SNAKE RIVER FLOW AUGMENTATION IMPACT ANALYSIS APPENDIX

Prepared for the

U.S. Army Corps of Engineers
Walla Walla District's

Lower Snake River Juvenile Salmon Migration
Feasibility Study and Environmental Impact Statement

United States Department of the Interior

Bureau of Reclamation

Pacific Northwest Region

Boise, Idaho

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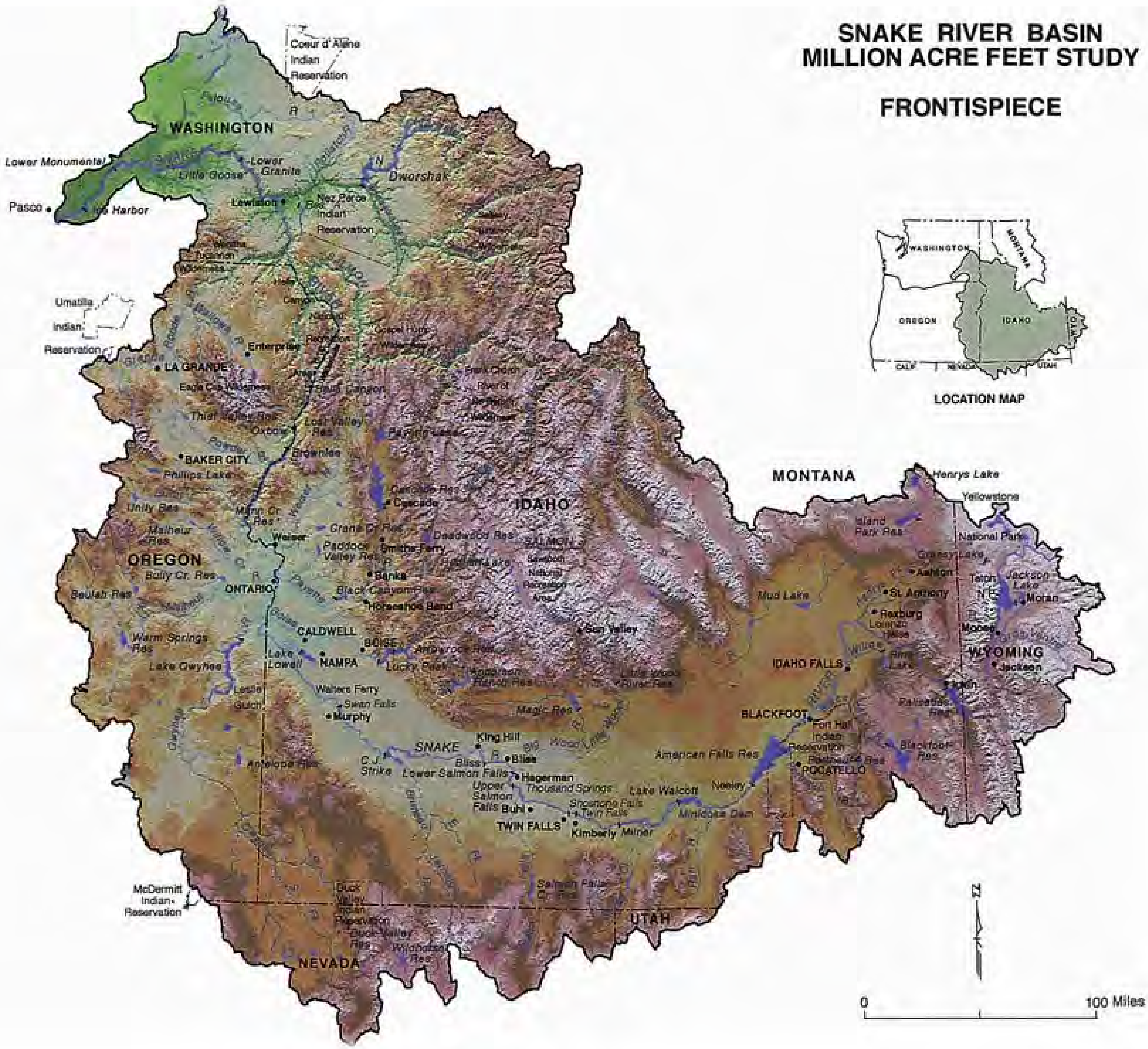
SNAKE RIVER BASIN
MILLION ACRE FEET STUDY

FRONTISPIECE



Acronyms and Abbreviations

(Includes some common acronyms and abbreviations that may not appear in this document)

1427i	A scenario in this analysis that provides up to 1,427,000 acre-feet of flow augmentation with large drawdown of Reclamation reservoirs.
1427r	A scenario in this analysis that provides up to 1,427,000 acre-feet of flow augmentation with reservoir elevations maintained near current levels.
BA	Biological assessment
BEA	Bureau of Economic Analysis (U.S. Department of Commerce)
BETTER	Box Exchange Transport Temperature Ecology Reservoir (a water quality model)
BIA	Bureau of Indian Affairs
BID	Burley Irrigation District
BIOP	Biological opinion
BLM	Bureau of Land Management
B.P.	Before present
BPA	Bonneville Power Administration
CES	Conservation Extension Service
cfs	Cubic feet per second
Corps	U.S. Army Corps of Engineers
CRFMP	Columbia River Fish Mitigation Program
CRP	Conservation Reserve Program
CVPIA	Central Valley Project Improvement Act
CWA	Clean Water Act
DO	Dissolved Oxygen

Acronyms and Abbreviations

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DREW	Drawdown Regional Economic Workgroup
DDT	Dichlorodiphenyltrichloroethane
EIS	Environmental Impact Statement
EP	Effective Precipitation
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ETAW	Evapotranspiration of Applied Water
FCRPS	Federal Columbia River Power System
FERC	Federal Energy Regulatory Commission
FIRE	Finance, investment, and real estate
HCNRA	Hells Canyon National Recreation Area
HUC	Hydrologic unit code
I.C.	Idaho Code
IDFG	Idaho Department of Fish and Game
IDPR	Idaho Department of Parks and Recreation
IDWR	Idaho Department of Water Resources
IMPLAN	Impact Analysis for Planning, an input-output economic modeling framework that provides a detailed picture of a regional economy and predicts potential effects on that economy
INEEL	Idaho National Engineering and Environmental Lab
I-O	Input-Output
IPC	Idaho Power Company
ITA	Indian trust asset
IWRB	Idaho Water Resources Board
kW	Kilowatt

Acronyms and Abbreviations

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kWh	Kilowatt-hour
MAF	Million acre-feet
M&I	Municipal and industrial
mg/L	Milligrams per liter
MODSIM	A river basin hydrology network flow simulation model capable of assessing past, present, and future water management policies
MW	Megawatt
MWh	Megawatt-hour
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPPC	Northwest Power Planning Council
NPS	National Park Service
ODFW	Oregon Department of Fish and Wildlife
OWRD	Oregon Water Resources Department
PATH	Plan for Analyzing and Testing Hypotheses (see glossary)
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RFC	River Forecast Center, National Weather Service
RM	River mile
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
SBC	Surface bypass and collection device
SHPO	State Historic Preservation Officer
SIIPR	Southern Idaho Irrigation Pumping Rate
SRDSS	Snake River Decision Support System
SR^3	Snake River Resources Review

Acronyms and Abbreviations

(Includes some common acronyms and abbreviations that may not appear in this document)

SRPA	Snake River Plain Aquifer
T&E	Threatened and endangered (species)
TCP	Traditional cultural property
TMDL	Total maximum daily load (refers to pollutants)
TMT	Technical Management Team
TSC	Reclamation’s Denver Technical Service Center
TWG	Technical Work Group
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WGFD	Wyoming Game and Fish Department
U.S.C	United States Code

Glossary

A-run steelhead	An anadromous fish that spends an average of 1 year in the ocean before returning to spawning streams and attain a size of 4-8 pounds (see B-run steelhead).
Acre-foot	Volume of water equivalent to 1 foot deep over an area of 1 acre; 326,000 gallons.
Active storage	Reservoir space allocation available for release.
Acerbic	Living in the absence of oxygen or produced by such organisms.
Anoxic	Lack of oxygen to the extent that an organism is damaged.
Bank full	Maximum stream flow that raises the water level to the top of the bank without flooding.
B-run steelhead	An anadromous fish that spends an average of 2 years in the ocean and grow to 12-20 pounds as adults.
Blaney-Criddle program	A computer program that is used to estimate the consumptive water use of crops consumptive based on the type of crop and the environmental conditions of the area.
Conservation pool	A minimum reservoir elevation (or pool volume) target. Administratively determined, recognizing that lower elevations are possible during drought conditions.
Consumptive use	Use that permanently removes the water from the system.
Contracted storage space	Portion of the active storage space for which there are contracts with specific individuals and entities for use.
Cost allocation	A method of distributing the construction costs and the annual operating costs of Federal projects among the benefitting functions. This is a first step to identifying the amount of annual payment needed to recover the Federal cost of construction and operation of a project.
Dead storage	Reservoir storage allocation that is below the lowest outlet level and cannot be released from the pool by gravity.
Entrainment	Passing through a dam.
Escapement	The number of adult anadromous spawning fish that have returned to spawn.

Glossary

Exclusive flood control space	Reservoir storage allocation that is filled only to help regulate inflow to reduce downstream flood damage.
Flood control rules	Tables or graphs that indicate the amount of reservoir space to be maintained under various conditions to provide specific levels of flood control downstream.
Freshet	A substantial natural increase in streamflow, typically in the spring.
Four lower Snake River dams	Lower Granite, Little Goose, Lower Monumental, and Ice Harbor; owned and operated by the Corps.
Hells Canyon complex	Brownlee, Oxbow, and Hells Canyon Dams on the main Snake River; owned and operated by IPC.
Implementation Team	A multi-party group of senior-level policymakers established in NMFS 1995 BIOP to provide executive level management and direction over salmon protection efforts. Supervises the TMT.
Inactive storage	Reservoir storage allocation between dead storage and active storage elevations. Normally retained for specific operating requirements.
Joint-use storage	Active storage allocation that may be used for more than one purpose, most often flood control and irrigation.
Last-to-fill rule	A rule related to the operation of Idaho rental pools. The space occupied by water placed into the rental the previous year and used for downstream purposes can be filled only after all other contracted space fills. Without this rule the contractors that don't place water in the rental pool would be penalized in years that the reservoir does not fill.
Load	The total demand for electricity.
Nonprime farmlands	A USDA category of farmland that does not meet the qualifications for prime farmlands.
Lower Snake River	The reach of the Snake River from Brownlee Reservoir to the mouth.
Main stem	The major stream channel, exclusive of tributaries.
Middle Snake River	The reach of the Snake River from Milner Dam to Brownlee Reservoir (this section is sometimes included in the Upper Snake River designation).

Glossary

Natural flow rights	State granted water rights to use the natural flow of a stream, as opposed to reservoir storage.
Nonreimbursable costs	Federal project costs that are absorbed by the Federal Government as opposed to reimbursable costs to be repaid by specific beneficiaries.
Off-peak	Refers to electric load or generation at times when the electric load is significantly less than at other times.
On-peak	Refers to electric load or generation at times when the electric load is near the maximum during the day (usually during the morning on week days)
Power head	Hydraulic head (elevation of water) necessary for proper operation of hydroelectric generators. Part of the inactive space allocation.
Plan for Analyzing and Testing Hypotheses	A group of Federal, state, and tribal biologist that NMFS confers with to develop data relative to salmon survival and recovery.
Reacquired storage space	Contracted storage space that Reclamation has purchased from a spaceholder.
Reallocation	A change in the distribution of costs by function.
Reassigned storage space	Uncontracted storage space that Reclamation uses for designated purposes.
Reauthorization	Congressional action that changes the original authorization of a Federal project.
Reclamation Act of 1902	Established a Reclamation fund and authorized the Secretary of the Interior to use the fund to make examinations and surveys and to locate and construct irrigation works in the 16 (later 17) western states.
Reclamation Project	"The term 'project' shall mean any reclamation or irrigation project including incidental features thereof, authorized by the Federal reclamation laws, or constructed by the United States pursuant to said laws, or any project constructed or operated and maintained by the Secretary [of the Interior] through the Bureau of Reclamation for the reclamation of arid lands or other purposes."
Reimbursable costs	Costs associated with a Federal Project that are required to be repaid by a non-Federal beneficiary.

Glossary

Rental pool	The functional process authorized by the Idaho Water Bank Statutes which allows local committees to administer rental of stored water. Three rental pools are currently operating: Upper Snake, Boise, and Payette. These rental pools administer only stored water. Reservoir spaceholder may consign stored water to the rental pool which then leases the water to applicants. A rental pool is essentially an accounting procedure for water rights and are not a physical structure.
Repayment contract	A permanent contract between Reclamation and an individual or entity that gives the shareholder use of project facilities in return for paying a portion of the construction and operating costs of a Reclamation project. See spaceholder contract.
River basin	The geographic area drained by a river.
River mile	The distance in miles from the mouth of a river to a given point upstream as measured following the center of the stream bed.
Run-of-river	Refers to hydroelectric power generation facilities that have limited water storage capacity so that the amount of power generated at any instant is generally proportional to the natural flow of the river.
Spaceholder	The individual or entity that hold a spaceholder contract.
Spaceholder contract	A type of repayment contract for reservoir space in which the contractor receives the water that accumulates in the contracted storage space. Usually includes the right to carry over water from year to year in the contracted space.
Subbasin	The geographic area drained by a stream that is tributary to another stream.
Taking	An action by a public governing body to appropriate a private asset; requires compensation.
Technical Management Team	An interagency group of fisheries managers and river operators that make inseason decisions on river operations based on the NMFS' 1995 BIOP for Snake River wild salmon and on the 1998 Steelhead BIOP (NMFS).
Total maximum daily load	The sum of the individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background and a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure that relates to a state's water quality standard.
Turnover (reservoir)	Mixing of stratified water zones (cold on bottom and warm on top) that normally occurs in the spring and the fall when weather conditions cause the top layer to become colder than the lower layer

Glossary

Uncontracted storage	That portion of the active reservoir pool not under contract.
Upper Snake River	The reach of the Snake River extending from Milner Dam to the headwaters (also occasionally used to indicate the Snake River from Brownlee Reservoir to the headwaters).
Waterbank	Idaho's water bank was initiated by a 1984 Idaho Law. It allows water rights holders and reservoir spaceholders to temporarily rent their water to other users through the State administered water bank or through local rental pools.
Water service contracts	A fixed-term contract where the buyer contracts to receive a specific amount of water each year.
Water rights	A type of property right administered by the state for use of state waters.

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Executive Summary

Introduction

The U.S. Army Corps of Engineers is conducting the Lower Snake River Juvenile Migration Study in response to concerns about the propagation of the Snake River salmon and steelhead. Populations of these anadromous fish continue to decline to the point that one run is listed as endangered and others are listed as threatened under the Endangered Species Acts. One measure for improving juvenile migration is to provide flow augmentation water from the Snake River upstream of Lower Granite Lake to improve streamflows and move juveniles salmon and steelhead more rapidly toward the ocean.

In 1995, Reclamation agreed to provide 427,000 acre-feet of flow augmentation water and has been doing so every year since. The Corps requested that the Bureau of Reclamation analyze the effects of providing a flow augmentation at a level 1,000,000 acre-feet greater than the current level of 427,000 acre-feet. Reclamation developed and analyzed the following scenarios:

- Base Case: Provide 427,000 acre-feet of flow augmentation water each year (existing condition since 1993).

- No Augmentation: Provide no water for flow augmentation (condition prior to 1991).

- 1427i: Provide up to 1,427,000 acre-feet of flow augmentation water to meet deficits in flow targets at Lower Granite Dam. Irrigation shortages would be minimized by using large drawdowns of Reclamation reservoirs.

- 1427r: Provide up to 1,427,000 acre-feet of flow augmentation water to meet deficits in flow targets at Lower Granite Dam. Reservoir elevations would be maintained at or near the Base Case levels with shortages assumed by irrigation.

All larger reservoirs in the Snake River basin upstream of Lower Granite Lake, with the exception of those owned by Idaho Power Company, are owned by Reclamation and operated as part of Federal Reclamation projects. These reservoirs have a total combined capacity of about 7.9 million acre-feet of which 7 million acre-feet are in active space, capable of storing water for irrigation, flood control, and other uses. The remaining capacity is mostly in inactive space needed for reservoir operations. Of the total amount of active space, 6.3 million acre-feet have been contracted to users primarily for irrigation water supply. All active space not under contract, about 690,000 acre-feet, has been assigned to a variety of purposes, primarily related to environmental quality improvement; this amount includes about 159,000 acre-feet of space now assigned to flow augmentation.

Reclamation evaluated other potential water supplies and identified about 293,640 acre-feet in natural flows now used to irrigate about 221,500 acres in five areas in Wyoming, Nevada, Idaho, and Oregon for this analysis. In addition, Reclamation would continue to use the 17,650 acre-feet of natural flows purchased in 1997 as part of the Base Case program of obtaining water supplies for flow augmentation. The total amount of natural flow used in this hydrologic analysis was 311,290 acre-feet. Reclamation did not evaluate the potential for use of storage in non-Reclamation reservoirs, use of groundwater, or development of new storage.

In this analysis the Bureau of Reclamation has attempted to estimate the environmental, economic, social, cultural and recreational effects of acquiring natural flow rights and storage space to provide up to 1,427,000 acre-feet of water for flow augmentation. Due to a limited timeframe, the study does not attempt to address all possible impacts nor does it represent specific outcomes.

Flow Augmentation Scenarios

The 1,427,000-acre-foot scenarios for this analysis are conceptual only. Selection of water sources for flow augmentation has a direct bearing on the type, location, and degree of potential impact on economies, natural resources, and communities. For this analysis, larger blocks of water were identified for acquisition based primarily on water rights, refill of reservoirs, and reduction of potential adverse impacts. Acquisition of water to implement a 1,427,000 acre-foot scenario would likely result in an entirely different mix of water sources based at least in part on economics, Federal-state negotiations, and other factors including the method of acquisition. The effect of such factors on the acquisition of water for flow augmentation is speculative at present. As a result, the reader is cautioned that although potential effects, especially economic effects, have been identified in some detail, the analysis remains conceptual.

Base Case

For this analysis, Reclamation assumed that the pattern of water acquisition for the Base Case would remain unchanged. Water acquisition consists of a small amount of natural flow rights and storage space, reassignment of Reclamation storage space, and annual purchase of rental water. Delivery of the 427,000 acre-feet relies heavily on the annual purchase of water from rental pools in good and normal water years and the use of water in Reclamation inactive space (powerhead space) in drought years. In the past, water from rental pools has made up about 60 percent of the total amount of water delivered for flow augmentation.

No Augmentation

The No Augmentation Scenario assumes operations as they existed before 1991 when no water was released downstream for flow augmentation.

1427i and 1427r Scenarios

The 1427i and 1427r scenarios are identical in goal—to provide up to 1,427,000 acre-feet to help meet target flows at Lower Granite Dam as identified in the 1995 Biological Opinion of the National Marine Fisheries Service on the Federal Columbia River Power System. Both scenarios would include the same amount of water acquired from natural flow rights, but much different amounts of water acquired from Reclamation storage. The two scenarios represent two ends of a possible continuum of ways to reach the flow augmentation goal using Reclamation storage. Under the 1427i scenario, water shortages to users of water from Reclamation reservoirs would be minimized to the extent possible by large drawdown of reservoirs. Under the 1427r scenario, Reclamation reservoirs would be maintained near current water levels but water users who have contracted for Reclamation storage would suffer more serious shortages.

The water supply for the 1427i and 1427r scenario was assumed to include Base Case water supply minus rental pool acquisitions. It is anticipated there would be little or no water consigned to water rental pools due to large purchase of water for the 1427i and 1427r scenarios and resultant water shortages for irrigators.

Natural flow rights were assumed to be available in every year. However, most of the water for flow augmentation would come from acquisition of storage space and reassignment of storage in Reclamation reservoirs. Water that accumulates in this space would vary from year to year.

The amount of water needed for the 1427r scenario would be much larger than the amount needed for the 1427i scenario. Under the 1427i scenario, storage space reassigned or purchased for flow augmentation would be released as needed without concern for reservoir levels. Under the 1427r scenario, maintaining reservoir levels equivalent to the Base Case would require reassignment and purchase of much larger amounts of storage space.

Tables S-1 and S-2 summarize the sources and volumes of water used in the hydrologic analysis. All of the Reclamation water sources consist of storage space in reservoirs located (1) on the main stem of the Snake River, (2) in the Boise River basin, (3) in the Payette River Basin, and (4) on the Owyhee River. As can be seen in tables S-1 and S-2, the largest water source for either scenario is Reclamation storage space. Total storage space needs to be much larger than the volume provided each year because the storage space is not filled each year and about 313,000 acre-feet of space is inactive storage that is used only in emergencies. (Inactive storage space is space needed for operational purposes and is not part of the storage available for contract.)

Table S-1 Water Sources Used for the 1427i Scenario

Location	Volume (Acre-Feet)		
	Base Case	Additional	Total
Natural Flow Rights[1]			
Wyoming	0	27,640	27,640
Nevada	0	21,900	21,900
Idaho (Salmon River basin)	0	87,470	87,470
Idaho (Snake River)	0	134,950	134,950
Oregon	17,650	21,680	39,330
Total	17,650	293,640	311,290
Storage Space in Reclamation Reservoirs[2]			
Upstream of Milner Dam	[3]294,896	821,191	1,116,087
Boise/Payette River basins	[4]176,932	425,000	601,932
Owyhee River basin	0	200,000	200,000
Total storage space	471,828	1,446,191	1,918,019

[1]This amount of water is assumed to be available each year.
[2]The volume of storage space. The amount of water available to that storage space varies from year to year and was determined by hydrologic runs using the 62-year historical period of 1928-1989.
[3]Includes 272,000 acre-feet of inactive space.
[4]Includes 41,000 acre-feet of inactive space.

Table S-2 Water Sources Used for the 1427r Scenario			
Location	Volume (Acre-Feet)		
	Base Case	Additional	Total
Natural Flow Rights[1]			
Wyoming	0	27,640	27,640
Nevada	0	21,900	21,900
Idaho (Salmon River basin)	0	87,470	87,470
Idaho (Snake River)	0	134,950	134,950
Oregon	17,650	21,680	39,330
Total	17,650	293,640	311,290
Storage Space in Reclamation Reservoirs[2]			
Upstream of Milner Dam	[3]294,896	1,818,224	2,113,120
Boise/Payette River basins	[4]176,932	984,000	1,160,932
Owyhee River basin	0	200,000	200,000
Total storage space	471,828	3,002,224	3,474,052

[1]This amount of water is assumed to be available each year.
[2]The volume of storage space. The amount of water available to that storage space varies from year to year and was determined by hydrologic runs using the 62-year historical period of 1928-1989.
[3]Includes 272,000 acre-feet of inactive space.
[4]Includes 41,000 acre-feet of inactive space.

Hydrologic Analysis

Hydrologic analysis for this study is based on computer simulation using MODSIM. MODSIM is a river basin network flow model in which water is allocated consistent with hydrological, physical, and institutional aspects of a river basin. The model includes direct flow rights, instream flow rights, reservoir storage rights, reservoir system operational requirements, and water exchanges and operational priorities. The simulation attempts to work within the parameters of the real operating system.

Hydrologic data provided by the simulation included tables and graphs of end of month contents of reservoirs and average monthly flows for key river reaches over a 62-year period of analysis. The model uses the historical water supply for the period of 1928-1989 as input to determine the effect of the scenarios. Also included in the model are the current system of reservoirs, the 1991 acreage of irrigation, and the current system operation for flood control and refill of reservoirs.

Hydrologic data, primarily in the form of tables of reservoir end of month content and average monthly streamflows, were provided to the technical experts in fields of economics, fish and wildlife, water quality, and recreation.

Flow Augmentation Goals

Based on the hydrologic analysis, the flow augmentation goals would be met to the following extent:

- Base Case — 82 percent of years
- 1427i — 97 percent of years
- 1427r — 100 percent of years

Table S-3 shows that the Base Case would deliver a minimum of 179,000 acre-feet in any year but would deliver 427,000 acre-feet in 51 of 62 years.

Table S-3 Base Case Future Delivery of Augmentation Flows

Volume Delivered	Percentage of Years Met	Number of Years Met
427,000 acre-feet	82	51 of 62
300,000 acre-feet	92	57 of 62
250,000 acre-feet	95	59 of 62
179,000 acre-feet	100	62 of 62

Table S-4 shows that the 1427i scenario would deliver 1,427,000 acre-feet in 38 of 40 years when the deficit at Lower Granite Dam exceeds 1,427,000 acre-feet and would deliver the deficit amount in every year when the deficit was less than 1,427,000 acre-feet.

Table S-4 1427i Future Delivery of Augmentation Flows

Volume Delivered	Percentage of Years Met	Number of Years Met
Lower Granite Dam Flow Deficit exceeds 1,427,000 acre-feet		
1,427,000 acre-feet	95 percent	38 of 40 years
1,200,000 acre-feet	98 percent	39 of 40 years
1,100,000 acre-feet	100 percent	40 of 40 years
Lower Granite Dam Flow Deficit less than 1,427,000 acre-feet		
Amount varies each year	100 percent	22 of 22 years

Table S-5 shows that the 1427r Scenario would deliver 1,427,000 acre-feet in every year that the deficit at Lower Granite Dam would exceed 1,427,000 acre-feet and would deliver the deficit amount in every year when the deficit was less than 1,427,000 acre-feet.

Table S-5 1427r Future Delivery of Augmentation Flows		
Volume Delivered	Percentage of Years Met	Number of Years Met
Lower Granite Dam Flow Deficit exceed 1,427,000 acre-feet		
1,427,000 acre-feet	100 percent	40 of 40 years
Lower Granite Dam Target less than 1,427,000 acre-feet		
Amount varies each year	100 percent	22 of 22 years

Irrigation Shortages

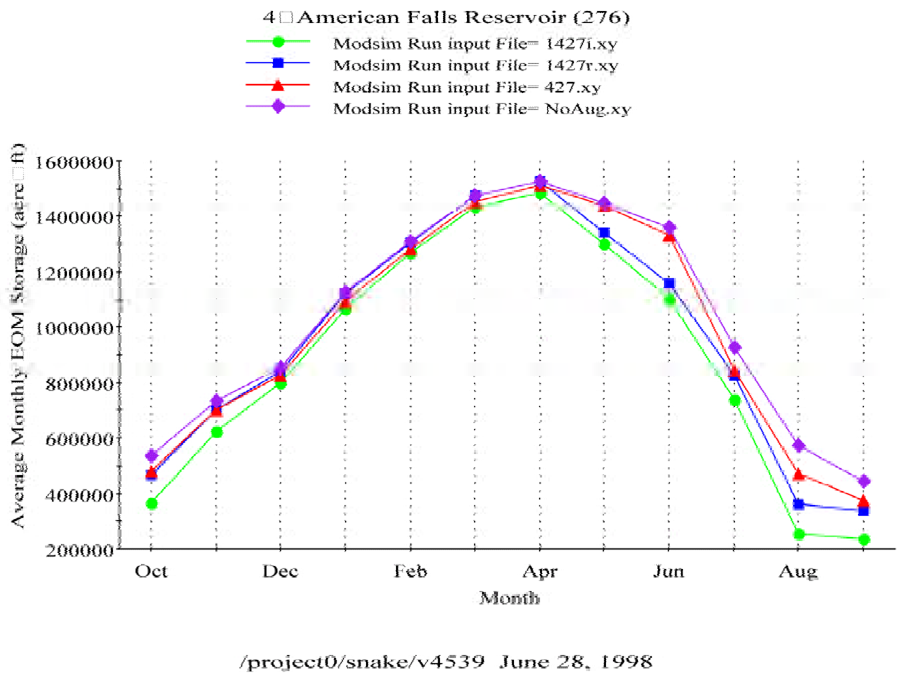
Flow augmentation would reduce the amount of water available for irrigation of lands in Reclamation projects. Based on the hydrologic analysis, tables of irrigation shortages for the average, a dry year, and a wet year were developed. Irrigation shortage is considered to be the difference between the demand for irrigation water and the amount of water available from Reclamation storage. The Base Case and No Augmentation Scenario do not differ significantly and there are shortages even in wet years. Table S-6 summarizes the data.

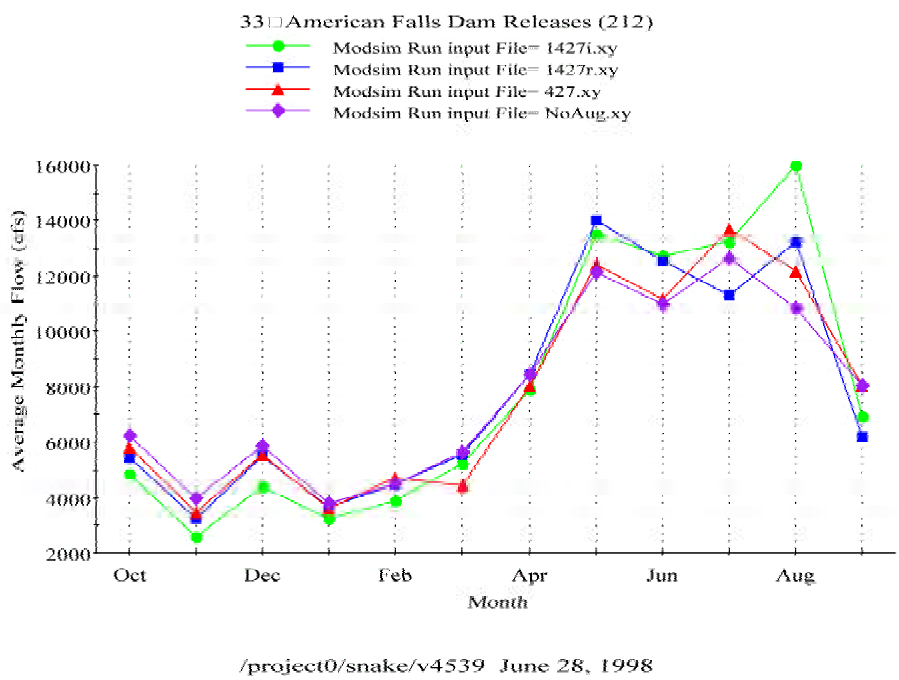
Table S-6 Irrigation Shortages for All Scenarios (Acre-Feet)				
Period	Base Case	No Augmentation	1427i	1427r
Average (1928-1989)	72,216	72,964	187,743	770,746
Dry year (1977)	335,634	444,607	1,043,335	2,201,459
Wet year (l983)	2,261	2,261	3,593	132,633
Average annual diversion is 11,779,498 acre-feet under the Base Case				

Reservoir and Streamflow Effects

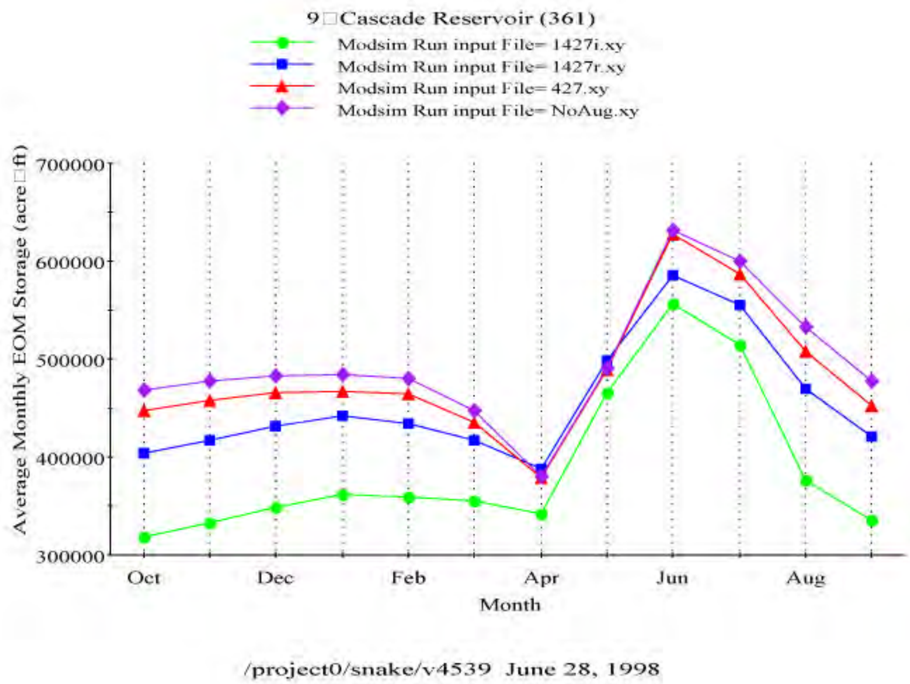
Graphs of the average end-of-month content and average monthly outflow for American Falls and Cascade Reservoirs illustrate the effects of the scenarios. These sites show extreme differences among the scenarios. Other sites show smaller differences among scenarios and some sites show negligible differences when averaged over the 62-year period of analysis. Most reservoirs in some years would be drawn down much further under the 1427i scenario than under the Base Case or the 1427r scenario.

