) - 14 1/2 mi	Yes-Warm Spring Cr.		No	Yes
7	No detail		11.3 mi	Yes-Gold Fork Cr.	500 cfs	No	Yes
8	Marsh Cr-Red Fish L. Canal 3 1/2 mi 21 mi. 24 mi.	Marsh Cr. Pump Line 4400' Valley Cr.Pump Line 3200'	Bear V-M.Cr. Tunnel 3.85 mi. Salmon R. to Red Fish Lake 2.83 mi.	Yes-Johnson Cr. to S. Fork of Boise River	1500 cfs	No	Yes

Scheme No.	Type of Conveyance and Mileage Estimate			Natural Channel	Conveyance Capacity Needed Total maximum	Uniform Rate	Non-Uniform Rate
	New Open Channel	Closed Conduit Surface	Closed Conduit Tunnel				
1	27	28	29	30	31	32	33
8 (Cont'd)	Salmon R diversion Channel to tunnel 1000'		Red Fish L to Johnson Cr. 21 mi				
9	a/ M.F. Stanley 1 mi-outlet 2700' b/ Stanley-S.F. Payette 4200' c/ S.F. Payette-N.F. Boise 800' d/ e/ M.F. Boise to S.F. Boise 2600'	d/ Penstock 3000'	a/ M.F. Salmon-Stanley 12.8 mi b/ Stanley-S.F. Payette 14.5 mi c/ S.F. Payette-N.S. Boise 5.3 mi d/ N.S. Boise-M.F. Boise 6.6 mi e/ N.F. Boise-S.F. Boise 9 1/2 mi	Feather R	a/ M.F.S.-Stanley-500 cfs b/ Stanley-S.F. Payette c/ S.F. Payette-N.F. Boise d/ N.F. Boise-M.F. Boise e/ N.F. Boise-S.F. Boise	--	Yes
10	a/ Marsh Creek Diversion 1. 8000' 2. 6400' b/ Stanley Lake-S.F. Payette 10,000'		a/ Marsh Creek 5.4 mi b/ Stanley Lake-S.F. Payette 8 mi c/ S.F. Payette-N.F. Boise 7.4 mi	Segments of Payette & Boise River	a/ Marsh Creek-Stanley b/ Stanley-S.F. Payette c/ S.F. Payette-N.F. Boise	--	Yes

Scheme No.	Type of Conveyance and Mileage Estimate			Natural Channel	Conveyance Capacity Needed Total maximum	Uniform Rate	Non-Uniform Rate
	New Open Channel	Closed Conduit Surface	Closed Conduit Tunnel				
1	27	28	29	30	31	32	33
10 (Cont'd)		d/ Penstock 4500' e/ Penstock 2000' f/ Penstock 3.45 mi	d/ Power Tunnel-N.F. Boise 4.4 mi e/ N.F. Boise-M.F. Boise 6.6 mi f/ M.F. Boise to Feather R. 9.6 mi		d/ N.F. Boise-M.F. Boise f/ M.F. Boise-Feather R.		
11	a/ Marsh Cr. Diversion 1. 8000' 2. 6400' b/ Stanley to Redfish Lake 10,000' c/ Johnson Cr-Bridge Cr. Pond Canal 6.8 mi	a/ Johnson Cr Penstock 12,200' b/ Bridge Cr. c/ Big Smoky d/ Jumbo Cr. 309' e/ Bascum Ranch 260' f/ Abbott Cr. 133' g/ Dog Cr. 217'	a/ Marsh Creek 5.4 mi b/ Redfish Lake-Johnson Cr. 22.7 mi	Segments of Boise R.	a/ Marsh Cr.-Stanley b/ Stanley-Redfish Lake c/ Redfish Lake-Johnson Cr. d/ Johnson Cr-Bridge Cr. / Power plants and dams on downstream	--	Yes

Scheme No.	New Open Channel	Closed Conduit Surface	Closed Conduit Tunnel	Natural Channel	Conveyance Capacity Needed Total Maximum	Uniform Rate	Non-Uniform Rate
1	27	28	29	30	31	32	33
12			3 mi	Segments of Boise River	Not given	--	Yes
13	3 mi		11.3 mi	Chilly Sinks	Not given	--	Yes
14	a/ Marsh Cr-Redfish L. Canal 3 1/2 mi b/ 21 mi c/ 24 mi d/ Salmon R. Diversion Channel to Redfish L. 1000'	a/ Marsh Cr. Pump Line 4400' b/ Valley Cr Pump Line 3200'	a/ Bear Valley-Marsh Cr. Tunnel 3.85 mi d/ Salmon R to Redfish L. 2.83 mi e/ Redfish L. Tunnel to Johnson Cr. 22.7 mi f/ Big Smokey Dam to Soldier Cr Tunnel 8.5 mi	Segments of Johnson Cr and Soldier Cr to Big Wood R.	1500 cfs	No	Yes
15	-	-	-	-	Not given	-	-
16	-	-	-	-	Not given	-	-
17	-	-	-	-	Not given	-	-

Table 5. Summary Information on Conceptual Schemes Proposed for Utilizing Salmon River Water for Irrigation Outside the Salmon River Basin

F. STORAGE INFORMATION

No.	Location of River Basin	County/State	Capacity	Surface Area	Annual	Cyclic	Other Purposes of Storage
1	34	35	36	37	38	39	40
1	Snake	Idaho	Not specific	Not specific	No	Yes	All uses of water
2	Snake	Idaho	Not given	Not given	Only	No	Power, flood control, recreation
3	Payette	Valley	1,000,000AF		No	Yes	Power, recreation
4	Payette & Salmon	Idaho	600,000AF L.F. Cr. 400,000AF Sq. M 2,250,000AF Crevice			Yes	Power, flood control, recreation
5	Salmon R	Custer	250,000 AF	3,700 ac	Yes		Recreation
6	Salmon	Valley Custer	170,000 AF		Yes		Recreation
7	Salmon R (S.F.)	Valley			Yes		Recreation
8	Salmon R Middle F. & Main Stem	Valley Custer	Bear V 120,000 AF Marsh Cr. 60,000 AF Red F. Lake 102,000 AF		Yes		Recreation

No.	Location of River Basin	County/State	Capacity	Surface Area	Annual	Cyclic	Other Purposes of Storage
1	34	35	36	37	38	39	40
9	Salmon R M. Fork	Valley	MF Salmon 200,000 AF		Yes		Recreation
			Stanley 300,000 AF		Yes		Recreation
10	Salmon R	Valley	Bear V 120,000 AF		Yes		Recreation
			Marsh Cr. 60,000 AF		Yes		
			Stanley 375,000 AF		Yes		
11	M.S. Salmon Salmon R. Boise R.	Valley	Bear Valley 120,000 AF	Not Evaluated	Yes	No	Power & Recreation
			Marsh Cr. 60,000 AF	" "	Yes	No	
			Stanley 375,000 AF	" "	Yes	No	
			Big Smoky 85,000 AF	" "	Yes	No	
			Jumbo Cr. 60,000 AF	" "	Yes	No	
			Bascum Ranch 37,000 AF	" "	Yes	No	
			Abbott Cr 15,000 AF	" "	Yes	No	
			Dog Cr. 70,000 AF	" "	Yes	No	
12	Salmon R	Custer	Redfish Lake 102,000 AF		Yes	No	Power & Recreation
13	Salmon	Custer	Clayton Res		No	Yes	Recreation

No.	Location of River Basin	County/State	Capacity	Surface Area	Annual	Cyclic	Other Purposes of Storage
1	34	35	36	37	38	39	40
14	Salmon R	Valley	Bear Valley 120,000 AF				
	Middle Fork	Custer	Marsh Cr R 60,000 AF				
	South F. Boise	Custer	Redfish Lake 102,000 AF				
			Big Smoky R. 88,100 AF	1070 ac.	Yes	No	Power & Recreation
15	Yellowstone R Snake River Colorado R	Montana Idaho Wyoming	Not Evaluated	Not Evaluated	Yes	Yes	Power & Recreation
16	Missouri R	Montana	Not Evaluated	Not Evaluated	Yes	Yes	Power & Recreation
17	Colorado R	Nevada	Not Evaluated	Not Evaluated	Yes	Yes	Power & Recreation

Table 5. Summary Information on Conceptual Schemes Proposed for Utilizing Salmon River Water for Irrigation Outside the Salmon River Basin

G. ELEVATION & POWER INFORMATION

Scheme No.	Elevation Diversion Point/s	Elevation Discharge Point/s	Highest Lift Point	Estimated Total Static Lifts	Power Required	Power Discharge Line	Potential Pumped Storage
1	41	42	43	44	45	46	47
1	340' at McNary Dam	Salmon R to Snake R @ Brownlee 2077'	5150 Oregon Diversion	4810'	71.4×10^9 kwh	Yes	None
2	1700'	1500' at tunnel outlet	-	-	-	No	None
3	4850'	-	-	-	-	-	-
4	2420 Crevice Back Water	6150 - Squaw M. Reservoir 6400 - L. French Cr. Res.	6150	3730	2.82×10^9	Yes but small	Yes
5	6250'	6000'	None	None	None	Yes	None
6	6465'	6400'	None	None	None	Yes	None
7	5400'	5300'	None	None	None	None	None
8	6510'	6382'	Lift Bear V 180' Marsh C. 70' Valley Cr. 250'	180'	-	Yes 168' Hs 17000 kw Plant	None
9	M.F. Salmon Stanley	6500' approx.	Gravity flow	None	-	Yes 640'Head 95.000 kw	None

Scheme No.	Elevation Diversion Point/s	Elevation Discharge Point/s	Highest Lift Point	Estimated Total Static Lifts	Power Required	Power Discharge Line	Potential Pumped Storage
1	41	42	43	44	45	46	47
10	M.F. Salmon	Redfish Lake 6,600' Approx.	Bear Valley 180' Marsh Cr Tunnel 6650'	180'	-	Yes a/360' @ Stanley Reser. b/886' @ NF Boise R. c/ 650' M.F. Boise	None
11	Stanley Res & Redfish Lake	Numerous points	Tunnel at Redfish Lake	-	No	d/138' Feather R e/188' Dog Cr D	No
13	Road Cr at 6000'	6000'	6300'	300'	Not Reported	-	-
14	Redfish Lake Portal 6510 Big Smoky Res 5600'	6382' Not given	Lift Bear V 180' Marsh Cr 70' Valley Cr 250'	180' 70' 250'	- - -	Yes 168' 1700 kw plant	None
15	Yellowstone R 5100' Hoback R 5920	Beaver Cr (Green R) 7720'	7720	Yellowstone to Henry's Lake 1640' Hoback R to Beaver Cr on Green R 1700'	Not Evaluated	-	None

Scheme No.	Elevation Diversion Point/s	Elevation Discharge Point/s	Highest Lift Point	Estimated Total Static Lifts	Power Required	Power Discharge Line	Potential Pumped Storage
1	41	42	43	44	45	46	47
16	N. Fork, Idaho 3600'	Centennial Res 6605'	6605'+	3005'	Not Evaluated	-	Yes
17	Thousand Springs on Snake R 2890'	Lake Mead 1229'	Not indicated	Not indicated	Not Evaluated	-	Yes

Table 5. Summary Information on Conceptual Schemes Proposed for Utilizing Salmon River Water for Irrigation Outside the Salmon River Basin

H. WATER SUPPLY AND HYDROLOGY INFORMATION

Scheme No.	Gross at Diversion	Estimated Annual Volume	Losses Conveyance	Reuse Potential	Quality Problems
1	48	49	50	51	52
1	5, 10, 15 mill. A.F.	5m, 10m, 15m A.F.	(Substantial)	Yes	Minimum flow problems
2	5 million (Max.)	5,000,000 A.F.	Not Evaluated	Yes	Minimum flow problems
3	5 million (Max.)	5,000,000 A.F.	Not Evaluated	Yes	Minimum flow problems
4	6,000,000	3,250,000 A.F.	900,000 A.F.	Yes	None enroute
5	388,000 A.F.	388,000 A.F.	116,400	Yes	None enroute
6	330,000 A.F.	330,000 A.F.	99,000	Yes	None enroute
7	75,000 A.F.	75,000 A.F.	Not Evaluated	Yes	None enroute
8	738,000 A.F.	738,000 A.F.	Not Evaluated	Yes	None, quality improvement on Boise R.
9	738,000 A.F.	738,000 A.F.	Not Evaluated	Yes	None, quality improvement on Boise R.
10	738,000 A.F.	738,000 A.F.	Not Evaluated	Yes	None, quality improvement on Boise R.
11	738,000 A.F.	738,000 A.F.	Not Evaluated	Yes	None, quality improvement on Boise R.
12	Not indicated	Not indicated	Not Evaluated	Yes	None, quality improvement on Boise R.

Scheme No.	Gross at Diversion	Estimated Annual Volume	Losses Conveyance	Reuse Potential	Quality Problems
1	48	49	50	51	52
13	800,000 A.F.	800,000 A.F.	Not Evaluated	Yes	None, quality improvement on Boise R.
14	738,000 A.F.	738,000 A.F.	Not Evaluated	Yes	None
15	2,000,000 A.F.	2,000,000 A.F.	Substantial	Yes	None, Improve other rivers
16	8,000,000 A.F. (Max.)	8,000,000 A.F. (Max)	Substantial	Yes	None, Improve other rivers
17	2,500,000 A.F.	2,500,000 A.F.	Substantial	Yes	None, Improve other rivers

Table 5. Summary Information on Conceptual Schemes Proposed for Utilizing Salmon River Water for Irrigation Outside the Salmon River Basin

I. IRRIGATION USE INFORMATION

Scheme No.	Intended State	Intended County	Other Use	Crops		Comments
				Acreage	Water Required (acre feet)	
1	53	54	55	56	57	58
1	Oregon, Idaho Nevada, Arizona California	All Southwest Idaho counties	Multipurpose	No specific figure		Extreme institutional problems
2	Idaho, Oregon Nevada	All Southwest Ida. counties	Multipurpose	No specific figure		Fish problems, institutional problems
3	Idaho	All Southwest Ida. counties	Multipurpose	No specific figure		Probably a poor B/C ratio
4	Idaho Oregon	Elmore Owyhee Ada Canyon Owyhee, Ore Malhuer	Multipurpose	Row Crops Forage Cereal 1,050,000 ac	2,100,000 AF	A 20-30 year development period Poor B/C at present
5	Idaho	Elmore Owyhee Ada Canyon	Power enroute	135,800 ac	271,600 AF	10 year development problem of flooding at Stanley
6	Idaho	Elmore Owyhee Ada Canyon	Power enroute	115,500 ac	231,000 AF	10 year development problem on Middle Fork as Wild River

Scheme No.	Intended State	Intended County	Other Use	Crops		Comments
				Acreage	Water Required (acre feet)	
1	53	54	55	56	57	58
7	Idaho	Elmore Owyhee Ada Canyon	Recreation	26,250 ac	52,500 AF	5 year development small amount has questionable value
8	Idaho	Elmore Owyhee Ada Canyon	Recreation			10 year development Middle Fork Water
9	Idaho	Elmore Owyhee Ada Canyon	Recreation Power enroute			10 year development period. Middle Fork Water as Wild River
10	Idaho	Elmore Owyhee Ada Canyon	Recreation Power enroute			15 year development period. Middle Fork Water as Wild River
11	Idaho	Elmore Owyhee Ada Canyon	Recreation Power enroute			15 year development period. Middle Fork Water as Wild River
12	Idaho	Elmore Owyhee Ada Canyon	Recreation Power enroute			10 year development period. No Middle Fork Water

Scheme No.	Intended State	Intended County	Other Use	Crops		Comments
				Acreage	Water Required (acre feet)	
1	53	54	55	56	57	58
13	Idaho	Custer Blaine Lincoln Jerome Gooding Twin Falls	Recreation			10 year development at least
14	Idaho	Custer Blaine Lincoln Jerome Gooding Twin Falls	Recreation			10 year development at least
15	Arizona California		Power enroute Recreation	Not indicated	Not indicated	20 year development period. Extreme instiutional problems
16	Western States		Power enroute Recreation Municipal & Industrial Water	Not indicated	Not indicated	Very long development period. Extreme institutional problems
17	California		Power enroute	Not indicated	Not indicated	Extreme institutional problems. Storage needed in Snake River Basin