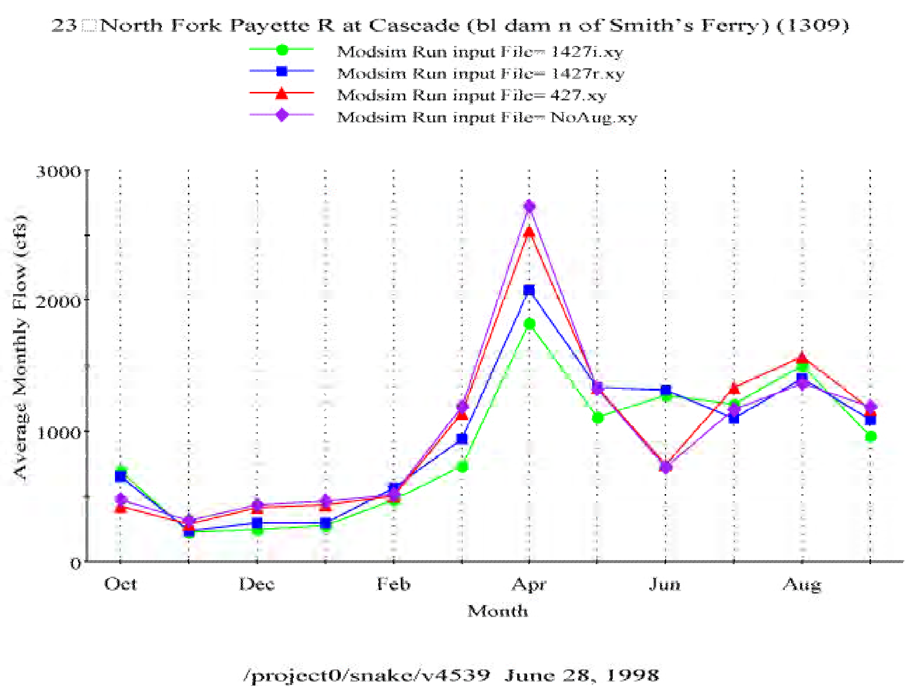
Table 2-7 shows some differences that could be expected with respect to reservoir minimum pools and minimum outflows of selected reservoirs. Target minimum pools at some reservoirs would be maintained about an equal percentage of the years under all scenarios.





American Falls Reservoir Average End of Month Content and Average Monthly Release





Cacades Reservoir Average End of Month Content and Average Monthly Release

Table S-7 Maintenance of Reservoir Target Minimum Pools and Target Minimum Releases (Percent of years over a 62-year period of analysis)				
Reservoir	Base Case	No Augmentation	1427i	1427r
American Falls Reservoir 100,000 acre-feet minimum (in September)	58	66	34	56
Cascade Reservoir 300,000 acre-feet minimum (year-round)	95	95	70	100
American Falls release 300 cfs minimum release at Neeley (November-March)	85	87	82	88
Lucky Peak 80 cfs minimum release (November-February)	80	80	72	85
Owyhee Dam 10 cfs minimum release (October-March)	15	15	10	10

If end-of-month contents are compared over all months for the entire 62-year period of analysis, most reservoirs show a lower average content under the 1427i scenario compared to the Base Case. Average end-of-month content of most reservoirs under the 1427r and No Augmentation scenarios would not be significantly different from the Base Case. Table S-8 summarizes reservoir average content as a percent of the Base Case reservoir content.

Table S-8 Average End-of-Month Reservoir Content Over the 62-year Analysis Period (Percent of the Base Case)				
Reservoir	Base Case	No Augmentation	1427i	1427r
Jackson Lake	100	99	92	98
Palisades Reservoir	100	103	89	102
Island Park Reservoir	100	100	101	101
American Falls Reservoir	100	107	86	97
Lake Walcott	100	100	100	100
Anderson Ranch Reservoir	100	101	88	96
Arrowrock Reservoir	100	102	66	121
Lucky Peak Lake	100	100	87	105
Deadwood Reservoir	100	100	100	100
Cascade Reservoir	100	103	80	96
Owyhee Reservoir	100	98	90	103

Under the 1427i and 1427r scenarios, streamflows downstream of most reservoirs would generally be greater from April through September and less during the fall and winter compared to the Base Case. These effects would be particularly significant immediately downstream from reservoirs that provide a large amount of the flow augmentation water. Streamflows with the No Augmentation scenario would not be significantly different from the Base Case except in the reach immediately downstream from Milner Dam. In this reach, flows would be significantly reduced during the April through September period.

Economic Analysis

National and Regional Perspectives

Changes in agricultural production, hydropower generation, and recreation due to the flow augmentation scenarios would have national and regional economic impacts. National economic impacts were identified for agriculture, hydropower, and recreation; regional impacts were identified only for agriculture and recreation. In general, the No Augmentation scenario was found to be indistinguishable from the Base Case.

The economic analyses measure impacts of the scenarios from (1) the national view which considers the net effects to the nation and (2) the regional perspective which identifies economic gains and losses to specific functional economic regions in the Snake River basin.

Under the national perspective only those gains or losses at the national level are identified. Generally, national effects represent the initial or primary response of a specific resource category (e.g., irrigation, hydropower, recreation) to a change. For example, a scenario showing less water being available to irrigation, may reduce irrigated farm income. This is a negative effect to the national economy. Potential changes in the value of the output of goods and services were estimated for irrigation, hydropower, and recreation.

Under the regional perspective the potential economic consequences of the 1427i and 1427r scenarios on sales, employment, and income for four identified functional economic regions were estimated. These regional impacts represent the change in the economy of a region resulting from a change in the operation of the Snake River basin water supply. For example, a change in the irrigation water supply, in addition to the direct impact to irrigated farming, may also potentially affect those industries or sectors supplying inputs to irrigated farming located within the particular region. Regional impacts also reflect the succeeding rounds of spending by related businesses and households. Because of the nature of what is being measured, regional impacts are not directly additive to the impacts measured from the national perspective. Regional impacts were developed by preparing a regional input-output model (IMPLAN) constructed for four functional economic regions in the Snake River basin.

Results of the economic analysis are summarized in table S-11.

Water Acquisition Costs

In order to meet the flow and volume targets at Lower Granite Dam additional water would be required from the Snake River basin. The analysis assumes that water would be acquired from willing sellers. Accordingly, a comparison of impacts is not complete without acknowledging the budgetary requirements for water acquisition and related transaction costs.

Different methods of estimating the cost are addressed. A low to medium estimate is to base water acquisition cost on recent purchases by Reclamation in the Snake River basin. An escalation component is added using correlative relationships from other water basins in the West, recognizing the relative influence on the market for purchases of this size. Using this method, the annual water acquisition cost could range from $10.4 million to $31.2 million for the 1427i scenario and from $31.1 million to $87.2 million for the 1427r scenario. Using these figures, the lump sum costs (capitalized values) would be $151.3 million to $453.8 million for the 1427i scenario and $452.2 million to $1.3 billion for the 1427r scenario.

In addition to the water acquisition cost, which is income paid to the seller, there are other potential costs associated with implementation, that may be borne by Federal and State governments, and by other entities. These transaction costs may include, but are not limited to: water right identification, contract negotiation costs, legal costs, monitoring, revegetation costs for lands taken out of production, in lieu O&M costs to irrigation districts and property taxes, weed and erosion control, environmental compliance costs, and potential mitigation costs.

Transaction costs were estimated as annual costs and are projected to range from $2.4 million to $4.8 million for the 1427i scenario and from $7.3 million to $14.7 million for the 1427r scenario.

Resource Analysis

Water Quality

Water quality changes overall would not be dramatic. However, the 1427i scenario would adversely affect water quality in American Falls Reservoir and Cascade Reservoir. Riverflows downstream of reservoirs that provide flow augmentation water would increase during the summer flow augmentation period but would decrease relative to the Base Case during the winter. The latter is particularly true with the 1427i scenario. Water quality of reservoirs is closely linked to content. In general, the higher the content, the better the water quality and the less chance of sluicing sediments downstream (see table S-8).

Fish

Releases of flow augmentation water would decrease reservoir carryover and reduce annual minimum pools in some years. Reduced pools could lead to increased fish emigration at American Falls and Palisades Reservoirs. Reduced pools and increased fluctuations would reduce total available habitat and fish productivity in affected reservoirs. The effect of the 1427i and 1427r scenarios compared to the Base Case would vary from stream reach to stream reach and from reservoir to reservoir. In general, the 1427i scenario would result in adverse conditions for most reservoirs and river reaches compared to the Base Case and the 1427r scenario. In contrast, the 1427r scenario would result in improved conditions in some reaches or in some reaches at some times compared to the Base Case. Whether these changes would result in any significant change in fish populations is unclear.

Wildlife and Vegetation, Including Wetlands and Riparian Habitat

The No Augmentation scenario would have little effect on the wildlife, vegetation, or wetland communities of the affected area as compared to the Base Case. The 1427i and 1427r scenarios may result in improved streamside wetland and riparian habitat vigor due to improved downstream flows. Both scenarios would result in significant reductions of irrigated crops and increase in fallow lands and/or dry land crops and vegetation, with 1427r having the greatest effect--especially in the middle Snake River area. There would be significant reductions in reservoir levels and carryover under the 1427i scenario, adversely affecting reservoir shoreline wetlands and riparian communities. More mudflats, used as feeding habitat by some animals, would be exposed.

Threatened and Endangered Species

The area for this analysis of flow augmentation options is the home or within the migration pattern of a wide variety of species listed under the Endangered Species Act. Species that could potentially be affected by one or more of the flow augmentation scenarios were identified and considered for evaluation. These species are listed in table S-9.

Table S-9 Endangered Species Act Federally Listed Species Found Within the Area and Considered in this Analysis

Common Name[1]	Scientific Name	Major Streams and Reservoirs Where Present
Federally Listed Endangered Species		
1 - American peregrine falcon	*Falco peregrinus anatum* and *Falco peregrinus tundrius*	Main stem and Henrys Fork including associated reservoirs, Lake Owyhee and downstream, Boise River and Payette Rivers including associated reservoirs.
2 - Snake River sockeye salmon	*Oncorhynchus nerka*	Lower Snake River downstream of Hells Canyon Dam; critical habitat designation, Salmon River
3 - Idaho springsnail	*Pyrgulopsis idahoensis*	Middle Snake River (Bancroft Springs to downstream of C.J. Strike Dam)
3 - Snake River physa	*Physa natricina*	Upper Snake River and middle Snake River (Jackson Bridge to Bancroft Springs)
3 - Utah valvata snail	*Valvata utahensis*	Upper Snake River and middle Snake River (from American Falls Dam to upstream of Lower Salmon Falls Dam)
Federally Listed Threatened Species		
1 - Bald Eagle	*Haliaeetus leucocephalus*	Main stem and Henrys Fork to Brownlee Dam including associated reservoirs; Ririe Lake/Willow Creek; Boise and Payette Rivers and associated reservoirs.
2 - Snake River spring/summer chinook salmon	*Oncorhynchus tshawytscha*	Lower Snake River (downstream of Hells Canyon Dam); critical habitat designation; Grande Ronde River, Salmon River
2 - Snake River fall chinook salmon	*Oncorhynchus tshawytscha*	Lower Snake River (downstream of Hells Canyon Dam); critical habitat designation, Clearwater River
2 - Snake River steelhead trout	*Oncorhynchus mykiss*	Lower Snake River (downstream of Hells Canyon Dam); Sweetwater Creek, Clearwater River
3 - Bliss Rapids snail	*Taylorconcha serpenticola*	Middle Snake River (Thousand Springs to King Hill/Clover Creek)
4 - Ute ladies' tresses	*Spiranthes diluvialis*	South Fork Snake River
2 - Bull trout	*Salvelinus confluentus*	Boise River; Payette River; Malheur River

[1] The numerical designations indicate: 1 - Birds; 2 - Fish; 3 - Invertebrates; 4 - Plants

Salmon and steelhead species were not evaluated as hydrologic modeling did not include modeling the basin downstream of Hells Canyon Dam where these species are located. In addition, overall analysis of effects on salmon and steelhead is within the purview of the Corps analysis. Nonetheless, the Base Case and No Augmentation would have no effect on the flows of the Grande Ronde and Salmon Rivers. The 1427i and 1427r scenarios would likely increase spring and summer flows and improve habitat for salmon and steelhead in those streams.

The 1427i and 1427r scenarios are not likely to affect or adversely affect any of the species listed in table S-9 with the exception of aquatic snails. Aquatic snails would not be affected or adversely affected upstream of Hagerman. Downstream of Hagerman, flows during August under the 1427i and 1427r scenarios would be rated as somewhat adverse for snails because the increase in flows under these scenarios would create temporary habitat which would later be dewatered possibly stranding snails. Flows downstream of C.J. Strike Dam would likely be adverse to snails under the 1427i and 1427r scenarios during the month of August due to oscillations in flow releases.

Cultural Resources

Cultural resources is a broad term that includes prehistoric, historic, architectural, and traditional cultural properties. It includes such things as archaeological sites, districts, buildings, structures, and objects; standing historic structures or objects; locations of important historic events; and places or resources that are important to the cultural practices and beliefs of a living community. The National Register lists Traditional Cultural Property that is associated with cultural practices or beliefs of a living community that are rooted in that community’s history and are important to maintaining the continued cultural and traditional religious identity of that community. Some archaeological sites qualify as traditional cultural properties. Indian Trust Assets are also included in cultural resources but are discussed separately in the Indian Trust Assets section.

Cultural resources at reservoirs are currently affected by changing water levels which cause wave action, inundation, and possible exposure of archeological deposits. These effects tend to be cumulative, may occur under the Base Case, and would tend to increase under the 1427i and 1427r scenarios. Under the 1427i scenario reservoirs would be drawn down more often and for longer periods and would also negatively affect Traditional Cultural Properties by desiccating wetland plants for longer period and reducing the availability of these resources. These effects under the 1427i scenario would be greater than under the Base Case. In contrast, the effects of the 1427r scenario on Traditional Cultural Properties at reservoirs would not be significantly different from the Base Case.

Increased flow velocities downstream of reservoirs that provide flow augmentation water for the 1427i and 1427r scenarios may affect cultural resources but the effect would likely be negligible.

Indian Trust Assets

The United States, with the Secretary of the Interior as the trustee, holds many assets in trust for Indian tribes and individuals and has a responsibility to protect and maintain rights reserved or granted by treaties, statutes, and executive orders. This trust responsibility requires that all Federal agencies, including Reclamation, take all actions reasonably necessary to protect trust assets.

The Department of the Interior defines Indian trust assets as legal interests in property held in trust by the United States for Indian tribes or individuals. Examples of trust assets are lands, minerals, hunting and fishing rights, and water rights. Reclamation operations can affect these trust assets in river corridors and reservoirs. Effects can extend beyond the river corridor to Federal lands where some tribes hold off-reservation treaty rights.

The Snake River basin upstream of Lower Granite Lake includes aboriginal areas of the following:

- Nez Perce Tribe (the Nez Perce Indian Reservation is in the Clearwater drainage which is not included in this analysis).

- Confederated Tribes of the Umatilla Reservation of Oregon (the Umatilla Indian Reservation is in the Umatilla River Drainage which is not included in this analysis).

- Shoshone-Bannock Tribes of the Fort Hall Indian Reservation in eastern Idaho.

- Northwestern Band of the Shoshoni Indians of Utah (there is no reservation to be included).

- Shoshone-Paiute Tribes of the Duck Valley Indian Reservation in southern Idaho and northern Nevada.

- Burns-Paiute Tribes (the Burns-Paiute Indian Reservation near Burns, Oregon is not in the Snake River drainage and not included in this analysis)

Salmon and steelhead populations, a portion of which are Indian trust assets, are not addressed in this analysis. Identifying overall effects on these resources is within the purview of the overall Corps study and will be addressed by the Corps.

In the Snake River basin upstream of Milner Dam, there could be some beneficial and some adverse effects on resident fish, wildlife, and vegetation due to the 1427i and 1427r scenarios. Overall, it is projected that there would be no net effect. The 1427i and 1427r scenarios are not likely to affect Indian trust assets downstream of Milner Dam.

Recreation

The Snake River basin contains some of the most important and highly valued recreation resources in the Pacific Northwest; some of these resources have national prominence. Some river reaches and reservoirs are located within or near national parks, national forests, state parks, and local parks. Recreation resources afford a wide spectrum of recreation opportunities which have added to the quality of life and formed an important component of the regional economy. In addition, there are specially designated recreation areas, wildlife refuges, and trophy fisheries. Water resources are a recreation magnet in this arid region.

Time constraints of this analysis made it necessary to limit the analysis to 11 representative Reclamation reservoirs and river reaches downstream of those reservoirs. Other reservoirs and river reaches affected by flow augmentation operations could be expected to experience similar effects. C.J. Strike and Brownlee Reservoirs are important sites for recreation on the main stem Snake River but were not evaluated due to a lack of readily available data. It can be assumed that recreation at these reservoirs would be affected by flow augmentation but neither a quantitative nor qualitative analysis was possible without additional data.

The analysis of possible effects on recreation focused on visitation as the marker of changes in recreation. Furthermore, it was assumed that most recreation occurs during the 5-month period of May through September and that most visits at reservoirs are water-dependent or water-related. Major water related activities include boating, fishing, camping, viewing, and day use including picnicking and swimming. Boat ramp access and the ability to boat and fish were major factors used in determining potential changes in recreation visitation at reservoirs and stream reaches.

The hydrologic model of the No Augmentation scenario indicates minimal differences in storage at a few reservoirs in the basin from the Base Case scenario. Therefore, recreation visitation at these reservoirs would not likely change from the Base Case scenario; an analysis of the No Augmentation scenario was not made.

Loss of recreation would be far more widespread and greater in depth with the 1427i scenario than with the 1427r scenario. Recreation losses would be greater for the Boise River reach below Boise River Diversion Dam than for any other site. Other sites with a loss greater than 20 percent include American Falls Reservoir, Cascade Reservoir, and Lucky Peak Lake. Overall, recreation loss would be greater with the 1427i scenario than with the 1427r scenario at all but two sites. Table S-10 summarizes the percent of recreation use projected with the 1427i and 1427r scenario compared to the Base Case

Table S-10 Summary of Potential Summer Recreation Visitation (Percent Compared to Base Case)

Area	1427i	1427r
Jackson Lake	99	100
Palisades Reservoir	89	100
American Falls Reservoir	77	92
Lucky Peak Lake	80	100
Cascade Reservoir	75	93
Lake Owyhee	89	92
Snake River downstream of Jackson Lake Dam	86	94
Snake River downstream of Palisades Dam	94	100
Boise River downstream of Boise River Diversion Dam	25	18
NF Payette River downstream of Cascade Dam	96	99
Payette River downstream of Banks	100	100

Wild and Scenic Rivers

There are numerous river reaches listed under the Wild and Scenic Rivers Act of 1968 that could potentially be affected by the flow augmentation scenarios. These include two reaches of the Snake River main stem, several stream reaches in the Owyhee River basin, several stream reaches in the Salmon River basin and several segments of the Grande Ronde River.

In addition to listed reaches there are numerous other reaches of the Snake, Bruneau, and Owyhee River that have been identified for potential addition to the National Wild and Scenic Rivers system.

The flow augmentation scenarios would increase flows during the summer months and decrease flows during the winter months. The No Augmentation scenario would have the opposite effect but would generally not be significantly different from the Base Case. Although a definitive analysis was not made, it is clear that the flow augmentation scenarios would have little or no effect on the status of river segments currently included in the National Wild and Scenic Rivers system.

Social Analysis

The focus of the social analysis was potential irrigation and recreation related impacts on (1) those who live in irrigation service areas and (2) those who use reservoirs and rivers for recreation purposes.

Eight irrigation service areas were identified based on irrigation water supplies that could be impacted by one or more of the flow augmentation scenarios. Three of the irrigation service areas receive water from Reclamation reservoirs and five irrigation service areas use natural streamflows for irrigation.
Loss of storage water in the three Reclamation irrigation service areas would result in a varying amount of irrigated acreage from year to year depending on the annual runoff. In the five natural flow irrigation service areas, a specific acreage of irrigation would be eliminated in each and every year. As a result, the effects would be different for communities associated with the Reclamation service areas as compared to communities associated with the natural flow areas.

As indicated earlier, Reclamation identified 11 reservoirs and river reaches for the analysis of potential effects of the flow augmentation scenarios on recreation.

Given the magnitude of the Snake River basin and the conceptual level of the scenarios, case studies were made of two irrigation service areas and two recreation areas. Under this approach, hydrology, economic, and other data were collected on the 1427i and 1427r scenarios and used in discussions with a limited number of knowledgeable persons in the case study areas. These discussions helped identify potential impacts to communities, families, and individuals. Discussions were also held with a few individuals in each irrigation service area to help identify unique conditions and impacts that might be potentially more significant to specific irrigation service areas.

There would be no difference between the 1427i and 1427r scenarios in the natural flow service areas because the curtailment of irrigation would be the same under both scenarios. The effects on communities, families, and individuals could be significant in these natural flow areas because many of the communities are isolated, rural or highly dependent on irrigated agriculture (low economic diversity). Loss of jobs, income, and sales would not easily be absorbed by these communities. Overall social well being of these communities would decline.

In contrast, the Reclamation Service areas would be adversely affect much more by the 1427r scenario compared to the 1427i scenario. Rural communities associated with the Reclamation Service areas and those with low economic diversity would be adversely affected by the 1427i and 1427r scenarios. Communities with little rural character and considerable economic diversity would be least affected.

Implementation Concerns and Issues

The possibility of acquiring sufficient natural flow rights and storage space to provide an additional 1 million acre-feet from the upper Snake River basin to augment flows for salmon migration creates a number of concerns for the residents of the area, the states, tribes, and the Federal Government. The current augmentation program, which provides only 427,000 acre-feet, has not been without its share of problems or controversy.

Irrigators, hydropower producers and consumers, reservoir boaters, river floaters, reservoir and river anglers, campers, and others compete for a limited resource, and each group desires water for their specific objectives. Population growth in a number of communities in or near the basin has resulted in additional demands on the limited water supply. It follows that any operational change of the river and reservoir system that may reallocate water downstream would unite local interests in strong opposition.

It would be impossible to provide an additional 1 million acre-feet for flow augmentation without significant impact to natural resources, recreation, and economic sectors. The Federal Government does not have exclusive control over such a vast amount of storage space in the Snake River basin as would be needed to provide the additional water. Therefore, any program that requires the acquisition of large amounts of water would necessitate the reallocation of existing water rights and/or contract entitlements held by irrigation entities in Idaho and Oregon and, possibly, in Wyoming and Nevada.

Each state has laws that regulate the acquisition and utilization of water and the issuance of water rights. These laws vary from state to state, but generally limit the use of water according to their individual definition of beneficial use. Under state law, any variance in water use from the terms identified in the water right generally requires authorization by the state through an approval of a transfer of water right.

In Idaho, transfers involving more than 50 cfs or more than 5,000 acre-feet must be explicitly approved by the state legislature. Reclamation's effort to secure the present flow augmentation amount of 427,000 acre-feet has been a difficult, and often arduous, undertaking.

Discussions with governmental and water user interests in Idaho, Nevada, and Wyoming indicate that a call for 1,427,000 acre-feet would not be acceptable under any circumstances and would be vehemently opposed. Oregon water officials have never expressed an opinion.

There are two possible actions that could be used to carry out a flow augmentation program, administrative action and legislative action. Typically, administrative action involves utilizing existing authority to appropriate water for flow augmentation. Conversely, legislative action would require the Congress to clarify, authorize, and fund a water acquisition effort.

The acquisition of storage space sufficient to provide 1,427,000 acre-feet of water for flow augmentation would impose significant impacts on Reclamation projects; financial impacts to the local area, and Federal budget impacts. The magnitude of the potential impacts argues, for pragmatic if not legal reasons, that a legislative approach that includes Congressional authorization would be necessary.

The legislative approach used in the analysis is the willing buyer/willing seller option. Other possible choices include prior or superior claims and taking. However, these choice appear to carry a high social and political price. The options are discussed below.

Prior or Superior Claims

This option would invoke the "prior or superior claims" provisions of Reclamation repayment contracts and reallocate stored water for flow augmentation with no reimbursement to project beneficiaries for their loss of stored water. Most, if not all, water user repayment contracts in the basin contain a clause that exempts the United States from liability in the event of a shortage of water. One of the causes of shortage is listed as "prior or superior claims." If the prior or superior claims clause were invoked, and sustained by the courts in the inevitable legal challenges that would arise, water would be released from Reclamation project reservoirs on the basis that the Endangered Species Act need constitutes a superior claim. Using this approach, the United States would not be liable for monetary damages associated with the water released.

Although this option could be implemented relatively quickly, the actual release of water could be delayed an indefinite period of time due to probable litigation. This option would have severe political implications. If flow augmentation were attempted through this approach, affected water users would likely fight the release of water by every legal means possible. The extreme degree of contention that would result from this approach is difficult to describe.

Taking

Under this option, Reclamation would release stored water on the basis that it constitutes a taking, for which compensation (lost income) must be paid. Congress might direct Reclamation to release contracted water for flow augmentation, subject to claims for damages. The water users would seek to enjoin Reclamation from releasing water until the matter was resolved.

Like the prior or superior claims option, this approach could be implemented relatively quickly. Also similarly, this approach could generate unfavorable political fallout and would likely become involved in the courts.

Willing Buyer/Willing Seller

Under this option a willing buyer/willing seller program would be instituted. The current flow augmentation program acquires water through the willing buyer/willing seller approach.

Though local opposition may occur, this option appears to be the most benign from a social/political perspective. Other advantages include the possibility of targeting certain water supplies (i.e., natural flows, non-Federal storage, diversions in the salmon corridor, etc.).

However, disadvantages to the willing buyer/willing seller approach have been identified. The amount of time necessary to purchase the required water rights and ultimately implement this option would be extreme. It would take several years to obtain the natural flow rights and storage space sufficient to provide an additional volume of water as large as 1,000,000 acre-feet. In addition, experience has demonstrated that when massive volumes of a resource are sought in the open market, the prices rise rapidly and dramatically.

Moreover, no long-term, willing-seller water acquisition has occurred in the Western States at a magnitude comparable to what is being examined in this study. The logistics and cost of negotiating acquisition contracts at this scale would have to be addressed prior to implementation.

It is apparent that the 1427i and 1427r scenarios, if implemented, could require an extensive amount of time, labor, and funding. In addition, each option appears to have a number of factors that could detract from its overall effectiveness in providing flow augmentation. Consequently, any option selected would likely require considerable monitoring and oversight.

Conclusions

It is important to recognize that the 1,427,000 acre-foot scenarios for this analysis are only conceptual, and therefore, the analysis is conceptual. In some cases, due to a lack of empirical data, estimations and assumptions were used in developing modeling simulations. The model results cannot precisely depict all future operations and circumstances. The implementation of an additional 1 million acre-feet of flow augmentation would, most certainly, have an affect that reaches far beyond the scope of this theoretical analysis.

However, it should be noted that this analysis did reveal some fundamental certainties:

- There are no new undiscovered or unallocated sources of water available to provide an additional 1 million acre-feet of flow augmentation.
- Reclamation does not have sufficient storage space to provide a large amount of water for flow augmentation without significant impacts to natural resources, recreation, and economic sectors.
- The acquisition of additional water to provide a total of 1,427,000 acre-feet would require the reallocation of existing water rights and/or contract entitlements.
- Reclamation could not meet present obligations to project beneficiaries if it were required to provide an additional 1 million acre-feet for flow augmentation.
- It would take several years to obtain the necessary water using the willing buyer/willing seller method.
- Any water acquired upstream would need protection from hostile diversion in all states through which the water passes.
- Affected water users would strenuously oppose and resist a call for 1,427,000 acre-feet of flow augmentation.
- Reclamation could not guarantee that 1,427,000 acre-feet would be provided for flow augmentation every year.
- The cost of acquiring natural flow rights and storage space to provide 1,427,000 acre-feet of flow augmentation would be substantial and would have substantial budget effects for the implementing agency.

Table S-11 summarizes the findings of the flow augmentation analysis.