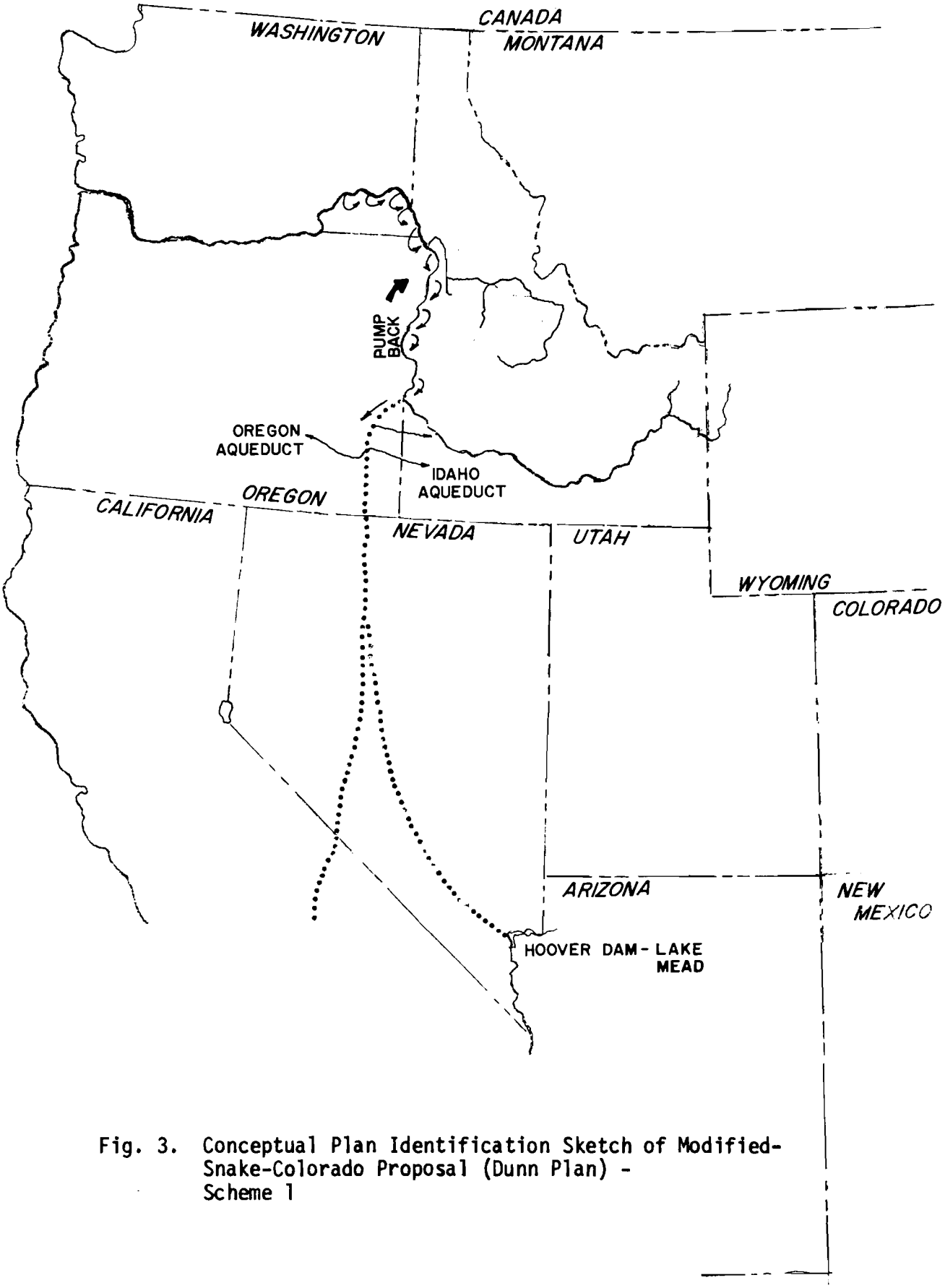


Fig. 3. Conceptual Plan Identification Sketch of Modified-Snake-Colorado Proposal (Dunn Plan) - Scheme 1

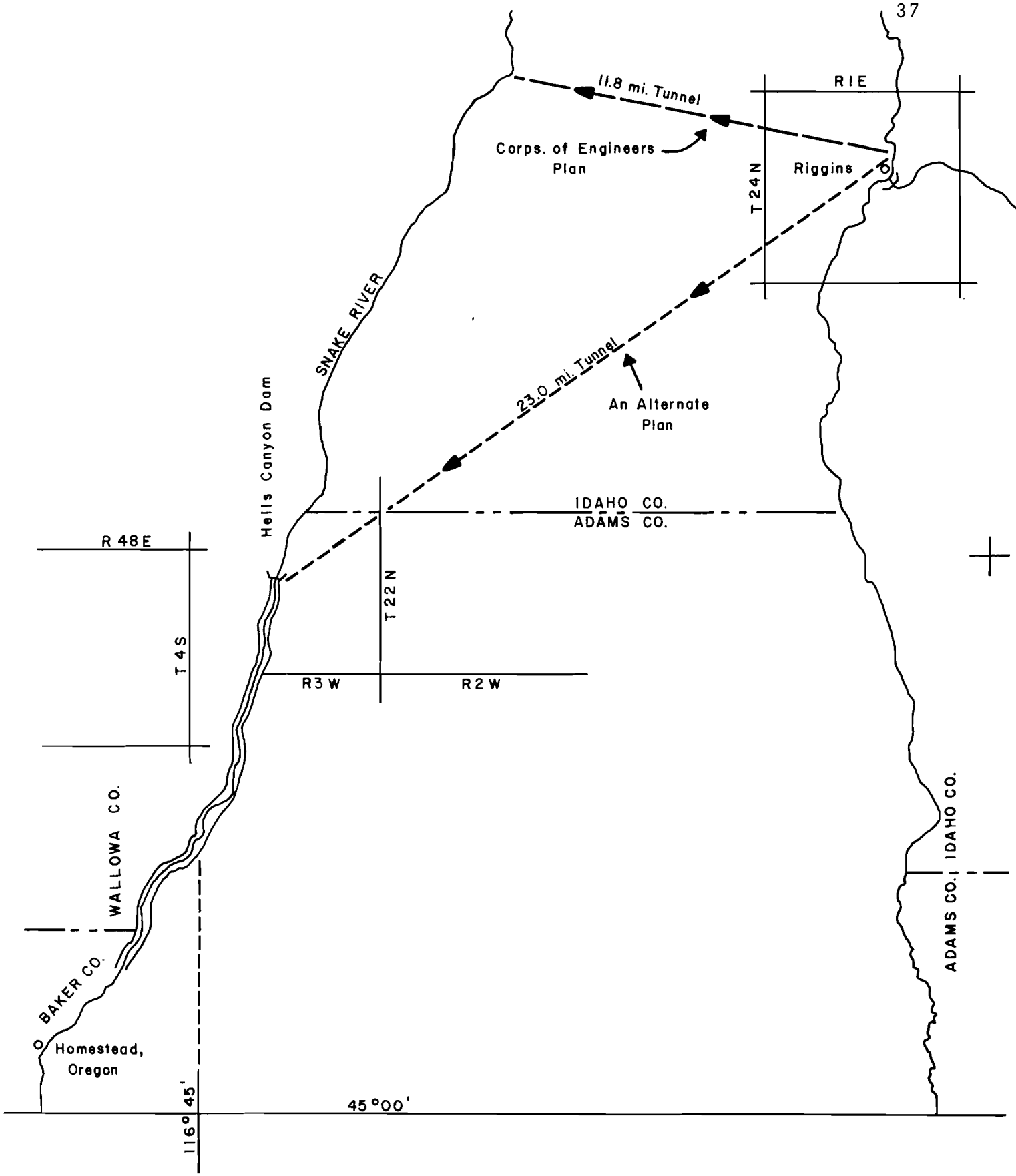


Figure 4. Conceptual Plan Identification Sketch of Riggins-Snake Diversion - Scheme 2

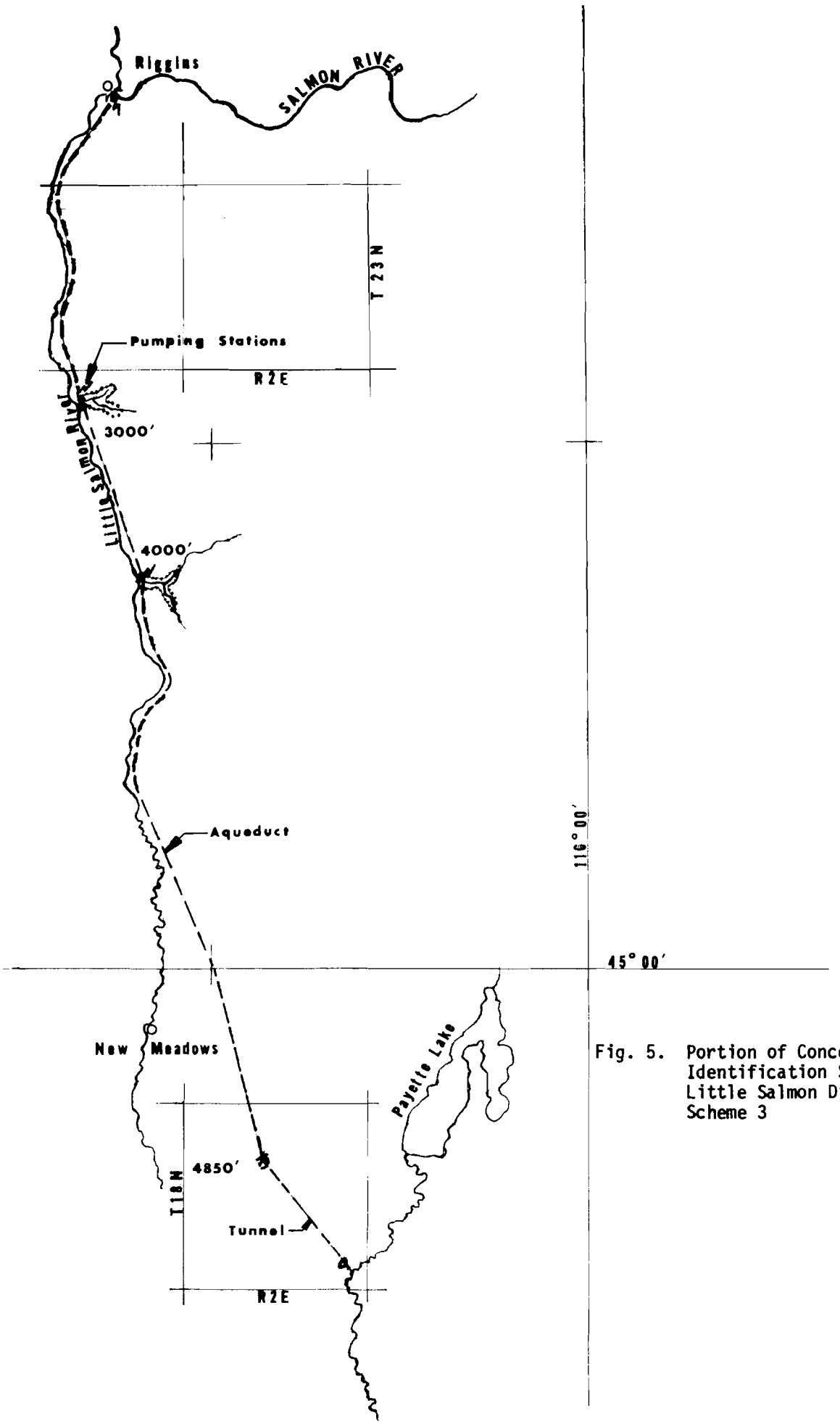


Fig. 5. Portion of Conceptual Plan Identification Sketch of Little Salmon Diversion - Scheme 3

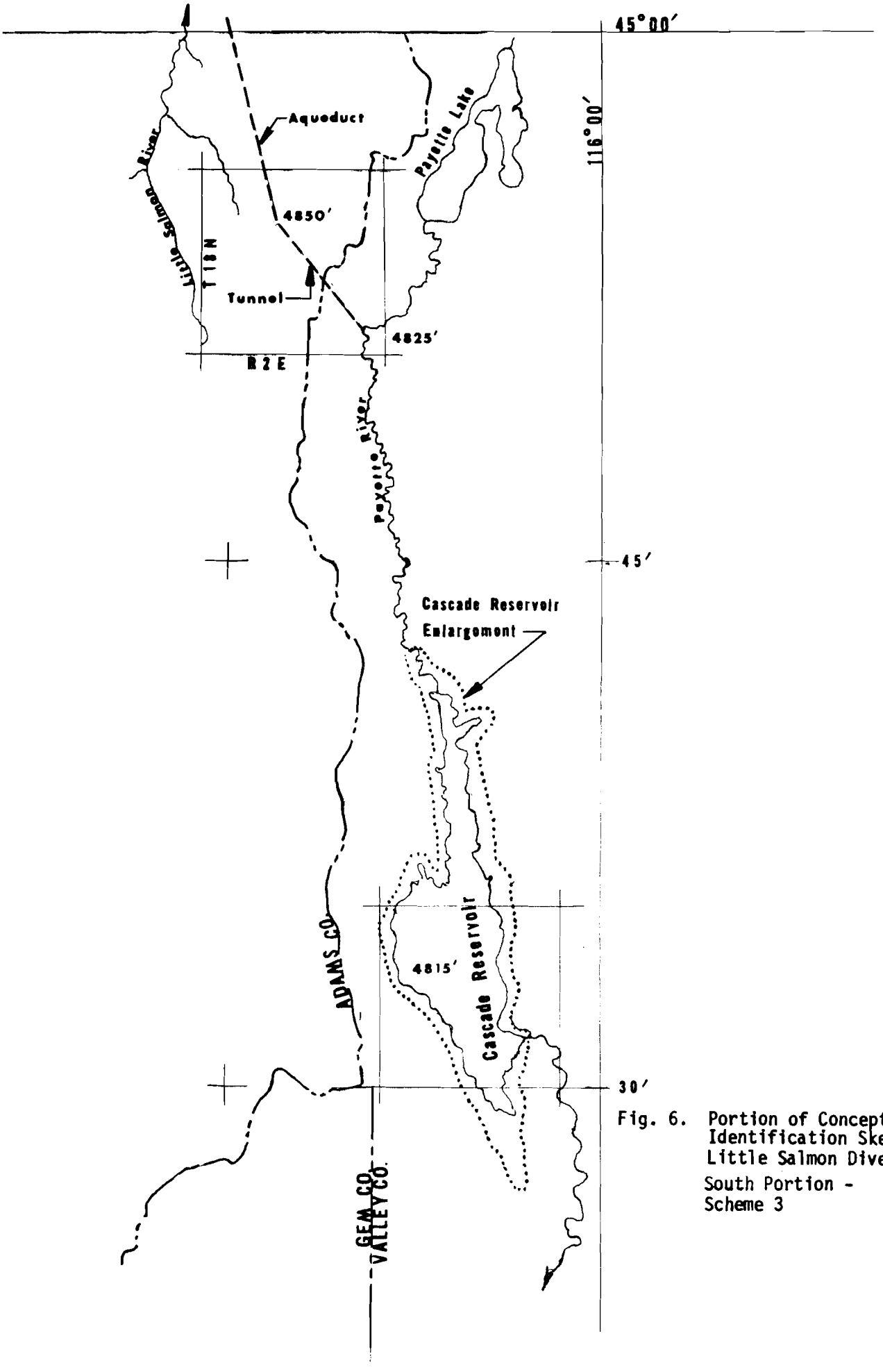


Fig. 6. Portion of Conceptual Plan Identification Sketch of Little Salmon Diversion South Portion - Scheme 3

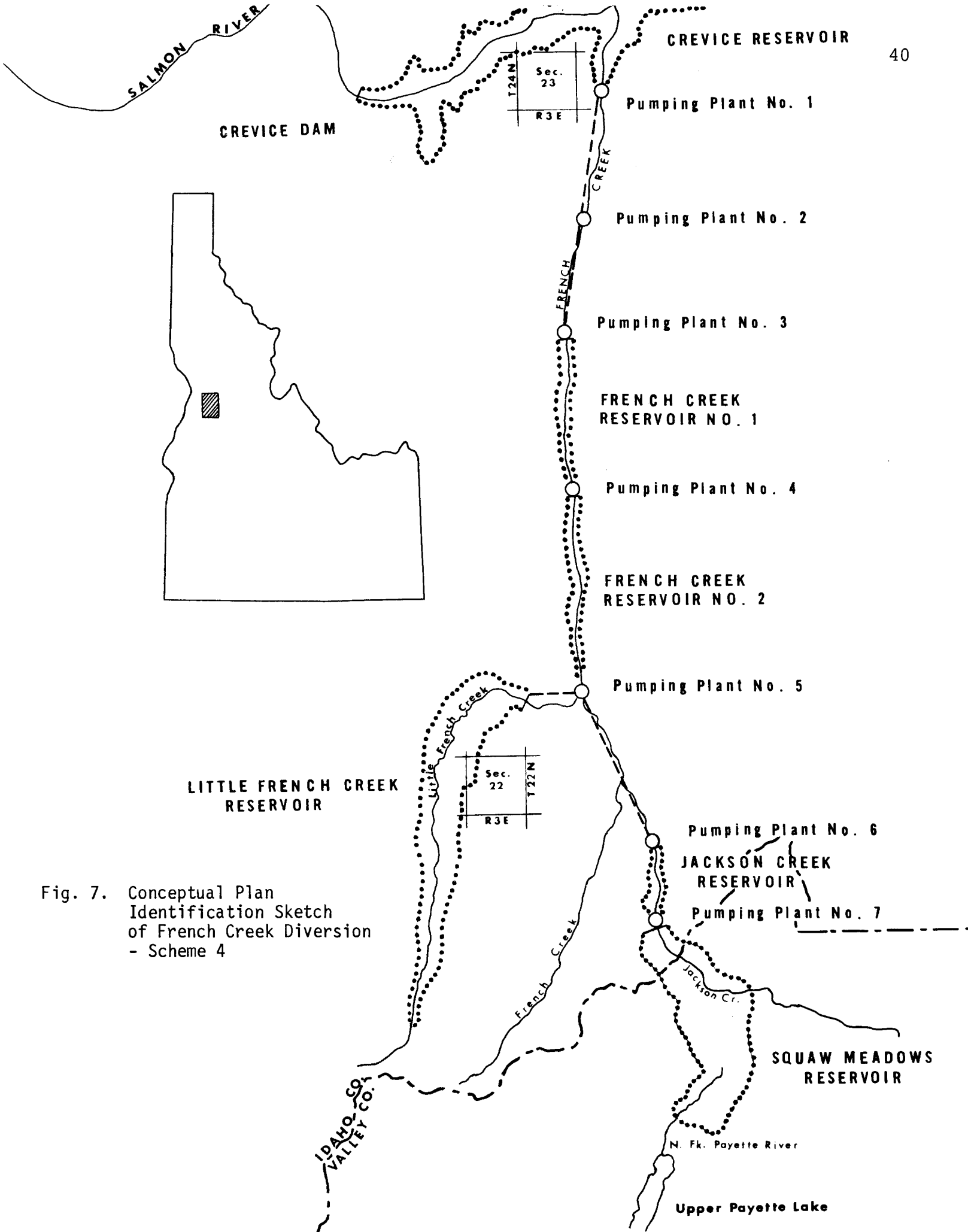


Fig. 7. Conceptual Plan Identification Sketch of French Creek Diversion - Scheme 4

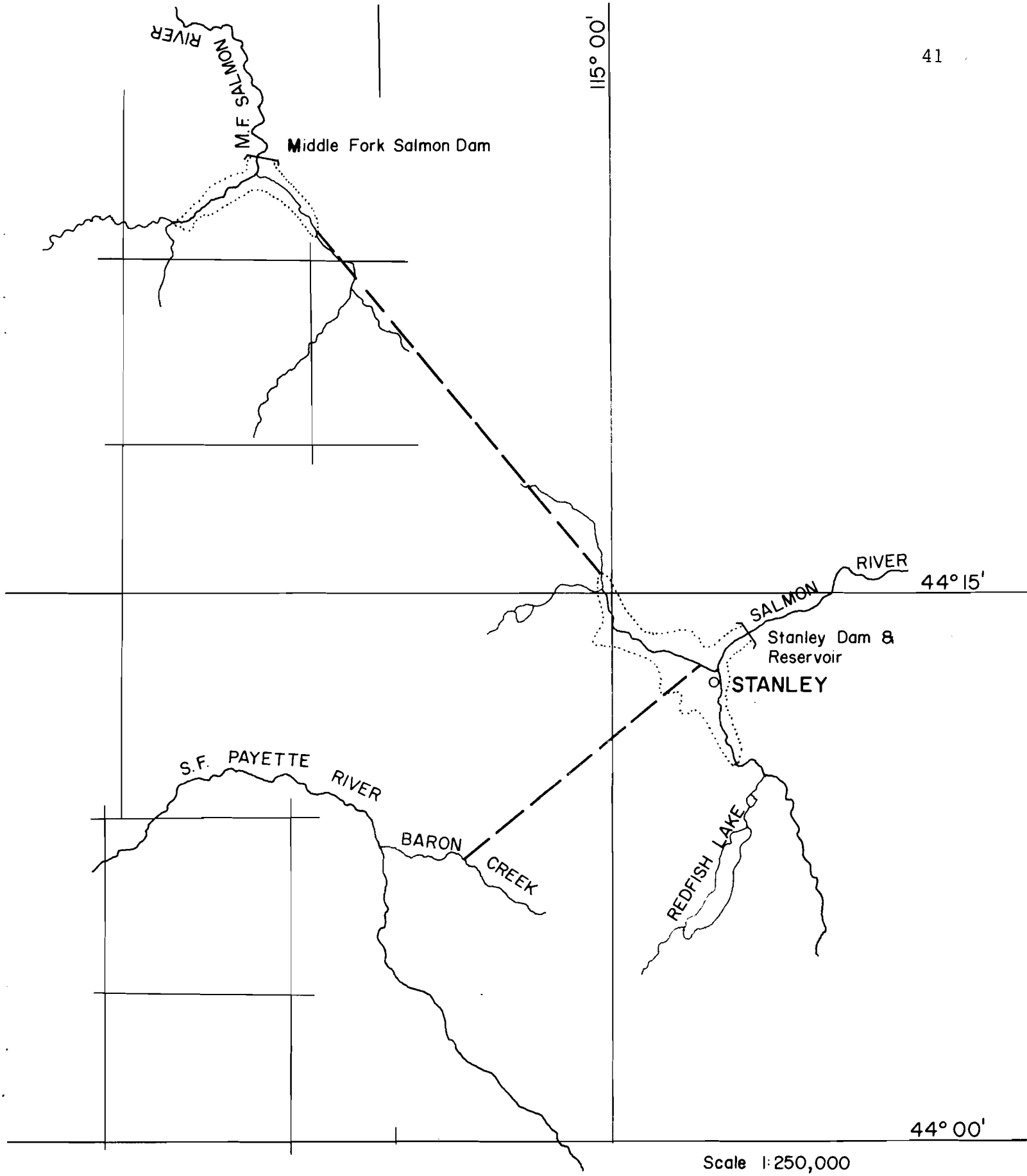


Fig. 8. Conceptual Plan Identification Sketch
Payette Diversion to Baron Creek -
Scheme 5

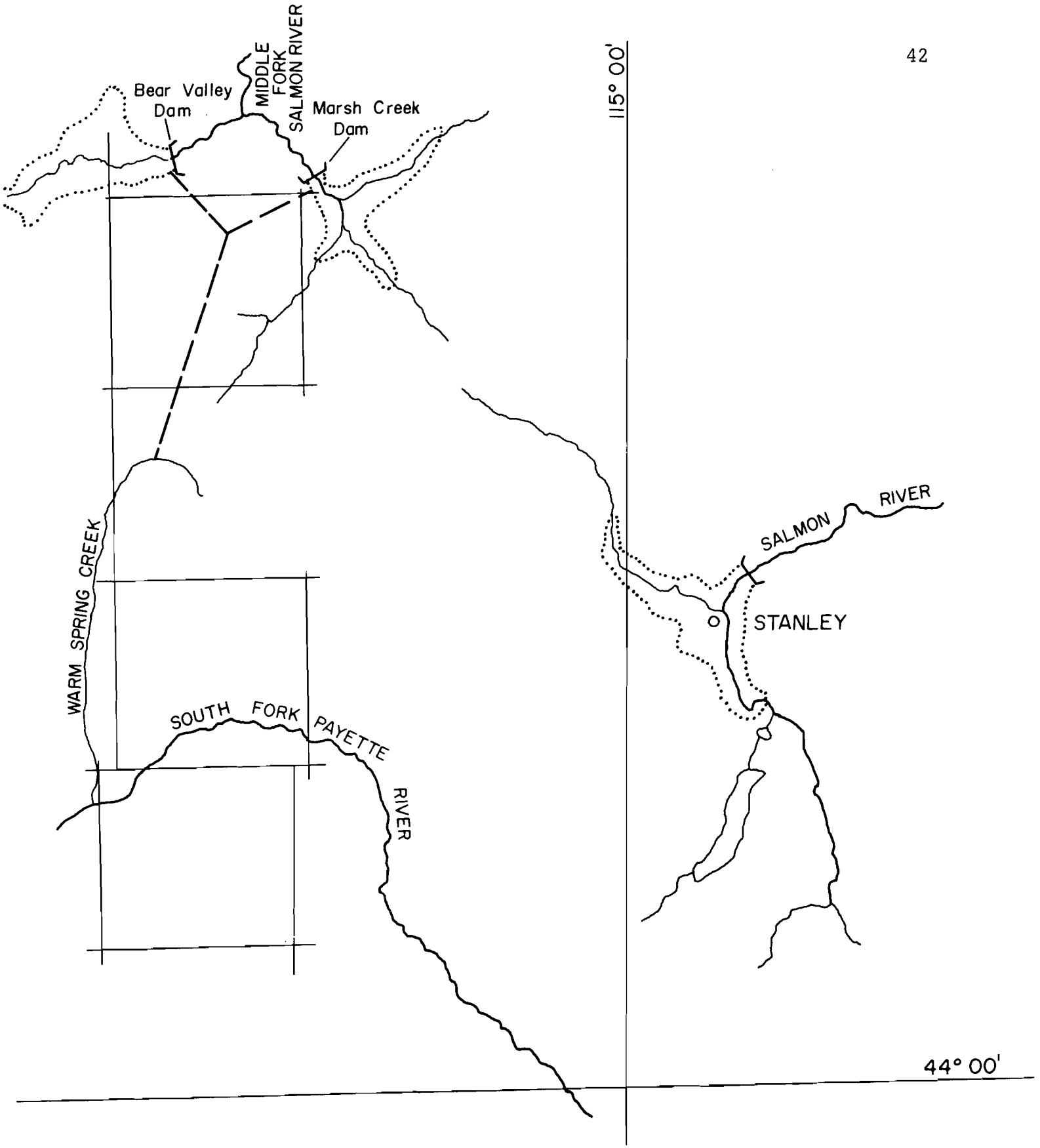


Fig. 9. Conceptual Plan Identification Sketch
Payette Diversion to Warm Spring Creek -
Scheme 6

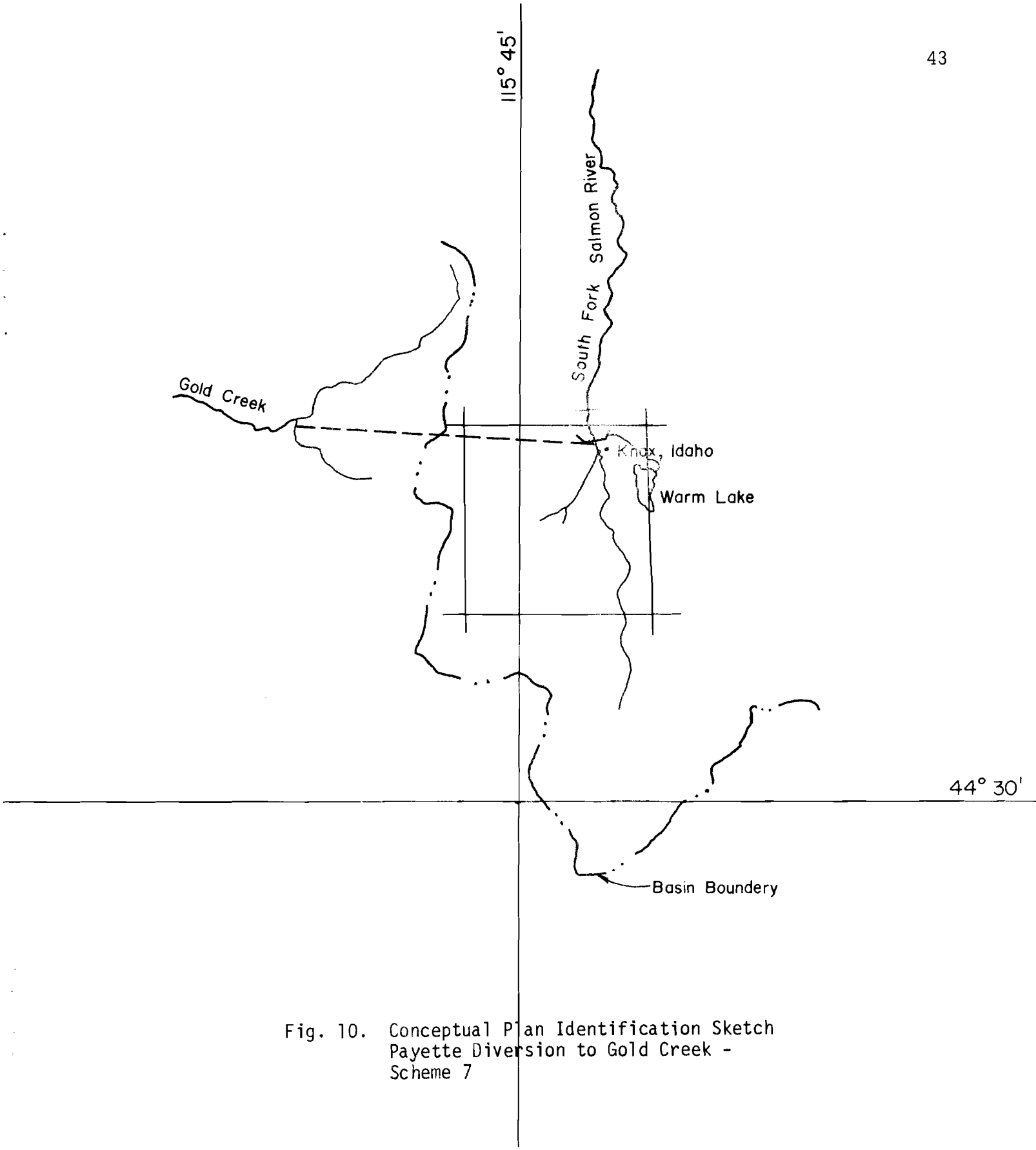


Fig. 10. Conceptual Plan Identification Sketch
Payette Diversion to Gold Creek -
Scheme 7

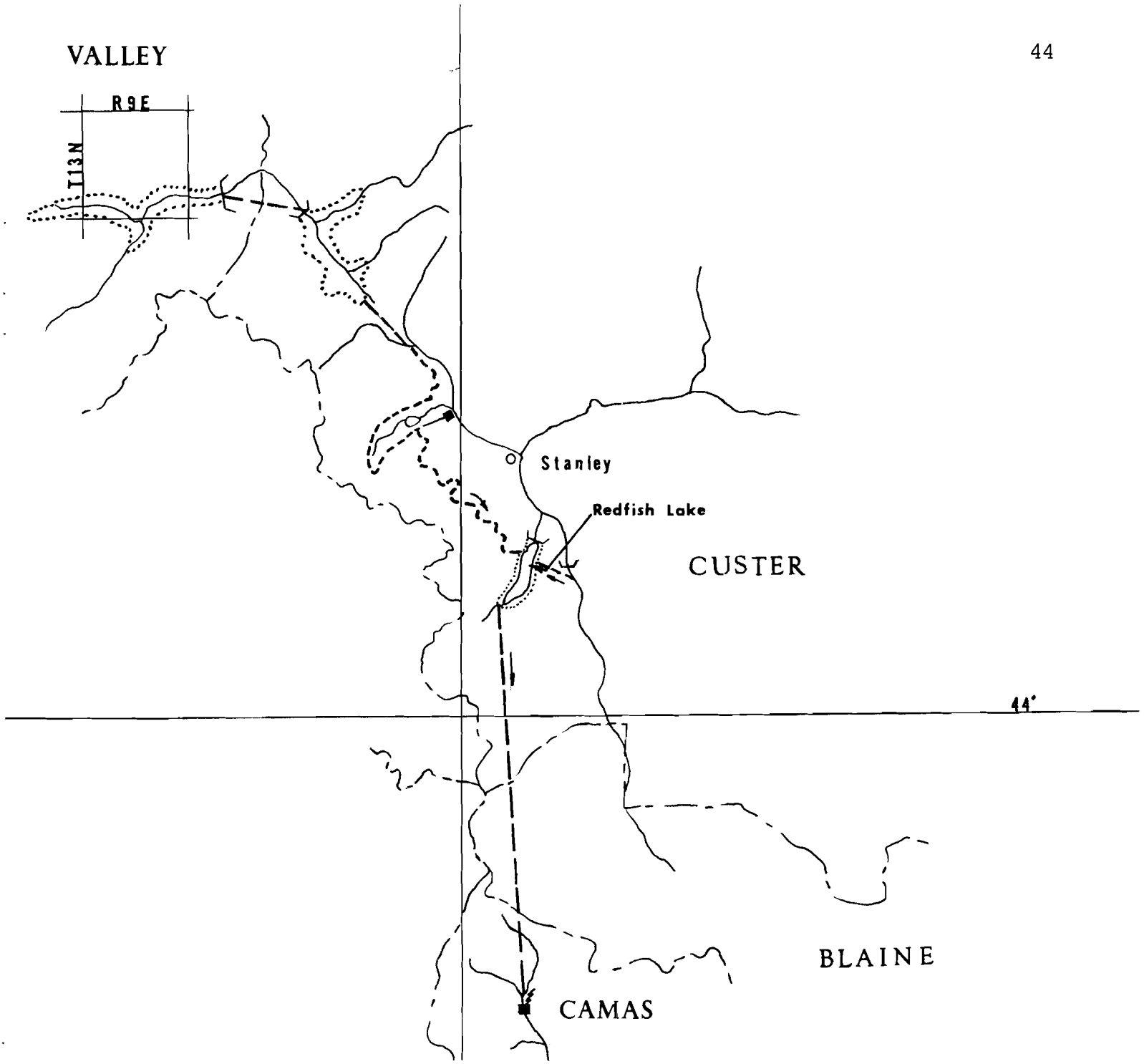


Fig. 11. Conceptual Plan Identification Sketch
Denver Plan -
Scheme 8

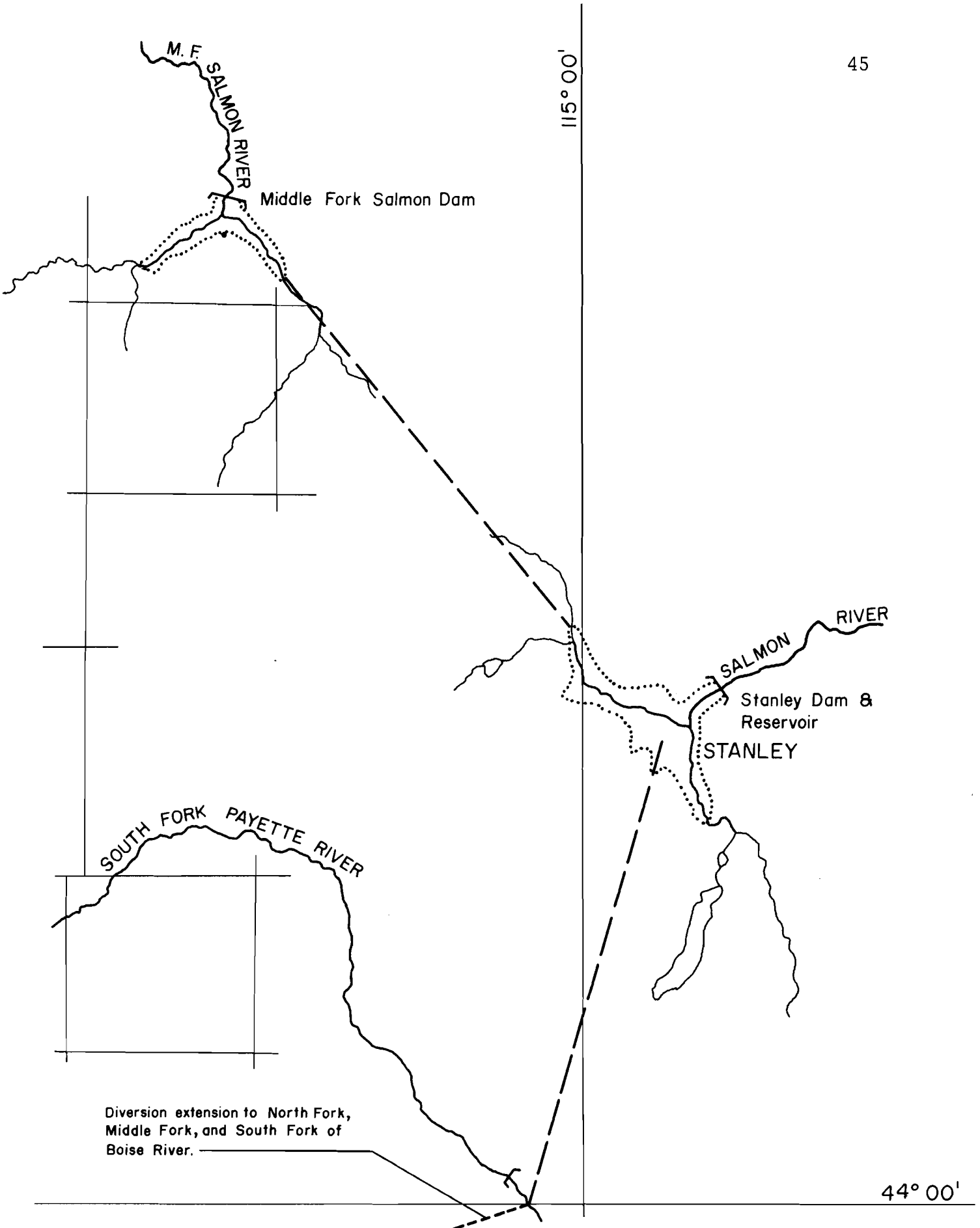


Fig. 12. Conceptual Plan Identification Sketch Boise Diversion Plan II - Scheme 9