Table S-11 Summary of Findings on Flow Augmentation

Item	Base Case	No Augmentation	1427i	1427r
Water Sources				
Natural flow purchases (acre-feet)	17,650	0	311,290	311,290
Annual rental pool purchases -- average (acre-feet)	250,000	0	0	0
Reservoir reassigned space (acre-feet)	98,554	0	323,554	323,554
Reservoir purchased space (acre-feet)	60,274	0	1,260,274	3,260,274
Inactive space (powerhead) (acre-feet)	313,000	0	313,000	313,000
Goal Achievement				
Years achieved (years of 62-year period of analysis)	51 of 62 (82 percent)	Not applicable	60 of 62 (97 percent)	62 of 62 (100 percent)
Reservoirs				
Average end-of-month content (62-year period)	No change	Negligible change	Would vary from 66 percent to 101 percent of the Base Case	Would vary from 96 percent to 105 percent of Base Case
Maintain or exceed recommended minimum content	No change	Negligible change	Less often maintained at most reservoirs	Negligible change
Streamflows				
April-September	No change	Negligible change except a significant decrease downstream of Milner Dam	Increased flows in most reaches downstream of reservoirs that provide flow augmentation water	Increased flows in most reaches downstream of reservoirs that provide flow augmentation water
October-March	No change	Negligible change	Decreased flows	Decreased flows
National Economic Effects--Agriculture				

Table S-11 Summary of Findings on Flow Augmentation				
Item	**Base Case**	**No Augmentation**	**1427i**	**1427r**
Decrease in irrigated acres in average water-year	[1]0	0	243,000	360,000
Decrease in irrigated acres in dry water-year	([2])	([2])	376,000	643,000
Decrease in value of production in average water-year	[3]0	0	$90,204,000	$136,433,000
Decrease in value of production in dry water-year	([2])	([2])	$141,202,000	$243,737,000
Loss of proprietors income and other property income (annual)	0	0	$46,691,000	$81,357,000
Water acquisition cost (annual) Low estimate High estimate	0	0	$10,414,000 $31,243,000	$31,128,000 $87,157,000
[1]Base Case average irrigated acreage is 3,364,000 acres [2]Not estimated [3]Base Case average value of production is $2,019,934,000				
National Economics Effects–Hydropower				
Average annual generation of 20 powerplants (MWh)	4,745,253	4,748,269	4,649,455	4,827,067
Change in annual value (1998 dollars, 7.125 percent discount rate)	0	0	-$2,715,000	$1,876,000
National Economic Effects–Recreation (11 Selected Sites)				
Loss in recreation visitation (annual)	0	0	504,000	212,000
Loss in recreation value (annual)	0	0	$13,664,000	$4,069,000

Table S-11 Summary of Findings on Flow Augmentation				
Item	**Base Case**	**No Augmentation**	**1427i**	**1427r**
Regional Economic Effects–Agriculture				
Employment–jobs lost (annual)	[1]0	0	2,543	3,612
Income lost (annual)	[2]0	0	$44,700,000	$51,976,000
Sales lost (annual)	[3]0	0	$95,200,000	$130,400,000
[1]Base Case regional jobs total 658,543 [2]Base Case regional income totals $23,310,023,000 [3]Base Case regional sales total $46,777,512,000				
Regional Economic Effects–Recreation (11 Selected Sites)				
Visitation lost (annual)	[1]0	0	43,453	14,021
Expenditures lost (annual)	[2]0	0	$1,014,000	$322,000
[1]Base Case visitation is 2,961,640. [2]Base Case expenditures not estimated.				
Water Quality Changes				
Overall basin change	None	None	Slight improvement	Improvement
Jackson Lake to American Falls Reservoir	None	Insignificant improvement	Slightly decrease in quality	No significant change
American Falls Reservoir and downstream	None	Slight improvement	Slight increase in sediment discharge	
Lake Walcott	None	Negligible change	Negligible change	Negligible change
Milner Dam to King Hill	None	Slightly decreased quality during summer	Improved quality in summer, improved flows would tend to move sediment downstream	Improved quality in summer, improved flows would tend to move sediment downstream

Table S-11 Summary of Findings on Flow Augmentation

Item	Base Case	No Augmentation	1427i	1427r
Boise River basin	None	None	Slightly decrease in quality during the winter	Slight improvement in quality
Cascade Reservoir	None	Slight improvement	Decreased quality year-round	Improved quality during the winter, decreased quality at other times
Lake Owyhee	None	None	Slight improvement	
Salmon and Grande Ronde River basins	None	None	Possible improvement	
Fish–Change in Quality or Amount of Habitat				
Snake River and reservoirs upstream of Milner Dam	None	Negligible change to slight improvement	Slightly adverse	Negligible change to slight improvement
Snake River from Milner to Buhl	None	Slight improvement	Slightly adverse	Slight improvement
Boise River basin	None	Negligible change to slight improvement	Slightly adverse	Negligible change to slight improvement
Cascade Reservoir	None	Improvement	Adverse	Slightly adverse
Payette River basin (other than Cascade Reservoir)	None	Negligible change	Negligible change	Negligible change
Grande Ronde and Salmon Rivers	None	None	Slight improvement	Slight improvement
Wildlife and Vegetation Including Wetlands and Riparian Areas				
Streamside	None	None	Improvement	Improvement
Reservoirs	None	None	Adverse	Net effect could be negligible
Irrigated crops areas	None	None	Adverse	Very adverse

Table S-11 Summary of Findings on Flow Augmentation				
Item	**Base Case**	**No Augmentation**	**1427i**	**1427r**
Threatened and Endangered Species–Change in Habitat				
American Peregrine Falcon	No effect			
Salmon and steelhead	Not analyzed, there are no salmon and steelhead upstream of Hells Canyon Dam. Effect in Grande Ronde and Salmon River not analyzed.			
Aquatic Snails				
General	None	Slight improvement	Slightly adverse	
Lake Walcott	None	Negligible change	Negligible change	
Downstream of Milner Dam	None	Slight improvement	None	
At Hagerman	None	Negligible change	Adverse during August, negligible change in other months	
C.J. Strike Dam releases	None	Negligible change	Adverse August-September, negligible change in other months	
Bald Eagle				
Reservoir habitat	None	Slight decrease	Decrease	Slight decrease
River reach habitat	None	None	None	None
Population change	None	None likely	None likely	None likely
Ute Ladies' Tresses	None	None	Slightly adverse near Heise	
Bull Trout	No effect	Negligible effect	Negligible effect to a slight improvement	
Cultural Resources–Change in Condition from Base Case				
Reservoir areas	None	Negligible change	Slightly adverse	Negligible change
Stream areas	None	Negligible change	Negligible change	Negligible change
Indian Trust Assets	No change	Negligible change	Negligible change	Negligible change

Table S-11 Summary of Findings on Flow Augmentation				
Item	**Base Case**	**No Augmentation**	**1427i**	**1427r**
Recreation–Percent Loss of Summertime Visitation – 11 Sites Evaluated				
Jackson Lake	None	None	1	None
Palisades Reservoir	None	None	11	None
American Falls Reservoir	None	None	13	8
Lucky Peak Lake	None	None	20	None
Cascade Reservoir	None	None	25	7
Lake Owyhee	None	None	11	8
Snake River downstream of Jackson Lake Dam	None	None	14	6
Snake River downstream of Palisades Dam	None	None	6	None
Boise River downstream of Boise River Diversion Dam	None	None	75	82
N.F. Payette River downstream of Cascade Dam	None	None	4	1
Payette River downstream of Banks	None	None	None	None

Table S-11 Summary of Findings on Flow Augmentation				
Item	**Base Case**	**No Augmentation**	**1427i**	**1427r**
Wild and Scenic Rivers	No change	No change	No change	No change
Social Effects				
Reclamation irrigation service areas	No change	No change	Changes would be minor	Agricultural businesses would decline, rural communities would become less viable due to changes in tax base and services, demographic changes could be significant as younger population moves away, rural character of communities could change, quality of life would significantly decrease in some areas.
Natural flow irrigation service areas	None	None	A significant number of jobs in local areas would be lost, agricultural businesses would decline and some would close (remote areas would be affect the most), rural communities would become	

Table S-11 Summary of Findings on Flow Augmentation				
Item	**Base Case**	**No Augmentation**	**1427i**	**1427r**
			less viable due to changes in tax base and services, demographic changes would be most areas would lose population, the quality and character of rural communities would be irreversibly changed, family stability, security, and functionality would be adversely affected.	
Social Justice	No change	No change	Minorities and low income populations would be adversely affected the most due to a change in economic conditions. Workers not associated with agriculture or agriculture support industries would not likely be affected.	

1 Introduction

This chapter provides background information on Federal activities geared toward improvement of fish passage in the lower Snake River and the role of the Bureau of Reclamation (Reclamation) in the Lower Snake River Juvenile Salmon Migration Feasibility Study being conducted by the U.S. Army Corps of Engineer (Corps). It outlines the purpose, scope, and objective of this flow augmentation analysis.

1.1 U.S. Army Corps of Engineers Study

The Corps is conducting a Lower Snake River Juvenile Salmon Migration Feasibility Study; completion of a feasibility report and Environmental Impact Statement are anticipated for late 1999. That study focuses on alternative actions to improve migration conditions for anadromous fish in the lower Snake River. A notice of intent to develop an environmental impact statement (EIS) was issued by the Corps in the Federal Register on June 5, 1995.

1.1.1 Background and Need For Action

Congress passed the Pacific Northwest Electric Power Planning and Conservation Act (Public Law 96-501) in 1980. The act created the Northwest Power Planning Council (NPPC) and charged it, among other things, to develop a fish and wildlife program to protect and enhance fish and wildlife and to mitigate for losses due to hydroelectric project development and operations. The NPPC adopted its Fish and Wildlife Program in 1982. Federal, state, and local governments and agencies, Native American interests, and others have actively participated in periodic revisions of the NPPC's Columbia River Fish and Wildlife Program and efforts to enhance the anadromous fishery of the Columbia River system.

In 1990, several parties filed petitions with the National Marine Fisheries Service (NMFS) to list species of Snake River and Columbia River salmon as threatened or endangered under the Endangered Species Act (ESA). Senator Mark Hatfield of Oregon convened a regional "Salmon Summit" outside the formal ESA process to seek reversal of declines in the petitioned stocks. Although the Salmon Summit did not result in a regional plan to avoid listing of species, it did identify some desired actions. Among these was flow augmentation from Reclamation projects. Subsequently, the NPPC adopted certain priority projects in its Columbia River Basin Fish and Wildlife Program in 1991 and called on Reclamation to provide water for flow augmentation.

On November 20, 1991, the Snake River sockeye salmon (*Oncorhynchus nerka*) was listed as endangered, and, on April 22, 1992, the Snake River spring/summer and fall chinook (*O. tshawytscha)* salmon were listed as threatened. Although other aquatic species have been listed under the ESA, the driving force to provide flow augmentation has been the listed salmon.

The Corps, Reclamation, and the Bonneville Power Administration (BPA) joined in 1992 to begin consultations with the NMFS and the U.S. Fish and Wildlife Service (USFWS) to evaluate the operational effects of the Federal Columbia River Power System (FCRPS) on the listed species. The FCRPS consultation involved 14 Federal hydroelectric dams in the Columbia and Snake River basins operated and managed by the Corps and Reclamation; BPA was included in the consultation because it is the agency that markets the generated electricity. The three FCRPS agencies submitted biological assessments (BA) to NMFS and USFWS in 1993 and 1994. In legal challenges filed by the Idaho Department of Fish and Game (IDFG) and others, the U.S. District Court for Oregon ruled that NMFS' 1993 Biological Opinion (BIOP) was inadequate. The 1994 BIOP had been patterned after the 1993 opinion, and a legal challenge appeared inevitable. To comply with the district court order, the plaintiffs and defendants to the suit agreed to develop a new multiyear BIOP, effective in 1995.

On March 2, 1995, the NMFS issued a BIOP on operation of the FCRPS with respect to endangered Snake River spring/summer chinook, Snake River fall chinook, and Snake River sockeye. This BIOP concluded that effects of the proposed operations of Federal hydroelectric dams in the Columbia and Snake River basins would jeopardize the continued existence of the listed Snake River salmon stocks. NMFS included a Reasonable and Prudent Alternative (RPA) in the 1995 BIOP which, if implemented by the three FCRPS operating agencies, would avoid further jeopardy to the salmon runs. The RPA called on Reclamation to annually provide 427,000 acre-feet of water from its Snake River basin reservoir storage system for flow augmentation to improve juvenile salmon survival during the downstream migration period. Reclamation formally accepted the RPA in its March 10, 1995, Record of Decision (ROD) and committed to provide flow augmentation from its reservoirs and private water rights in the basin above Lower Granite Lake.

Flow augmentation in the lower Snake River and the Columbia River is a key component of the 1995 BIOP and NPPC's Fish and Wildlife Program. The primary purpose of augmentation is to provide flows for juvenile salmon migration from April 10 through August. Salmon managers have set seasonal target flows at various sites. The targets can vary from year to year. The target at Lower Granite Lake is 85,000-100,000 cubic feet per second (cfs) from April 10 through June 20 and 50,000-55,000 cfs from June 21 through August 31.

Salmon managers can call for volumes of up to 1.2 MAF from Dworshak Dam (owned and operated by the Corps) on the North Fork Clearwater River and up to 237,000 acre-feet from Brownlee Reservoir (operated by the Idaho Power Company (IPC)) on the Snake River to meet target flows at Lower Granite Dam on the Snake River and McNary Dam on the lower Columbia River. In addition, up to 2,160,000 acre-feet from Grand Coulee, Libby, and Hungry Horse Dams in the upper Columbia River contribute to target flows at McNary Dam. An additional 1 million acre-feet (MAF) can also be released from Canadian storage water whenever the April-July forecast at The Dalles, Oregon, is less than 90 MAF.

Salmon mangers also call for 427,000 acre-feet from Reclamation reservoirs to meet target flows at Lower Granite Dam. Reclamation began providing 427,000 acre-feet each year from the Snake River basin upstream from Brownlee Dam before the 1995 BIOP was issued and has provided that amount every year since 1993. This water was secured from Reclamation's uncontracted reservoir space, water rentals, and by permanent acquisition of reservoir storage space and natural flow rights.

1.1.2 Corps Request for Assistance

One element included in several of the Corps alternatives for the future operation of the lower Snake River is flow augmentation using water supplies from the upper Snake River. Since Reclamation already provided some flow augmentation and is the primary Federal entity operating reservoirs in the upper Snake River, the Corps asked Reclamation for assistance in developing further information on flow augmentation.

The Corps asked Reclamation to analyze the impacts of providing additional flow using water from the upper Snake River at the following levels:

- Base Case/existing condition (providing 427,000 acre-feet/year)
- No flow augmentation
- Additional flow augmentation of 1 MAF (providing a total of 1,427,000 acre-feet/year)

The request included provisions for funding Reclamation to prepare a report on the results (Snake River Flow Augmentation Impact Analysis Report).

1.2 Reclamation Flow Augmentation Impact Analysis

1.2.1 Scope

The scope of Reclamation's analysis is based on an intergovernmental agreement between the Corps and Reclamation, which requests that Reclamation:

- Analyze specific levels of flow augmentation (none, 427,000 acre-feet, and 1,427,000 acre-feet) to help meet target flows at Lower Granite Lake,
- Identify the effects of implementing these scenarios, and
- Prepare this Snake River Flow Augmentation Impact Analysis that documents the findings of the analysis. Reclamation's report is to be of sufficient detail to provide supplemental information for decisions associated with the Corps' Lower Snake River Juvenile Salmon Migration Feasibility Study.

As the analysis progressed, it became obvious that providing 1,427,000 acre-feet from the upper Snake River could have dramatic effects on current water uses. Those effects could vary depending on the selection of water sources for flow augmentation. River and reservoir operations which could reduce impacts to one sector are likely to increase impacts to other sectors.

Reclamation faced several serious constraints in preparing this analysis. Time and data are the two major constraints. Given the time constraint, it would be impossible to go through a typical public review process that would identify acceptable levels of impacts to various water uses and to identify specific water sources for a flow augmentation of 1,427,000 acre-feet. Reclamation found it necessary to independently identify two scenarios for analysis. One scenario focuses on limiting impacts to irrigation and the other scenario focuses on limiting impacts to reservoir-based environmental and recreational opportunities. Reclamation also recognizes that in the event that an additional volume of flow augmentation from the upper Snake River is selected, future analysis will require intense public input to carefully identify specific water sources and site specific effects.

Data is the other constraint to analysis. Reclamation has collected and centralized a large amount of data on Reclamation reservoirs, the stream reaches downstream from those reservoirs, and lands irrigated with water supplied from Reclamation reservoirs. In contrast, data on other stream reaches, private storage facilities, and lands irrigated from natural flows or privately developed storage is scarce and widely scattered. To complete this analysis on flow augmentation in the timeframe required, Reclamation concentrated primarily on areas where Reclamation had already developed hydrologic and other data. This meant not only excluding privately developed reservoirs but also reservoirs developed by the Bureau of Indian Affairs (BIA).

The geographic scope of this analysis is the Snake River basin upstream of Lower Granite Lake, excluding the Clearwater drainage. The Clearwater was excluded from this analysis because Dworshak Dam and Reservoir, operated by the Corps, is the only major storage control in that drainage. Any analysis of Dworshak operations is the responsibility of the Corps. Two small reservoirs of the Lewiston Orchards Project (a Reclamation Project) and very limited private irrigation are too minor to have any measurable effect on the flow of the Clearwater.

Within this general geographic boundary, Reclamation's analysis is limited to the main stem Snake River and those subbasins that would provide flow augmentation water, whether from Reclamation reservoirs or acquisition of natural flow rights currently used for private irrigation operations. As a convenience in this analysis, Ririe Dam, a Corps facility operated by Reclamation, and Lucky Peak Dam, owned and operated by the Corps in the Boise River basin, are aggregated with Reclamation facilities and not separated out as Corps facilities. Reclamation markets the water in Lucky Peak Lake and its operation is fully integrated with the two upstream Reclamation reservoirs.

Reclamation developed and analyzed four scenarios for use by the Corps in its alternatives:

- Base Case: Provide 427,000 acre-feet of flow augmentation water each year (existing condition since 1993).

- No Augmentation: Provide no water for flow augmentation (condition prior to 1991).

- 1427i: Provide up to 1,427,000 acre-feet of flow augmentation water to meet deficits in flow targets at Lower Granite Dam. Irrigation shortages would be minimized by using large drawdowns of Reclamation reservoirs.

- 1427r: Provide up to 1,427,000 acre-feet of flow augmentation water to meet deficits in flow targets at Lower Granite Dam. Reservoir elevations would be maintained at or near the Base Case levels with shortages assumed by irrigation.

These four scenarios were evaluated using technical information developed through Reclamation's Snake River Resources Review (SR^3). The SR^3 is developing improved tools for decisionmakers to use in considering competing or conflicting demands for operation of the Snake River system.

Hydrologic modeling and interpretation provide the basis for identifying potential effects on irrigation, fish, wildlife, water quality, hydroelectric generation, recreation, cultural resources, local and regional communities and economies, and Indian trust assets. Due to the limited time to conduct this analysis, it was not possible to address impacts to all potentially affected areas. Reclamation's technical staff selected representative focus reaches from those previously identified for SR^3 based on resource locations to assist in this programmatic level analysis. The focus reaches selected for this flow augmentation analysis may vary from resource to resource; however, most of the focus reaches are located between Jackson Lake Dam in Wyoming and Brownlee Dam in Idaho. The 12 focus reaches used in this analysis are listed in table 1-1.

Table 1-1 Focus Reaches Identified for Flow Augmentation Analysis			
Major Reach		Extent	Reservoir
1	South Fork Snake River	Jackson Lake to Henrys Fork	Jackson Lake, Palisades
2	Henrys Fork	Henrys Lake to Snake River	Henrys Lake[1], Island Park
3	Willow Creek	Ririe Lake to Snake River	Ririe Lake
4	Upper Snake River	Henrys Fork Confluence to Milner Dam	American Falls, Lake Walcott, Milner Lake[2]
5	Middle Snake River	Milner Dam to Brownlee Dam	C. J. Strike[3] Brownlee[3]
6	Boise River	South Fork and Main Stem Boise River—Anderson Ranch Reservoir to Snake River	Anderson Ranch Arrowrock Lucky Peak[4] Lake Lowell
7	Payette River	North Fork/Main Stem Payette and Deadwood Rivers—Cascade and Deadwood Reservoirs to Snake River	Cascade Deadwood Black Canyon[2]
8	Owyhee River	Lake Owyhee to Snake River	Lake Owyhee
9	Snake River through Hells Canyon complex	Brownlee Dam to Hells Canyon Dam	Oxbow[3] Hells Canyon[3]
10	Lemhi River basin	Headwaters to the mouth at Salmon River	none
11	Salmon River basin	Headwaters to the mouth at Snake River	none
12	Grande Ronde River basin	Headwaters to the mouth at Snake River	none

[1]Henrys Lake is owned and operated by North Fork Reservoir Company
[2]Not a storage facility
[3]Brownlee is owned and operated by IPC
[4]Lucky Peak Dam is owned and operated by the Corps; the powerplant is owned by four irrigation districts and operated by the city of Seattle; Reclamation markets storage in the reservoir.
[5]Lower Granite Dam is owned and operated by the Corps.

Reclamation is aware of many issues attached to the concept of flow augmentation; however, this analysis is limited to the scope of the intergovernmental agreement between the Corps and Reclamation. Issues considered outside the scope of this flow augmentation analysis include:

- Analysis of BIA and non-Federal storage facilities.
- Identification of specific, individual water sources for the 1, 427,000 acre-feet.
- Identification of other possible levels of flow augmentation.
- Identification of current water rights holders that would be willing to relinquish their rights for the sake of flow augmentation.
- Identification of potential new storage sites.
- Identification of potential mitigation measures.
- Identification of unavoidable and irreversible impacts.

- Whether flow augmentation is justified as a means to halt the decline or to recover endangered lower Snake River species.

- Policy decision about the appropriateness of reallocating supplies to flow augmentation.

- Make recommendations.

1.2.2 Objective

This analysis identifies the capability of the Snake River basin to provide 1,427,000 acre-feet for flow augmentation in the lower Snake River. It is a programmatic analysis of the range and magnitude of impacts that can be expected from a decision to provide additional flow augmentation. Information contained in this document depicts representative – not specific – outcomes.

The scenarios presented in this document are intended to represent the kinds of actions that would be necessary and the resource commitments that could be required for flow augmentation. Therefore, the results of this study are not of sufficient detail to provide a complete analysis of impacts or specific reallocations of water to salmon flow augmentation. Impacts associated with reallocation of water would require separate site-specific analysis prior to actual acquisition. Both state and congressional action would be required prior to implementation of flow augmentation greater than 427,000 acre-feet.

1.3 Authorities

The Corps is conducting its Lower Snake River Juvenile Fish Migration Feasibility Study/EIS under existing authority for projects on the lower Snake River (Rivers and Harbors Act of 1945, Public Law 79-14, dated March 2, 1945). Reclamation is providing information and evaluating potential flow augmentation components under the general authority of the Reclamation Act of 1902 as amended and supplemented.

1.4 Arrangement of Report

Chapters 1-4 provide general background information, while chapters 5-8 discuss potential impacts. A short description of each chapters is given below:

Chapter 1 Introduction – Generally discusses the reasons Reclamation prepared this report on Snake River flow augmentation for the Corps.

Chapter 2 Background – Discusses the existing storage system developed by Reclamation and the Corps, groundwater interactions, and the general operation of the Snake River system upstream of Brownlee Dam.

Chapter 3 Water Sources For Flow Augmentation – Discusses the water sources Reclamation examined for potential use in providing additional downstream flow augmentation.

Chapter 4 Flow Augmentation Scenarios – Describes the four flow augmentation scenarios including the goals of each scenario.

Chapter 5 Hydrologic Analysis – Discusses the methods used for hydrologic modeling and the selection of water sources for each scenario and provides model findings on the success of each scenario in meeting flow augmentation goals, irrigation shortages that would be induced, and potential riverflow and reservoir content changes.

Chapter 6 Economic Analyses – Discusses national economic effects related to potential changes in irrigated agriculture, hydroelectric power generation, and recreation opportunities. Also discusses regional economic effects related to potential changes in irrigated agriculture and recreation opportunities with respect to jobs, sales, and regional income.

Chapter 7 Resource Analysis – Discusses the findings related to potential changes in water quality, fish, wildlife, vegetation, wetlands, threatened and endangered species, cultural resources, Indian trust assets, recreation, and Wild and Scenic rivers.

Chapter 8 Social Analysis – Discusses the general findings of potential effects on communities, families, and individuals along with concerns and views of water users and others.

Chapter 9 Implementation Issues and Concerns – Discusses potential methods of acquisition of water for flow augmentation against the background of state water law and other Federal actions.

Chapter 10 Consultation and Coordination – Discusses the background on consultation for this analysis and lists outreach activities.

Chapter 11 List of Preparers – List individuals and backgrounds of those involved in the technical analysis and preparation of this document.

Chapter 12 References – Lists documents cited and general references used in the preparation of this document; organized by chapter.

Attachments – Several attachments are included at the end of this report that provide some additional technical detail.

2 Setting

This chapter provides a brief overview of the water resources of the area, river and reservoir operations, and agency responsibilities. For more information on Reclamation facilities and operations the reader is directed to other Reclamation publications (Reclamation, 1996a; 1996b; 1997).

2.1 Snake River and Tributaries

The Snake River and its tributaries (see frontispiece) drain about 103,200 square miles in western Wyoming, southern and central Idaho, northern Utah, northern Nevada, eastern Oregon, and southeast Washington.

The Snake River is about 1,000-miles long and is the largest tributary of the Columbia River. It originates in Yellowstone National Park at an elevation in excess of 9500 feet, flows through western Wyoming and southern Idaho, and forms much of the Oregon/Idaho border and a small part of the Washington/Idaho border before turning west to join the Columbia River near Pasco, Washington. Most of the State of Idaho south of Lewiston is within the Snake River basin, which drains about 87 percent of the State.

Summers are warm and dry and winters are cold. Precipitation is low in the summer and early fall and higher during the late fall, winter, and spring. Although precipitation varies over the basin, average annual precipitation at lower elevations is generally about 15 inches and falls mostly in the winter as a mixture of rain and snow. Precipitation at higher elevations averages up to 40 inches per year with most falling as snow during the winter. These climatic conditions generally produce riverflows that can peak at very high levels as snow melts in the spring and early summer, decline throughout the summer to a minimum, and remain low during the fall and winter.

The Snake River and its tributaries fall into six natural divisions on the basis of flows and river operations. These are:

- Snake River basin upstream of Milner Dam (upper Snake River).
- Snake River basin from Milner Dam to Brownlee Dam (middle Snake River).
- Boise River basin.
- Payette River basin.
- Other tributaries upstream of Brownlee Dam.
- Main stem and tributaries between Brownlee Dam and Lower Granite Lake (lower Snake River).

2.1.1 Snake River Main Stem and Henrys Fork Upstream of Milner Dam

The Snake River valley upstream from Milner Dam contains a fertile plain and many natural water channels, which attracted indigenous peoples as well as the settlers from the east. Arid conditions in the west led to adoption of the prior appropriation doctrine of water rights which stipulated that stream water could be used without ownership of abutting land provided that the use did not interfere with an earlier use. As the population grew and spread throughout the upper Snake River basin, canals were built and storage dams constructed so springtime flows could be held for irrigation use during the hot summers. There are now seven Reclamation storage facilities located in the Snake River basin upstream of Milner Dam. The BIA operates two storage facilities for irrigation of lands on the Fort Hall Indian Reservation located along the main stem near Blackfoot and Pocatello, Idaho.

2.1.2 Snake River Main Stem from Milner Dam to Brownlee Dam

In much of this reach, the river has carved a channel down through the fertile lands to form a canyon that in many places is quite narrow and several hundred feet deep. The area, for the most part, is sparsely settled, but some of the surrounding plain is irrigated using highlift pumps. All of the irrigation development is private and much has been developed along a narrow strip close to the river to reduce pumping costs or the costs of long gravity diversion canals. All of the dams on this reach of the main stem are owned and operated by IPC.

The flow past Milner Dam is usually no more than 200 cfs during the summer except for flow augmentation releases. Thousand Springs, downstream from Milner Dam and near Hagerman, Idaho, is a spectacular outpouring from the eastern Snake River Plain Aquifer (SRPA) that provides an average annual flow to the main stem of about 5,300 cfs.

2.1.3 Boise and Payette Rivers

The lower Boise Valley is an area of intense irrigation development. Irrigated agriculture near the river expanded to higher bench lands, which required an extensive system of private canals to deliver water, but water supplies in the Boise River became inadequate to meet all the irrigation needs. Reclamation constructed the Boise Project in two parts–the Arrowrock Division and the Payette Division. Two Reclamation storage dams and one diversion dam and one Corps storage dam were constructed on the Boise River. Three Reclamation dams (two storage dams and one diversion dam) were constructed on the Payette River. Reclamation facilities provide most of the water supply for irrigation and flood control in these basins.

2.1.4 Other Tributaries Upstream of Brownlee Dam

Reclamation has constructed storage reservoirs in six other river basins upstream of Brownlee Dam. These are the Little Wood, Owyhee, Malheur, Weiser, Burnt, and Powder River basins. Five of these basins form a contiguous area in eastern Oregon and western Idaho (the Owyhee River basin extends into northern Nevada as well). The Little Wood River is a tributary of the Big Wood River, which joins the Snake River about 68 stream miles downstream from Milner Dam.

2.1.5 Snake River and Tributaries Between Brownlee Dam and Lower Granite Lake

This main stem reach is the site of the famous Hells Canyon. The only dams on this reach of the main stem are three IPC dams. Major tributaries are the Salmon and the Grande Ronde Rivers.

Several wilderness and recreation areas are located in this region. The large Frank Church River of No Return Wilderness, the smaller Gospel Hump Wilderness, and the Sawtooth National Recreation Area are located in the Salmon River basin. Located adjacent to the main stem and downstream from Hells Canyon Dam are the Hells Canyon Wilderness and the Hells Canyon National Recreation Area. All or a major portion of the Eagle Cap Wilderness and the Wenaha-Tucannon Wilderness lie within the Grande Ronde River basin.

As indicated earlier, the Clearwater River basin technically lies in this region but is outside the geographical scope of this analysis.

2.2 Existing Storage System

2.2.1 Federal Storage

All Reclamation storage facilities in the part of the Snake River basin considered in this analysis are located upstream from Brownlee Reservoir. As indicated earlier, the two Corps facilities (Lucky Peak and Ririe) are included as Reclamation storage for the purpose of this study. Reclamation facilities provide the only significant operational control over the flows of the main stem Snake River and the tributaries where they are located. The purpose of Reclamation reservoir storage is usually stated in the original authorizing legislation. Table 2-1 summarizes Reclamation project and storage facility authorizations for the Snake River basin by chronology of authorization. Subsequent Federal legislation, however, has added some purposes.

Table 2-2 summarizes Reclamation storage space in 21 on-stream storage facilities in the Snake River basin. Total active capacity is about 7 MAF. About 6.3 MAF of storage space (about 90 percent of active capacity) are contracted and essentially all of it is for irrigation; non-irrigation contracts total only 4,800 acre-feet of space for M&I and about 44,300 acre-feet for hydroelectric power. All space not contracted has been assigned to specific uses. These uses include minor amounts for mitigation and reservoir accounts (accumulation of sediment and evaporation of water) and larger amounts for conservation pools (Cascade and Deadwood), streamflow maintenance (Deadwood and Lucky Peak), and salmon flow augmentation (American Falls, Cascade, Deadwood, Lucky Peak, Jackson Lake, and Palisades).

The BIA operates three storage facilities in connection with Indian irrigation projects. Blackfoot Reservoir on the Blackfoot River and Grays Lake on Willow Creek south of Idaho Falls, Idaho provide a water supply for the Fort Hall Indian Project. Grays Lake, because of its small active capacity is operated primarily for fish and wildlife enhancement. Wild Horse Reservoir, located on the Owyhee River in northern Nevada, is operated to provide a water supply for the Duck Valley (Indian) Project.