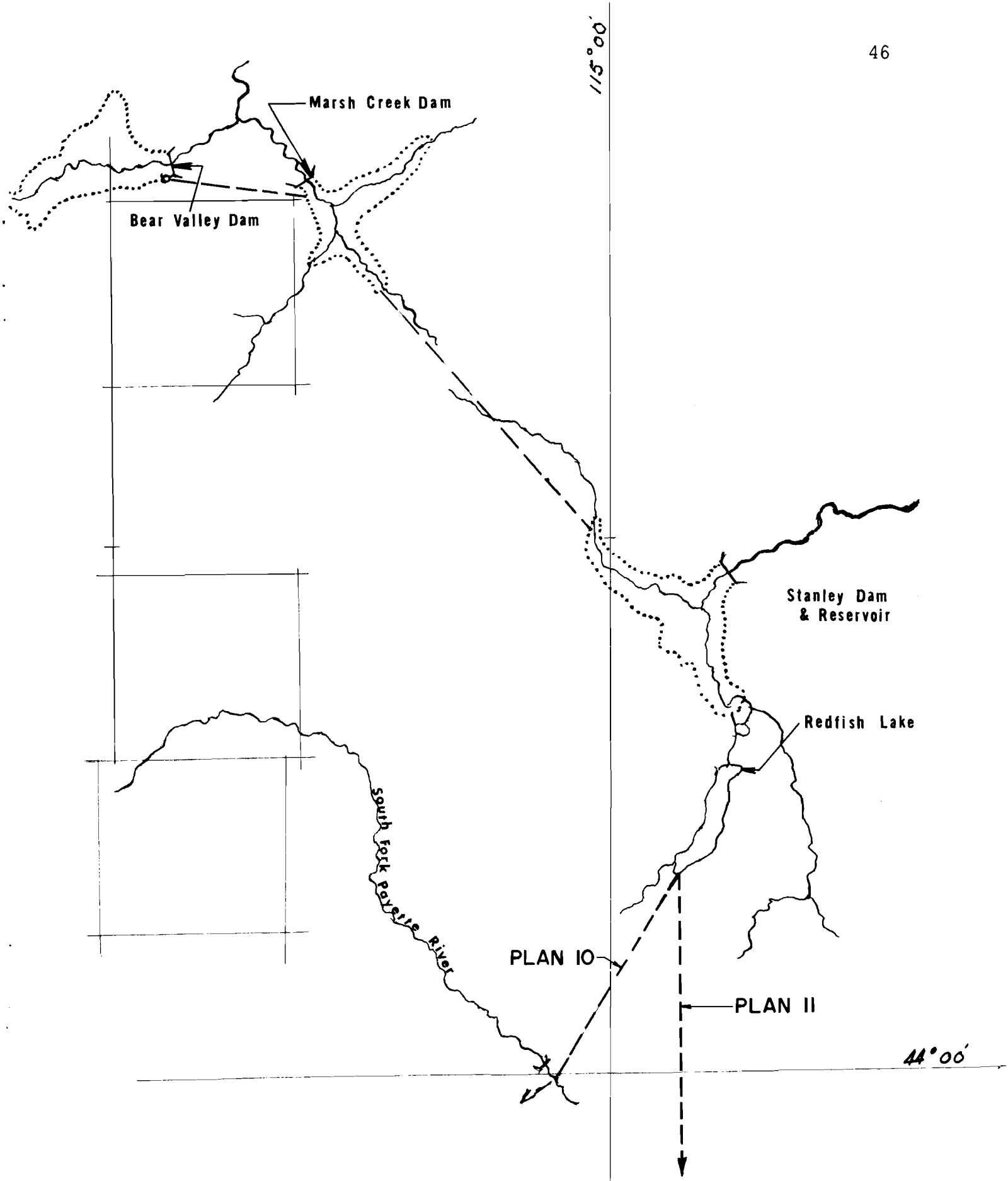


Fig. 13. Conceptual Plan Identification Sketch
Boise Diversion Plans III and IV -
Schemes 10 and 11

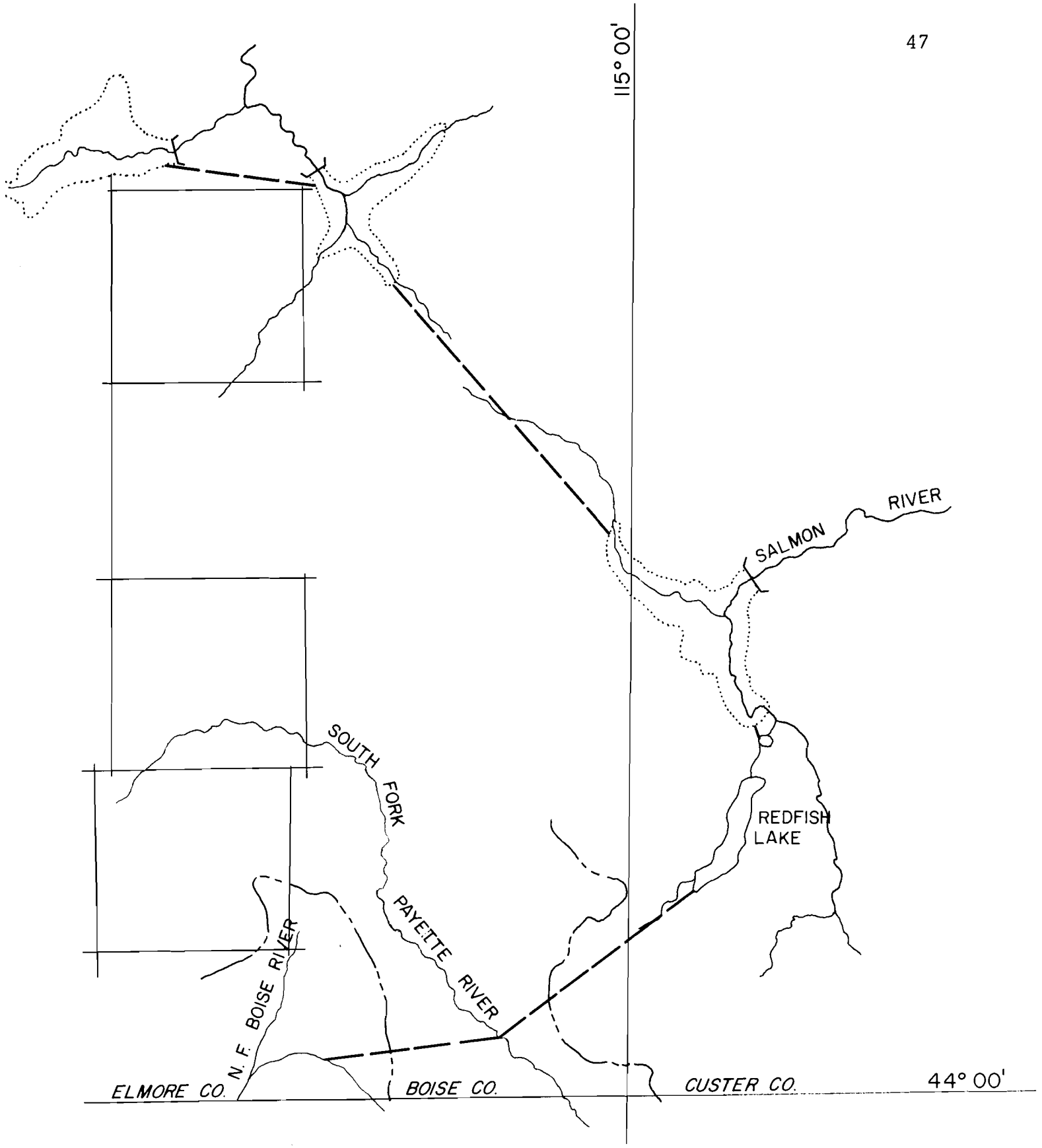


Fig. 14. Conceptual Plan Identification Sketch North Fork Boise Diversion to Ballentyne Creek - Scheme 12

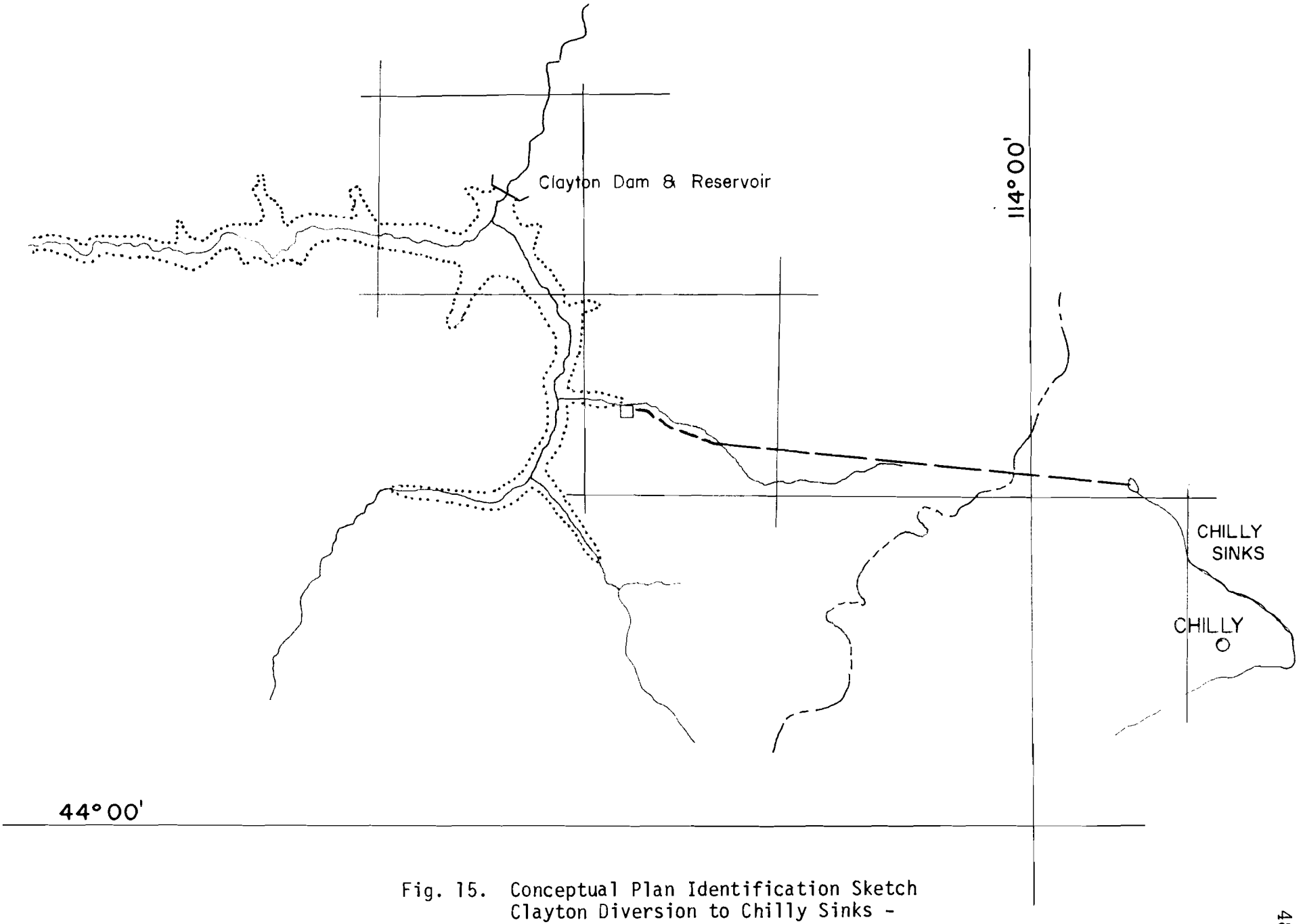


Fig. 15. Conceptual Plan Identification Sketch
Clayton Diversion to Chilly Sinks -
Scheme 13

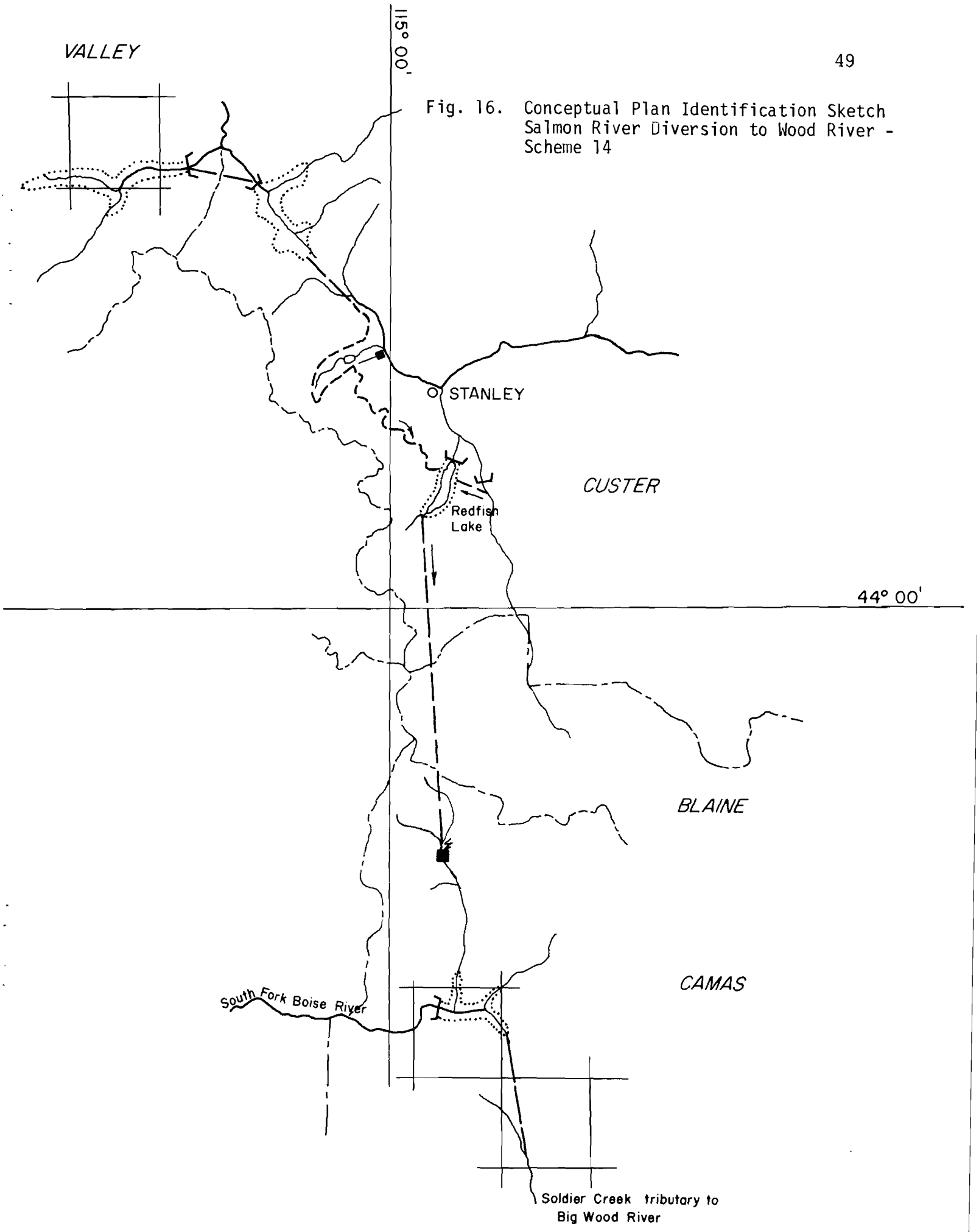


Fig. 16. Conceptual Plan Identification Sketch Salmon River Diversion to Wood River - Scheme 14

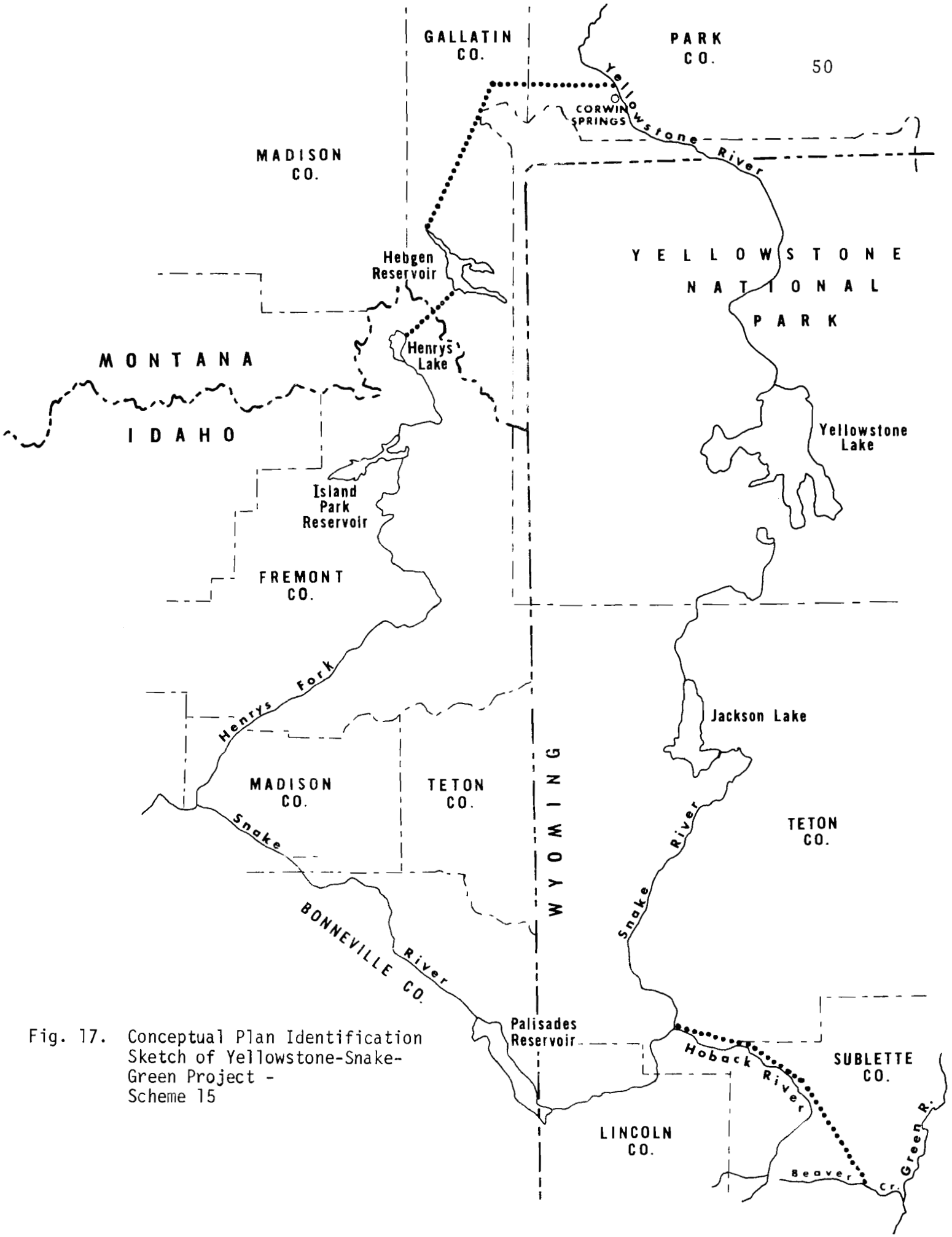


Fig. 17. Conceptual Plan Identification Sketch of Yellowstone-Snake-Green Project - Scheme 15

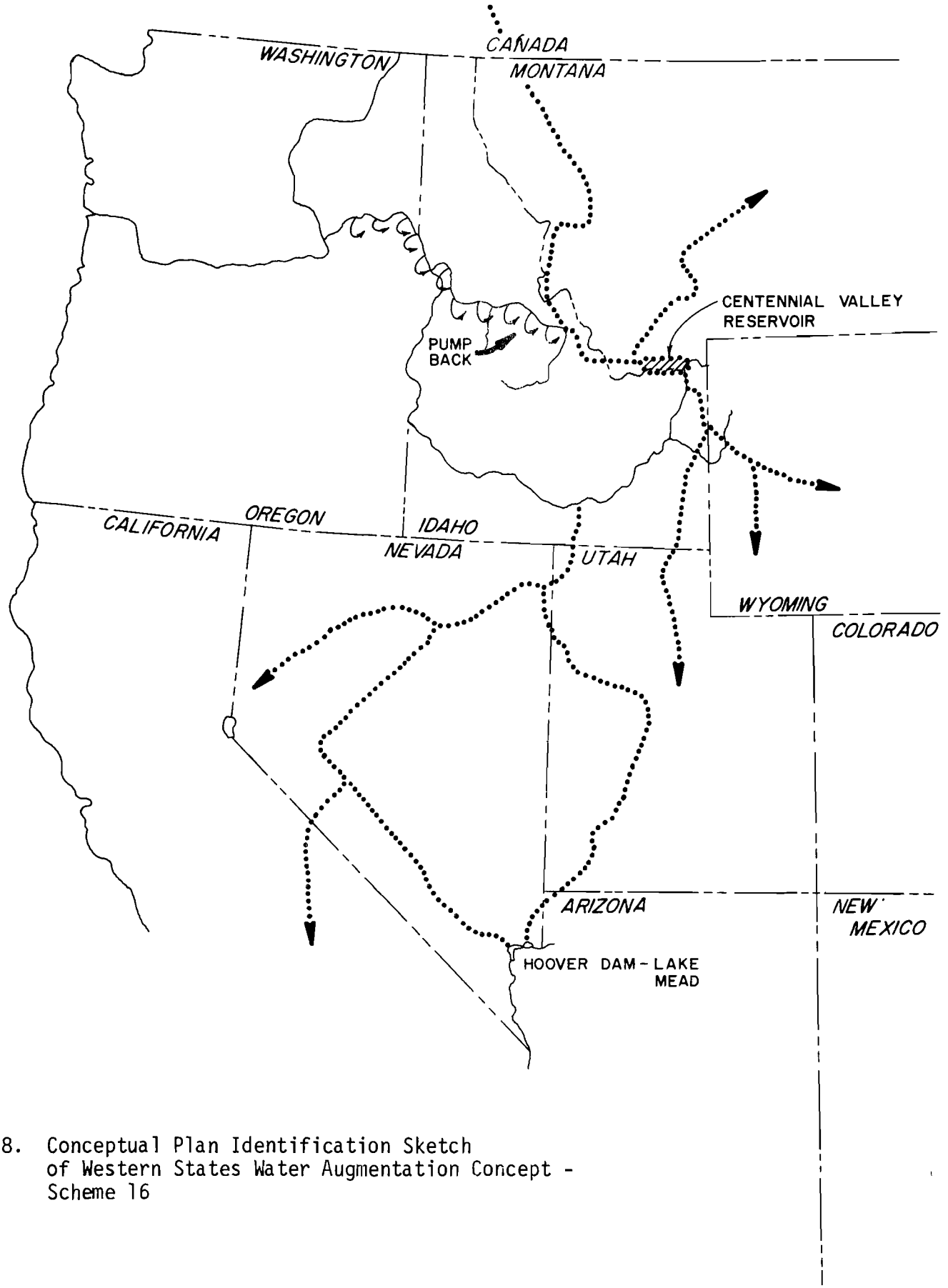


Fig. 18. Conceptual Plan Identification Sketch of Western States Water Augmentation Concept - Scheme 16

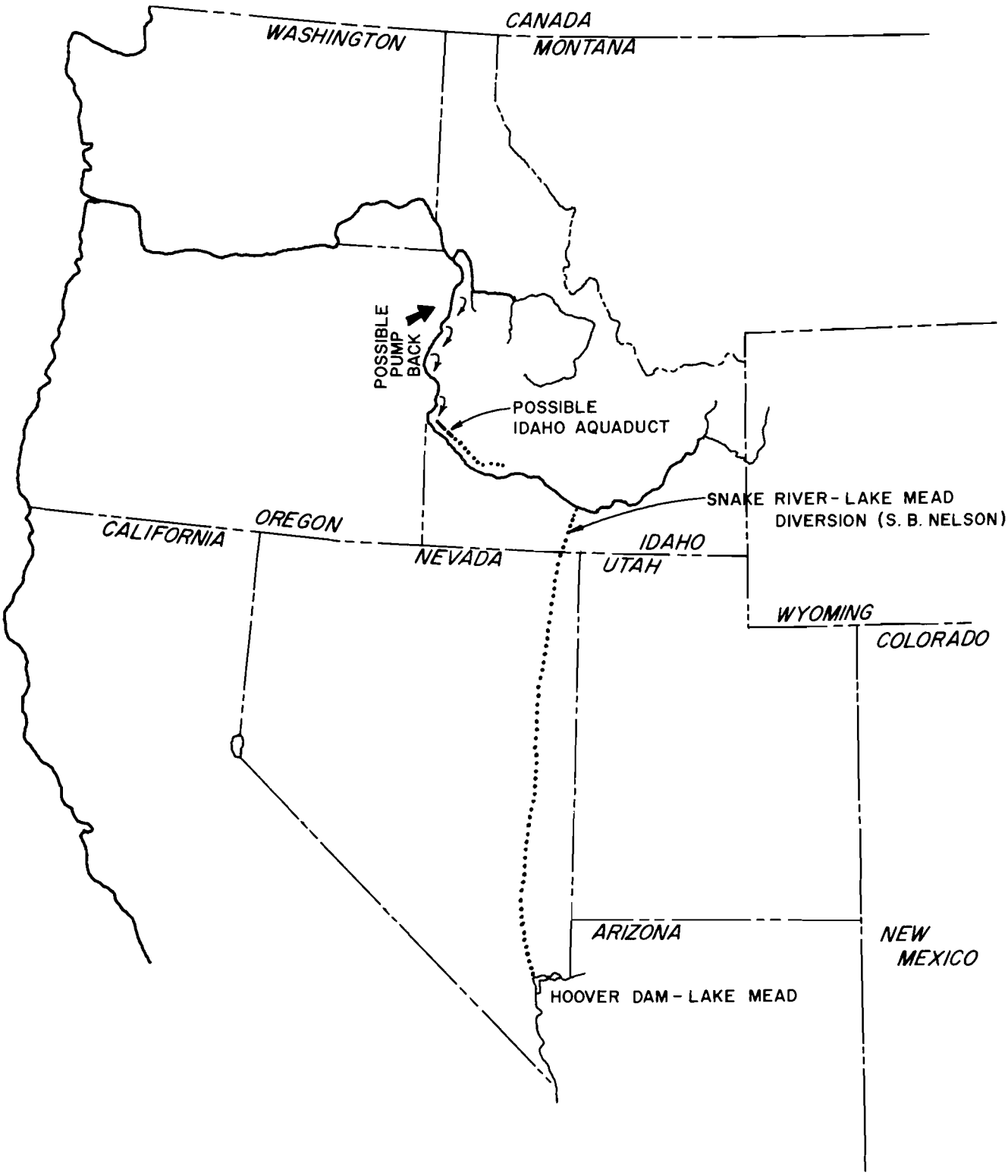


Fig. 19. Conceptual Plan Identification Sketch of Snake River-Lake Mead Diversion - Scheme 17

The last three conceptual schemes shown in the table are inter-basin transfers that have been suggested and do not in all cases indicate a direct transfer of water out of the Salmon River Basin. In the case of the modified Yellowstone-Snake Green River Diversion (Scheme 15) there is no real connection of taking water from the Salmon River, but it does illustrate an alternative for water supply primarily of water for irrigation in the southwest which may be referred to in later analysis. For the Western States Water Augmentation concept (Scheme 16) the plan is rather indefinite as to the amount of water that might be taken out of the Salmon or even the Snake River System but the concept actually proposed pumping water up the Salmon River to a point slightly upstream of North Fork, Idaho and then by an aquaduct and tunnel water would be pumped to a colossal reservoir in Centennial Valley in Montana. This does present a possible development use. As a further example of the demand for water reference, the Snake River - Lake Mead Diversion (Scheme 17) is mentioned. This plan by the Los Angeles Water and Power Board was originally proposed as taking 2,000,000 acre-feet of water from the Snake River system at Thousand Springs, Idaho. This was refuted by the Bureau of Reclamation as not being possible because there was no water available in certain years in the Snake River above the Thousand Springs point. It is conceivable that such a demand could be met by diversion from the Salmon River to the Snake System. Before such would be acceptable however, the future demands of irrigation development in the Snake River Basin above Weiser, Idaho would have to be considered and probably met before such were accomplished. The institutional and legal restraints are difficult to quanitfy but they are real and represent a consideration in the evaluation of alternatives.

Primary attention in the conceptual plans has been given to the possible use of Salmon River water for irrigation use in Idaho, but it is recognized that certain pumpback plans might be devised to use the water in eastern Oregon or it might conceivably be transferred to the Southwestern United States to augment inadequate supplies in that area of our country.

The Summary Report of Oregon's Long-Range Requirements for Water (18) is ample evidence that their are opportunities for augmentation water supply for irrigation outside the Salmon River drainage and outside the State of Idaho boundaries. These are therefore identified. In making a

general model for evaluating potential alternatives for water supply outside a given river being considered for inclusion as a wild river as part of the National Wild and Scenic River System, this is definitely mentioned as a possibility.

PROJECTED IRRIGATION USE OF SALMON RIVER WATER

With water needs identified and various conceptual plans surveyed for means of transferring water from the Salmon River to various points of use, it becomes necessary to try to project the irrigation use in some kind of geographical and time realm. A series of tables has been prepared to present this analysis.

In-Basin Irrigation Use

This first analysis has been made to determine what the in-basin use might be and what would be projected values of this use. Table 6 presents the summary of the projected irrigation use and benefits from Salmon River water used in the Salmon River Basin.

A complete discussion of the derivation of this information follows:

Column 1 of Table 6 identifies the possible conceptual plan or development that might most logically be expected to bring about the indicated use. Columns 2 and 3 present projected irrigation acreages as taken from the study by Corey and Sutter (12) for the years 2020 and 2070. Method A of their Table 14 is used in this analysis. Columns 4 and 5 present projected additional farm irrigation water requirements for the years 2020 and 2070. The analysis assumed farm irrigation requirements in 1970 were the same as 1966 as presented by Corey and Sutter (12) in their Table 16.

To arrive at a value for irrigation water, it was assumed that value as of 1970 would be no better than projects such as the Challis

TABLE 6

Summary of Projected Irrigation Use and Benefits from
Salmon River Water In-Basin Use

DIVERSIONS POINTS ANYWHERE ABOVE MOUTH

Possible Conceptual Plan or Use Pattern	Projected Acreage		Projected Additional Water Need & Use		Projected B/C Ratio	Projected Gross Values of Water		Projected Net Values of Water
	Yr 2020	Yr 2070	2020	2070		$/Ac.	$/Ac.Ft.	$/Ac.Ft.
	acres	acres	Ac.Ft.	Ac.Ft.	B:C			
1	2	3	4	5	6	7	8	9
Small private developments and projects like U.S.B.R.-Challis Project.	131,000	158,000	9,000	62,000	1.54:1	66.50	20.70* 31.80**	7.25* 11.15**
Comment on effect of irrigation use on possible conflict with use as Wild River.	Most of the development will occur above North Fork and only in very dry years would such small demand have any noticeable effect on free flowing river. The critical reach would be from the town of North Fork to the mouth of the Middle Fork of the Salmon River. Overall effect considered negligible.							

*Based on a water requirement of 3.2 Ac.Ft./Ac.

**Based on a water requirement of 2.08 Ac.Ft./Ac.

project. From the Challis Project Report (13) irrigation benefits were indicated to be $139,000 for 2,730 acres. This includes direct, indirect and public benefits. The gross benefit per acre by division gives $51 per acre as of 1964. To update this to 1970 prices the writer used the Construction Costs Trends (19) of the U. S. Bureau of Reclamation. The composite curve of the U. S. Bureau of Reclamation showed a cost index of 133 for 1964 and for 1970 an index of 173. Using this ratio then the per acre benefit for 1970 was found to be $66.50 as shown in Column 7 of Table 6.

The appropriatness of using a construction cost index was questioned during the preparation of this report so a brief comparison of other methods of updating the reported gross benefits per acre was made. The construction cost index was compared with the crop production index of the U. S. Department of Agriculture (19) and also the prices received index of the Agricultural Statistics of the U. S. Department of Agriculture. This was done for the reported benefit values of several projects proposed during the 1960's that were used as a basis of evaluations in this study. The comparison is shown in Table 7. In order to show an upper limit of irrigation benefit values in this study the construction index technique of updating benefit values was used in all subsequent tables even though it is recognized that other approaches may more nearly be what would be expected to have occurred.