Table 2-1 Authorization of Reclamation Projects and Storage Facilities			
Date	**Authorization**	**Storage Facility and Construction**[1]	**Original Authorized Purpose**[2]
1904/4/23	Minidoka Project authorized by the Secretary of the Interior (under the 1902 Reclamation Act) on April 23, 1904. Includes Minidoka Dam, Jackson Lake Dam, and American Falls Dam[3].	Minidoka Dam 1904-1906 Jackson Lake Dam, 1907, 1910-11, 1916 American Falls Dam 1925-27	Irrigation and power
1905/3/27	Boise Project authorized by the Secretary of the Interior (under the Reclamation Act of 1902) on March 27, 1905. Includes Deer Flat Dams (Lake Lowell).	Deer Flat Dams 1906-1908, 1909, 1911, 1913, 1938	Irrigation
1911/1/6	Arrowrock Dam authorized by the Secretary of the Interior (under 1902 Reclamation Act) on January 6, 1911.	Arrowrock Dam 1911-1915, 1937	Irrigation
1926/10/21	The Vale Project was authorized by the President (under the 1902 Reclamation Act) on October 21, 1926. Includes purchase of one-half interest in Warm Springs Reservoir and construction of Agency Valley Dam (Beulah Reservoir).	Agency Valley Dam 1935	Irrigation
1926/10/12	Owyhee Project authorized by the President (under 1902 Reclamation Act) on October 12, 1926.	Owyhee Dam 1927-1932	Irrigation
1928/10/19	Deadwood Dam authorized by the President (under 1902 Reclamation Act) on October 19, 1928.	Deadwood Dam 1929-1931	Irrigation and downstream power
1931/3/18	The Baker Project was authorized by the President on March 18, 1931. Includes Thief Valley Reservoir.	Thief Valley Dam 1931-1932	Irrigation
1935/8/13	The Burnt River Project was apparently authorized by the President on August 13, 1935. On September 25, 1935, the Secretary of the Interior found the Burnt River Project to be feasible. The President, apparently approving the project, approved an allotment of funds for construction of the reservoir on August 13, 1935. A copy of the Secretary's recommendation with date and approval signature of the President has not been found and does not appear to exist.	Unity Dam 1936-1939	Irrigation
1935/9/20	Grassy Lake Dam authorized by the President on September 20, 1935 (under 1902 Reclamation Act).	Grassy Lake Dam 1932-39	Irrigation
1935/9/20	Island Park Dam is authorized by the President on September 20, 1935 (under 1902 Reclamation Act).	Island Park Dam 1935-38	Irrigation
1935/12/19	Payette Division authorized by the President (under 1902 Reclamation Act) on December 19, 1935. Includes Cascade Dam.	Cascade Dam 1946-1948	Irrigation and power
1940/6/25	Anderson Ranch Dam authorized by the Secretary of the Interior on June 25, 1940	Anderson Ranch Dam	Irrigation, power, flood control, and

Table 2-1 Authorization of Reclamation Projects and Storage Facilities			
Date	**Authorization**	**Storage Facility and Construction**[1]	**Original Authorized Purpose**[2]
	(under Reclamation Act of 1939)	1941-1950	conservation of fish and recreation
1946/7/24	Lucky Peak Dam authorized by Congress by Act of July 24, 1946.	Lucky Peak Dam 1949-1957	Flood control and irrigation
1950/9/30	Palisades Dam was authorized by Secretary of the Interior on December 9, 1941. The dam was reauthorized by Congress by Act of September 30, 1950.	Palisades Dam 1951-57	Irrigation, power, flood control, and fish and wildlife
1950/9/30	Minidoka Project, Northside Pumping Division authorized by Congress by Act of September 30, 1950.	None	Irrigation
1954/10/31	Michaud Flat Irrigation Project authorized by Congress by Act of August 31, 1954 (Public Law 741, 83rd Congress).	None	Irrigation
1956/8/6	The Little Wood River Project was authorized by Congress on August 6, 1956 (Public Law 993, 84th Congress). Included enlarging Little Wood River Dam.	Little Wood River Dam (enlargement)	Irrigation, flood control, recreation, and fish and wildlife preservation and propagation.
1959/9/9	The Bully Creek Extension was authorized by Congress by Act of September 9, 1959 (Public Law 86-248).	Bully Creek Dam 1963	Irrigation, flood control, recreation, and fish and wildlife preservation and propagation
1962/8/16	The Mann Creek Project was authorized by Congress by Act of August 16, 1962, (Public Law 87-589).	Mann Creek Dam 1965-1967	Irrigation, conserving and developing fish and wildlife, and recreation
1962/9/27	The Baker Project, Upper Division was authorized by Congress by Act of September 27, 1962 (Public Law 87-706). Includes Mason Dam.	Mason Dam 1968	Irrigation, flood control, conservation of fish and wildlife, and recreation.
1962/10/23	Ririe Dam authorized by Act of October 23, 1962.	Ririe Dam[4] 1970-77	Flood control, irrigation, and recreation.
1973/12/28	Replacement of American Falls Dam was authorized by Congress by Act of December 28, 1973.	American Falls Dam Replacement 1976-78	Irrigation and power

[1]Multiple construction periods indicate reconstruction or additional construction to reach the current storage capacity.
[2]The Act of September 30, 1950, by reference, appears to authorize the upper Snake River Reservoir system to be operated for flood control in addition to other purposes. In addition, several flood control acts have essentially authorized flood control at all Reclamation reservoirs. Public Law 89-72 along with Public Law 102-575 have essentially authorized recreation (including fish and wildlife enhancement) at all Reclamation projects. However, this authorization is primarily for construction of facilities and management of lands and does not authorize a change in the use of storage space in a reservoir.
[3]Legislation in 1924 addresses purchase of Indian lands and expenditure of monies for construction of the reservoir; however, a specific document authorizing construction has not been identified.
[4]Constructed by the Corps, but operated by Reclamation.

Table 2-2 Reservoir Space in Bureau of Reclamation Reservoirs Upstream of Brownlee Dam (Acre-Feet)[i]

Reservoir	Total Capacity	Active Capacity				Inactive	Flood Surcharge[iii]	Dead
		Total	Contracted[ii]	Formally Assigned To Other Uses	Formally assigned to Flow Augmentation			
STATE OF WYOMING								
Grassy Lake	15,500	15,200	15,200				700	300
Jackson Lake	847,000	847,000	843,077		[iv]3,923		32,500	([v])
STATE OF IDAHO								
American Falls	1,672,600	1,672,600	1,663,640		[4] 8,952			
Anderson Ranch	493,200	423,200	422,800	[vi]400		[vii]41,000	10,500	29,000
Arrowrock	286,600	286,600	286,600				14,300	
Cascade	703,200	653,200	313,682	[viii]269,900	69,600	[ix]50,000	157,000	
Deadwood	162,000	161,900	56,851	[x]79,650	25,400	[xi]100	29,600	
Island Park	135,600	135,600	135,200			[xii]400	34,000	
Little Wood	30,000	30,000	28,000	2,000	0	0	3,300	
Lucky Peak[xiii]	293,100	264,400	71,018	[xiv]152,420	[xv]40,932	[xvi]28,700	13,900	
Mann Creek	12,500	10,900	10,900			[xvii]200	2,400	1,400
Minidoka (Walcott)	210,200	95,200	95,200			[xviii]115,000	10,000	unknown
Palisades	1,401,000	1,200,000	1,189,978		[xix]10,022	[xx]157,000	16,000	44,000
Ririe	100,500	90,500	80,500	[xxi]10,000		[xxii]6,000		4,000
STATE OF OREGON								
Beulah	59,900	59,900	59,900				6,100	
Bully Creek	31,600	30,000	30,000				7,300	1,600
Owyhee	1,120,000	715,000	715,000			[xxiii]405,000		
Phillips Lake	95,500	90,500	73,500	17,000		[xxiv]1,500	16,000	3,500
Thief Valley	13,300	13,300	13,300					
Unity	25,500	25,000	24,970				3,600	500
Warm Springs	192,400	191,000	191,000					1,400
TOTALS	7,901,200	7,011,000	6,320,316	531,370	158,829	804,900	357,200	85,700
TOTAL (Formally Assigned to Other Uses and Flow Augmentation)					690,199			

2.2.2 Non-Federal Storage

There are numerous small reservoirs owned by a variety of individuals and entities throughout the Snake River basin. However, the total amount of storage, other than IPC, is small and the operations of these facilities is generally not affected by Reclamation operations.

IPC owns numerous facilities and is the only non-Federal entity with significant storage in the Snake River basin. Most of the IPC facilities are operated as run-of-river or have some capability for load following. Brownlee Reservoir with an active capacity of 975,000 acre-feet, is the largest reservoir.

2.2.3 Riverflows and Basin Outflow

Average annual flow of the main stem Snake River and various tributaries vary widely by location, due to tributary inflows, diversions, and interactions with underlying aquifers. For example, flow at Heise, upstream of the Henrys Fork confluence, averages about 4.5 MAF while flow past Milner Dam, well downstream, averages less than 2 MAF. The comparatively low flow past Milner is due in part to the operation of large reservoirs and the diversion of streamflows for irrigation. In contrast, the average flow at King Hill further downstream, is about 6.5 MAF. This increased flow is due primarily to inflow at Thousands Springs, other tributary inflow, irrigation return flows, and less intense irrigation development downstream of Milner Dam. Average flow of the main stem near Weiser, Idaho is about 12 MAF.

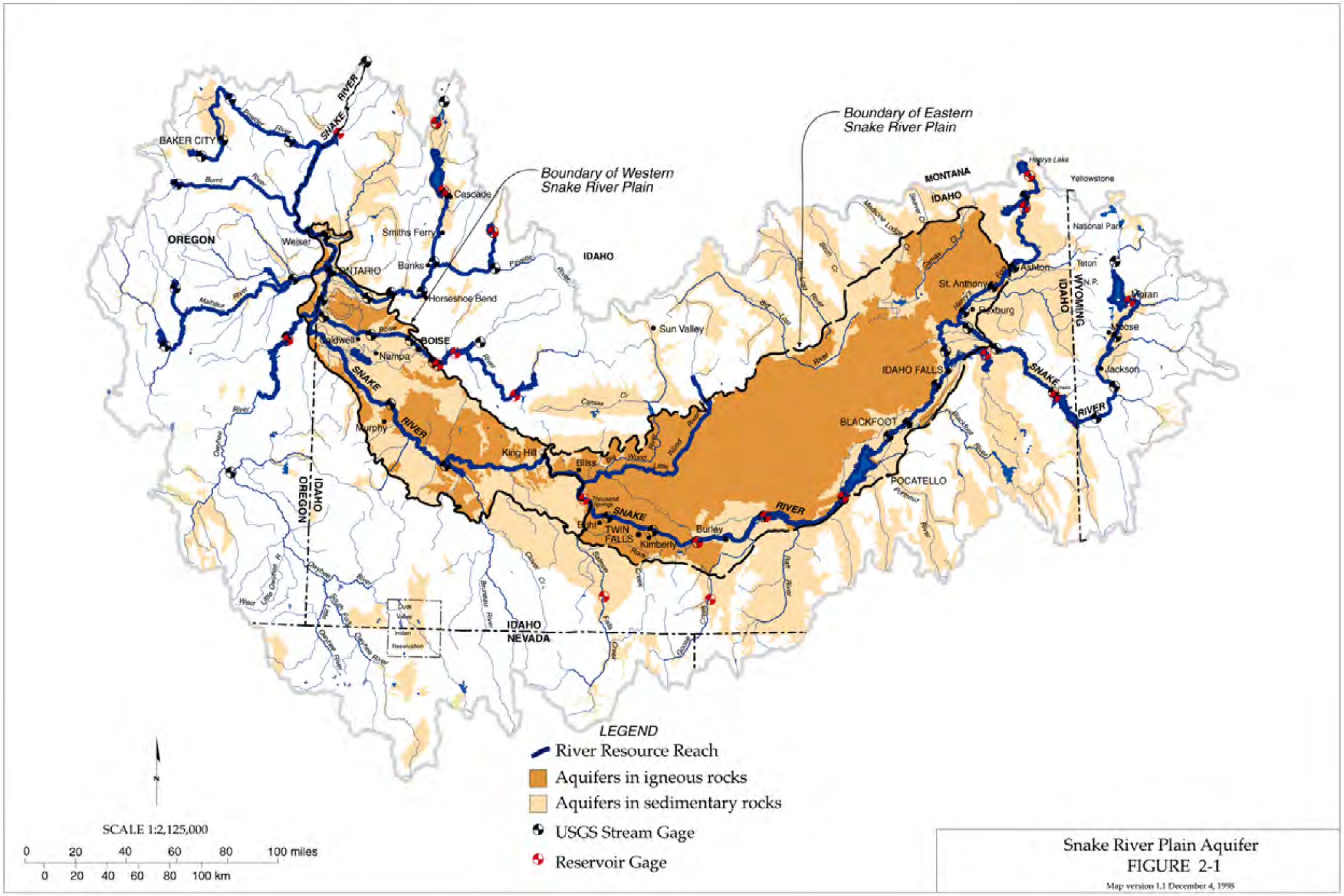
The average outflow of the Snake River at Lewiston, Idaho (upper end of Lower Granite Lake) is about 36 MAF. Nearly one-half of this flow is due to the combined flows of the Salmon, Clearwater, and Grande Ronde Rivers. Average annual outflow at Hells Canyon Dam is about 14 MAF.

2.3 Groundwater

2.3.1 Background

Groundwater is an integral part of the water supply in the Snake River basin and occurs to various degrees throughout the basin. The SRPA is one of the largest groundwater systems in the United States, containing about 250 MAF in the top 500 feet. The SRPA is separated into eastern and western regions on the basis of unique geohydrologic characteristics. The eastern SRPA covers about 10,800 square miles and is composed primarily of several thousand feet of layered basalt (Lindholm, 1996). It underlies the Snake River basin from near St. Anthony, in Fremont County, to King Hill, in Elmore County. The western SRPA system is smaller, covering about 4,800 square miles, and is composed primarily of up to 5,000 feet of sedimentary deposits of silt, clay, sand, and gravel with sporadic basalt interflow zones. The western SRPA underlies the Snake River basin from King Hill to Weiser. Most of the water in the western SRPA is located in the Boise and Payette River basins.

The extent of the SRPA is shown in figure 2-1 along with other aquifers in the basin. Aquifers in the subbasins tributary to the Snake River provide groundwater for use within the individual subbasins and provide various amounts of recharge to the SRPA in the form of subsurface groundwater inflow


Boundary of Western
Snake River Plain
Boundary of Eastern
Snake River Plain
BAKER CITY
OREGON
IDAHO
MONTANA
WYOMING
NEVADA
SNAKE RIVER
Cascade
Smiths Ferry
Banks
Horseshoe Bend
ONTARIO
Weiser
BOISE
Caldwell
Nampa
Murphy
King Hill
Bliss
Sun Valley
TWIN FALLS
Kimberly
Burley
Buhl
POCATELLO
BLACKFOOT
IDAHO FALLS
St. Anthony
Rexburg
Ashton
Jackson
Moran
Yellowstone
National Park
LEGEND
River Resource Reach
Aquifers in igneous rocks
Aquifers in sedimentary rocks
USGS Stream Gage
Reservoir Gage
SCALE 1:2,125,000
0 20 40 60 80 100 miles
0 20 40 60 80 100 km
Snake River Plain Aquifer
FIGURE 2-1
Map version 1.1 December 4, 1998

Under natural conditions, recharge to the eastern SRPA occurs primarily from deep percolation of rainfall and subsurface inflow from tributary aquifers. Expansion of irrigated agriculture in the late 1800's caused significant recharge due to deep percolation of water applied to irrigated lands and seepage from conveyance canals (Stearns et al., 1938).

Deposits of the western SRPA transmit and yield considerably less water than do the basalt interflow zones of the eastern SRPA. Consequently, the productivity of the western SRPA is much less than the eastern SRPA although it is greatest in the Boise River valley (Lindholm, 1996).

Valley-fill aquifers in tributary valleys consist primarily of unconsolidated gravel, sand, silt, and clay and provide groundwater supply for various uses within the individual subbasins tributary to the Snake River. Wells in valley-fill aquifers generally are less than 200 feet deep.

Groundwater supplies most of the M&I water uses in the basin. The quality of groundwater generally is acceptable for most purposes and surpasses national drinking water standards. However, water quality measurements through 1986 indicated that about 10 percent of water samples from the eastern SRPA contain more nitrate than the drinking water standard of 10 milligrams of per liter (mg/L) (USGS, 1988). A ready avenue for transport of contaminants exists in areas where permeable rocks are common between land surface and the water table.

Groundwater recharge and discharge processes are linked closely with surface-water supply and use. Groundwater generally is recharged from river losses and from the infiltration of precipitation and irrigation applications while discharge is to wells, springs, and as river gains. Changes in river operations, irrigation diversions, or irrigation practices may impact groundwater supplies. For example, increasing irrigation efficiency by conversion from flood to sprinkler irrigation methods may lead to reduced diversions and immediately provide greater instream flow. Unless crop consumptive use declines (by crop conversion or reduced production), groundwater recharge would be decreased and long-term river gains will decline. Also, groundwater use may impact the surface-water supply. Groundwater withdrawals for irrigation and other uses may reduce river gains and increase river losses; artificial groundwater recharge may increase river gains and reduce river losses.

Groundwater budget data, both recent and historic, are insufficient to quantify relationships between groundwater and surface water in many tributary basins and areas adjacent to the Snake River downstream from Brownlee Reservoir. Reports that describe groundwater conditions for the Palouse River (Nassar and Walters, 1975) in Idaho; the Owyhee, Malheur, Burnt, and Powder Rivers (Newcomb, 1960) in Oregon; and the Columbia Plateau (Whiteman, K.J. et al., 1994) in Washington indicate that groundwater is an important component of the water supply in those basins, but that groundwater yield is minor compared to the overall surface-water supply of the Snake River basin.

2.3.1.1 Eastern SRPA

Springs that flow into the Snake River at Thousand Springs and into American Falls Reservoir between Neely and Blackfoot are major points of groundwater discharge from the eastern SRPA. Records indicate that spring discharge has been relatively stable in the Neely-Blackfoot reach of the Snake River at about 2,500 cfs from 1912 to 1980 (Kjelstrom, 1986).

In 1980, the Snake River gained about 1.9 MAF from groundwater inflow between Blackfoot and American Falls Dam and 4.7 MAF between Kimberly and King Hill (Lindholm, 1996). The river loses water upstream from Blackfoot and in the vicinity of Lake Walcott throughout the year. Practically all flow in the Snake River is diverted at Milner Dam for irrigation during the growing season.

The Thousand Springs reach effectively separates the groundwater hydrology of the eastern SRPA from that of the western SRPA. Much of the groundwater from the eastern SRPA discharges naturally to a series of spectacular springs that flow into the Snake River. About 50 percent of annual streamflow of the Snake River near King Hill is from groundwater discharge. Discharge from individual springs near King Hill ranges from a few hundred to several hundred cubic feet per second. Many spring outlets are located at the bottom of alcoves that extend hundreds of feet into the 300-foot-high north face of the Snake River canyon. Discharge from these springs supports the largest freshwater aquaculture industry in the world.

Irrigation water application after the late 1800s in excess of crop growth requirements added to the amount of groundwater in storage in the eastern SRPA and caused water levels in the aquifer system to rise. Discharge at Thousand Springs increased from about 4,200 cfs since the early 1900s to about 6,800 cfs by the mid-1950's, as shown on figure 2-2, as a result of increased groundwater storage and water level rises.

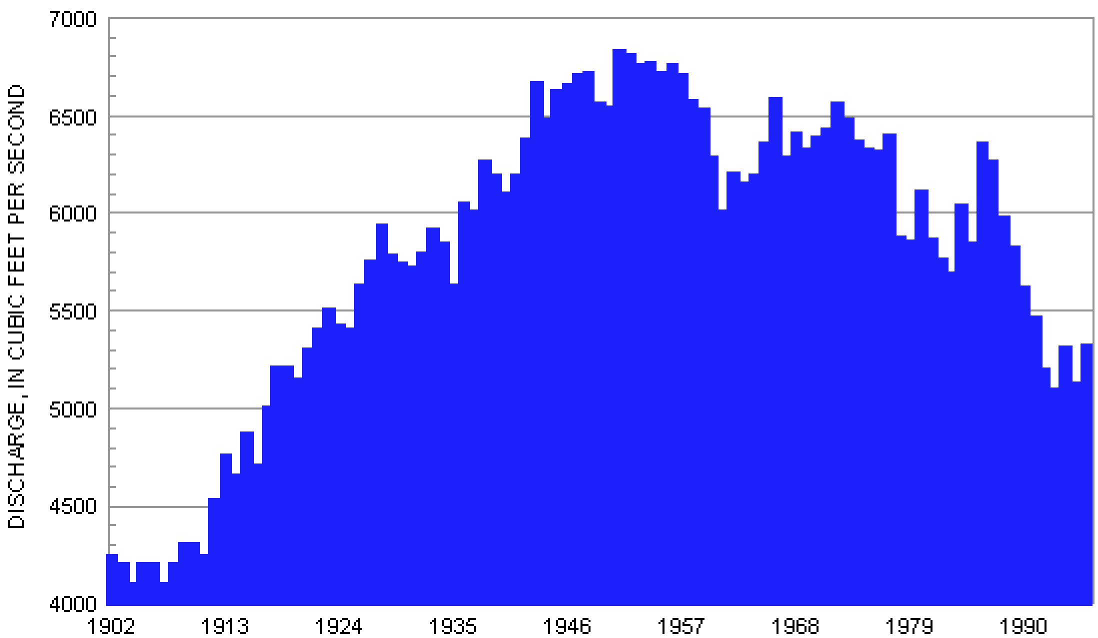


Figure 2-2 Groundwater Discharge from the Eastern Snake River Plain Aquifer to the Thousand Springs Reach of the Snake River, 1902 – 1996 (data provided by Tom Brennan, USGS, Boise, ID, 1997)

Spring discharge in the 1990s for the Milner Dam to King Hill reach has been in the range of 5,000-5,500 cfs. The stabilization and decline of spring discharge from highs in the mid-1950's have been attributed to the widespread increase in groundwater pumping for irrigation, a decrease in surface-water diversions for irrigation that corresponded with the conversion from flood to sprinkler irrigation, and periodic drought conditions. Changes in irrigation practices, river operations, and managed recharge activities in the Snake River plain could impact the groundwater hydrology of the eastern SRPA. Groundwater yield from basins tributary to the eastern SRPA totaled about 2,000 cfs in 1980 or about 15 percent of the recharge to the eastern SRPA (Garabedian, 1992). Therefore, irrigation practices and river operations that affect the hydrology in tributary basins could have a marked effect on the hydrology of the eastern SRPA.

2.3.1.2 Western SRPA

Interchange between groundwater in the western SRPA and the Snake River is less than 1,000 cfs (Kjelstrom, 1995). The Boise River is the largest tributary river that flows through part of the western SRPA and provides a water supply of sufficient magnitude to have made the lower Boise River valley the most productive part of the western SRPA. A comprehensive geohydrologic investigation of the lower Boise River valley is in the second of a 5-year study (Petrich, 1997). Changes in irrigation and river operations in the Boise and Payette Rivers could affect groundwater yield from the western SRPA in the Boise and Payette River valleys. Groundwater yield from other basins tributary to the western SRPA was negligible in 1980 (Kjelstrom, 1986).

2.4 Surface-Water/Groundwater Interactions and Usage

Surface-water and groundwater systems are hydrologically connected; that is, changes in recharge or discharge from the SRPA affect surface flows. Water infiltrating from irrigation and streamflow provides a significant portion of the groundwater budget. At other places, the Snake River channel is below the regional water table and the aquifer discharges to the river.

Conjunctive management of surface and groundwater appear to be increasing in importance as local declines in groundwater storage adversely affect spring flows and availability of groundwater for irrigation pumping. Conjunctive management is an issue for the Idaho Department of Water Resources (IDWR) and the Oregon Water Resources Department (OWRD) since the vast majority of groundwater withdrawals are typically by non-Reclamation junior water rights holders. The prospects for obtaining significant volumes of water for flow augmentation in association with conjunctive management are not promising due to the complexity of the interrelationships between groundwater and surface-water and the substantial time lag that is associated with groundwater depletions or recharge (whether natural or managed).

In the 1990's, two separate requests were made by those relying on spring flow discharge and groundwater to regulate upgradient pumping by junior water rights holders in Idaho. These actions created a flurry of increased activity and concern about the condition of the SRPA. One key court ruling found that IDWR must conjunctively manage groundwater and surface-water supplies and meet the prior rights of those relying on springflows at Thousand Springs.

2.5 Water Use

Reliable data on water use in the Grande Ronde and Salmon River basins was difficult to obtain in the timeframe for this analysis. Diversions and consumptive water use in these basins is primarily for irrigated agriculture, but the total quantity used in these two basins is relatively small compared to the rest of the Snake River basin. For this analysis, data on water use and consumption, is limited to the Snake River basin upstream of Brownlee Dam.

Irrigated agriculture accounts for almost 99 percent of all out-of-stream water diversions and groundwater pumping from the Snake River basin. Essentially all surface water diversions and about 95 percent of all groundwater diversions are used for irrigation. Virtually all domestic, public supply, and industrial requirements in the basin are met from the remaining 5 percent of groundwater diversions.

Reclamation (Reclamation, 1997) estimates that about 14.5 million acre-feet of water are diverted from streams and about 7.5 million acre-feet are pumped from groundwater in the basin upstream of Brownlee Dam. Of the streamflow diversion, Reclamation estimates that about 8.5 MAF return to the river or aquifers for a total consumptive use from surface diversions of 6 MAF.

In contrast, the Idaho Water Resource Board (IWRB) estimates that a total of about 16.6 MAF of surface waters are diverted and conveyed by more than 3,000 miles of canals and laterals to irrigated fields (IWRB, 1996). Of this amount, gravity diversions from the main Snake River total about 9.5 MAF, gravity diversions from tributaries total about 6 MAF, and pumpage from the main Snake River and tributaries totals about 1 MAF. In addition, about 3.5 MAF of groundwater, mostly from the upper Snake River basin, is annually supplied to agricultural lands. A comparison of surface-water diversions and groundwater withdrawals for irrigation based on IWRB data is shown in figure 2-3.

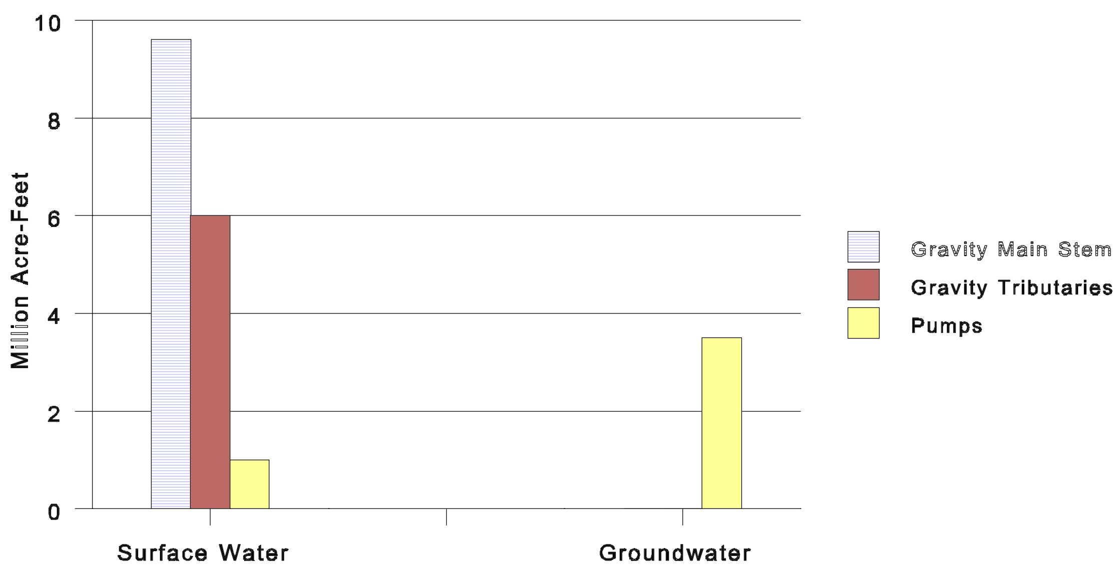


Figure 2-3 Surface Water Diversions and Groundwater Withdrawals

Most M&I water is supplied from groundwater utilizing private or public utility systems concentrated in the Boise, Pocatello, Twin Falls, and Idaho Falls areas and has no significant affect on reservoir operations. Industrial water is primarily used for food processing, including potato and sugar beets; phosphate mining/processing; dairy products production; and manufacturing. In the Boise valley, groundwater is also used in computer chip production.

2.6 River and Reservoir System Operations

An in-depth discussion on river and reservoir operations in the Snake River basin can be found in Reclamation's Combined Report (Reclamation 1996a, 1996b, 1997a). The discussion for this section has generally been summarized from those documents.

River and reservoir operations are based largely on state laws related to water resources, construction of large Federal Reclamation projects, and ownership and operation of major river control structures. Overriding much of the river operation by Reclamation, the Corps, and the IPC are water rights administered by the states, requirements for flood control operations specified in Federal legislation, and IPC operations requirements defined in its Federal Energy Regulatory Commission (FERC) licenses.

2.6.1 General Operation

Reclamation reservoirs are operated primarily for irrigation water supply and flood control. Hydroelectric power generation, recreation, and fish and wildlife functions (other than maintaining streamflows) are secondary or incidental to the project operations because water is generally not released specifically for those purposes. Each Reclamation facility was originally authorized by congressional legislation and constructed for specific purposes; however, subsequent Federal legislation has modified operational requirements and sometimes imposes significant constraints on how the individual facilities may be operated. Reclamation project operations include releases to meet earlier dated natural flow rights.

Operation strategies have been developed for all Reclamation reservoirs. At the end of the irrigation season in October (when most consumptive use demands have been met), many of the reservoirs are lowered or maintained at summer drawdown levels to leave sufficient storage space to control winter inflows. During the spring snowmelt period, reservoir storage and outflow are carefully controlled to protect and maintain facility integrity, protect downstream areas from flood damage, and fill the reservoirs as runoff declines. During the summer irrigation period, the reservoirs are drawn down to meet downstream irrigation needs.

Reclamation works closely with the watermasters to assure an exchange of information on streamflows and to assure that releases from storage meet irrigation demands. These procedures vary by basin and even by river reach. If the demand can be met from more than one reservoir, Reclamation decides from which reservoir to make releases. Watermasters rely on their respective state water resources department to help provide information and analysis for water diversions and deliveries to water users. A water rights accounting is maintained to assure that, regardless of where water is physically stored, the storage and use of water are properly accounted to the appropriate rights and spaceholders.

The Snake River reservoirs upstream of Milner Dam are operated as a unified storage system where water is stored and released in a manner that maximizes the capability of the storage reservoirs. This means that water is, to the extent possible, retained in those reservoirs that are most difficult to refill and released from the reservoirs that are most likely to refill in the following year. In practice, water is stored as far upstream as possible regardless of storage right priorities. The storage and use of water is properly accounted to the appropriate rights and spaceholders regardless of where water is stored or from where releases are made.

The Boise and Payette River systems are operated separately. The four reservoirs on the Boise River system are operated as a unified storage system and the two reservoirs of the Payette River system are operated as a unified system. In that way, the capability of the storage reservoirs is maximized. To the extent possible, water is stored at the upper most reservoir (Anderson Ranch Reservoir) in the Boise system. In the Payette system, Cascade and Deadwood Reservoirs are operated in parallel to keep refill capabilities of the two reservoirs equal.

Reclamation storage reservoirs in other tributaries are operated independently by irrigation districts for irrigation water supply and, in some cases, flood control. The two reservoirs of the Baker Project are also operated independently of each other to serve lands in two separate areas. Although the multiple reservoirs of the Vale Project are operated as a unified system, the capability of maximizing storage is limited because each reservoir is located on a different tributary. However, some water can be moved from upstream reservoirs to the furthest downstream reservoir via a feeder canal. The general operating seasons for these basins are based on climatological pattern, runoff, and irrigation demand and are the same as for the upper Snake River reservoirs.

IPC operates most of the non-Federal hydroelectric powerplants in the basin. IPC facilities are the major source of control on the main stem Snake River from Milner Dam to Lower Granite Lake. Some of IPC facilities are essentially run-of-river powerplants with minimal storage capacity to adjust flows for short-term power needs. However, C.J. Strike, Brownlee, Oxbow, and Hells Canyon have sufficient storage to be operated on a seasonal basis.

2.6.2 Water Rights

Idaho State water law is based on the priority of appropriation or "first in time is first in right" principle, and the Idaho State Constitution affirms that all waters of the State are public waters. The IDWR's system for the regulation of water identifies beneficial uses and the amounts of water that individuals may use. Permits, licenses, and decrees (adjudicated water rights) indicate water may be diverted from streams or groundwater, the amount of water that may be diverted, the purpose, the diversion points, and how much water may be stored in reservoirs. Water rights considerations may reach beyond the initial diversion and application of water, extending to how and when the unconsumed water returns to the river system or to an aquifer. This is because of the large volumes of return flows and the interactions between groundwater and surface water. IDWR controls the process of distributing water and accounting the amount of use. Water from federally-developed storage is controlled further by contracts with the Federal government. Reclamation and State watermasters work closely in this process.

The States of Wyoming, Oregon, and Nevada also adhere to the prior appropriation doctrine, affirm that all waters of the state are public waters, and have a process for granting water rights. These procedures are slightly different in each state but have the same general goal of managing water for beneficial use. States use the concept of beneficial use to quantify the water right acquired under the prior appropriation doctrine; one is entitled to receive only that amount of water that is actually put to a use that is recognized as beneficial by the state.

Pursuant to the mandate of Section 8 of the Reclamation Act of 1902, Reclamation acquires water rights for its projects under state law. Reclamation most often has obtained its project water rights by making application to the appropriate state agency, which would grant water rights for the entire project in the name of the United States. The water rights were perfected when the project irrigators put the water to beneficial use and the state confirmed that use through issue of final water certificates or an adjudication. Oregon water rights system includes storage permits and primary and secondary permits for diversion from storage. The certificate, generally issued to the United States and held by the Bureau of Reclamation, describes the lands that receive the project water and also allows the storage of the project water in the reservoir. Federal and state laws generally recognize that the Reclamation project irrigators jointly hold title to the project rights with the United States retaining legal title and irrigators holding beneficial title.