To calculate the value of water per acre foot, it was necessary to compute or estimate the farm irrigation water requirement. Two methods were used to make this estimate. First, a crop requirement for the crop requiring the most water was taken from Table 6 of Sutter and Correy, Consumptive Irrigation Requirements for Crops in Idaho (27) which showed irrigation crop requirement of 19.3 inches based on use for alfalfa. An irrigation efficiency of 50 percent was assumed and the farm requirement was found to be 3.2 acre feet per acre. The second type of estimate merely involved dividing the cropland acreage value as obtained from Table 14, Corey and Sutter (17) (129,000 acres) into the farm irrigation requirement of 268,000 acre feet, giving a water requirement per acre of 2.08 acre feet.

The values of water requirement per acre were divided into the projected 1970 gross values of irrigation per acre. The two figures for

Table 7. Inflation in Gross Water Values by Selected Indices

PROJECT	Value based on Project Report		Values Adjusted to 1970		
	Year	Value	Construction[19] Index	Crop[20] Prdn Index	Prices[21] Received Index
Challis	1964	$ 51.00	$ 66.50	$ 57.12	$ 60.18
Ririe	1961	$ 74.50	$102.10	$ 84.92	$ 87.16
Oakley Fan	1961	$ 90.00	$123.50	$102.87	$105.30
Mountain Hm	1966	$ 82.60	$102.00	$ 89.56	$ 86.89

[19]Bureau of Reclamation Composite Index.

[20]USDA Economic Research Service, Changes in Farm Production and Efficiency (1971) Statistical Bulletin No. 233, June, 1971, Table 7, Mountain States.

[21]USDA, Agricultural Statistics, 1970.

the two different methods are shown in Column 8 of Table 6. To arrive at a desired net value of irrigation water per acre foot, it was impossible within time restraints of the study to try to obtain cost data for each given transfer scheme or irrigation project, but to reach some estimate it was assumed that the cost-benefit ratio for such development would not exceed the best project proposal that had been reported by federal agency studies in the basin. On this basis, the cost-benefit ratio for the Challis Project (13) was used. This is shown in Column 6 as 1.54:1. Then dividing 1.54 into the gross value of water per acre foot and deducting the cost from the gross value the net value was obtained. The respective values for two different water requirement estimates is given in Column 9 of Table 6. In the bottom part of Table 6 a comment has been added for the effect such diversion would have on the wild river status in the Salmon River system. In this case no segmenting of the Salmon River was made with respect to where the diversion would be made because of the relative minor amount of water involved.

Out-of-Basin Irrigation Use

In this part of the analysis the Salmon River has been segmented into various reaches from which diversion is considered likely to occur and further restraints have been placed on where the water would be used. In this manner, a type of modeling technique of systems analysis of a planned choice is exercised. To further explain this, a detailed discussion follows for Table 8.

In the case of Table 8, two restraints are assumed 1) that diversion of water from Salmon River will be limited to points above North Fork, Idaho and 2) the water use for irrigation would be limited to Upper Snake River Basin 1. This geographic designation is sub-area 5 as indicated in the Idaho Water Resource Board study by Wells, Peterson and Kelly (23). This essentially covers that area above the Power-Blaine County line of the Snake River drainage, or roughly above Milner Dam. The same pattern of table is used as discussed in the previous section treating, Table 6. Under Column 1 of Table 8, the scheme for development was chosen as Scheme No. 5 because it proposes diversion of water from the Salmon River that has its origin

TABLE 8

Summary of Projected Irrigation Use and Benefits from
Salmon River Water Out-Of-Basin Use

USE LIMITED TO UPPER SNAKE RIVER BASIN 1

DIVERSION LIMITED TO POINTS ABOVE NORTH FORK, IDAHO

Possible Conceptual Plan or Use Pattern and Comments	Projected Acreage		Projected Additional Water Need & Use		Projected B/C Ratio	Projected Gross Values of Water		Projected Net Values of Water
	Yr 2020	Yr 2070	2020	2070		$/Ac.	$/Ac.Ft.	$Ac./Ft.
	acres	acres	Ac.Ft.	Ac.Ft.	B:C			
1	2	3	4	5	6			
Conceptual Plan 5 with trades of water to allow upstream use of Snake River Water now used downstream.	1,363,000	2,074,000	None	-1,117,000 need 388,000 available	2.0:1	102.10	32.00* 45.80**	16.00* 22.90**
Comment on effect of irrigation use on possible conflict with use as Wild River.	This amount of diversion listed in Column 5 is over 1/3 the water runoff at North Fork and that amount would definitely be adverse to the free flowing water in the Salmon River below North Fork. No effect on Middle Fork of Salmon River.							

*Based on a water requirement of 3.32 Ac.Ft./Ac.

**Based on a water requirement of 2.25 Ac.Ft./Ac.

above North Fork, Idaho and appears to be the best plan to meet the assigned restraints. The actual development of a system to use this water would entail a complicated trade of water delivered to the Payette System and then a retention of more water in the Snake River above Milner Dam. Institutionally this would appear to be very difficult, but it would still appear to be the most economical way to utilize water from the Salmon River in the Upper Snake River Basin 1. Projected irrigated acreage as reported by Corey and Sutter (12) is given in Columns 2 and 3. As a basis for projecting the amount of additional Salmon River water that might be used in the Upper Snake River Basin 1, values of farm irrigation requirements for 1966 were reported in Table 16 of Corey and Sutter to be 2,300,000 acre feet. The estimated requirement for 2020 was 3,067,000 acre feet. The difference leaves a projected additional requirement for irrigation water of 767,000 acre feet. H. T. Nelson (24) in a report to the Idaho Water Resource Board indicated the average annual surplus at Milner Dam in the Snake River of 1,250,000 acre feet. This is confirmed in the Snake River Recharge Report (2). It is here considered that this water could be more economically developed to meet the projected additional requirement for irrigation water in Upper Snake River Basin 1 so Column 4 reports "none" as the projected additional Salmon River water that would be used by the year 2020.

For estimating the additional irrigation water requirement in the Upper Snake River Basin 1, Corey and Sutter (12) reported a requirement for the year 2070 to be 4,667,000 acre feet. Deducting the 1966 demand figure of 2,300,000 acre feet gives additional needed by 2070 to be 2,367,000 acre feet. Of this amount 1,250,000 could be supplied from the reported average annual surplus flows above Milner Dam. Thus leaving a theoretical deficiency for the year 2070 of 1,117,000 acre feet, the upper negative figure shown in Column 5 of Table 8. Analysing the conceptual plans, it is noted that the reasonable maximum diversion by the various plans of only 388,000 acre feet, the lower figure in Column 5 of Table 8. This is the governing restrained amount of water projected for use from the Salmon River. If water were diverted from the Salmon River down nearer North Fork, Idaho, it is conceivable that more than 388,000 acre feet could be theoretically diverted but costs would be prohibitive to convey the water to the Upper Snake River Basin 1 because of conveyance distance and lift necessary to make the transfer.

Now to estimate the projected gross value of water to be used in Upper Snake River Basin 1, a maximum reported irrigation benefit was that of the Ririe project as reported in Volume 1, Summary Report, Upper Snake River Basin of U. S. Bureau of Reclamation and Corps of Engineers as published in 1961 (25) and indicated on pages 7-48 to 7-52. The figure of benefit was computed to be $74.30. Updating this by the previously mentioned method, the projected gross value of irrigation was found to be $102.10 as reported in Column 7, Table 8. Gross value per acre foot was found to be $32.00 per acre foot and $45.80 per acre foot. These figures agree with an estimate sent in a personal communication from F. M. Warnick (April 17, 1970, former Regional Planning Engineer, Region 1, U. S. Bureau of Reclamation in which the irrigation benefit for supplemental water in the Upper Snake River basin was given as $34.00 per acre foot).

The listed benefit-cost ratio for the best project was 2.0:1 and so projected value of water was found to be $16.00 acre foot and $22.90 per acre foot as reported in Column 9 of Table 8. For later use in modeling the potential foregone, a comment is made at the bottom of Table 8 of the effect of an irrigation diversion of Scheme 5 on possible conflict with use as a Wild River for points below North Fork, Idaho on the Salmon River.

Table 9 has been developed with a restraint that diversions of Salmon River water be above North Fork, Idaho, and that the water be limited to use in Upper Snake River Basin 2. The same conceptual plan is considered to be operative for these restraints. The projected irrigated acreages for the years 2020 and 2070 were taken from Corey and Sutter (12) and are reported in Columns 2 and 3 of Table 9. To arrive at projected requirement for additional water from Salmon River water the farm irrigation requirement according to Corey and Sutter for 2020 in Basin 2 as 3,037,000 acre feet the 1966 requirement for 1966 was listed as 2,510,000 acre feet or a 527,000 acre foot deficiency. Recalling that for the year 2020 the Upper Snake River Basin 1 had a surpluse, this was calculated to be 483,000 acre feet, by subtracting Upper Snake River Basin 1 deficiency (767,000 acre feet) from the 1,250,000 acre foot average annual surplus at Milner Dam (2). Recognizing that the 483,000 surplus Snake River waters from Upper Snake River Basin 1 would be used in Upper Snake River Basin 2 before Salmon River could be economically

TABLE 9

Summary of Projected Irrigation Use and Benefits from
Salmon River Water Out-Of-Basin Use

USE LIMITED TO UPPER SNAKE RIVER BASIN 2

DIVERSION LIMITED TO POINTS ABOVE NORTH FORK, IDAHO

Possible Conceptual Plan or Use Pattern and Comments	Projected Acreage		Projected Additional Water Need & Use		Projected B/C Ratio	Projected Gross Values of Water		Projected Net Values of Water
	Yr 2020	Yr 2070	2020	2070		$/Ac.	$/Ac.Ft.	$/Ac.Ft.
	acres	acres	Ac.Ft.	Ac.Ft.	B:C			
1	2	3	4	5	6	7	8	9
Conceptual Plan 5 with trades of water to allow upstream use of Salmon River Water	1,182,000	1,755,000	None 44,000	-777,000 need 388,000 available	2.6:1	123.50	34.90* 47.90**	21.50* 29.50**
Comment on effect of irrigation use on possible conflict with use as Wild River.	This amount of diversion listed in Column 5 is over 1/3 the water runoff at North Fork and that amount would definitely be adverse to the free flowing water in the Salmon River below North Fork. No affect on the Middle Fork of Salmon River.							

*Based on a water requirement of 3.54 Ac.Ft./Ac.

**Based on a water requirement of 2.58 Ac.Ft./Ac.

developed then 527,000 acre feet less 483,000 acre feet would leave 44,000 acre feet (Column 4, Table 9) as the maximum amount of Salmon River water that would conceivably be used in Upper Snake River Basin 2 up to the year 2020. Similar calculation for the year 2070 reveal a deficiency of -777,000 acre feet (Column 5, Table 9) in the Upper Snake Basin 2. However, the restraint of the most logical development scheme utilizing only Salmon River water in that stretch of segment of the river.

To arrive at projected gross value of the water with the Table 9 restraints, it was found that the Oakley Fan Project gives the highest benefit for irrigation. The 1961 Upper Snake River - Summary Report (25) shows a 1961 benefit of $90.00 per acre. Updating this to 1970 gives a value of $123.50 per acre. Estimates for farm irrigation requirements by the two methods gives 4.00 acre feet per acre and 2.62 acre feet per acre. Using these figures projected gross value of water used from Salmon River would be $34.90 per acre foot and $47.90 per acre foot respectively. The Oakley Fan Project benefit-cost ratio is shown to be 2.6:1. The projected net value of the water as restrained for use is calculated to be $21.50 per acre foot and $29.50 per acre foot respectively. Similar effects with regard to wild rivers are recognized for this group of restraints as mentioned for case of Table 8.

A further restraint might be to limit use of water to the Southwest Idaho sub-basin. Table 10 has been developed with the same restraint of no diversions below North Fork, Idaho. The same technique was used in preparation of this table as previously explained except the projected additional Salmon River Water Need as reported in Column 4 and 5 needs elaboration. The explanation follows: For the year 2020 the estimated farm irrigation water requirement is shown to be 3,917,000 acre feet and estimated 1966 demand according to Corey and Sutter (12) is 2,222,000 acre feet leaving a -1,695,000 deficiency. In addition there is a 44,000 acre foot deficiency that might be met by withholding Snake River water now used in the Southwest Idaho sub-basin thus creating a maximum deficit of 1,695,000 plus 44,000 or 1,739,000 acre foot deficiency by the year 2020. However, unused flows in the Payette River system are reported to be 1,400,000 and in the Boise River system of 330,000 acre feet as reported in the Southwest Idaho Water Development Project report (26) 1966.

TABLE 10

Summary of Projected Irrigation Use and Benefits from
Salmon River Water Out-Of-Basin Use

USE LIMITED TO SOUTHWEST IDAHO SUB-BASIN

DIVERSION LIMITED TO POINTS ABOVE NORTH FORK, IDAHO

Projected Conceptual Plan or Use Pattern and Comments	Projected Acreage		Projected Additional Water Need & Use		Projected B/C Ratio	Projected Gross Values of Water		Projected Net Values of Water
	Yr 2020	Yr 2070	2020	2070		$/Ac.	$/Ac.Ft.	$/Ac.Ft.
	acres	acres	Ac.Ft.	Ac.Ft.	B:C			
1	2	3	4	5	6	7	8	9
Conceptual Plan 5 with trades of water to allow upstream use of Snake River water now used downstream in S.W. Idaho.	1,304,000	2,181,000	-9,000 need None	-2,590,000 need 388,000 available	1.96:1	102.00	21.50* 34.40**	10.95* 17.60**
Comment on effect of irrigation use on possible conflict with use as Wild River.	The amount of water diversion or use listed in Column 5 is over 1/3 the water runoff at North Fork and such a withdrawl would definitely be adverse to the free flowing water in the Salmon River below North Fork, Idaho. No effect on Middle Fork of Salmon River anticipated negligible interference with the 9,000 needed from the Salmon River up to the year 2020.							

*Based on a water requirement of 4.75 Ac.Ft./Ac.

**Based on a water requirement of 2.93 Ac.Ft./Ac.

Similar calculations reveal a total deficit in the Southwest Idaho sub-basin of -2,590,000 acre feet as of the year 2070. Actually the amount projected for use from Salmon River basin as limited by the restraint of diversion permitted only above North Fork, Idaho will only permit a water use of 388,000 as limited by Conceptual Plan 5. The data shown in the Table for projected gross value of water was computed by using irrigation benefit data from the Mountain Home Division of the Southwest Idaho Development project. Figures in this report (26) indicate an irrigation benefit as of 1966 of $82.60 per acre. Updating this to 1970 indicates the value would be $102.00 per acre. The benefit-cost ratio for that project was reported at 1.96:1 so the projected gross benefits or values would be $21.50 per acre foot and $34.40 per acre foot respectfully as governed by the calculated water requirement per acre.

It is interesting to compare these values with the studies of Lindeborg (27) on Dry Lake, Twin Falls and Minidoka areas. In his bulletin Lindeborg reported a marginal value of product of water at $27.24 per acre-foot which gives a confirmation of the range of value that might be assigned to the water that could be used in that part of the State. Proceeding on with the analysis, Table 11 was developed using as the restraints, 1) use of the water limited to Upper Snake Sub-basin 1 and 2) diversion to be limited to those above the confluence of the Middle Fork of the Salmon River with the main river. Only changes from Table 8 are in Column 1 and Column 5. A study of the conceptual plans indicates Conceptual Plans 13 and 14 would be the most logical plans for development. The amount of water that can be logically developed would be 738,000 acre feet as recorded in Column 5. Projected values of water would remain the same as those calculated and reported in Table 8. Different impact effects on a possible wild river system as already enacted are indicated in the bottom of the Table 11.

Table 12 has been developed in a similar manner and offers the restraints; 1) use of water limited to upper Snake sub-basin 2 and 2) diversion to be limited to those above the confluence of the Middle Fork of the Salmon River with the main river. Only changes from Table 9 are in Column 1 and Column 5. Similar reasoning to that explained for Table 11 hold for the reported values in this table.

TABLE 11

Summary of Projected Irrigation Use and Benefits from
Salmon River Water Out-Of-Basin Use

USE LIMITED TO UPPER SNAKE RIVER BASIN 1

DIVERSION LIMITED TO POINTS ABOVE THE MOUTH OF MIDDLE FORK

Projected Conceptual Plan or Use Pattern and Comments	Projected Acreage		Projected Additional Water Need & Use		Projected B/C Ratio	Projected Gross Values of Water		Projected Net Values of Water
	Yr 2020	Yr 2070	2020	2070				
	acres	acres	Ac.Ft.	Ac.Ft.	B:C	$/Ac.	$/Ac.Ft.	$/Ac.Ft.
1	2	3	4	5	6	7	8	9
Conceptual Plans 13 and 14 would appear to offer possible plans if trades were allowed for downstream use of Snake River Water.	1,363,000	2,074,000	None	-1,117,000 need 738,000 available	2.0:1	102.10	32.00* 25.80**	16.00* 22.90**
Comment on effect of irrigation use on possible conflict with use as Wild River.	These plans propose transfer of water out of Middle Fork of Salmon River in Marsh Creek and Bear Valley Creek as well as water from this upper reach of main Salmon River. This would negate use of any portion of Salmon River as Wild River flows above Middle Fork mouth would be adversely affected.							

*Based on a water requirement of 3.32 Ac.Ft./Ac.

**Based on a water requirement of 2.25 Ac.Ft./Ac.

TABLE 12

Summary of Projected Irrigation Use and Benefits from
Salmon River Water Out-Of-Basin Use

USE LIMITED TO UPPER SNAKE RIVER BASIN 2

DIVERSION LIMITED TO POINTS ABOVE THE MOUTH OF MIDDLE FORK

Projected Conceptual Plan or Use Pattern and Comments	Projected Acreage		Projected Additional Water Need & Use		Projected B/C Ratio	Projected Gross Values of Water		Projected Net Values of Water
	Yr 2020	Yr 2070	2020	2070		$/Ac.	$/Ac.Ft.	$/Ac.Ft.
	acres	acres	Ac.Ft.	Ac.Ft.	B:C			
1	2	3	4	5	6	7	8	9
Conceptual Plans 13 and 14 would appear to offer possible plans if trades were allowed for downstream use of Snake River Water.	1,182,000	1,755,000	44,000	-1,117,000 need 738,000 available	2.6:1	123.50 123.50	34.90* 47.90**	21.50* 29.50**
Comment on effect of irrigation use on possible conflict with use as Wild River.	These plans propose transfer of water out of Middle Fork of Salmon River in Marsh Creek and Bear Valley Creek as well as water from upper reach of main Salmon River. This would negate use of any portion of Salmon River as Wild River. Flows above Middle Fork mouth would be adversely affected.							

*Based on a water requirement of 3.54 Ac.Ft./Ac.

**Based on a water requirement of 2.58 Ac.Ft./Ac.

Table 13 has been developed in the foregoing manner and offers the restraints; 1) use of water limited to Southwest Idaho Sub-basin and 2) diversion to be limited to those above the confluence of the Middle Fork of the Salmon River with the main river. The only changes from Table 10 are in Columns 1, Column 5 and the impact commentary at the bottom of the table.

Table 14 has been developed following the usual pattern but the restraints are as follows: 1) irrigation water use limited to any where in Idaho which would essentially mean the three sub-basins of Upper Snake 1, Upper Snake 2, and Southwest Idaho Sub-basin, and 2) diversion of Salmon River water limited to points above French Creek in the Salmon River system. Projections of water need and water available are shown for both the years 2020 and 2070. Hydrologically there is over 5,000,000 acre feet available at French Creek, but to leave a viable stream below, a maximum reasonable diversion is set at 4,500,000 acre feet annually. Projected valuation for Columns 7, 8, and 9 come from earlier calculations. The comments on the effect of such an action or development plan on the Salmon River system as a wild river is indicated briefly at the bottom of the table. Conceptual Plan 4 as studied by Professor Peebles was used as a plan to meet this alternative of development.

Table 15 has been developed by moving downstream on the restraint of diversion. For information in this table the restraints are: 1) irrigation water use limited to anywhere in Idaho, and 2) diversion of Salmon River water limited to points above Riggins in the Salmon River system. Projects for water need and water available for the years 2020 and 2070 are shown in Column 4 and 5. Note an availability figure of 5,000,000 acre feet is listed as the maximum diversion of Salmon River water available for the year 2070. This was an assumption of what would be possible to divert and still maintain a viable stream below Riggins. Conceptual Plans 2 or 3 would meet this action program. Comments on the impact of such development on the Salmon River system as Wild River are presented in the bottom of Table 15.

Moving on down the Salmon River another restraint is applied to develop the data for Table 16. In this case the restraints are: 1) irrigation water use limited to anywhere in Idaho 2) diversions of Salmon River

TABLE 13

Summary of Projected Irrigation Use and Benefits from
Salmon River Water Out-Of-Basin Use

USE LIMITED TO SOUTHWEST IDAHO SUB-BASIN

DIVERSION LIMITED TO POINTS ABOVE THE MOUTH OF MIDDLE FORK

Projected Conceptual Plan or Use Pattern and Comments	Projected Acreage		Projected Additional Water Need & Use		Projected B/C Ratio	Projected Gross Values of Water		Projected Net Values of Water
	Yr 2020	Yr 2070	2020	2070		$/Ac.	$/Ac.Ft.	$/Ac.Ft.
	acres	acres	Ac.Ft.	Ac.Ft.	B:C			
1	2	3	4	5	6	7	8	9
Conceptual Plans 13 and 14 would appear to offer plans to best supply the needed water in the Southwest Idaho Sub-Basin.	1,304,000	2,181,000	-9,000 need & available	-2,590,000 need 738,000 available	1.96:1	102.00	21.50* 34.40**	10.95* 17.60**
Comment on effect of irrigation use on possible conflict with use as Wild River.	These plans propose transfer of water out of the Middle Fork of Salmon River in Marsh Creek and Bear Valley Creek as well as water from the upper reaches of the Main Salmon River. This would appear negate use of any portion of the Salmon River as a Wild River. Flows in the Middle Fork and above the Middle Fork would be adversely affected.							

*Based on a water requirement of 4.75 Ac.Ft./Ac.

**Based on a water requirement of 2.93 Ac.Ft./Ac.

TABLE 14

Summary of Projected Irrigation Use and Benefits from
Salmon River Water Out-Of-Basin Use

PROPOSED USE LIMITED TO USE IN IDAHO

DIVERSION LIMITED TO POINTS ABOVE FRENCH CREEK

Projected Conceptual Plan or Use Pattern and Comments	Projected Acreage		Projected Additional Water Need & Use		Projected B/C Ratio	Projected Gross Values of Water		Projected Net Value of Water
	Yr 2020	Yr 2070	2020	2070	B:C	$/Ac.	$/Ac.Ft.	$/Ac.Ft.
	acres	acres	Ac.Ft.	Ac.Ft.				
1	2	3	4	5	6	7	8	9
Upper Snake 1 Upper Snake 2 Southwest Idaho	1,363,000 1,182,000 1,304,000	2,074,800 1,750,000 2,181,000	None 44,000 1,695,000	1,117,000 2,047,000 4,320,000				
Conceptual Plan 4 and trades to allow more Snake River use in Upper Snake River 1 & 2. Most water would logically be used in S.W. Idaho.			-1,739,000 need 1,730,000 available -9,000 Idaho need	-7,484,000 need 4,500,000 available	1.96:1	102.00	21.50* 34.40**	10.95* 17.60**
Comment on effect of irrigation use on possible conflict with use as Wild River.	If fish facilities were provided for passing a French Creek Diversion only points downstream from Mouth of French Creek would be eliminated as potential for Wild River use. The scheme would be very expensive unless power and storage would be added to development plan which might push unaffected reach of the Salmon River up above French Creek.							

*Based on a water requirement of 4.75 Ac.Ft./Ac.

**Based on a water requirement of 2.93 Ac.Ft./Ac.

TABLE 15

Summary of Projected Irrigation Use and Benefits from
Salmon River Water Out-Of-Basin Use

PROPOSED USE LIMITED TO USE IN IDAHO

DIVERSION LIMITED TO POINTS ABOVE RIGGINS

Projected Conceptual Plan or Use Pattern and Comments	Projected Acreage		Projected Additional Water Need & Use		Projected B/C Ratio	Projected Gross Values of Water		Projected Net Value of Water
	Yr 2020	Yr 2070	2020	2070	B:C	$/Ac.	$/Ac.Ft.	$/Ac.Ft.
	acres	acres	Ac.Ft.	Ac.Ft.				
1	2	3	4	5	6	7	8	9
Upper Snake 1 Upper Snake 2 Southwest Idaho	1,363,000 1,182,000 1,304,000	2,074,000 1,750,000 2,181,000	None 44,000 1,695,000	1,117,000 2,047,000 4,320,000				
Conceptual Plan 2 or 3 would allow this if trading of existing water rights were possible.			-1,739,000 need 1,730,000 available -9,000 Idaho need	-7,484,000 need 5,000,000 available	1.96:1	102.00	21.50* 34.40**	10.95* 17.60**
Comments on effect of irrigation use on possible conflict with use as Wild River.	If fish passage facilities were provided for passing a diversion structure at Riggins only points downstream of Riggins would be eliminated as potential Wild River segments. The scheme has merit over Conceptual Plan 4 because of cost and chance to provide cheaper, less environmentally disturbing water storage enroute to use.							

*Based on a water requirement of 4.75 Ac.Ft./Ac.

**Based on a water requirement of 2.93 Ac.Ft./Ac.

TABLE 16

Summary of Projected Irrigation Use and Benefits from
Salmon River Water Out-Of-Basin Use

PROPOSED USE LIMITED TO USE IN IDAHO

DIVERSION LIMITED TO MOUTH OF SALMON RIVER

Projected Conceptual Plan or Use Pattern and Comments	Projected Acreage		Projected Additional Water Need & Use		Projected B/C Ratio	Projected Gross Values of Water		Projected Net Value of Water
	Yr 2020	Yr 2070	2020	2070	B:C	$/Ac.	$/Ac.Ft.	$/Ac.Ft.
	acres	acres	Ac.Ft.	Ac.Ft.				
1	2	3	4	5	6	7	8	9
Upper Snake 1 Upper Snake 2 Southwest Idaho	1,363,000 1,182,000 1,304,000	2,074,000 1,750,000 2,181,000	None 44,000 1,695,000	1,117,000 2,047,000 4,320,000				
Conceptual Plan 1 with pump-back up the Snake River would require trading of water all the way up Snake River from Weiser, Idaho			-1,739,000 need 1,730,000 available -9,000 Idaho need	-7,484,000 need 7,484,000 available	1.96:1	102.00	21.50* 34.40**	10.95* 17.60**
Comments on effect of irrigation use on possible conflict with use of Salmon River as a Wild River.	If fish passage facilities were provided for passing fish as the confluence of Salmon River with the Snake River there would be no interference with the Salmon River as a Wild River. There would be an average of 8,000,000 Ac.Ft. runoff available as a maximum for irrigation use. Naturally this would reduce power production downstream.							

*Based on a water requirement of 4.35 Ac.Ft./Ac.

**Based on a water requirement of 2.93 Ac.Ft./Ac.

water limited to points above the mouth of the Salmon River, in other words diversions could be made anywhere. However, to meet projected needs in the year 2070 it is obvious that Conceptual Plan 1 would meet the maximum need best. As indicated in Column 5, 7,084,000 acre feet of water could conceivably be diverted at the mouth to meet that expected water deficiency as projected for the year 2070. It is interesting to note that if suitable fish passage facilities could be developed at the confluence of the Salmon River with the Snake such a projected action could be done and not affect the Wild River status on the entire Salmon River.

Utilizing information from the State of Oregon (18) a further projected irrigation alternative of use is presented. This is presented in Table 17. The restraints in this case are:

1) irrigation water use limited to Idaho and Oregon
2) diversion of Salmon River to be made only at the mouth of the Salmon River.

The figures in Columns 3 and 5 were developed by using data from the Summary Report of Oregon's Long Range Requirements for Water (18) published in May, 1969. Only data are available for the projected 2070 requirements. This indicates that potential use does exceed the supply of water. No increased value is ascribed to such a scheme so values reported are those that were computed for possible use in the Southwest Idaho Sub-basin and are based on benefits reported by the U. S. Bureau of Reclamation study (26) of the Mountain Home Division of the Southwest Idaho Water Development project.

It is conjectured that for the year 2020 demands Oregon may have a unsupplied need of irrigation water that theoretically could be supplied from Salmon River water. It is unlikely, however, that it would exceed that unsupplied need as calculated for Idaho of 9,000 acre feet. On this basis, it is contended that irrigation water development of out-of-basin diversion for irrigation would not be necessary until after the year 2020. This statement is made on the basis that other pending demands for irrigation water supply to such areas as the arid areas of the Southwestern United States could be met by other means more economically and more institutionally acceptable than by having to utilize Salmon River water.

A brief commentary needs to be expressed regarding the Conceptual Plans 15, 16, and 17 as to their influence on the evaluation of the

TABLE 17

Summary of Projected Irrigation Use and Benefits from
Salmon River Water Out-Of-Basin Use

PROPOSED USE LIMITED TO USE IN IDAHO AND OREGON (EASTERN PORTION)

DIVERSION LIMITED TO MOUTH OF SALMON RIVER

Projected Conceptual Plan or Use Pattern and Comments	Projected Acreage		Projected Additional Water Need & Use		Projected B/C Ratio	Projected Gross Values of Water		Projected Net Value of Water
	Yr 2020	Yr 2070	2020	2070	B:C	$/Ac.	$/Ac.Ft.	$/Ac.Ft.
	acres	acres	Ac.Ft.	Ac.Ft.				
1	2	3	4	5	6	7	8	9
Upper Snake 1 Upper Snake 2 Southwest Idaho Oregon-Malhuer R. Basin	1,363,000 1,182,000 1,304,000 --	2,074,000 1,750,000 2,181,000 757,200	None -44,000 -1,695,000	-1,117,000 -2,047,000 4,320,000 2,126,000				
Conceptual Plan 1 with pump-back up the Snake River would require trading of water in both Idaho and Oregon above Weiser River.			-1,739,000 need 1,730,000 available -9,000 Idaho need	-9,610,000 need 8,000,000 available	1.96:1	103.50	25.90* 39.50**	12.70* 19.40**
Comment on effect of irrigation use on possible conflict with use of Salmon River as a Wild River.	If fish passage facilities were provided for passing fish up the Salmon River at the confluence of Salmon River with the Snake River there would be no interference with the Salmon River as a Wild River. This assumes no storage would be necessary on the Salmon but that complete capture of Salmon River water would be made up to the average annual yield. This would reduce power production.							

*Based on a water requirement of 4.00 Ac.Ft./Ac.

**Based on a water requirement of 2.62 Ac.Ft./Ac.

specific potential for out-of-basin use of water for irrigation. Plan 15 (16) the Yellowstone-Snake-Green diversion was presented to indicate two ideas; one, is that this diversion could conceivably divert more water out of Idaho than it brought in and if so this would mean that Salmon River water might be looked on as replacement water, the second idea, is that it is possible that a Yellowstone River diversion could theoretically be utilized in Idaho and conceivably could be developed more economically as a means of meeting the Upper Snake River basins deficiencies as projected in the analysis of using Salmon River water in out-of-basin diversion to Southern Idaho. Both ideas are extremely wrought with institutional restraints in the form of State ownership of water and are considered as very unlikely, but they do represent a "far-out" alternative.

Conceptual Plan 16, Smith's (5) Western States Water Augmentation plan is very vague in amount of water to be diverted and the possible timing of need for such is not yet known. This plan did propose some type of pump back up the Salmon River from its mouth and a diversion out of river at some point near North Fork thence to a large reservoir on Centennial Valley in Montana near the Idaho border. Such a diversion would completely eliminate the Salmon River as a wild river. Whether such a scheme would be economical is questioned but in studying it in the scope of Smith's studies it is suggested that alternative sources of water and a different conveyance route would appear to be possible, and so any benefits to use of Salmon River water would simply be the marginal cost that would be necessary to provide the alternative diversion and conveyance system. This again is a far-out idea but is presented as a published scheme that impinges on the area being analysed in this report.

The last diversion plan, conceptual plan 17 as proposed by Nelson (17) is not even a diversion out of the Salmon River but such a diversion would in reality deplete the water available for Southern Idaho irrigation development and thus might bring to possibility an earlier need for Salmon River water for irrigation than is projected in the tabular systems analysis presented in Tables 8 through 17. This threat at times appears real but real factual costs estimates have never come to the attention of the writer and in the various alternatives that are being suggested for augmenting the supply of water to the Southwestern United States, it does not appear to offer much reality.

Since this study is for general methodology for evaluating alternatives for possible inclusion of rivers in a wild river system another necessary analytical approach should be explained. To consider such an analysis assume that downstream from the segments of the river and drainage basin an area is available for irrigation development. To make it more realistic assume the area would be in the vicinity of Pasco, Washington. In order to develop such a hypothetical area, it may be necessary to develop major irrigation storage within the boundaries of the Salmon River study area. If such downstream use and value were above the computed values that have been shown in the various tables developed for out-of-basin use projected for Southern Idaho areas we would have a higher economic return. In reality of analysis of the Salmon River system, it is recognized that if irrigation demand exists downstream say in the Pasco, Washington area, a more adequate and a more economical supply of water exists in the form of Columbia River water or even water from the Clearwater River system than the utilization of Salmon River water. This decision-tree type of analysis then has eliminated one more alternative.

In summing up this section, it is contended that a reasonable number of most likely alternatives for irrigation use have been presented. Actual benefits or values have not been computed but a hypothetical 1970 value has been arrived at by choosing maximum present day irrigation benefits from proposed large scale irrigation projects that have been proposed by bona fide agencies. It is recognized that smaller individual land development efforts may have demonstrated higher value to be ascribed to irrigation. In general these are high value crops that may not have market potential to merit the acreages projected in the studies referred to in this analysis.

These projections give a basis for further study, it appears in the official study called for under the Wild and Scenic Rivers Act, Public Law 90-542 and now being pursued under a joint-study arrangement by the U. S. Forest Service and the State of Idaho that particular alternatives suggested for development would merit consideration. One would be study of a plan similar to Conceptual Plan 5 which would utilize values diverted from the Salmon River above North Fork, Idaho. An actual cost analysis is needed to give a more realistic appraisal to the net value of such irrigation development. A second alternative that would merit a more

detailed study is a deatiled cost appraisal of a development similar to conceptual plan 2 or 3 which would divert water at Riggins. Understandibly very major institutional problems exist and some elaboration and elucidation of such problems would seem to be valuable to decision makers.