Reclamation holds title to the storage rights for all Reclamation storage facilities in the Snake River basin upstream above Milner Dam, in the Payette and Boise River basins, and in most other Reclamation reservoirs in the basin upstream of Lower Granite Lake. A compact between Idaho and Wyoming allows water stored in Jackson Lake and Grassy Lake to be used as though the reservoirs were located in Idaho. Reclamation also holds some natural flow rights. Some Oregon storage rights are held by irrigation entities and most natural flow rights are held by others.

A general adjudication of Idaho water rights in the Snake River basin was filed on December 19, 1987, and is ongoing in the 5th District Court of the State of Idaho for the County of Twin Falls (Case Number 39576). All water rights (surface and groundwater) claimed by more than 62,000 separate individuals and entities in the basin are included in the adjudication. Prior court decisions, Federal treaties, Federal contracts, and acts of Congress have bequeathed a legacy of uncertainty, confusion, and a multitiered system of irrigation delivery priorities. Reclamation claims use of water in the basin for several of its projects. The adjudication of water rights includes Federal reserved water right claims associated with the Shoshone-Bannock Tribes of the Fort Hall Indian Reservation and the Nez Perce Tribe. The Snake River basin adjudication is ongoing without a firm conclusion date.

A water rights agreement of 1990 among the Shoshone-Bannock Tribes, the State of Idaho, the United States, and certain Idaho water users settled litigation involving claims made by the United States on behalf of the Shoshone-Bannock Tribes to water rights in the upper Snake River basin and its tributaries. The agreement revised the date of natural flow rights belonging to the tribe to become the earliest date on the Snake River; retained the tribes storage rights; and provided storage space, without repayment obligations, to mitigate affected water users. A final consent decree concerning the tribes' rights to upper Snake River basin water was signed by the court.

The impetus for constructing most Reclamation dams in the Snake River basin, as elsewhere in the 17 Western States, was to provide a water supply for irrigation to reclaim arid lands. Construction of storage for irrigation water supply also provided the opportunity for some flood control. As a result, some reservoirs constructed fairly late in the development of the area include flood control authorization at the time of construction. In addition, Ririe and Lucky Peak Dams were constructed primarily for flood control. IPC constructed its facilities specifically to generate electricity. Other non-Federal reservoirs in the basin were constructed for a variety of purposes but primarily for irrigation.

Reclamation has spaceholder contracts with dozens of entities and supplies water when spaceholders call for their share. Through these contracts, irrigators are entitled to use storage space in Reclamation reservoirs by paying a portion of the project's construction costs and their share of allocated operation costs. The spaceholder contracts are a type of repayment contract that specifies the manner in which reservoirs are operated and includes provisions that Reclamation operate to maximize the available water supply. These spaceholder contracts provide the contractor with water that accrues to the contracted space with water being carried over to the next year up to the total of the contracted space. Spaceholder contracts at Reclamation reservoirs are in perpetuity (nonexpiring) while those for water in Lucky Peak Lake are 40-year renewable water-service contracts.

2.6.3.2 Irrigation

Most of the irrigated land upstream of Lower Granite Lake is located within the State of Idaho and amounts to more than 3 million acres. However, lands irrigated from the Snake River and its tributaries also include lands in western Wyoming, northern Nevada, and eastern Oregon. The average amount of land irrigated (and harvested) in the total region between 1988 and 1995 was nearly 3.4 million acres. Of this total, about 1.6 million acres are in Reclamation projects (receive all of the water or part of the water from Reclamation storage facilities).

Irrigated lands can be placed into three categories: (1) privately developed lands that receive a water supply from natural streamflows, groundwater, or private storage reservoirs; (2) privately developed lands that receive supplemental water from Federal storage developments; and (3) public domain lands for which a full irrigation supply was developed under the Federal Reclamation Act of 1902. Most, if not all of the water supply, for lands in the latter category is provided by the development of storage. All lands that receive a full or supplemental water supply from Reclamation (or Corps) developed storage are included in the statistics compiled for Reclamation projects and are considered to be Reclamation irrigated lands.

In this same area, during the 1988-1995 period, more than ½ million acres were dry-land farmed. It is clear that the factor limiting irrigated agriculture in this arid region continues to be water, not land availability. Early in this century, lands that were privately developed for irrigated agriculture often had an insufficient water supply. The development of water supplies by Reclamation, resulted in a conversion of lands from private irrigation to those included in Reclamation project. As soon as private lands received a supplemental water from Reclamation sources, Reclamation classified them as Federal irrigation. Nonetheless, many of these lands still receive the major source of water from natural flow rights that predate development of Reclamation storage.

Cropping patterns vary throughout the region, although alfalfa and pasture are found in all regions and are the major crops in the Grande Ronde River basin. Potatoes, wheat, and other grains are important in most regions. Sugar beets along with dry edible beans are important crops in the south-central part of Idaho. The reader is directed to chapter 6 for more detail on irrigated agriculture in the region.

2.6.3.3 Flood Control

The Act of September 30, 1950, authorizing the construction of Palisades Dam, by reference, authorizes the Reclamation reservoirs upstream of Milner Dam to be operated for flood control. In addition, the Flood Control Act of 1944 and other related acts have essentially authorized flood control at all Reclamation reservoirs. Under the Flood Control Act of 1944, the Corps is tasked with identifying flood control needs and developing flood control procedures as needed at Federal facilities.

Formal flood control rules have been developed under Section 7 of the 1944 Flood Control Act for many Reclamation reservoirs which are then operated with flood control as one of the primary operating purposes. In some cases, Reclamation has independently developed flood control rules for some reservoirs and requires the operating entities to follow those rules. Coordinated operations among several reservoirs and several agencies in parts of the Snake River basin provide the greatest flood control protection.

Flood control requirements are an important and complex operational consideration since they involve public safety and protection of property. Complexity arises from the uncertainty of runoff forecasting and attempts to balance flood control against reservoir refill for irrigation water supply.

2.6.3.4 Power Generation

Hydroelectric powerplants owned and operated by Reclamation and the Corps (Federal facilities) were constructed and are operated under Congressional authorization, while public and private powerplants (non-Federal facilities) are operated under FERC licenses. Several hydroelectric powerplants have been constructed and are operated by non-Federal entities at Reclamation dams. These powerplants are operated under FERC regulations.

Hydropower is specifically mentioned in the original authorization of several Reclamation reservoirs as shown on table 2-1. However, water is not released specifically for power generation at Reclamation reservoirs. Power generation depends on the releases of water for other project purposes. There are two exceptions to the above: (1) where there was a water right for power generation at the site prior to construction of the Reclamation dam and (2) when a power generating entity has a contract for storage space in a Reclamation reservoir. In these cases, Reclamation releases water as required to meet the water right or the contract.

Power generation is the major operating consideration at dams and diversions owned by IPC and at some other facilities authorized under FERC regulations. Many of these are run-of-river facilities that generate electricity with little or no change in streamflow. Some of the IPC facilities have sufficient storage capacity to shape flows and generate electricity to follow load demands. These non-Reclamation facilities are operated to maximize revenue within the limits of the FERC licenses and state water rights and have seasonal, daily, and diurnal variations in power revenue per kilowatt-hour.

There are 36 hydroelectric powerplants with a nameplate capacity greater than 5 megawatts (MW) in the Snake River basin upstream of Brownlee Reservoir. Reclamation and IPC facilities account for most of the installed capacity in the basin. Chapter 6 and attachment D provide specific information on the powerplants that were modeled and evaluated in this flow augmentation analysis.

2.6.3.5 Municipal and Industrial Water (M&I)

Municipal and Industrial (M&I) water supply is not a consideration in current river and reservoir operations in the basin. There are only three contracts for M&I water in Reclamation storage space for a total of 4,800 acre-feet of space in Anderson Ranch and Lucky Peak Lake. The procedure for releasing and accounting this water is essentially the same as for irrigation water contracts.

Most M&I water is supplied from groundwater using private or public utility systems which are concentrated in Boise, Pocatello, Twin Falls, and Idaho Falls. Reservoir operations are not modified to meet groundwater M&I needs.

2.6.3.6 Recreation

Recreation is specifically authorized at some Reclamation reservoirs as shown on table 2-1. Public Law 89-72 and Public Law 102-575 authorized construction of recreation facilities and management of lands for recreation purposes (including fish and wildlife enhancement) at all Reclamation projects. However, these laws do not authorize a change in the use of storage space or operation of reservoirs for recreation purposes.

Some FERC permits for hydropower facilities also address recreation and have provisions for adjusting releases specifically for recreation or water quality. Examples include the Milner Powerplant, the American Falls Powerplant, and the Cascade Powerplant (all operated by IPC).

2.6.3.7 Fish and Wildlife

Authorities under which the Reclamation dams and reservoirs were constructed and are now operated do not generally include fish and wildlife enhancement, except as provided under Public Law 89-72 and Public Law 102-575. Existing provisions for fish and wildlife enhancement are generally limited to managing land surfaces and providing protective measures, but do not include managing the water supply for that purpose. Fish and wildlife operations are included in the original authorizations of specific projects as shown on table 2-1.

Snake River facilities, in recent years, have been managed to accommodate fish and wildlife concerns including protecting species listed under the ESA. Reclamation operations include streamflow augmentation downstream of some dams and maintenance of reservoir conservation pools at some reservoirs to help maintain and support fish and wildlife habitat, water quality, and recreation. Operational considerations include target conservation pools and streamflows along with providing water to augment flows for salmon migration in the lower Snake River. Reclamation's objective has been to meet the contractual obligations and meet fish and wildlife considerations where practicable.

Reclamation's ROD in response to the 1995 BIOP and an agreement among Reclamation, IPC, and the USFWS form the basis for current operations to provide salmon flow augmentation in the lower Snake River. Reclamation obtains water for this purpose, under the authority of the ESA, from uncontracted storage space, acquisition of contract entitlements at Reclamation reservoirs, acquisition of natural flow water rights, and annual purchases of water from rental pools. Reclamation recently submitted a BA (Reclamation, 1998) to the NMFS and USFWS on the operation of its projects above Lower Granite Lake and the impacts on endangered plants, animals, and fish.

Some FERC licenses have provisions for protecting fish and wildlife. These provisions have generally included physical or operational modifications to help maintain water quality. In recent years, some IPC facilities have been required under FERC licenses to consider ESA species.

2.6.3.8 Water Quality

Water quality of reservoir pools and associated downstream river reaches is an operating concern. In most cases, Reclamation addresses water quality concerns at reservoirs by designating a specific volume of uncontracted storage space to be used as a conservation pool. Maintaining a conservation pool is also a means of addressing downstream water quality concerns when it is known that low pool elevations result in release of sediment from the reservoir. Reclamation also designates volumes of uncontracted storage space to be used to maintain the water quality of downstream reaches. These designations are made with the full realization that conservation pools and minimum flow targets for downstream reaches may not be achievable in drought conditions. Where there is no uncontracted storage space, Reclamation is without means of independently addressing water quality.

2.7 Agency and Entity Responsibilities

Federal, state, private, and local entities are involved in operation of the Snake River system. Operating entities are responsible for operating within the parameters of Federal and state laws and regulatory agencies are responsible to assure that operations are within those parameters.

2.7.1 Reclamation

Reclamation is responsible for the operation of its facilities, whether those facilities are operated directly by Reclamation staff or operated by the contracting entities. All Reclamation facilities are operated in accordance with authorizing and subsequent Federal legislation and state laws and in cooperation with the Corps and state water resource agencies. Reclamation coordinates its operations with all involved Federal, state, and local entities.

Storage contracts, in general, limit water operations to those that provide benefit to contract holders. State water law limits appropriation of water to beneficial uses and defines those uses. Nonetheless, there remains flexibility to address some fish, wildlife, and recreation preservation and enhancement concerns.

In effect, Reclamation is the primary entity involved in regulating flows in the Snake River upstream of Milner Dam since all of the major storage is owned and/or operated by Reclamation. The same is true for the Boise and Payette Rivers since all of the major storage, with the exception of Lucky Peak, is owned and operated by Reclamation. In other tributaries with facilities owned by Reclamation but operated by contracting entities, Reclamation has a more limited role but maintains certain responsibilities for maintenance, operation, and coordination.

2.7.2 Corps

The Corps is responsible for the operation of Lucky Peak Dam. More importantly, the Corps, through the Flood Control Act of 1944, is the responsible Federal agency for developing flood control rules and for oversight of flood control at all Federal dams. Reclamation and the Corps cooperatively develop formal flood control rules for the operation of many dams. During the flood control season, the Corps and Reclamation independently develop runoff forecasts, compare those forecasts, and then decide on a single runoff forecast for flood control operation. The Corps and Reclamation work closely to coordinate operations.

2.7.3 State Water Resource Agencies

The States of Wyoming, Idaho, Oregon, and Nevada have all adopted the prior appropriation doctrine for water rights (see Water Rights section) and have developed procedures for the administration of water rights. State water resource agencies have been created to handle the administration of state laws related to water. Included in their responsibilities are overseeing the water rights process (establishing, permitting, and issuing water rights), water distribution including protection of water rights, and adjudication. Other activities can relate to dam safety, floodplain management, groundwater recharge, and state waterbanks. State agencies are often charged with identifying problems and needs and with developing state water plans for the future development and administration of water resources.

State agencies most concerned with the geographical area identified for this flow augmentation analysis are: Wyoming State Engineer, IDWR, IWRB, Nevada Department of Conservation and Natural Resources, Oregon Water Resources Commission, and OWRD.

2.7.4 Idaho Power Company (IPC)

IPC owns and operates several major dams with hydropower facilities within the Snake River basin. IPC has the responsibility to operate its facilities according to the FERC licenses and according to the water rights administered by IDWR. FERC licenses are site specific and may address requirements to operate for flood control, recreation, water quality, and fish and wildlife protection and enhancement. Except where constrained by specific provisions within the individual project FERC licenses, or other agreements, IPC operates all of its facilities to maximize the reliability and economic benefits of power generation. IPC is now involved in the relicensing process as many of its projects will soon be up for renewal.

In recent years, IPC has modified its Brownlee operations, in coordination with NMFS and BPA, to provide augmentation flows for endangered salmon. IPC carefully protects its ability to manage Brownlee Dam, its only significant storage facility, for power generation purposes. For this analysis Reclamation has assumed that Brownlee operations would continue as in the recent past. The extent to which Brownlee operations could or should be further modified for salmon flow augmentation is a matter that appears to require the direct involvement of IPC. There is one change that would be required to provide an additional 1MAF and would affect IPC. IPC, with support from other Idaho interests, has insisted that releases past Milner Dam be made at levels not to exceed 1,500 cfs. This constraint could not be maintained if an additional 1 MAF is provided downstream.

2.8 Natural Resources

A wide variety of natural resources and habitats are found in the Snake River basin. Some fish and wildlife species are resident while others are migratory and some are native while others are introduced. Cold water fish species, including anadromous fish, are the major management focus of fishery agencies, but a variety of warm water fish species are also present and managed as productive fisheries.

Many wildlife species, including a number of ESA-listed species, depend upon the unique habitats provided by the Snake River system for all or part of their existence. Of particular note are birds. One of the largest concentration of nesting raptors in the world is found in the Snake River Birds of Prey National Conservation Area located along the main stem Snake River. Reservoirs and lakes provide essential habitat for migrating waterfowl. American Falls is in the North American Waterfowl Management Plan - Waterfowl Habitat Area of Special Concern.

Coniferous and deciduous forests, scrub-shrub wetlands, emergent wetlands, and other habitats, provide food and cover for waterfowl, shorebirds, marsh birds, wading birds, aquatic and other furbearers, large ungulates, and other wildlife.

Riverine islands, some of which are under Federal or state protection, provide unique sanctuary and protection for waterfowl. Approximately 260 islands exist between Palisades and the confluence of the Henrys Fork and hundreds of islands can be found between the Henrys Fork confluence and Brownlee Dam.

Fish, wildlife, and habitats that could be affected by providing flow augmentation water are more fully described in chapter 7.

2.9 Social Aspects

Indigenous native peoples populated the area for thousands of years. In the mid 1800s, two Indian reservations were established in the general geographic area covered by this analysis. These are the Fort Hall Indian Reservation located along the Snake River in eastern Idaho and the Duck Valley Indian Reservation located in south Idaho and northern Nevada. The Indian tribes that live on these two reservations, tribes associated with other reservations, and tribes without reservations retain specific rights with respect to the use and harvest of natural resources in the Snake River basin. The Fort McDermitt Indian Reservation (Nevada and Oregon), the Umatilla Indian Reservation (Oregon), and the Coeur d'Alene Indian Reservation (Idaho) are located just outside the boundaries of the area covered by this analysis.

Idaho was predominantly rural from the time it was a territory until the 1960's and 1970's when manufacturing, services, and other sectors began growing and populations became more concentrated around specific communities. The economy of the State has been based on the stable agricultural industry as well as timber and mining. Western Wyoming, eastern Oregon, and northern Nevada are largely rural with economies based primarily on agriculture and livestock, food processing, and timber. Much of the economy of these areas is closely linked to the Snake River due to the arid climate. Agriculture and the related infrastructure throughout the Snake River basin is heavily influenced by the irrigation of land. The climate makes irrigation essential to intensive agriculture.

Irrigated agriculture was the focus for the development of many communities and continues to be a dominant economic force in many of those communities. Irrigation areas associated with Reclamation projects are located in three major areas: (1) southeastern Idaho from American Falls on the main stem to Ashton on the Henrys Fork, (2) southern Idaho along the main stem from the confluence of the Big Wood River to Minidoka, and (3) western Idaho along the lower Boise and Payette River and eastern Oregon along the lower reaches of the Owyhee and Malheur Rivers. Reclamation projects and private irrigation have been developed on several other tributaries.

Some communities have developed economies primarily related to tourism and recreation, e.g., Jackson, Wyoming and Cascade, Idaho. Much of the tourism and recreation in these and other areas is also dependent on streams and flatwater including natural lakes and Reclamation storage reservoirs. Recreation is dependent on a good water supply, water quality, and the presence of sufficient populations of fish and wildlife. State and local economies are dependent on the river and associated fish, wildlife, and vegetation. A more detailed discussion of social aspects is in chapter 8.

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i. Contracted and Formally Assigned space categories are given to the nearest 1 acre-foot; other space categories are rounded to the nearest 100 acre-feet. As a consequence totals for some columns reflect rounding errors.

ii. Except for Minidoka and Lucky Peak, all contracts are spaceholder (share of reservoir capacity) repayment contracts. Minidoka storage is included in the original Minidoka Project and addressed in conventional repayment contracts. Lucky Peak contracts are spaceholder water service contracts, which are subject to for renewal in 2005 - 2008.

iii. Above the spillway and not storable.

iv. Purchased by Reclamation for salmon augmentation flow.

v. Dead storage is a natural lake, the volume of which has not been determined.

vi. Designated for mitigation of Safety-of-Dams repairs to Deer Flat Dam.

vii. Reserved for powerhead.

viii. Includes 250,000 acre-feet for minimum pool and 19,900 acre-feet designated for reservoir evaporation accounting.

ix. Reserved for sediment control and needed for use with 250,000 acre-feet minimum pool to maintain water quality and endangered bald eagles.

x. Includes 49,900 acre-feet for minimum pool and 29,750 acre-feet reserved for Deadwood River streamflow maintenance.

xi. Nominal amount.

xii. Reserved for sediment control.

xiii. Corps of Engineers facility with irrigation water marketed by the Bureau of Reclamation.

xiv. Boise River streamflow maintenance of which 50,000 acre-feet is reserved for the Idaho Department of Fish and Game.

xv. Transferred (3,554 acre-feet) or purchased (37,378 acre-feet) by Reclamation for salmon augmentation flow.

xvi. Corps of Engineers dead pool for reservoir fishing.

xvii. Reserved for sediment control.

xviii. Provides head for north side and south side Minidoka canals and Minidoka Powerplant.

xix. Repurchased by Reclamation for salmon flow augmentation.

xx. Reserved for powerhead.

xxi. Exclusive flood control.

xxii. Reserved for sediment control.

xxiii. Provides head for irrigation outlet.

xxiv. Reserved for sediment control.

3 Water Sources For Flow Augmentation

3.1 Introduction

Reclamation's analysis of the capability of the existing water resource to provide flow augmentation for salmon recognizes that the upper Snake River water resource base is essentially fully utilized at present. The over appropriation of natural flows in the early to mid 20th century led to the construction of Federal storage on the main stem and in several tributary basins. That storage space is currently under contract to spaceholders or has been assigned to specific uses. Some of the assigned uses include maintenance of reservoir pools and maintenance of streamflows to help preserve fish and wildlife resources. One of the assigned uses is flow augmentation in the lower Snake River.

These general facts indicate that there is no “free” water supply available in the basin. Water from the upper Snake River could be obtained for flow augmentation in the lower Snake River only by decreasing the amount of water currently used for other purposes. Since most of the water use in the basin is for irrigation, large levels of flow augmentation would necessarily decrease the water supply available for irrigated agriculture.

The purpose of this chapter is to enumerate and describe the sources of water and to identify the amount of water found to be physically available in the basin. Major questions with regard to how the water could be obtained and released for flow augmentation have not been resolved. Water acquisition issues are more fully discussed in chapter 9.

3.2 Potential Water Sources

Generally considered as sources of water are: existing Reclamation storage, existing non-Reclamation storage, new storage, natural flows owned by private individual and entities, groundwater, and water made available by conservation and by elimination of unauthorized water use. The following sections provide information on each water source.

Regardless of the source of flow augmentation water, the effect of using a part of that water supply for flow augmentation would be to reduce the water supply for irrigation. Selection of specific sources by location would shift effects to the area from which water was obtained. It is important to recognize that the programmatic nature of this analysis is not so much site specific as it is regional in terms of effects.

3.2.1 Reclamation Storage

3.2.1.1 Active Space

Reclamation reservoirs have a total of about 7 MAF of active storage space (see table 2-2). Of the active storage space, about 6.3 MAF are contracted to spaceholders. Some portion of this space could potentially be made available for flow augmentation.

Active space also includes about 160,000 acre-feet of space already assigned to flow augmentation. This space would continue to be available. The remaining active space of about 530,000 acre-feet is assigned to a variety of purposes including streamflow maintenance, reservoir conservation pools, and exclusive flood control space. The exclusive flood control space of 27,000 acre-feet is essential for flood control operations and would not likely be made available for flow augmentation. A portion of the remaining space assigned to other uses could be reassigned to flow augmentation.

3.2.1.2 Inactive Space

Inactive space in Reclamation reservoirs totals about 800,000 acre-feet and is reserved for the operation of powerplants (powerhead), operation of irrigation outlets (irrigation canal head), sediment control, and water quality. It is likely that only the portion used for powerhead could be made available.

Reclamation has, in the past, relied on water in the powerhead space to meet a portion of the flow augmentation commitments in dry years when there was little water in the rental pool. Powerhead space would continue to be made available for flow augmentation in the driest years.

3.2.1.3 Rental Pools

The current operation of Reclamation reservoirs makes possible the development of rental pools through which sellers with excess water can make water available to others with an inadequate water supply. Reclamation has relied on the rental pools to obtain a large portion of the existing 427,000 acre-feet requirement for flow augmentation. These rental pools can operate because a spaceholder contractor may have more water than needed in some years and can carry over that water to the next year or place it in a pool for others to purchase. Under current rules, the space for flow augmentation has last-to-fill status the following year. All other contracted space in the reservoir must fill the next season before water can be placed in the space occupied by the water sold in the previous season. This is primarily an accounting procedure to avoid penalizing spaceholders that do not sell water for downstream uses.

If the flow augmentation requirement remains at 427,000 acre-feet, rental pools could continue to supply a portion of the flow augmentation water.

Acquisition of large amounts of storage space, and annual release of the water that accumulates in that space, would reduce reservoir refill capability. Remaining spaceholders would suffer shortages at levels not previously experienced. The increased likelihood of shortages would be of such scale as to raise serious doubts as to the willingness of spaceholders to consign water to rental pools. As a result, Reclamation considers the rental pools as a source of water only for 427,000 acre-feet.

3.2.2 Non-Reclamation Storage

Reclamation determined that there was insufficient time to gather data to analyze the potential of non-Reclamation storage for flow augmentation.

The only significant federal storage in addition to Reclamation storage is the three BIA facilities that provide water to Indian irrigation projects. Any change in use of that water would require the approval of the tribes.

IPC owns the single largest block of private storage in the basin. IPC operations currently help shape flows for salmon augmentation and provide most of the electric power used in the area.

3.2.3 New Storage

New storage was not evaluated in this analysis. However, new storage sites in the basin have been analyzed in other reports (Corps, 1990; Reclamation, 1994). Construction of such storage would most likely be off-stream by a federal agency and would typically require a lengthy budget, study, and authorization process. Such a process could easily exceed 10 years before initiation of construction with first operation likely to follow in another 5 years. New storage is a potential long-term solution to add large amounts of flow augmentation water. This analysis did not consider new storage, in part, due to the long timeframe for development but also because study and authorization of such development for flow augmentation would require a process separate from the current Corps study.

3.2.4 Natural Flows

Another potential source of water for flow augmentation is natural flows that currently are diverted to irrigate private lands (lands that do not receive water from Reclamation projects). To obtain this water, the natural flow rights to those lands would be acquired, irrigation of those lands would be curtailed, and the flows currently diverted would remain instream for flow augmentation. Reclamation has already purchased the natural flow rights for irrigation of 4,420 acres of farmland in Oregon. The annual amount of water made available by this purchase is 17,650 acre-feet.

For this analysis, Reclamation considered privately irrigated lands in various areas in the Snake River basin upstream of Lower Granite Lake and assumed that the natural flow rights for lands totaling 221,500 acres could be acquired. These lands include:

- 68,000 acres in Idaho near Twin Falls irrigated by highlift pumping
- 30,000 acres in Wyoming upstream of Palisades Reservoir
- 15,000 acres in Nevada (Owyhee River basin)
- 71,500 acres in Idaho (Salmon River basin)
- 37,000 acres in Oregon (Grande Ronde River basin)

The annual amount of water that could be made available by curtailment of this irrigation is estimated at 293,640 acre-feet, the consumptive use for these lands.

In particular, pumping water from the declining aquifer would result in short term increases in flows. Over time; however, the pumping for flow augmentation would reduce natural accretion to the river and result in no long term increase inflows.

3.2.5 Groundwater

The complex relationship between surface and groundwater and the uncertainties existing in an already declining aquifer make it impractical to consider groundwater as a water source in this analysis. One suggestion is to pump water directly from the aquifer to the river and this would result in a short-term increase in flows. However, that pumping from a declining aquifer would reduce natural accretion to the river and result in no long-term increase in flows. Direct pumping would be impractical from an energy standpoint. Theoretically, the most effective means to increase streamflow would be to curtail some existing groundwater use. This would allow more outflow to streams; however, such water would not be immediately available because of the lag time associated with water movement through the aquifer. As a result of these considerations, Reclamation did not evaluate groundwater as a potential water source in this analysis.

3.2.6 Water Conservation

Since most of the water use in the basin is for irrigation, conservation as a water source would necessarily focus on irrigation. True water conservation within the irrigation sector requires irrigating fewer crops or switching to crops that use less water. Acquisition of Reclamation storage and natural flows for flow augmentation is a method of implementing water conservation.

Increasing conveyance system efficiency (reducing water losses) and improving onfarm water application efficiency is often considered to be water conservation. An increase in irrigation efficiency reduces water diversions and increases flows in the stream reach immediately downstream from the diversion. Further downstream below the point where return flows enter the river, there is no change in total surface flow except for minor changes due to changes in evaporation losses. Because of the geophysical structure of the Snake River basin upstream of Brownlee Dam, essentially all return flows from irrigation water application return to the stream somewhere upstream of Brownlee Dam. From the perspective of a basin water budget, improved irrigation efficiency would provide little or no water for other uses.

Improving water transport and application efficiency is a valuable water management tool and is actively pursued by Reclamation. Reclamation recognizes that improving irrigation efficiency can be valuable to local fish and wildlife resources by retaining flows within the stream but also recognizes that improving irrigation efficiency can result in local environmental degradation by drying wetlands. This may be a tradeoff for increasing local flows to protect and enhance aquatic resources.

In the final analysis, water conservation with respect to irrigation means irrigating fewer acres, and that is what acquiring water from storage or natural flows would do.

3.2.7 Elimination of Unauthorized Use

Lands that can be irrigated using water from Reclamation storage and/or using project facilities are strictly defined on the basis of location and total number of acres. In many areas, land that are not authorized to receive water and/or the total number of acres irrigated exceed that authorized by contract or legislation. This use of water has been ongoing for many years and is, in part, due to new technologies. For example sprinkler technology available since the 1960s allows efficient water application over a large area, but it may be impractical to avoid application of water to small interspersed parcels of land that were originally classified as non-irrigable and therefore not authorized to receive project water. Farmers often plant and harvest those interspersed areas rather than leave them in natural vegetation. In other cases, irrigation of new fields has developed over the years and is the result of intentional unauthorized use of water.

Elimination of all unauthorized use of water would provide very little water for flow augmentation. Simply stopping all instances of unauthorized use would not affect the water entitlements of irrigation districts which could continue to use that water supply on authorized lands, carry the water in storage for use during dry years, or place the water in a rental pool.

A reallocation or reassignment of water would be necessary to make the water available for flow augmentation. Reallocation of 1 MAF of water through acquisition of water for flow augmentation, as discussed in later chapters, would likely eliminate most unauthorized use. As a result, Reclamation did not spend the time to separately estimate the amount of water that might be made available from the possible elimination of unauthorized use.

3.3 Summary

There is a total of 7,815,400 acre-feet of active and inactive storage space in Reclamation reservoirs; of this amount, 27,000 acre-feet is exclusive flood control space leaving a total of 7,788,415 acre-feet of storage space in Reclamation reservoirs that is physically available for all other purposes. Reclamation also identified a natural flows of 311,290 acre-feet of water for flow augmentation use. Although the latter volume is largely arbitrary, it is based on specific acreages of privately irrigated lands including some lands irrigated by highlift pumping. Table 3-1 summarizes the findings on water availability for flow augmentation.

Table 3-1 Water Sources and Amounts Considered Available for Flow Augmentation

Water Source	Maximum Volume (Acre-Feet)
Reclamation Storage Space	
Contracted	6,320,316
Assigned to flow augmentation	158,829
Assigned to other uses (minus exclusive flood control space)	504,370
Inactive	804,900
Total	7,788,415
Rental Pools	
Districts 01, 63, and 65	Varies from year to year None would be available with a large assignment of storage to flow augmentation
Natural Flows	
Purchased	17,650
Wyoming potential	27,640
Idaho highlift pumping	134,950
Nevada potential	21,900
Salmon River basin potential	87,470
Grande Ronde River basin potential	21,680
Total natural flows	311,290
Non-Reclamation Reservoirs	Not evaluated
New Storage	Not evaluated
Groundwater	Not evaluated
Elimination of unauthorized water use	Not separated from contracted space
Water Conservation	Not a viable source

4 Flow Augmentation Scenarios

This chapter describes the flow augmentation scenarios analyzed by Reclamation. These scenarios are:

- Base Case: Provide 427,000 acre-feet of flow augmentation water each year (existing condition since 1993).

- No Augmentation: Provide no water for flow augmentation (condition prior to 1991).

- 1427i: Provide up to 1,427,000 acre-feet of flow augmentation water to meet deficits in flow targets at Lower Granite Dam. Irrigation shortages would be minimized by using large drawdowns of Reclamation reservoirs.

- 1427r: Provide up to 1,427,000 acre-feet of flow augmentation water to meet deficits in flow targets at Lower Granite Dam. Reservoir elevations would be maintained at or near the Base Case levels with shortages assumed by irrigation.

The Base Case is the standard against which other scenarios are compared to identify effects. The No Augmentation and the 1427 scenarios were requested by the Corps. Reclamation chose to analyze two 1427 scenarios and to pick a specific acreage of private land to retire from irrigated agriculture to provide a volume of water for flow augmentation. The remaining volume of water for flow augmentation would be obtained from Reclamation reservoirs. The two 1427 scenarios represent points near each end of a continuum of possible ways of providing large amounts of water from Reclamation reservoirs. The 1427i scenario represents one way of minimizing the effects on the lands irrigated from Reclamation reservoirs with negative effects on reservoir resources. The 1427r scenario is the reverse, emphasizing minimal effects on reservoir resources with adverse effects on irrigated lands.

These scenarios are conceptual to provide only general information. Development of the 1427 scenarios beyond the programmatic level presented in this analysis would also include comprehensive public involvement and site specific analysis.

4.1 Base Case Scenario

4.1.1 Description

The Base Case scenario represents the status quo against which the other scenarios are compared to determine effects. In 1991, Reclamation began a program of providing water for flow augmentation to aid downstream migration of endangered salmon in the lower Snake River. Reclamation committed to the current operation in Reclamation's 1995 ROD which was in response to NMFS 1995 BIOP. A key provision of the NMFS 1995 BIOP, and repeated in Reclamation's ROD, is that water purchases for flow augmentation must be made on a willing seller/willing buyer basis. The current target volume of 427,000 acre-feet has been provided each year since 1993; post augmentation accounting indicates that the volumes vary slightly from year to year but are as near to the 427,000 acre-feet target as operating practices allow.

Water for the current flow augmentation is obtained from the purchase of natural flow rights, reassignment and reacquisition of space in Reclamation reservoirs, and annual purchase of water through the Idaho Waterbank. IPC cooperates in this endeavor by helping shape flows at Brownlee Dam.

4.1.1.1 Historic Water Deliveries

Table 4-1 summarizes the sources and amounts of water delivered for flow augmentation from 1991 through 1998. Volumes in this table through 1997 are post augmentation accounting.

Table 4-1 Reclamation's Water Delivery for Flow Augmentation (Acre-Feet)

Source	1991	1992	1993	1994	1995	1996	1997	1998
UPPER SNAKE RIVER								
Reclamation space	15,000		206,617	285,954	22,396	22,396	22,396	22,896
American Falls					8,951	8,951	8,951	8,951
Jackson					3,923	3,923	3,923	3,923
Palisades			13,615	15,754	9,522	9,522	9,522	10,022
Palisades powerhead			18,794	153,530				
Minidoka powerhead			95,575	99,240				
Ririe			78,633	17,430				
Rentals	84,000	0	65,000	44,325	232,839	194,667	202,104	200,325
Subtotal	99,000	0	271,617	330,279	255,235	217,563	224,500	223,221
PAYETTE RIVER								
Reclamation space	28,874	90,000	95,000	61,883	94,242	95,000	95,000	95,000
Cascade			69,600	26,845	68,842	69,600	69,600	69,600
Deadwood			25,400	35,038	25,400	25,400	25,400	25,400
Rentals	73,651		34,971		50,758	56,300	60,000	50,000
Subtotal	102,525	90,000	129,971	61,883	145,000	151,300	155,000	145,000
BOISE RIVER								
Reclamation space			23,000	35,950	25,000	38,000	38,000	40,932
Anderson Ranch					3,000	3,000	3,000	
Anderson Ranch powerhead			20,000	10,950				
Lucky Peak			3,000	25,000	22,000	35,000	35,000	40,932
Rentals					2,000		2,000	
Subtotal	0	0	23,000	35,950	27,000	38,000	40,000	40,932
OREGON NATURAL FLOWS								
Skyline Farms						15,714	17,649	17,649
Oregon Water Trust						64	132	198
Subtotal	0	0	0	0	0	15,778	17,781	17,847
Grand Total	201,525	90,000	424,588	428,112	427,235	422,141	437,281	427,000

4.1.1.2 Permanently Acquired Water Sources

To date, Reclamation has reacquired 60,274 acre-feet of contracted storage space in Reclamation reservoirs and acquired 17,650 acre-feet from natural flow rights. Water that accumulates in reacquired storage space is transferred through a rental pool for use downstream under current Idaho law. The natural flow rights acquired to date were in Oregon where State water law permits the acquisition of natural flow water rights for instream use. At the time of closing that acquisition, the OWRD approved a change of use from irrigation to instream flow for the acquired water rights. All acquisitions have been made under the willing seller/willing buyer concept in which voluntary participation of both parties is essential.

Reclamation first determines the amount of natural flows and uncontracted storage space available each year before releasing reacquired storage space for flow augmentation. This method of operations reduces the probability of irrigation shortages in subsequent years. Table 4-2 summarizes reacquired contracted storage space and natural flow water rights

Table 4-2 Permanent Reclamation Acquisitions for Flow Augmentation

Entity	Acquisition Date	Right Acquired
Storage Space		
Salmon River Canal Company	December 1994	Repayment contract entitlement: 6,518 acre-feet in American Falls Reservoir
Canyon View Irrigation Company	August 1995	Repayment contract entitlement: 15,878 acre-feet in American Falls, Jackson, and Palisades Reservoirs
Palisades Water Users, Inc.	July 1998	Repayment contract entitlement: 500 acre-feet in Palisades Reservoir
Nampa and Meridian Irrigation District	July 1996	Water service contract entitlement: 35,000 acre-feet in Lucky Peak Lake
J.R. Simplot/Micron Corp.	January 1998	Water service contract entitlement: 2,378 acre-feet in Lucky Peak Lake
Total space		60,274 acre-feet of storage space
Natural Flow Right		
Skyline Farms	February 1997	17,650 acre-feet of natural flow rights

4.1.1.3 Reassigned Active Space and Inactive Space

A total of 98,554 acre-feet of uncontracted active storage space (95,000 acre-feet in Cascade Reservoir and 3,554 acre-feet in Lucky Peak Lake) has been reassigned to flow augmentation. This is released for flow augmentation in accordance with the provisions of I.C. 42-1763B. Water that accumulates in the reassigned active storage space is generally available every year. This source provides water as long as the ESA-listed anadromous fish runs require flow augmentation.

In the drought years of 1993 and 1994, Reclamation was unable to meet the commitment for 427,000 acre-feet without using water in the inactive storage space of Reclamation reservoirs. As a last resort, Reclamation released water held in previously never-used powerhead space in Palisades Reservoir, Lake Walcott (Minidoka), and Anderson Ranch Reservoir. Powerhead space is that part of the inactive capacity of a reservoir intended to provide a hydraulic head for the proper operation of hydroelectric generators. Without this hydraulic head, adverse flow conditions can develop in the system, requiring the generator units to be shut down. Reduced powerhead space resulted in some decrease in power production but did not affect the entitlements of contract spaceholders. Water in powerhead space is released in accordance with I.C. 42-1763B.

4.1.1.4 Rental Pools

Annual purchases of water placed in Idaho rental pools have helped Reclamation provide flow augmentation since 1991. The relative abundance and short term availability of this water supply makes the rental pool a priority source for flow augmentation water. After quantifying the amount of water available from natural flows and uncontracted reservoir space, Reclamation attempts to purchase the remaining water from rental pools to make up the 427,000 acre-feet. Reclamation makes requests for rental water through the watermaster of each rental pool. Reclamation, to date, has based its distribution of purchases among the three Idaho rental pools on the basis of availability of water and the cost of rentals.

Providing 427,000 acre-feet of water for flow augmentation each year is a continuous effort. Rental pools will be a significant source of water for the 427,000 acre-feet for the foreseeable future, and improving the reliability of rental pool supplies for flow augmentation is desirable. Strengthening existing rental markets and developing new ones appears to be an approach that can be supported by varied interests.

4.1.1.5 Delivery Plan

Flow augmentation water is usually requested in the lower Snake River during the downstream migration in July and August when Lower Granite Dam targets are not being met. This period generally coincides with the recession of natural flows and the draft of storage for irrigation. Storage releases for irrigation generally begin by early July, but may begin as early as April or May in a low water year. The strategy for release of the 427,000 acre-feet of flow augmentation water depends on the magnitude and timing of natural runoff at Milner, Lucky Peak, and Cascade Dams. Under current agreements, some augmentation water is released during periods when the target flows at Lower Granite Dam are already being met.

Each year, Reclamation provides a plan to the Technical Management Team (TMT) in mid-April. The TMT makes recommendations to Reclamation and the Corps on implementing delivery of water flow augmentation water. Reclamation monitors streamflow and reservoir conditions above Brownlee Dam and begins delivery in accordance with the augmentation plan and recommendations of the TMT. The deliveries essentially become inflow to Brownlee Reservoir and may be stored there for the TMT's scheduled release based on weekly requests to IPC. The TMT monitors delivery activities by posting information on the TMT web site.

TMT salmon managers have occasionally made system operation requests that varied from the annual plan of release. Reclamation accommodates these requests when it can and responds in writing when the requests cannot be accommodated.

4.1.1.5.1 Upper Snake River Releases

Reclamation typically begins flow augmentation releases from upper Snake River sources at the time irrigations storage releases begin, normally in June or early July. These releases are regulated to maintain a flow of 1,500 cfs past Milner Dam. This “feathering in” of flow augmentation releases is done in consideration of ESA-listed aquatic snails in downstream reaches. The release rate of 1,500 cfs also extends the period of time that augmentation water can provide instream benefits for water quality and resident fish and wildlife. It is also in accordance with an agreement with IPC. If augmentation releases begin late in the season, some of the upper Snake River releases will not reach the lower Snake River by the end of the salmon migration season in August. The Reclamation-IPC agreement provides for the delivery of all releases below Brownlee during the augmentation season. In return for limiting the delivery rate to 1,500 cfs, the IPC has agreed to predeliver from Brownlee Reservoir the portion of the augmentation release that arrives at Brownlee Reservoir after August 31.

Near the end of the seasonal flow augmentation release, Reclamation attempts to reduce flows in a manner that will limit the possibility of stranding ESA-listed snail species found downstream of Minidoka and Milner Dams. A maximum reduction rate of 100 cfs per day is currently used. This operation is initiated from an agreement with USFWS, IPC, and Reclamation (and separate ESA consultations) for upper Snake River flow augmentation (attachment A).

4.1.1.5.2 Boise River Releases

Reclamation typically requests that releases for flow augmentation begin when irrigation storage releases start and continue until all releases have been made. The release rate is relatively low, about 400 cfs above the irrigation release rate, due to Boise River recreation safety concerns and to avoid damage to gravel pushup dams. The Ada County Parks and Waterways considers 1,500 cfs to be the maximum safe riverflow, and irrigation releases are usually about 1,100 cfs. Temporary gravel pushup dams which divert water at flows below 1,250 cfs can be damaged at flows above 1,500 cfs.

4.1.1.5.3 Payette River Releases

The Payette River Watershed Council meets on a regular basis to discuss a variety of operational issues including flow augmentation. Reclamation participates in these meetings and seeks to develop consensus on a flow release plan. A general strategy has evolved to release some of the water in the summer and some in the winter. Releasing water in the summer benefits white-water recreation, water quality in the lower Payette River, and resident stream fish; releasing water in the winter benefits summer reservoir recreation, reservoir water quality, and resident lake fish at Cascade and Deadwood Reservoirs.

The split has been either 50/50 or 60/40 for summer/winter releases. This release pattern is feasible because IPC (a watershed council participant) drafts Brownlee Reservoir storage to meet summer salmon flows in the lower Snake River. The Payette River winter release generally begins in early to mid-December at a rate of 1,000 cfs to repay IPC for the summer Brownlee release. This strategy is acceptable for power production and creates space in Brownlee Reservoir to better manage flows downstream from Hells Canyon Dam during the fall chinook spawning season which is from mid-October to early December.

Summer releases from the Payette River begin in June or July and are usually made at a rate of about 1,000 cfs above irrigation deliveries until sometime in August. Although this modest rate lengthens the delivery time, it avoids damage to gravel pushup diversion dams and the need to rebuild those diversion structures after the augmentation season.

4.1.2 Costs

Approximately $5.7 million have been spent in recent years for the purchase of about 60,274 acre-feet of storage space in Reclamation reservoirs and about $1.3 million has been spent to purchase 17,600 acre-feet of natural flow rights. Reclamation also spends about $2.5 million annually to purchase rental water. Rental costs in 1997 were $5.40 per acre-foot for Payette rentals, $6.50 per acre-foot for Boise rentals, and $10.50 per acre-foot for upper Snake rentals.

To provide a more reliable water supply, Reclamation needs to continue to make additional permanent acquisitions of storage space and natural flow rights. Total costs are impossible to predict under a willing seller concept because Reclamation's presence within the marketplace and recognition that additional flow augmentation is needed may raise the market value of water.

See Chapter 9 for additional discussion of costs and other implementation concerns.

4.1.3 Funding

Flow augmentation costs have been funded under Reclamation's Columbia-Snake River Salmon Recovery program. These costs are non-reimbursable meaning that the entire cost is funded by the Federal Government. Annual appropriations are obtained through Reclamation's budgeting process and funds are expended as needed.

4.1.4 Implementation

Existing Idaho legislation (I.C. 42-1763B) was enacted in 1995 and expires on January 1, 2000. It covers only releases of water from storage (not natural flows) and specifies that the amount of flow augmentation that Reclamation can provide from all sources is limited to 427,000 acre-feet in any year. It also stipulates that the water released must also be used for power production in Idaho. The legislation, the NMFS 1995 BIOP, and the Reclamation ROD all specify that water must be obtained only from willing participants. The BIOP and ROD further specify that the flow augmentation releases will be made in accordance with state water law. Reclamation considers the current flow augmentation of 427,000 acre-feet to be a permanent program until such time as future decisions and the required Federal, state, and congressional actions change that decision.

Reclamation expects to again approach the IDWR and Idaho Legislature about long-term authority to release the 427,000 acre-feet and to allow the use of natural flows for flow augmentation. Handling a potential renewal of I.C. 42-1763B raises serious concerns as Idaho interests have been very reluctant to authorize any flow augmentation releases. From a practical standpoint, it would be necessary, in 1999, to reinitiate a request for change in use of storage space, an action that triggered passage of I.C. 42-1763B. In 1999, the region will be in the midst of a long-term decision about how much, if any, volume of water to request for flow augmentation.

4.2 No Augmentation Scenario

Under the No Augmentation scenario, Reclamation would provide no water for flow augmentation in the lower Snake River (the situation that existed prior to 1991). Reclamation would halt efforts to permanently acquire water sources, would no longer purchase rental water, and would likely retain all storage currently assigned to flow augmentation. Water that accumulates in the acquired space along with water that accumulates in reassigned uncontracted storage space would be available for operational flexibility in meeting a variety of uses.

4.3 1427i Scenario

The goal of this scenario is to provide up to a maximum of 1,427,000 acre-feet of water to meet deficiencies in target flows at Lower Granite Dam with no firm limits on Reclamation reservoir drawdown to preserve natural resources or recreation opportunities. The water to meet this goal would be obtained by purchase of natural flow rights, which necessarily reduces the acreage of private irrigation, and from Reclamation storage, which would result in shortages to irrigated lands in Reclamation projects. To keep the irrigation shortages to a minimum, reservoir space for flow augmentation would be carefully selected and reservoirs would be drawn down as needed.

4.3.1 Water Acquisition

Acquisition of large amounts of water rights and storage space to meet the goals of the 1427i Scenario are likely to be problematic. These issues are discussed in chapter 9. For this analysis it was simply assumed the water sources discussed in chapter 5 could be acquired.

4.3.2 Delivery Plan

Reclamation would continue to work with the TMT to time the release of water to arrive at the lower Snake River at times that target flows at Lower Granite Dam could not be met by natural flows and releases from Dworshak Reservoir. Reclamation releases would continue through the end of the flow augmentation season or until 1,427,000 acre-feet had been delivered. Brownlee Reservoir could continue to be used to shape about 427,000 acre-feet, but shaping of the additional 1MAF was not assumed. Reclamation releases would continue to meet channel criteria to avoid flooding, but current system agreements to constrain flow augmentation releases (1,500 cfs at Milner, 400 cfs at Boise, and 1,000 cfs at Payette) could not be followed and still deliver the entire flow augmentation during the augmentation period. In fact, delivery of the 1,427,000 acre-feet during the flow augmentation season would cause stream segments to approach flood stage during much of the augmentation season.

4.4 1427r Scenario

The goal of this scenario is to provide up to a maximum of 1,427,000 acre-feet of water to meet deficiencies in target flows at Lower Granite Dam while attempting to limit the drawdown of Reclamation reservoirs to current levels (Base Case scenario). The water to meet this goal would be obtained by purchase of natural flow rights, which would necessarily reduce the acreage of private irrigation, and from Reclamation storage which would result in shortages to irrigated lands in Reclamation projects. To limit the drawdown of Reclamation reservoirs, shortages to irrigated lands would be increased.

4.4.1 Water Acquisition

Acquisition of large amounts of water rights and storage space to meet the goals of the 1427r Scenario are likely to be problematic. These issues are discussed in the Implementation chapter. For this analysis it was simply assumed the water sources discussed in chapter 5 could be acquired.

4.4.2 Delivery Plan

Reclamation would continue to work with the TMT to time the release of water to arrive at the Lower Snake River at the time that target flows at Lower Granite Dam could not be met by natural flows and releases from Dworshak Reservoir. Reclamation releases would continue through the end of the flow augmentation season or until the 1,427,000 acre-feet had been delivered. Brownlee Reservoir could continue to be used to shape about 427,000 acre-feet, but shaping of the additional 1MAF was not assumed. Reclamation releases would continue to meet channel criteria to avoid flooding, but current system constraints on flow augmentation releases (1,500 cfs at Milner, 400 cfs at Boise, and 1,000 cfs at Payette) could not be followed and still deliver the entire flow augmentation during the augmentation period. In fact, delivery of the 1,427,000 acre-feet during the flow augmentation season would cause stream segments to approach flood stage during much of the augmentation season.

5 Hydrologic Analyses

This chapter summarizes the results of computer simulations of riverflows and reservoir levels that could be expected with the four flow augmentation scenarios. Also included in this chapter are the results of the groundwater modeling and analysis. Results of the hydrologic analysis in the form of graphs, tables, and text were provided to each of the technical disciplines for use in evaluating potential effects on specific natural, cultural, other resources. Thus, the hydrologic analysis is the basis for evaluating all potential effects of the scenarios.

To provide a quantitative analysis of potential streamflow changes in specific reaches and reservoir levels, it is necessary to select specific water sources. The selection of water sources for the Base Case was similar to the historical experience since 1993. The selection of water sources for the 1427i and 1427r scenarios was based on water rights, reservoir refill capability, and other factors that would tend to reduce adverse effects. An entirely different mix of water sources, including storage space in reservoirs not selected for inclusion in this analysis, is possible and entirely likely if a program to secure a large amount of water were implemented. Therefore, the results of the hydrology analysis should be viewed as representative and not definitive.

5.1 Methodology

5.1.1 Surface Water Model

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The hydrology for this analysis is based on computer simulation using MODSIM, a river basin network flow model. With this model, water is allocated consistent with hydrological, physical, and institutional aspects of a river basin. Some of the aspects used in the simulation include:

- Direct flow rights
- Instream flow rights
- Reservoir storage rights
- Reservoir system operations
- Exchanges and operational priorities

MODSIM represents the physical river system as a series of nodes and links. Nodes represent such aspects as reservoirs, demand/diversion structures, inflow locations, and stream gauge locations. Links represent stream reaches, canals, tunnels and other methods of water conveyance.

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5.1.2 Groundwater Model

Modeling of groundwater was not considered necessary for the Base Case, No Augmentation, and 1427i scenarios. Reductions in irrigation water application are considered so small that these scenarios would cause only small differences in the amount and timing of applied irrigation water in relationship to the overall basin water budget. As a result, there would be little change in groundwater recharge and relatively minor variations to aquifer storage and dynamics.

In contrast, the 1427r scenario could result in an average reduction of about 130,000 irrigated acres on the eastern Snake River Plain and that likely would affect groundwater discharge to springs that flow into the Snake River. A groundwater flow model of the eastern SRPA was used to identify the potential effect on groundwater of the 1427r scenario. These effects were then added to the MODSIM model. Also, reallocation of reservoir storage in the Boise and Payette River systems were considered to reduce groundwater discharge to those rivers. Section 5.3 discusses groundwater in the area, the modeling, and potential effects of the 1427r scenario on groundwater.

5.1.3 Period of Analysis and Level of Development

The historical water supply for the 62-year period of 1928-1989 was selected for this analysis. Data for water years later than 1989 is not complete.

The development assumed in the model is that of the early 1990s. This level of development includes the current system of reservoirs, the 1991 irrigation acreage, and the current system of operation for flood control and refill of reservoirs. Also assumed in the model are all of the current physical constraints for storage and release of water and the existing dams. These include maximum storage volumes at reservoirs; maximum release rates for spillways, penstocks, and valves; downstream channel capacities to avoid overbank flows; and minimum reservoir elevations for operation of hydroelectric generators and diversion of water to irrigation canals.

5.1.4 Scenarios and Flow Augmentation Goals

Four scenarios were modeled

- Base Case: Provide 427,000 acre-feet of flow augmentation water each year (existing condition since 1993).

- No Augmentation: Provide no water for flow augmentation (condition prior to 1991).

- 1427i: Provide up to 1,427,000 acre-feet of flow augmentation water to meet deficits in flow targets at Lower Granite Dam. Irrigation shortages would be minimized by using large drawdowns of Reclamation reservoirs.

- 1427r: Provide up to 1,427,000 acre-feet of flow augmentation water to meet deficits in flow targets at Lower Granite Dam. Reservoir elevations would be maintained at or near the Base Case levels with shortages assumed by irrigation.

The flow augmentation goal of each modeled scenario is to annually provide a volume of water to Lower Granite Lake each year (modeled as inflow to Brownlee Reservoir for this study). This volume of water is in addition to the "incidental" flow which is mostly spill in spring months from flood control operation and freshet local runoff below reservoirs. Incidental flow in the later summer and fall months is comprised mostly of stream gains in the lower basin, irrigation return flows, and some operational spill from major subbasins.

The goal of the Base Case (427,000 acre-feet flow augmentation) is to provide 427,000 acre-feet of water each year in a pattern that provides 75,000 acre-feet in June, 138,600 acre-feet in July, 140,400 acre-feet in August, and 72,000 acre-feet in September. The No Augmentation scenario would provide no water for flow augmentation. The goal of the 1427i and the 1427r scenarios is to provide a sufficient volume of water to meet monthly target deficits at Lower Granite Dam, but only up to a total of 1,427,000 acre-feet. Target flows at Lower Granite Dam under the 1995 BIOP are:

April 10-June 20	June 21-August 31

85,000-100,000 cfs	50,000-55,000 cfs

Reclamation modeled deficits in meeting target flows at Lower Granite Dam; the current operation of Dworshak Dam for flow augmentation was assumed. These monthly deficits, then became the flow augmentation goal for each month of modeling.

Figure 5-1 shows the probability of meeting the seasonal target volume (obtained by multiplying the seasonal average flow for the period of the flow augmentation season) under the current 1995 BIOP operation. This operation includes the Base Case target volume of 427,000 acre-feet delivered from the Snake River upstream of Brownlee Dam. The figure shows that seasonal deficit under the Base Case would range from over 8 MAF to about 250,000 acre-feet. Adding 1MAF would eliminate the deficit about 40 percent but there would still be a deficit about 60 percent of the time (follows the 1 MAF line to the intersection of the exceedance curve and then down to the percent probability of a deficit, 60 percent). Delivering an additional 1 MAF, a total of 1,427,000 acre-feet, is the goal of the 1427i and 1427r scenarios.

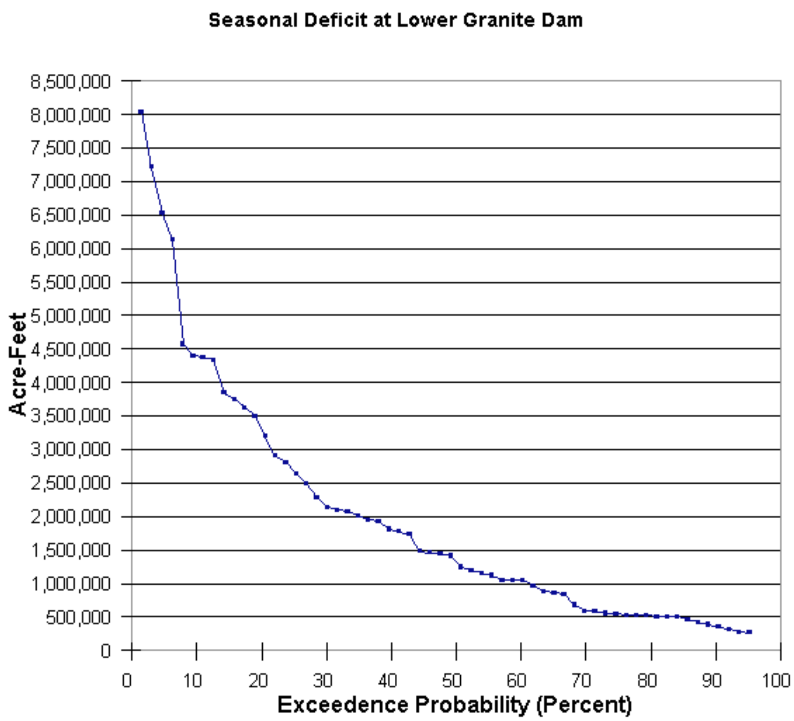

Figure 5-1 Probability of a Seasonal Deficit At Lower Granite Dam With the 1995 BIOP Flows which includes a target flow of 427,000 acre-feet from the Snake River upstream of Brownlee Reservoir

The 1995 BIOP provides that the flow targets are to be considered to be "seasonal averages." However, in the TMT and Implementation Team processes, the fish managers have expressed serious concerns whenever flow targets have not been met at any time, whether or not seasonal average flows exceeded flow targets. The "seasonal averages" of the BIOP recognize that it is highly unlikely that flow targets could be met every single day of the flow augmentation season. Even in the best water year, meeting a daily requirement is to be impossible. For example, the year 1997 was the best water year on record for many parts of the Northwest. The established target flows for 1997, based on the criteria established in the 1995 BIOP, were: April 10 - June 20 (100,000 cfs) and June 21 through August 31 (55,000 cfs). Although actual flows exceeded target flows by a considerable amount during most days of the migration period and the average far exceed the target, target flows were not achieved ever day. Flows past Lower Granite Dam during the 1997 Flow augmentation season are illustrated in attachment B.

5.1.5 Water Sources for Base Case

Base Case water supply has historically been obtained through the reassignment of some storage space, purchase of storage from spaceholders, annual purchases from the rental pools, purchase of natural flow rights, and use of powerhead space when other sources were insufficient. Sources used for the Base Case hydrology analysis are generally the same as those actually used and currently available. Sources used in the Base Case are shown in table 5-1.

Table 5-1 Water Sources for Base Case Hydrology (Acre-Feet)					
Item	Palisades	American Falls	Walcott	Jackson	Total
Snake River Upstream of Milner Dam					
Powerhead space	157,000		115,000		272,000
Rentals	237,000				237,000
Acquired space	10,022	8,951		3,923	22,896
Total Upstream of Milner Dam[1]					531,896
Boise and Payette River Basins					
Item	Cascade	Deadwood	Lucky Peak	Anderson Ranch	Total
Powerhead space				41,000	4,100
Rentals	60,000				60,000
Uncontracted space	69,600	25,400	3,554		135,900
Acquired space			37,378		
Total Boise/Payette					236,900
[1]Includes 237,000 acre-feet of actual water, the remainder is space which may not fill each year					

5.1.6 Selection of Water Sources and Assumptions for 1427r and 1427i

In identifying potential water sources for an additional 1MAF for flow augmentation, it was decided that a combination of sources–Reclamation storage and natural flow rights–should be used for the hydrology simulation. This spreads the burden over several areas including Reclamation project lands and privately irrigated lands rather than concentrating the burden in a smaller area. Privately irrigated non-prime farmlands in Wyoming, Nevada, Oregon, and Idaho along with the acreage of highlift pumpers along the Snake River in Idaho were identified. Acquisition of the natural flow rights for these irrigated lands would of necessity remove the lands from the irrigated land base. However, use of the land could vary and might include a switch from irrigated agriculture to dryland agriculture.

5.1.6.1 Natural Flow Rights

Little information was available on diversions for the selected lands with natural flow rights, so assumptions were made on cropping patterns and diversions. Farmlands, except those supplied by highlift pumping, were assumed to be planted in grass pasture and received a full water supply every year with an application efficiency of 50 percent. Lands supplied by highlift pumping are assumed to be planted in potatoes and to have an irrigation efficiency of 85 percent. Consumptive crop requirements were calculated with a Blaney-Criddle program using precipitation and temperature data applicable to each area and crop.

Calculation of return flows was necessary, since taking the lands out of production would alter streamflows not only during the irrigation season but also between irrigation seasons. Return flows from privately irrigated lands were estimated based on precipitation and temperature data for each area, a 50 percent irrigation efficiency from flood irrigation (50 percent of the water applied returns to the river), and half of the return flow is via the surface and half is by subsurface flow. Surface return flows were assumed to reenter the system in the proportion of 4/7 during the month of application, 2/7 the following month, and 1/7 the third month. Subsurface return flows were assumed to reenter the system proportionately over a period of a year. It was further assumed that there would be no return flows from lands irrigated by highlift pumps.

Natural flow rights from a total of 221,500 acres of land were identified as summarized in table 5-2.

Table 5-2 Lands and Natural Flow Rights Assumed for the 1427i and 1427r Scenarios

State	River Basin	Acres	Water Supply (Acre-Feet)
Wyoming	Snake	30,000	27,640
Nevada	Owyhee	15,000	21,900
Idaho	Salmon	71,500	87,470
Oregon	Grande Ronde	37,000	21,680
Idaho highlift pumping	Snake	68,000	134,950
Total		221,500	293,640

A total water supply of 311,290 acre-feet from natural flow rights was used with the 1427i and the 1427r scenarios. This includes the total from table 5-2 plus 17,650 acre-feet of natural flow rights purchased under Reclamation's current flow augmentation program. This latter natural flow right was associated with 4,420 acres of farmland in Oregon.

After water use values were computed and simulation runs had been made, Reclamation discovered that the lands irrigated by highlift pumping were usually planted in a crop rotation pattern that included the primary crops of potatoes along with beans, mint, onions, alfalfa, and wheat. A sensitivity analysis was done to determine how this might affect water use compared with a crop consisting of potatoes only. We assumed that 50 percent of the land at any one time would be planted in potatoes and the other 50 percent would be planted in equal amounts of beans, onions, wheat, and alfalfa. This sensitivity analysis assumed the worst case, a dry year (1977), when only 4 inches of rain fell. The results indicated that the combination of crops in a dry year use about 20.48 inches of water compared to 24.82 inches average annual use of a crop consisting of potatoes only. The total amount of water pumped during this worst case is about 25,900 acre-feet less than the value used in the study. Since the difference would be less in average and wet water years, Reclamation determined the difference in water use would not have a significant effect on the overall results of this flow augmentation analysis.

5.1.6.2 Reclamation Storage

Selection of storage space in Reclamation reservoirs was based on meeting the flow augmentation goal with the least adverse effect on irrigation (1427i) or reservoir resources (1427r). Factors considered were the amount of total storage space compared to the acres of land served, contracted space in more than one reservoir by a contracting entity, whether Reclamation storage was used as the full supply or supplemental supply to lands, and reservoir refill capability. The size of the block of water was another consideration in the simulation. Large blocks of water were identified for reallocation to simplify modeling. Reclamation storage was selected from reservoirs in three areas–upstream of Milner Dam, the Boise and Payette River basins, and the Owyhee River basin.

5.1.6.2.1 1427i Scenario

Table 5-3 summarizes the storage space selected from reservoirs upstream of Milner Dam.