It is recognized that in the foregoing analysis no account has been given to reduction in power benefits that would result due to interference by conceivable hydropower projects within the basin and in power production in existing and planned plants downstream on the Snake and Columbia Rivers. Likewise it is recognized that development of out-of-basin irrigation use would in some cases have a negative benefit to be ascribed to the irrigation benefit due to interference with projected hydropower development or established hydropower systems. This would certainly be true in the case of some of the water trades that would be necessary in the Upper Snake basins to implement given projects as defined by the analysis worked out under the various assumed restraints reported in Tables 8 through 16.

The foregoing has also been projected without consideration of limitations in river flows that might be dictated by certain water quality restraints that must be met in the form of existing and future water quality standards. This type of evaluation is extremely difficult but in the official studies referred to before a cost appraisal of such should be considered on say one or two of the alternatives recommended.

Hopefully in the overall project effort to model and consider the conflicting and competing resources uses as limited by possible inclusion of a river in a wild river system these will be brought out.

One of the difficulties in all these projections is the time restraint of when and if specific development plans would be developed. The net value will be greatly dependent on time of development, developmental period, and the possible financial costs that actually will develop as governed by such items as interest rates. Such are points out as facts that must be considered in an evaluation procedure.

IMPACT OF POSSIBLE IRRIGATION USE OF SALMON RIVER WATER ON POSSIBLE DESIGNATION OF WILD RIVER

As part of this report this section of a necessity becomes much more subjective but a reliance is still maintained on the various restraints and the projected irrigation needs uses and values reported in the previous section.

In-Basin Irrigation Use

Referring to Table 6, it is recognized that if irrigation development occurs in the basin, it will occur above North Fork, Idaho. In considering the entire Salmon River as a potential for inclusion in a Wild and Scenic Rivers system, it recognized that such irrigation development in the basin would probably interfere with the segment of the main Salmon River above North Fork, Idaho, but even the minor amount of water use of 9,000 acre feet by the year 2020 could occur and probably be tolerated as a development and still have inclusion of the segment of the Salmon River above North Fork if discretion were used in how such diversion would be made. It is contended that the value of such irrigation is minimal when compared with other projected irrigation uses and the more economical use for irrigation would be in favor of out-of-basin use. The small amount of irrigation use projected for the year 2020 and 2070 would indicate that such would have very little effect on the free flowing nature of the river below North Fork. The segment of the river between North Fork and the Mouth of the Middle Fork of the Salmon River would be a critical area during very dry years. As a compensation, it is conceivable that an irrigation development might be planned that would provide storage releases that would augment the low flows and thus maintain a more desirable free flowing stretch of the river in the form of higher stage between North Fork and the mouth of the Middle Fork of the Salmon River.

Out-of-Basin Irrigation Use

In considering the impact of the projected irrigation use out-of-basin as restrained by diversions being limited to those from the Salmon River system above North Fork reference is made to Tables 8, 9, and 10. Such use is projected to have potential for export of water up to 388,000 acre feet annually. This is over 1/3 of the average annual flow and would have an adverse effect over the entire length of the main Salmon River and would be particularly adverse to the possibility of the inclusion of the stretch above North Fork, Idaho. It would not have any effect on the inclusion of the Middle Fork of the Salmon River as it is now designated.

In considering diversion opportunities downstream, impact is discussed on the schemes that would divert water from the Salmon River at or upstream of the Middle Fork. It is obvious these plans facilitate marginal value product of irrigation water, since the water is applied to more production land, but the schemes suggested and reported would preclude inclusion of the Middle Fork of the Salmon River as a wild river and probably the entire reach of the main stem. As now regulated by the Wild and Scenic Rivers Act, this plan of development would be prohibited.

Moving on down the river, consideration is directed to diversions that would be made above French Creek's confluence with the Salmon River. In order to develop a projected diversion of 4,500,000 acre feet as reported in Table 14 two approaches might be considered that would have different impact. The first approach would be diversion at the confluence of French Creek that would take the water as it flowed by from a minor diversion dam or barrier and pumping to off - channel storage at rates equal to the available flows which would be very high during the flood season and thus prohibitively expensive. This would mean that the entire river system above French Creek could be included as a wild river. The segment of the river below French Creek to the confluence of Salmon River with the Snake River would of a consequence be prohibited from inclusion. The second approach would be to provide storage on the main stem of the Salmon River say at the Crevice Dam site so that pumping could be done on a more economical basis that would be more acceptable as a diversion possibility at the French Creek site. Such would move the limit of the area unaffected for inclusion as a wild river to a point about 25 miles above French Creek. Such an approach would also eliminate

the segment of the river below such back water of Crevice Dam to the mouth of Salmon River. Both approaches would have severe institutional obstacles to overcome.

Consideration of impact is next directed toward the possibility of diversion at Riggins. (See data in Table 15). It is conceivable that the diversion could be made on a flow available basis with a minimum impounding-type of structure at Riggins. This would imply rather large tunnel or pump capacity and in-transit storage to potential places of use, particularly as regards to handling spring flood runoff storage needs. Based on these premises the impact could be such that the Salmon River above Riggins could be included as a Wild river and still have the development described. The river segment below Riggins might be free flowing but the depleted flow would not appear to permit that stretch below Riggins to qualify for Wild River status. This appears to be one alternative of development that needs to be given more attention in the official joint study being conducted by the U. S. Forest Service and the State of Idaho.

Moving on down river with the constraints as developed in the analysis as mentioned in the previous section and reported in Tables 16 and 17, the impact here would appear to need a little explanation. Diversions at the mouth again under a very far-out and highly theoretical approach could conceivably be made without backing water up the Salmon River. If this were done the entire river could be designated for a Wild River status and still proceed with the conceptual plan for irrigation use outside the Salmon River Basin. More logically it would appear that development might more economically occur by utilizing an impoundment at Lower Canyon Dam site or at Nez Perce Dam site to provide the reservoir to make the out-of-basin transfer in some kind of pump-back scheme as discussed by Dunn (14). If such an impoundment were made, the Salmon River segment available for inclusion in a Wild River system would be decreased by some 40 miles.

If a conceptual Plan such as Scheme 16 were implemented, it would preclude all the main stem of the Salmon River up to North Fork, Idaho from possible inclusion, because to accomplish such would require a series of pump-back impoundments that would be completely unacceptable to wild river criteria.

By using this analysis and progressively relaxing restraints of areas of use and diversion possibilities, a spectrum of choice has been suggested that will be valuable in the subsequent model building of the overall evaluation methodology.

CONCLUSIONS AND RECOMMENDATIONS

From the foregoing study it is concluded that 1) an inventory of irrigation use potentials has been made that will be useful and necessary in developing a comprehensive methodology for evaluating value foregone of water development associated with Salmon River if it were included in a Wild and Scenic Rivers system, 2) the technique used does represent a rather unsophisticated approach that would have application in other areas, particularly Western United States, where certain reconnaissance level plans for use have been previously reported by such groups as resource and river basin planning commissions or committees, U. S. Bureau of Reclamation, U. S. Corps of Engineers, U. S. Soil Conservation Service, and state water agencies. A detailed flow chart of the procedure is presented in the appendix. 3) on the basis of analysis presented in this study it should be pointed out that no irrigation use that would interfere with possible inclusion of the Salmon River as a Wild River can be anticipated until after the year 2020, 4) this study does not include the diseconomies associated with possible conflict with other water development uses such as hydroelectric power, water quality control and flood control. These will have to be worked out in analysis that is planned for in the overall evaluation methodogy, 5) statements of impact of projected irrigation water use from Salmon River on possible Wild River status have been presented by segments and combinations of segments of the river.

It is recommended that a more sophisticated analysis of benefits and costs of two or three of the conceptual plans be studied by water development agencies to give a more accurate appraisal of present value

of irrigation potential. This would mean a more careful economic farm budget analysis of irrigation benefit in the most probable use area, and a cost estimate of the diversion and conveyance facilities including dams, canals, tunnels pumping plants, and other conveyance works. These might best be developed as multipurpose water development schemes that really have not been alluded in this subproject study. Such an approach would project use of dams, power plants and facilities that would try to develop an optimum of benefits such as hydroelectric power, flood control, fish and wildlife enhancement, water quality control, as well as irrigation use. Such water resource agencies as the U. S. Bureau of Reclamation, U. S. Corps of Engineers, Pacific Northwest River Basins Commission and the Idaho Water Resource Board are much better qualified and equipped to pursue such a study and their assistance would be a great value to the Forest Service in their official Salmon River study.

It is recommended that historical inventories of development plans and schemes be maintained as data banks for future planners so repetitive analysis will not be necessary and to provide more choice in the planning process.

A recommendation is made that additional thought and research be directed toward as to how to assign value over time to irrigation water use. In this study it is recognized that the projected net value of water is a 1970 value yet the figures of projected use represents demands in the years 2020 and 2070. Certainly the value of water will change with time, but how?

REFERENCES

(1) Pacific Northwest River Basins Commission, 1969, "Columbia - North Pacific Framework Study, Main Report and 15 Appendices, Prepared by Columbia - North Pacific Technical Staff, PNRBC, Vancouver, Washington.

(2) U. S. Bureau of Reclamation, 1962, "Snake Plain Recharge Project," Idaho, Special Report, Boise, Idaho, June, 1962.

(3) U. S. House of Representatives, 1962, "Columbia River and Tributaries," House Document No. 403, 87th Congress, 2d Session, Volume V, Appendix E, Plates 50, 51.

(4) Peebles, J. J., 1969, "Reconnaissance Survey of Storage Possibilities in French Creek Basin," University of Idaho, Water Resources Research Institute, Moscow, Idaho, October, 1969, pp. 4.

(5) Smith, L. G., 1968, "Western States Water Augmentation Concept," Copyright Lewis G. Smith, 1968, Federation of Rocky Mountain States, Inc., pp. 37, Figs. 9.

(6) Shoup, G. E., 1969, "History of Lemhi County," Idaho State Library, Published Originally in Salmon Recorder Herald, May 8 - October 23, 1940.

(7) Hoyt, W. G., 1935, "Water Utilization in the Snake River Basin," Water Supply Paper 657, Geological Survey, U. S. Department of the Interior, 379 pp.

(8) Idaho Water Resource Board, 1970, Map, "State of Idaho Irrigated and Potentially Irrigable Lands," 30"x 48" size.

(9) U. S. House of Representatives, 1950, The Columbia River, House Document 473, Eighty-First Congress, Second Session, Volumes 1 and 2, U. S. Bureau of Reclamation report.

(10) U. S. House of Representatives, 1952, "Columbia River and Tributaries Northwestern United States, House Document 531, Eighty-First Congress, Second Session, 8 Volumes, U. S. Corps of Engineers Report.

(11) Idaho Water Resource Board, 1970, "Potentially Irrigable Land in Idaho," Idaho Water Resource Board Report, Boise, Idaho, 32 pp.

(12) Corey, G. L. and R. J. Sutter, 1971, "Agricultural Water Needs - Consumptive Irrigation Requirements," Planning Report No. 5, A Study prepared by the Department of Agricultural Engineering, University of Idaho for Idaho Water Resource Board, 49 pp.

(13) U. S. Bureau of Reclamation, 1964, "Challis Project - Idaho," Project Report, Region 1, Boise, Idaho, March, 1964.

(14) U. S. Senate, Committee on Interior and Insular Affairs, 1967, "Central Arizona Project, Hearings before Subcommittee on Water and Power Resources of the Committee on Interior and Insular Affairs, 90th Congress, State of William G. Dunn, Civil Engineer, Water Resource Developments, October, 1965, pp. 718-728.

(15) U. S. Bureau of Reclamation, 1967, "Report on Past Plans for Diversion from Salmon River Basin, Typewritten Communication to Idaho Water Resource Board by Snake River Development Office, U. S. Bureau of Reclamation, April 7, 1967, pp. 12.

(16) Stetson, T. M., 1964, "Review of Pacific Southwest Water Plan," Consulting Engineer Report to Six Agency Committee, 909 South Broadway, Los Angeles, California, pp. 41, Figs. 5.

(17) Nelson, S. B., 1964, "Snake - Colorado Project," Paper presented at 32nd Annual Conference, California Utilities Association, March 11, 1964, Pasadena, California, 16 pp., also presented as report of Department of Water and Power, City of Los Angeles, October, 1963.

(18) Oregon State Water Resources Board, 1969, "Summary Report of Oregon's Long-Range Requirements for Water," Oregon Water Resource Board, Salem, Oregon, May, 1969.

(19) U. S. Bureau of Reclamation, 1970, "Construction Cost Trends," Engineering and Research Center, Office of Design and Construction, Denver, Colorado, October, 1970.

(20) U. S. Department of Agriculture, Economic Research Service, 1971, "Changes in Farm Production and Efficiency (1971)" Statistical Bulletin No. 233, Table 7, Mountain States.

(21) U. S Department of Agriculture, 1970, Agricultural Statistics.

(22) Sutter, R. J. and G. L. Corey, 1970, "Consumptive Irrigation Requirements for Crops in Idaho," Bulletin 516, Agricultural Experiment Station, University of Idaho; Moscow, Idaho, pp. 97.

(23) Wells, G. R., R. T. Peterson and J. M. Kelly, 1969, "Idaho Economic Base Study for Water Requirements," Volume I and II, Idaho Water Resource Board, p. 366.

(24) Nelson, H. T., 1967, "American Falls Replacement Problem," Statement to Idaho Water Resource Board, October 19, 1967, Boise, Idaho, 8 pp and attachment.

(25) U. S. Bureau of Reclamation and Corps of Engineers, 1961, "Upper Snake River Basin, Wyoming-Idaho-Utah-Nevada-Oregon," Volume I, Summary Report, U. S. Department of the Interior, Bureau of Reclamation, Region 1, Boise, Idaho and Corps of Engineers, U. S. Army Engineering District, Walla Walla, Washington.

(26) U. S. Bureau of Reclamation, 1966, "Southwest Idaho Water Development Project, Idaho," Planning Report of Region 1, Boise, Idaho.

(27) Lindeborg, K., 1970, "Economic Values of Irrigation Water in Four Areas Along the Snake River in Idaho, Bulletin 513, Idaho Agricultural Experiment Station, University of Idaho, 27 pp.

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APPENDIX

Flow Chart of Procedures

1. Inventory existing in-basin irrigation.
   Required: A. A detailed mapping and catalog of irrigation within basin by subbasins or watersheds.

2. Estimate projected use of water for irrigation within basin with respect to geographic areas of basin and time.
   Required:
   A. A detailed land classification of irrigable areas in the basin.
   B. An agricultural water needs analysis of these irrigable acres to project probable irrigation development based on availability of water and economic potential to permit such development.
   C. Subjective appraisal of the restraints such as legal and environmental limitations.

3. Inventory existing out-of-basin irrigation use that might have impact on possible inclusion of river as a wild river.
   Reauired:
   A. Adequate reconnaissance planning reports similar to the Pacific Northwest River Basin's "Columbia-North Pacific Framework Study" and the Idaho Water Resource Board's, "Idaho Water Resource Inventory.

4. Estimate the out-of-basin projected irrigation use from the study river as a source at certain points in time through a system of dividing your out-of-basin areas into subbasins with their own restraints for water supply identified from within and identification of alternatives for supply of the subbasin needs from other sources than the study river.

Required:
A. As detailed of water plans for the surrounding areas as possible.
B. May require special planning studies of reconnaissance nature in adjoining river basins.

5. Inventory all logical diversion possibilities in the form of conceptual plans for in-basin use and out-of-basin use. If enough alternatives from published studies do not give an adequate geographic distribution of possible diversions, fabricate the best diversion scheme possible under time restraints of study.
Required:
A. Feasibility and Reconnaissance water diversion studies.
B. Imagination of various physical water conveyance schemes.

6. Theoretical division of the study river into segments and choose restraints of particular plans that would be applicable if diversion for irrigation were permitted in selected segments of study river.
Required:
A. Detailed topographic maps
B. Information on flows available at various points.

7. Choose Best Conceptual Plan. By analytical means and by most objective manner the best conceptual plan, and identify magnitude of diversion by segment, proceeding from upstream to downstream segment. This identified projected quantity of water to be used both as to time and space.
Required:
A. As much economic data on diversion scheme costs as possible.
B. Information on possible legal and environmental restraints.
C. Storage opportunities in the basin.
D. Flow data throughout the various reaches of the study river.

8. Estimate an upper boundary of value of this water for irrigation use per acre as of present time. Base this on the highest benefit assigned to either recently completed projects or projects for which agencies and companies have feasibility level plans. Use this as maximum present value of water per acre.
   Required: A. Farm budget studies.
   B. Benefit analysis of irrigation use

9. Estimate farm irrigation demand for water.
   Required: A. A consumptive use technique for estimating water demand such as Blaney Criddle or Corey-Sutter approach.
   B. A farm and conveyance efficiency of use value for water in the area.

10. Compute gross value of water per acre foot dividing present value of irrigation per acre from 8 by farm irrigation demand for water from 9.

11. Choose a benefit-cost ratio from bona fide feasibility studies in the area. This can be the optimum or best project use area. May require detailed benefit-cost analysis.

12. Divide gross value of irrigation water per acre foot by Benefit-Cost ratio to get a measure of the least cost that might be assigned for supplying such water.

13. Subtract the least cost value obtained above in dollars per acre fot from the gross value of irrigation water to get present net value of water.

14. To obtain value of water for irrigation by segments or combinations of segments multiply projected quantity of use by these present net values of water recognizing each case where the water is projected for use and choose optimum based on greatest net benefit to be associated with a given segment or segments.

15. Analyze impact of various water developments of irrigation use by segments on the status or potential for possible inclusion and qualification for wild river status.