Table 5-3 Reservoir Sources Selected for the 1427i Scenario Upstream of Milner Dam (Acre-Feet)

Item	Palisades	American Falls	Walcott	Jackson	Ririe	Total
Base Case Sources						
Inactive space	157,000		115,000			272,000
Acquired space	10,022	8,951		3,923		22,896
Additional Storage for 1427i Scenario						
Contracted acquired	324,000	300,000		117,191	80,000	821,191
Total upstream of Milner Dam	491,022	308,951	115,000	121,114	80,000	1,116,087

Table 5-4 summarizes water sources selected in the Boise/Payette River basins for the 1427i scenario.

Table 5-4 Reservoir Sources Selected for the 1427i Scenario in the Boise/Payette River Basins (Acre-Feet)						
Item	Cascade	Deadwood	Lucky Peak	Arrowrock	Anderson Ranch	Total
Base Case Sources						
Inactive					41,000	41,000
Reassigned uncontracted	69,600	25,400	3,554			98,554
Acquired contracted			37,378			37,378
Additional Storage for 1427i						
Uncontracted reassigned	100,000	40,000	50,000			190,000
Contracted acquired	100,000		35,000		100,000	235,000
Total in Boise/Payette River basins	269,000	65,400	125,932		141,000	601,932

The water sources for the 1427i scenario also includes acquiring 200,000 acre-feet of active storage space in Lake Owyhee.

5.1.6.2.2 1427r Scenario

Table 5-5 summarizes water sources upstream of Milner Dam for the 1427r scenario.

Table 5-5 Reservoir Sources Selected for the 1427r Scenario Upstream of Milner Dam (Acre-Feet)						
Item	Palisades	American Falls	Walcott	Jackson	Ririe	Total
Base Case Sources						
Inactive storage	157,000		115,000			272,000
Acquired space	10,022	8,951		3,923		22,896
Additional Storage for 1427r						
Contracted acquired	424,033	800,000	97,000	417,191	80,000	1,818,224
Total upstream of Milner Dam	591,055	808,951	212,000	421,114	80,000	2,113,029

Table 5-6 summarizes water sources selected in the Boise and Payette River for the 1427r scenario.

Table 5-6 Reservoir Sources Selected for the 1427r Scenario in the Boise and Payette River Basins (Acre-Feet)						
Item	Cascade	Deadwood	Lucky Peak	Arrowrock	Anderson Ranch	Total
Base Case Sources						
Inactive space					41,000	41,000
Reassigned space	69,600	25,400	3,554			98,554
Acquired space			37,378			37,378
Additional Storage for 1427r						
Uncontracted reassigned	100,000	40,000	50,000			190,000
Contracted acquired	250,000		35,000	150,000	359,000	794,000
Total Boise/Payette River basins	419,600	65,400	125,932	150,000	400,000	1,160,932

The water sources for the 1427r scenario also includes 200,000 acre-feet of active storage space in Lake Owyhee.

5.1.6.3 Operation Requirements and Considerations

There are numerous formal and informal agreements on operation of the dams in the system. These range from reservoir elevations and riverflow restrictions related to flood control rules to informal rules of thumb that are met only when water supply and other conditions are favorable. Attachment C summarizes operating considerations and identifies those modeled for this analysis.

In general, flood control rules and more formal agreements on minimum target flows were modeled while less formal operational considerations that focus on improved fishery and water quality were not modeled. Although not modeled, some operating considerations would always be met. Section 5.2.4 provides information on how often selected operation considerations would be met.

5.1.6.4 Other Factors

Decreases in diversions and resulting decreases in return flows were computed for each of the natural flow water rights areas analyzed. These incremental gains and losses were used as input to MODSIM to analyze impacts on river and reservoir operations along with flow augmentation accomplishments.

After data sets were developed, surface water model runs were completed and results were summarized in terms of flows, irrigation diversions and shortages, reservoir levels, and storage accounts.

Power generation capability was quantified for each scenario using MODSIM output of flows and reservoir content.

5.1.7 Summary of Modeling

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5.1.7.1 No Augmentation Scenario

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Modeling for the No Augmentation scenario is based on the following:

- IDWR planning model data set of gains and diversions; physical representation of reaches, diversion, and return flow lags for the 1928-1989 period of record and early 1990s diversions and gain patterns.

- IDWR natural flow rights; rights of less than 4 cfs were consolidated.

- Reclamation storage contracts and other Reclamation data on constraints to reservoir and river operations.

5.1.7.2 Base Case

The Base Case adds to the No Augmentation scenario by assigning specific water sources (see table 5-1) to result in delivery of 427,000 acre-feet of inflow to Brownlee greater than incidental flow. Incidental flow is essentially the flow that isn't regulated. However, incidental flow under the Base Case decreases somewhat because flow augmentation results in less carryover in reservoirs, more reservoir space, and decreased spill during flood control.

5.1.7.3 1427i

The 1427i scenario adds to the No Augmentation scenario by assigning specific water sources (see tables 5-2, 5-3, and 5-4) to meet a demand of up to 1,427,000 acre-feet of flow augmentation water. The demand is defined as the deficit in meeting target flows at Lower Granite Dam under the current BIOP operation of the lower Snake River. An additional consideration is that reservoirs would be drafted to meet all demands.

5.1.7.4 1427r

The 1427r scenario adds to the No Augmentation scenario by assigning specific water sources (see tables 5-2, 5-5, and 5-6) to meet a demand of up to 1,427,000 acre-feet of flow augmentation water. Demand for flow augmentation is the same as for 1427i. However, the second consideration is that reservoir levels are to be maintained at levels similar to the Base Case in order to minimize adverse effects to reservoir water quality, recreation, and fish and wildlife.

The 1427r scenario requires nearly half of the active space in Reclamation reservoirs and would induce considerable irrigation shortage. This amount of shortage, or reduced application of water to irrigate crops, would have a significant effect on groundwater levels. As a result, potential effects on the eastern SRPA were modeled and incorporated into model results.

5.2 Model Findings

5.2.1 Flow Augmentation

The goal of the Base Case is to provide 427,000 acre-feet every year. The goal of the 1427i and 1427r scenarios is to provide up to 1,427,000 acre-feet to help meet the deficit in target flows at Lower Granite Dam. These deficits are less than 1,427,000 acre-feet in 22 of 62 years but range up to 8,242,005 acre-feet in the remaining 40 years.

Average monthly inflow to Brownlee Reservoir under the four scenarios is shown in figure 5-2.

5.2.1.1 Base Case Accomplishment

The hydrology simulation results in tables of monthly values of flows provided by flow augmentation and the total for the year. Annual totals provided by flow augmentation were compared with the annual goal of 427,000 acre-feet. The hydrologic model, using current water sources for flow augmentation, indicates that Reclamation can provide the target augmentation flow of 427,000 acre-feet in about 82 percent of the years (see table 5-7). In 92 percent of the years, 300,000 acre-feet can be provided and in 95 percent of the years 250,000 acre-feet can be provided. The minimum amount delivered in the driest year would be 179,000 acre-feet.

Table 5-7 Future Delivery of Augmentation Flows Under the Base Case Scenario (Based on the 62-year Period of Analysis (1928-1989)

Level of Flow Augmentation	Percentage of Time Met	Number of Years Met
427,000 acre-feet	82	51
300,000 acre-feet	92	57
250,000 acre-feet	95	59

Reclamation has determined that additional permanent acquisitions of storage space or natural flow rights would be needed to increase the reliability of providing the target flow of 427,000 acre-feet.

5.2.1.2 1427i Accomplishment

The annual flow augmentation totals provided by the 1427i scenario were compared with the seasonal deficit in meeting flow augmentation targets at Lower Granite Dam under the Base Case. The goal was considered met in any year that the seasonal total provided by the scenario was (1) greater than the deficit amount or (2) was 1,427,000 acre-feet. Deficits would be less than 1,427,000 in 22 of 62 years and the 1427i scenario would provide the deficit amount in each of those years. Deficits would be greater than 1,427,000 acre-feet in 40 of 62 years. The 1427i scenario would provide 1,427,000 acre-feet in 38 of 40 years and would provide 1.1 and 1.2 MAF in the remaining 2 years. In summary, the 1427i scenario meets the flow augmentation goal in 60 of 62 years (97 percent of the years).

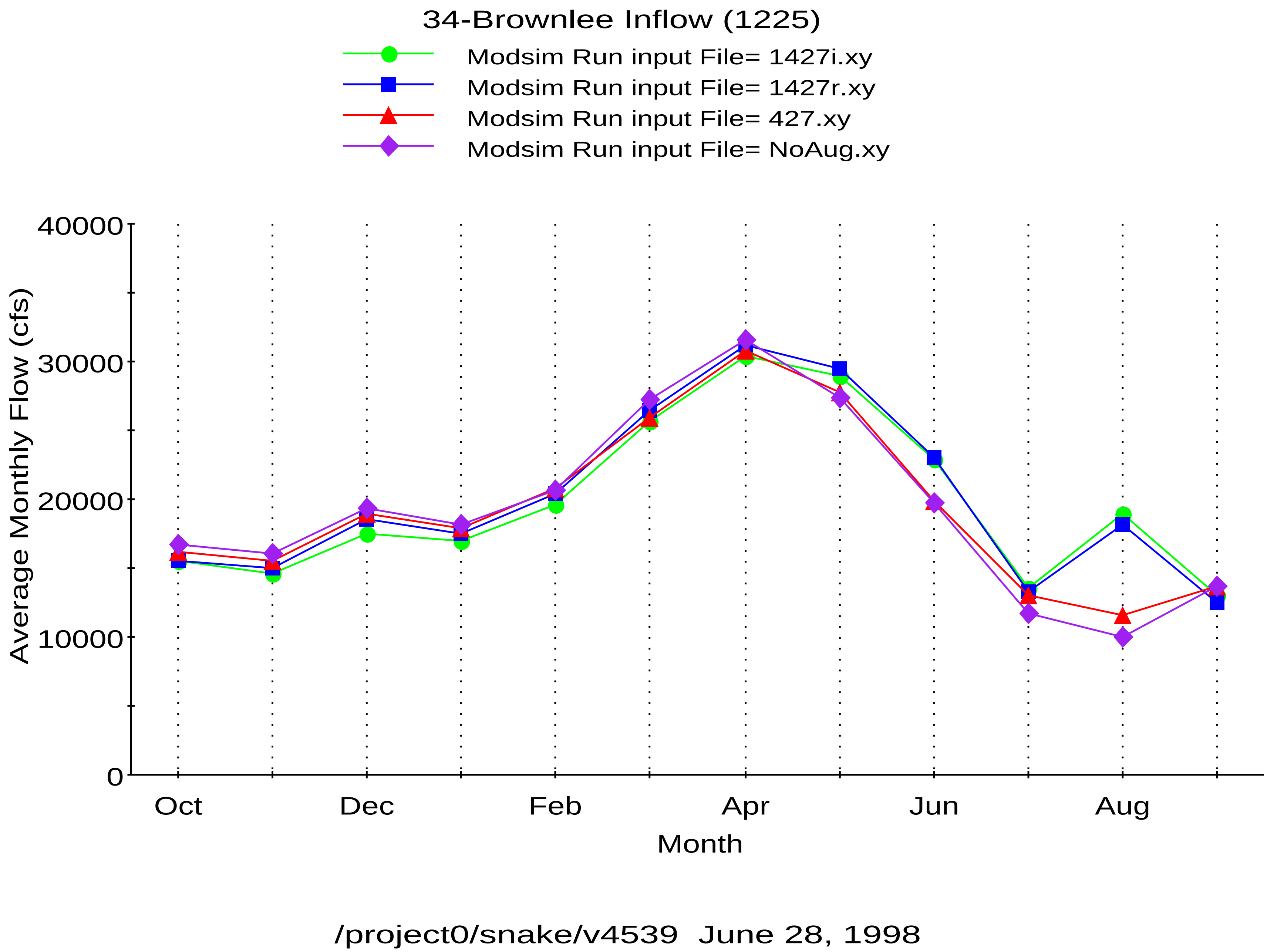

Figure 5-2 Average Monthly Inflow to Brownlee Reservoir

5.2.1.3 1427r Accomplishment

The annual flow augmentation totals provided by the 1427r scenario were compared with the seasonal deficit in meeting flow augmentation targets at Lower Granite Dam under the Base Case. As indicated in the previous section, the goal was considered met in any year that the seasonal total provided by the scenario was (1) greater than the deficit amount or (2) was 1,427,000 acre-feet. Deficits would be less than 1,427,000 in 22 of 62 years and would be greater than 1,427,000 acre-feet in 40 of 62 years. The 1427r scenario would provide the deficit amount in all years when the seasonal total was less than 1,427,000 acre-feet and would provide 1,427,000 acre-feet in all other years. In summary, the 1427i scenario meets the flow augmentation goal in 62 of 62 years (100 percent of the years).

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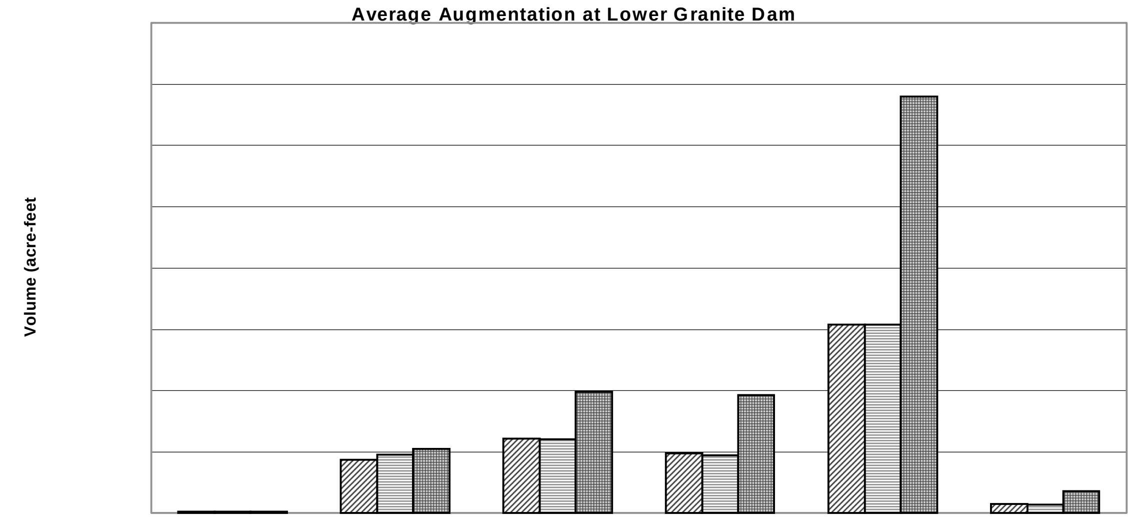
5.2.1.4 Relationships to Lower Granite Dam Target Flows

As indicated earlier and shown in figure 5-1, flow augmentation deficits are greater than 1,427,000 acre-feet during 60 percent of the period of record (1928-1989). As a result, implementation of the 1427i or 1427r scenario would fail to meet the deficit demand at Lower Granite Dam in at least 60 percent of the years. This failure to meet deficit demand is more striking when defined by months. Table 5-8 shows the demand by month at Lower Granite Dam and the number of months the target would be met under each scenario.

Table 5-8 Flows Targets at Lower Granite Dam During Augmentation Period and Accomplishment of the 1427i and 1427r Scenarios (Assumes Current Dworshak Operation and is Based on 62 Years of Historical Records, 1928 Through 1989)

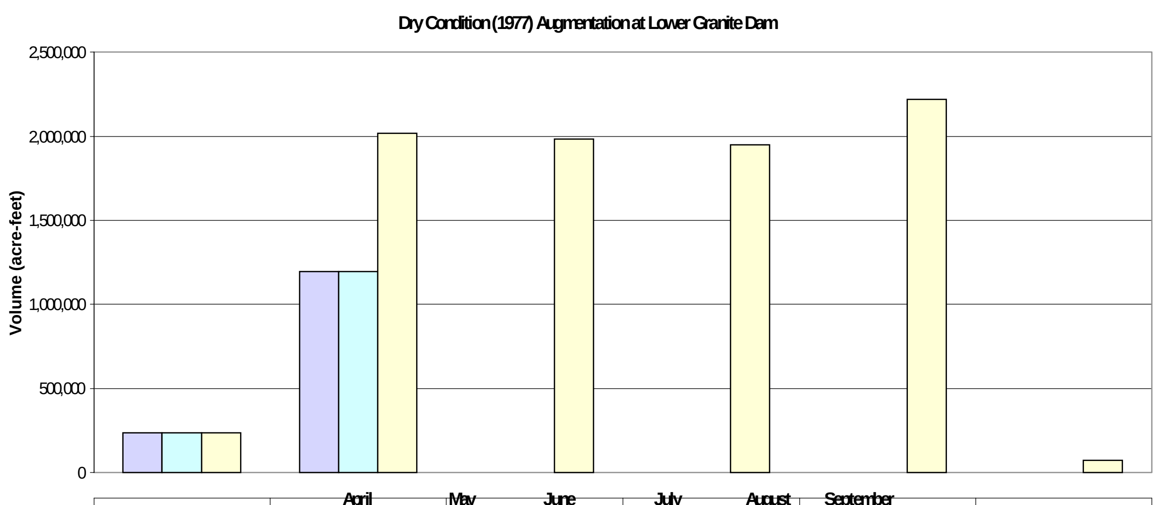
Period	April 10-30	May 1-31	June 1-31	July 1-31	August 1-31
Target flow	85,000 to 100,00 cfs	85,000 to 100,00 cfs	50,000 to 100,00 cfs	50,000 to 55,000 cfs	50,000 to 55,000 cfs
Scenarios	Number of Months Target Is Met out of 62 Months and (Percent of Months)				
1427i	62 (100)	59 (95)	53 (85)	48 (77)	25 (40)
1427r	62 (100)	60 (97)	54 (87)	50 (81)	26 (42)

Figures 5-3, 5-4, and 5-5 present information on demand and water provided in graphical form for the average water year, a dry year (1977,) and a wet year (1983). The month of September is included in the graphs because delivery requests for 427,000 acre-feet under the Base Case includes delivery of a portion of the water during September. It was assumed in the hydrologic studies that this request would continue into the future even though September is not within the 1995 BIOP target flow period.



	1	2	3	4	5	6
1427i Supply	3,933	174,494	242,254	194,252	615,165	29,083
1427r Supply	3,933	191,238	241,080	189,702	614,853	26,662
Demand	3,933	210,925	396,544	385,203	1,359,402	72,000
	April	**May**	**June**	**July**	**August**	**September**

Figure 5-3 Average Target Flow Demand and Water Supply Provided by the 1427I and 1427r Scenarios for the 1928-1989 Period



	1	2	3	4	5	6
1427i Supply	234,483	1,192,517	0	0	0	0
1427r Supply	234,483	1,192,517	0	0	0	0
Demand	234,483	2,017,943	1,981,139	1,948,466	2,217,951	72,000

Figure 5-4 Target Flow Demand and Water Supply Provided by the 1427I and 1427r Scenarios in a Dry Year (1977)

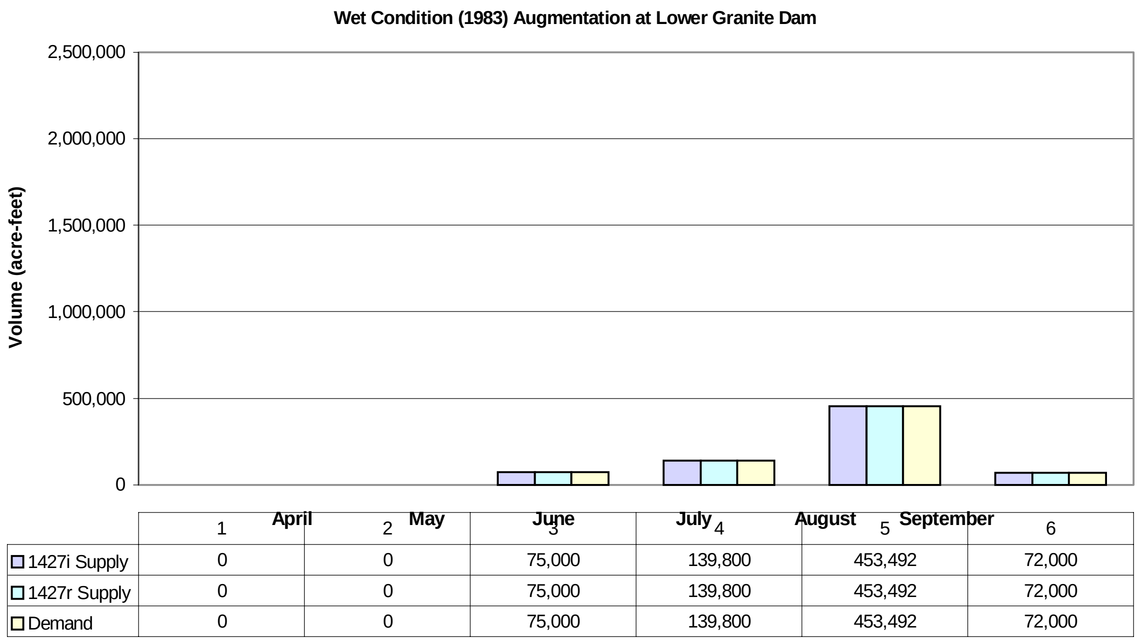


Figure 5-5 Target Flow Demand and the Water Supply Provided by the 1427I and 1427r Scenarios in a Wet Year (1983)

5.2.2 Irrigation Shortages

Irrigation demand and water available for diversion for Reclamation projects that would be affected by flow augmentation were identified. Based on these data, tables of irrigation shortages for an average, a dry year, and a wet year were developed. Table 5-9 summarizes the data.

Table 5-9 Irrigation Shortages for All Scenarios (Acre-Feet)

Hydrologic Condition	Base Case	No Augmentation	1427i	1427r
Average	72,216	72,964	187,743	770,746
Dry year (1977)	335,634	444,607	1,043,335	2,201,459
Wet year (l983)	2,261	2,261	3,593	132,633

5.2.3 River Flows and Reservoir Elevations

Exceedance curves, end of month reservoir contents, and average monthly flows for all modeled reservoirs and river reaches for each flow augmentation scenario were prepared and provided to technical personnel to use in evaluating the effects of the scenarios. This material is summarized in figures 5-6 to 5-23 which show average end of month contents and average monthly releases and end of season content (end of September) for the 62-year period of analysis for the following facilities:

- Jackson Lake

- American Falls Reservoir
- Milner Dam
- Anderson Ranch Reservoir
- Lucky Peak Lake
- Cascade Reservoir
- Deadwood Reservoir
- Lake Owyhee

In general, only the active portions of the reservoir content are modeled and included in the figures. However, exceptions are Palisades, Walcott, and Anderson Ranch Reservoirs which include active and inactive space. Inactive space in these reservoirs is used for powerhead which is used as a source of water for flow augmentation in this analysis.

Graphs of reservoir content and outflow for wet (1983) and dry (1977) water supply conditions are included in attachment D.

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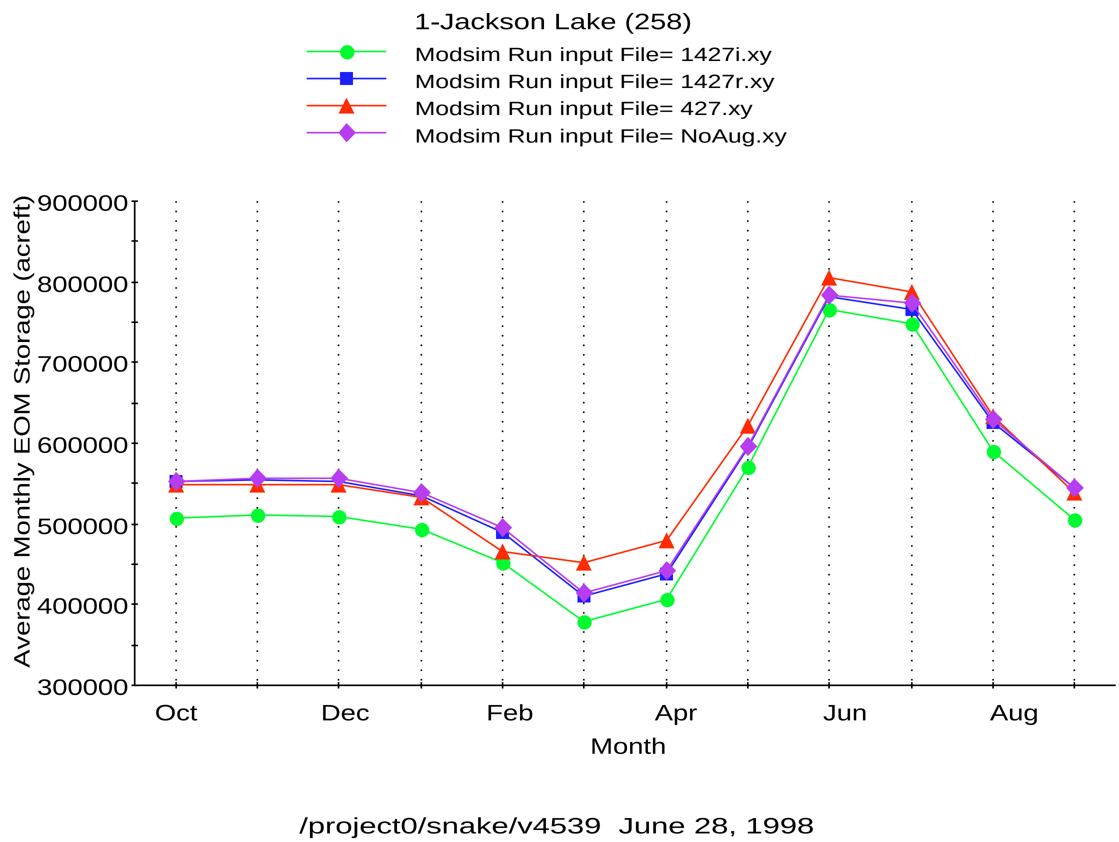
5.2.4 Operational Requirements and Considerations

This section provides information on how often selected operating considerations are met under each of the scenarios. These operating considerations are met only within operational flexibility while meeting irrigation demands and flow augmentation targets. A complete list of operating considerations and the reason for the consideration is included in attachment C.

5.2.4.1 Snake River Upstream of Milner Dam

Table 5-10 Percent of Time Selected Operating Considerations Are Met Upstream of Milner Dam

Reservoir and Consideration	Base Case	No Augmentation	1427i	1427r
Jackson Lake release				
280 cfs minimum (all months)	100	100	100	100
600 cfs maximum (October-March)	75	70	71	70
Palisades Reservoir release				
550 cfs minimum (October-March)	100	100	100	100
Island Park release				
2,000 cfs maximum (normal) (all months)	100	100	100	100
3,260 cfs maximum (flood control) (all months)	100	100	100	100
100 cfs minimum (October-March)	85	85	85	85
12,000 cfs maximum at Rexburg (all months)	100	100	100	100
American Falls				
100,000 acre-foot minimum (September)	58	66	34	56
4345 feet elevation maximum (November- March)	58	54	53	53
American Falls releases				
300 cfs minimum at Neeley (November-March)	85	87	82	88
20,000 cfs maximum at Minidoka (all months)	98	98	98	100
Lake Walcott (Minidoka Dam)				
4240 feet elevation minimum (November-February)	100	100	100	100
Milner Dam release–200 cfs minimum	84	80	82	85



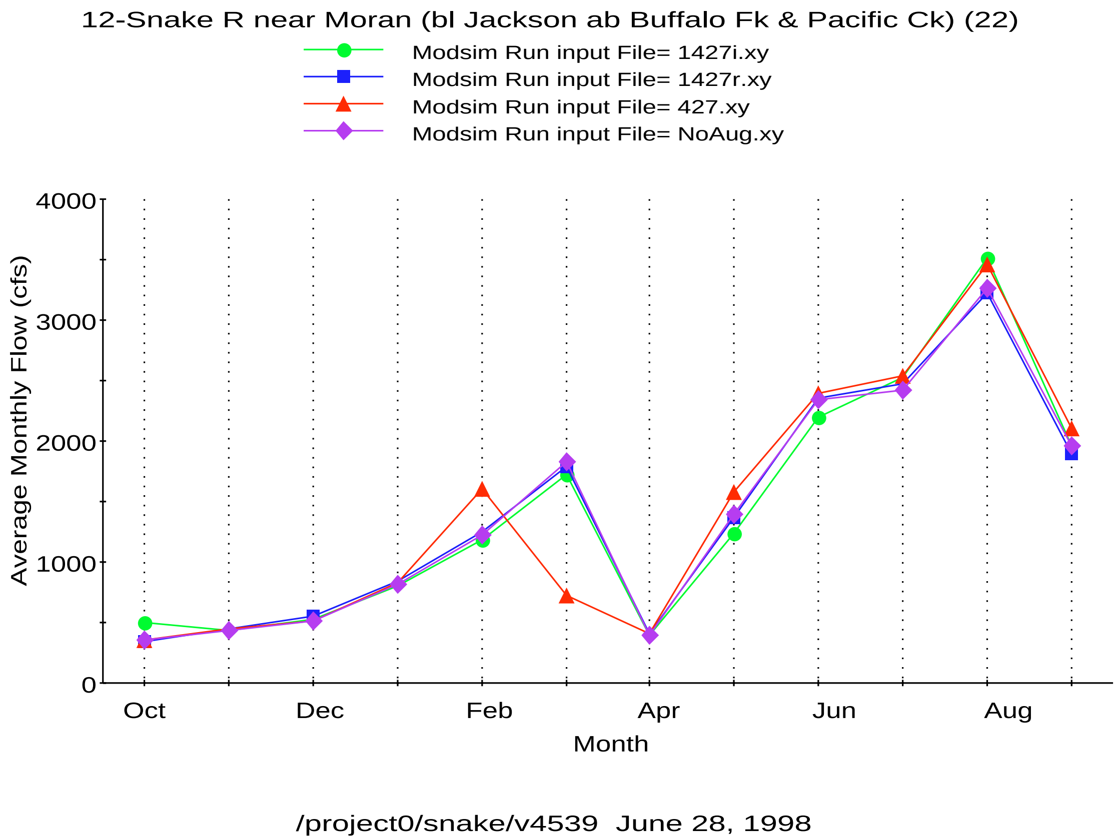
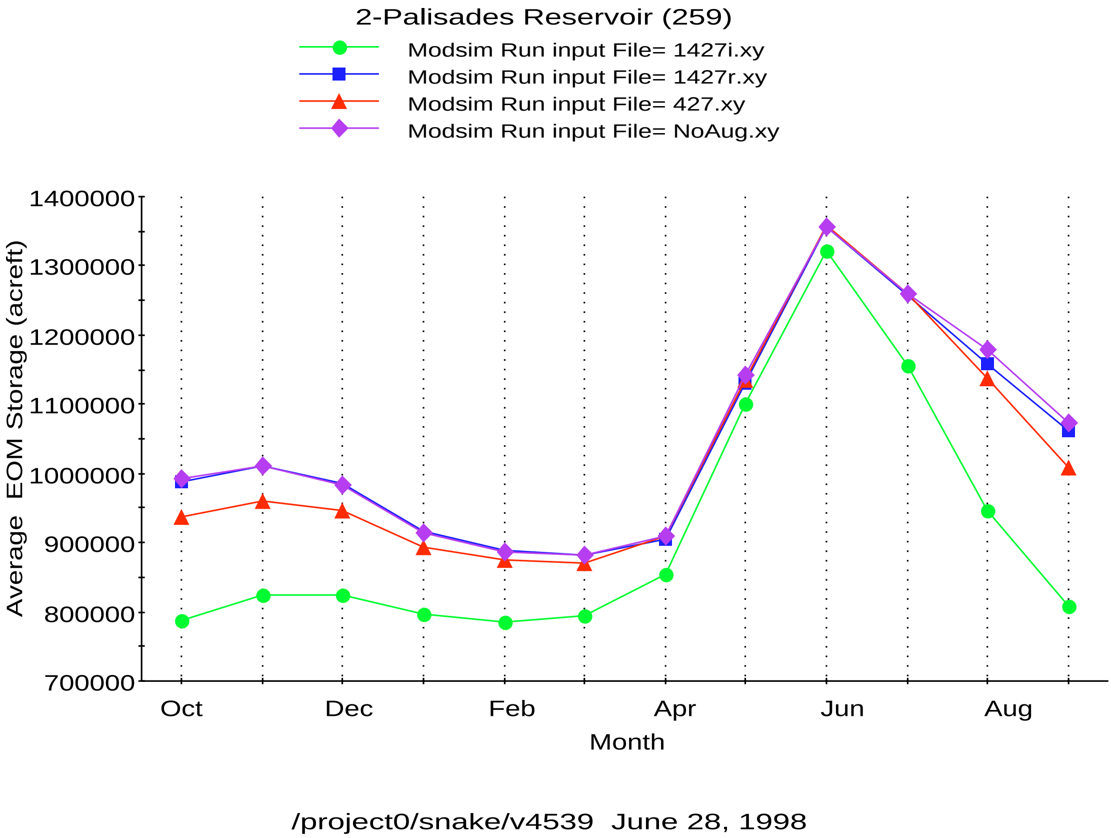


Figure 5-6 Jackson Lake Average end of Month Content and Average Monthly Release (Snake River Flow Near Moran)

Figure 5-7 Jackson Lake End of Season Content (1928-1989)



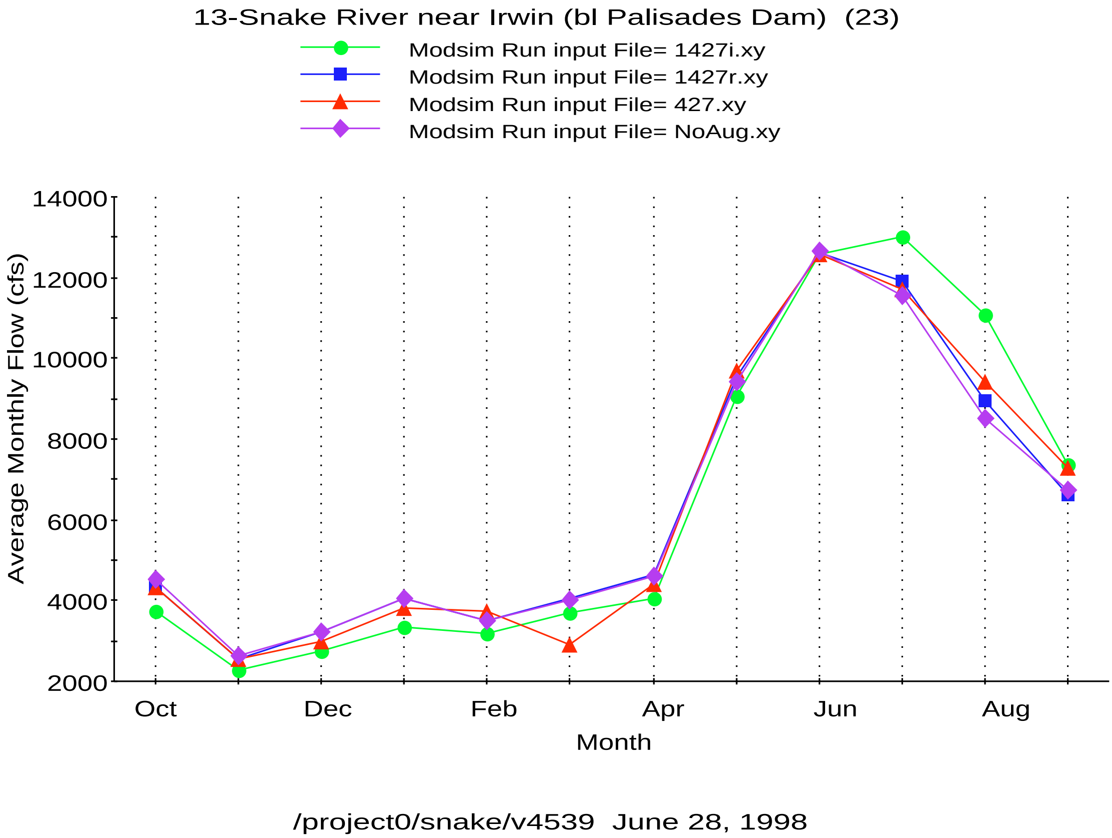


Figure 5-8 Palisades Reservoir Average End of Month Content and Average Monthly Release (Snake River Flow New Irwin)

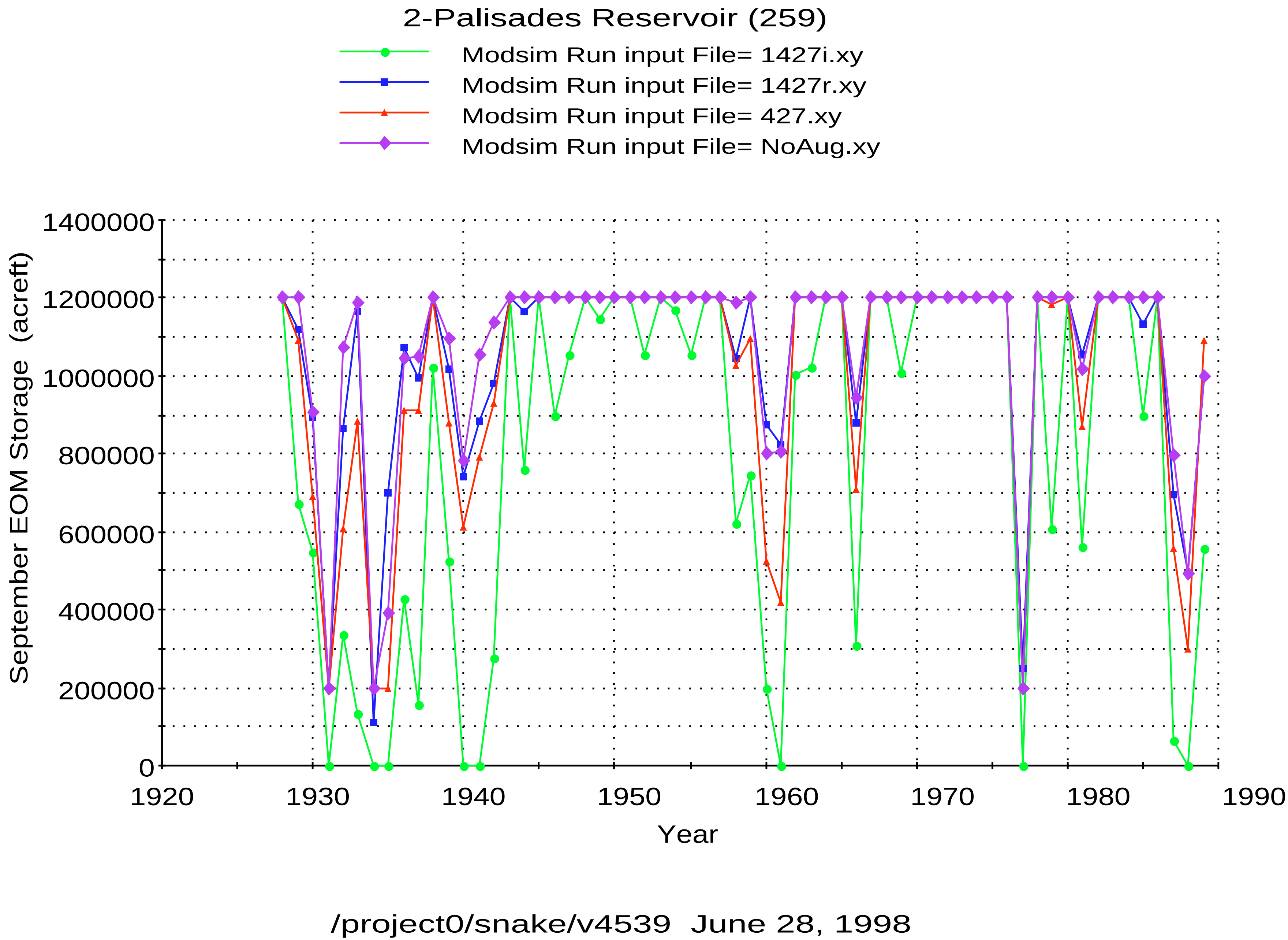
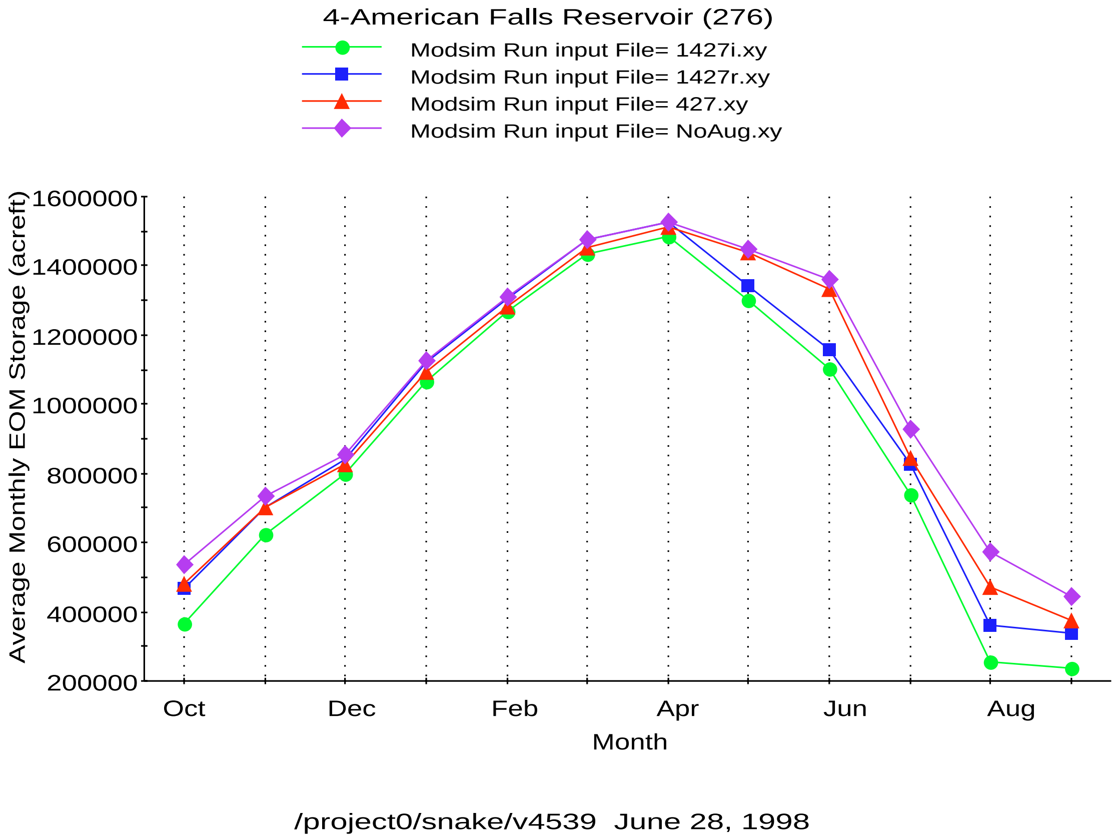


Figure 5-9 Palisades Reservoir End of Season Content (1928-1989)



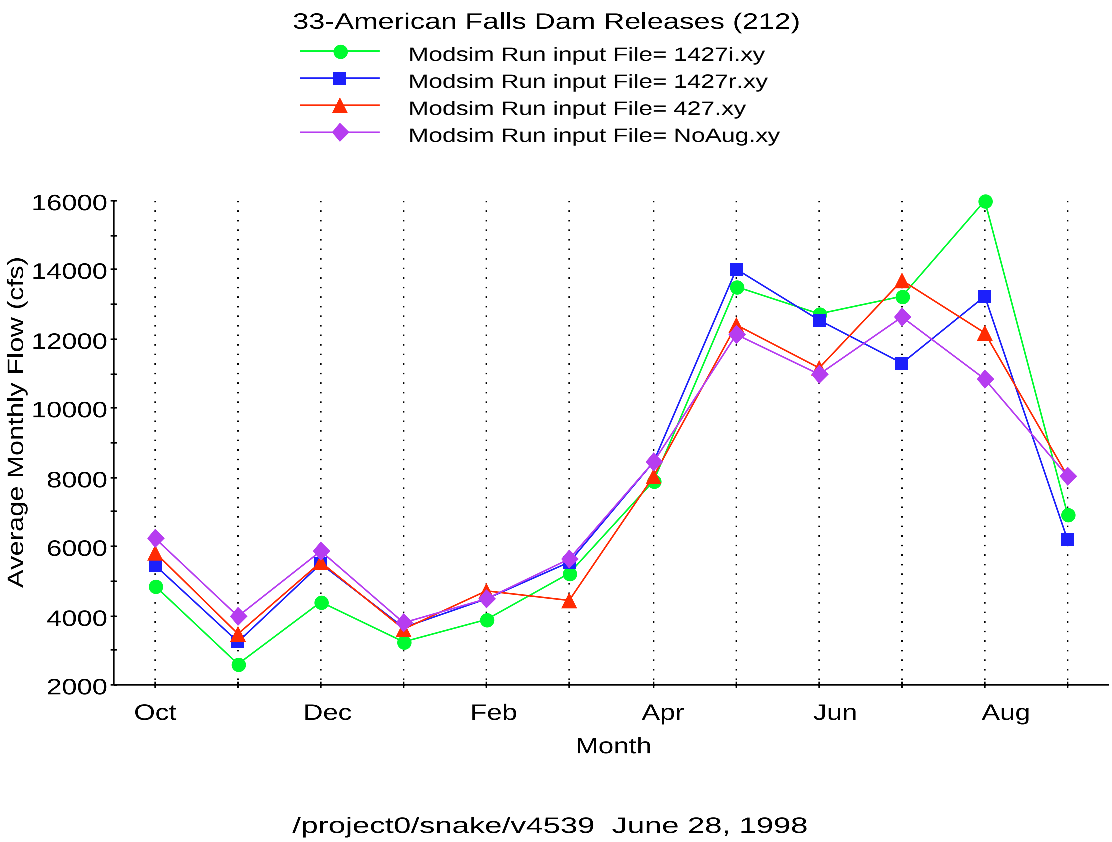


Figure 5-10 American Falls Reservoir Average End of Month Content and Average Monthly Release

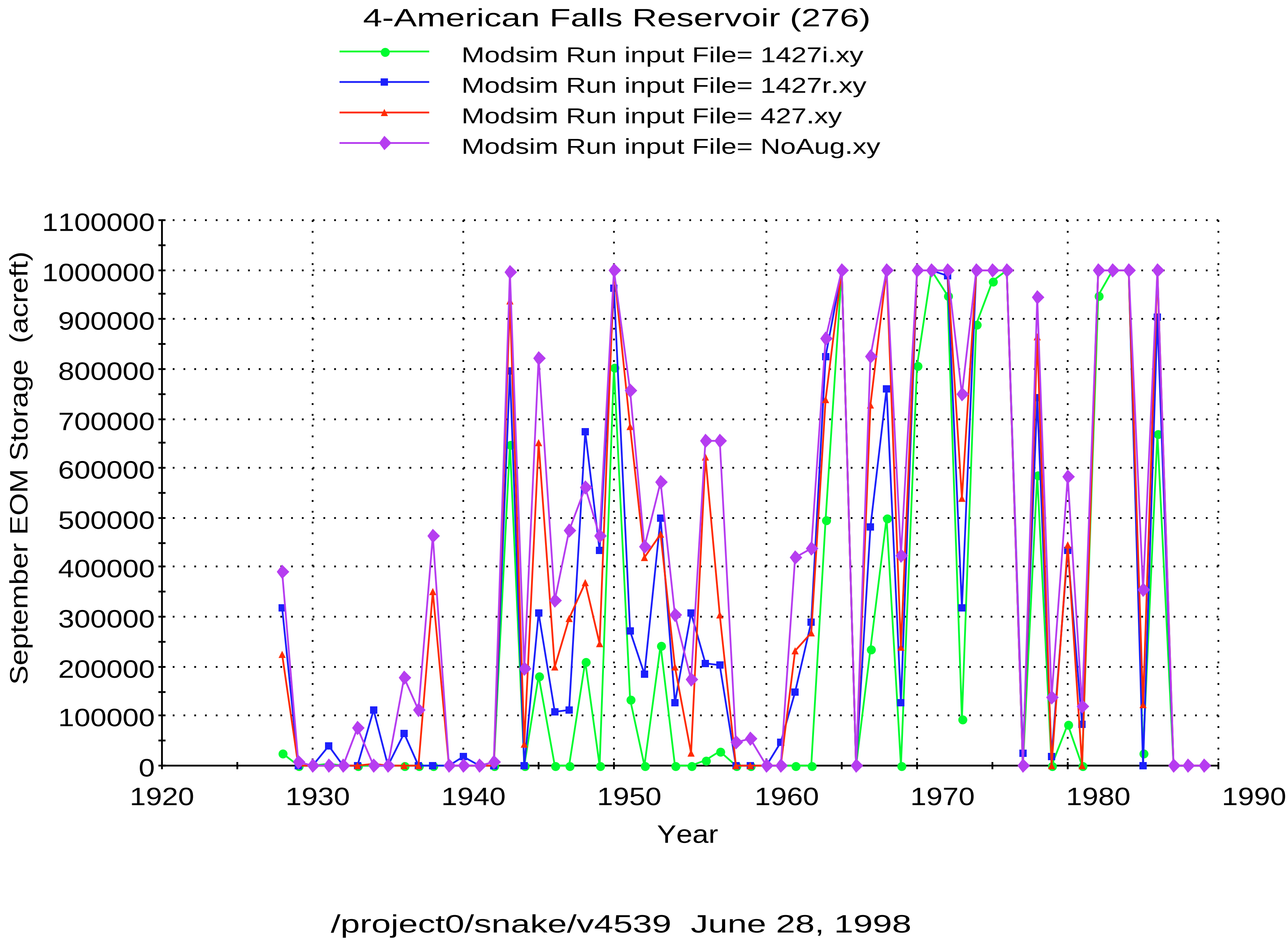


Figure 5-11 American Falls Reservoir End of Season Content (1928-1989)

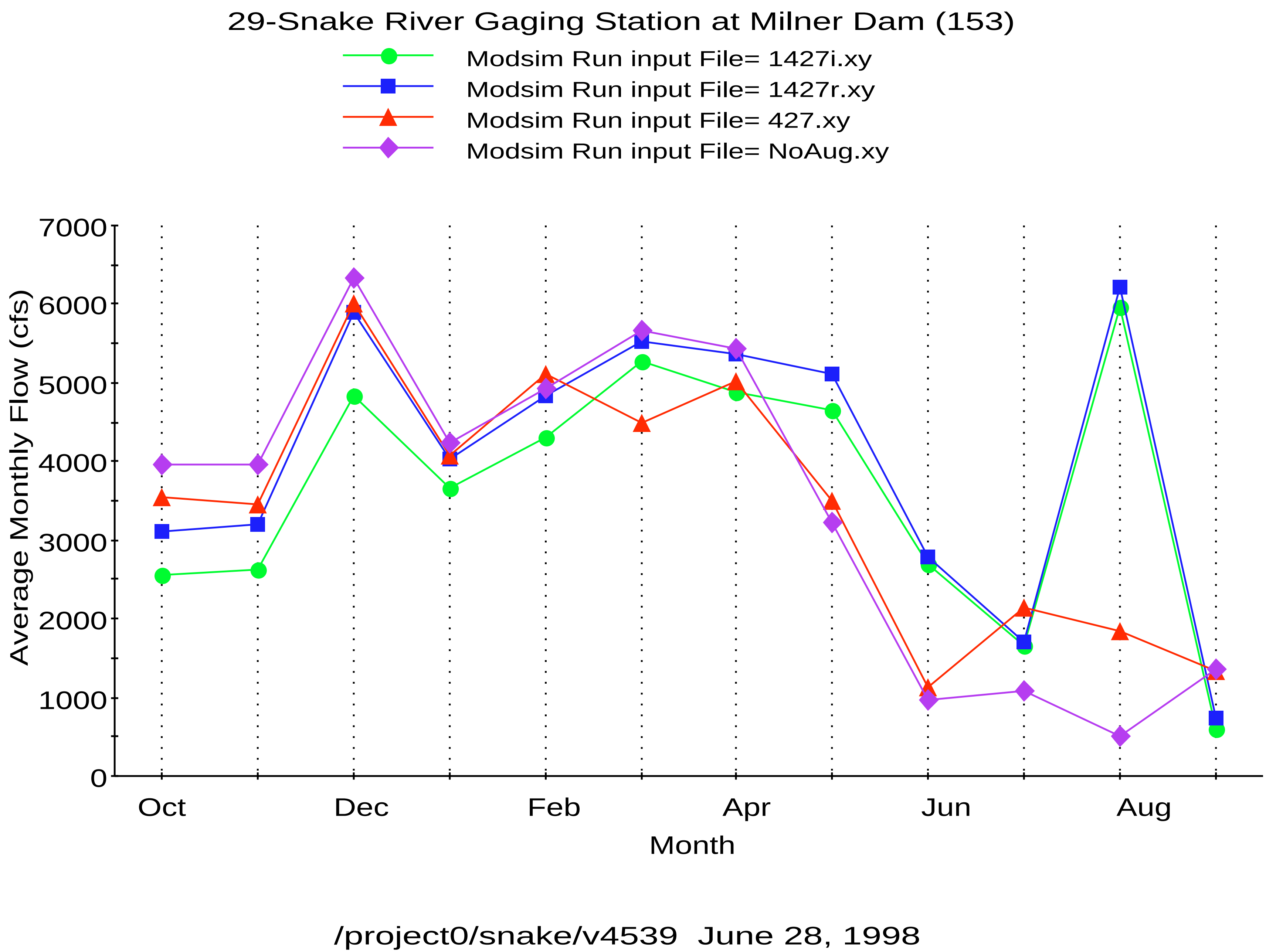
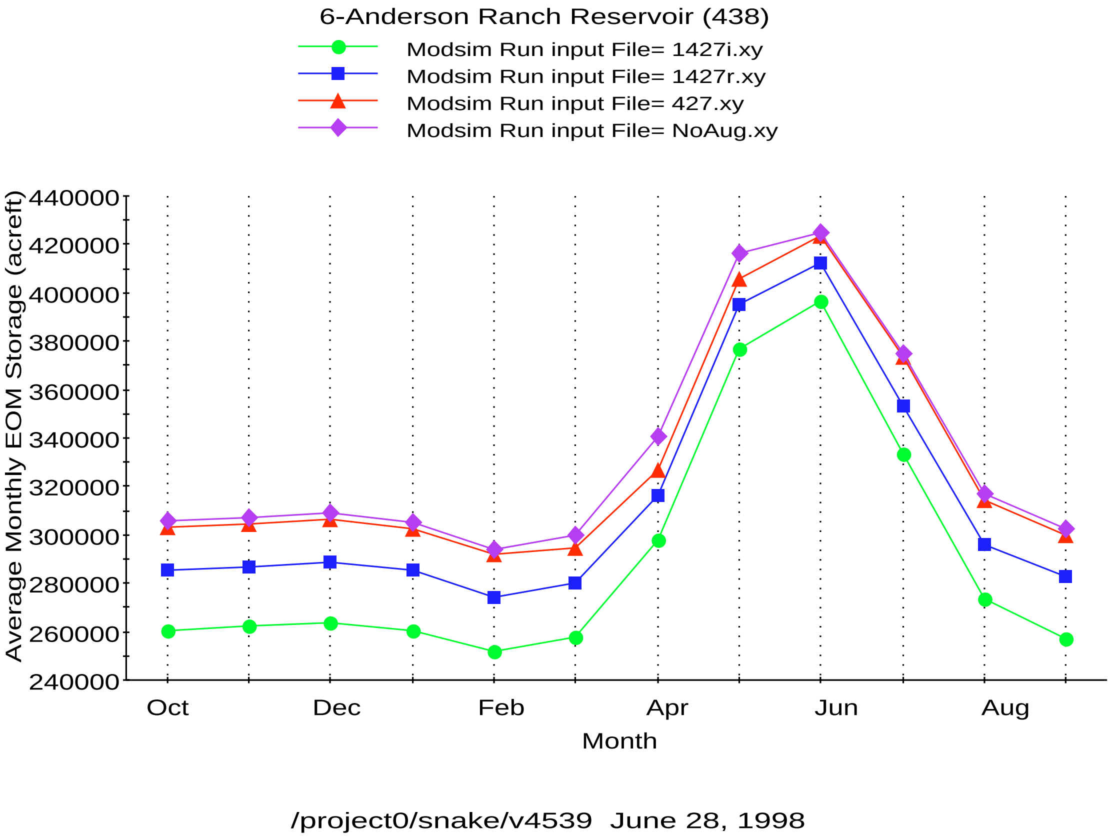


Figure 5-12 Milner Dam Average Monthly Release (Snake River Downstream of Milner Dam)



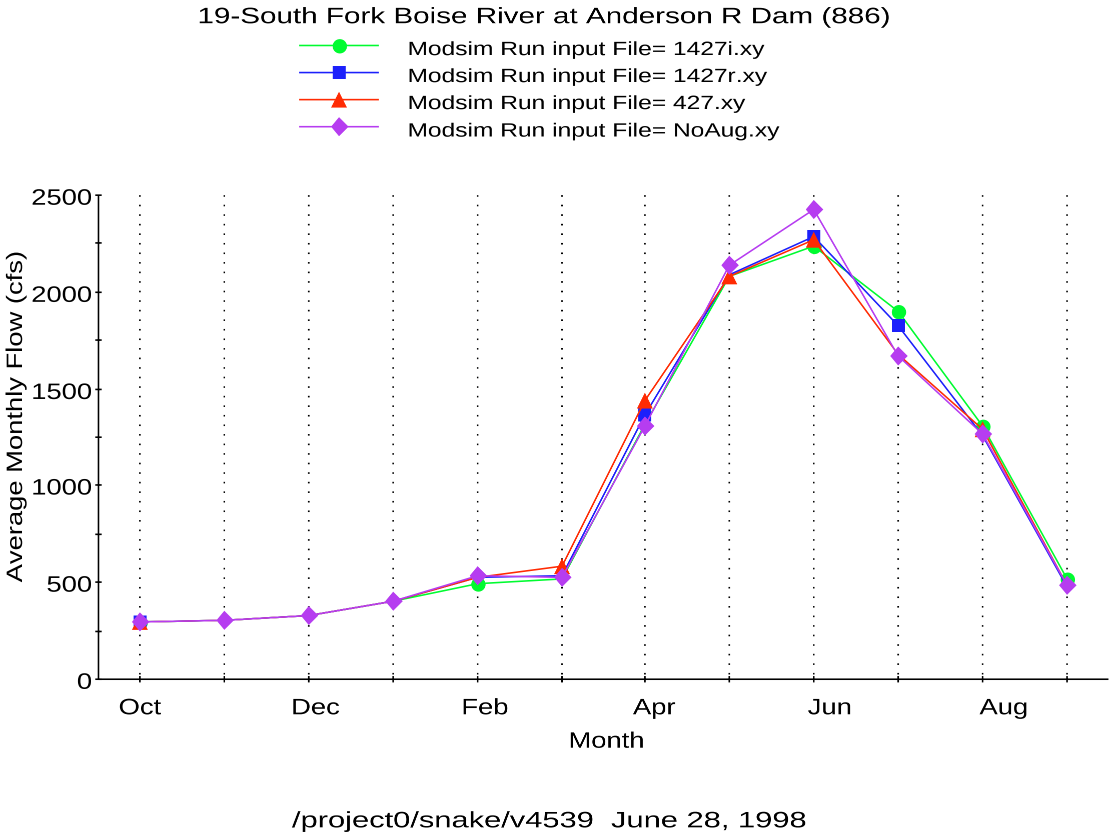


Figure 5-13 Anderson Ranch Reservoir Average End of Month Content and Average Monthly Release

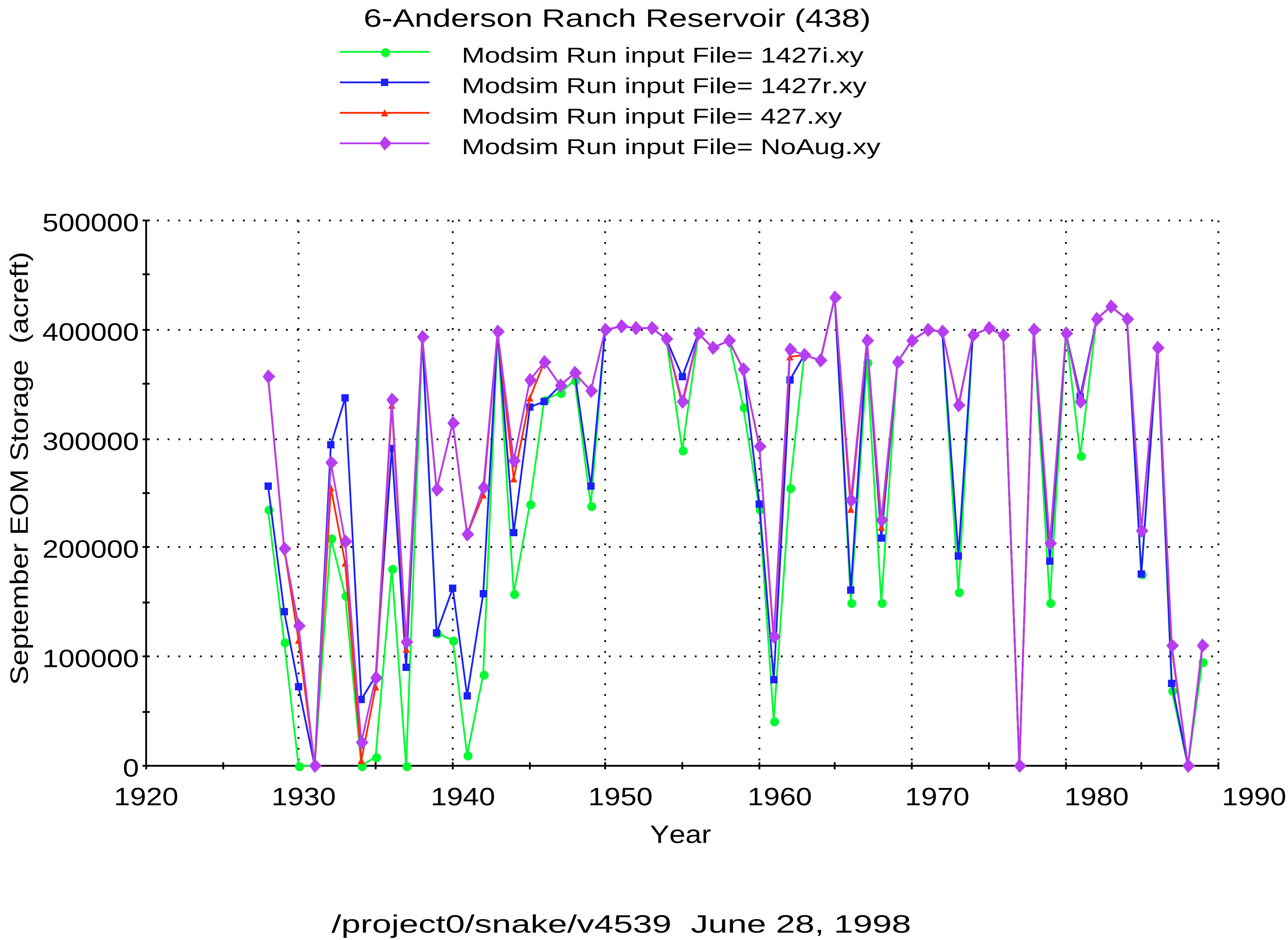


Figure 5-14 Anderson Ranch Reservoir End of Season Content (1928-1989)

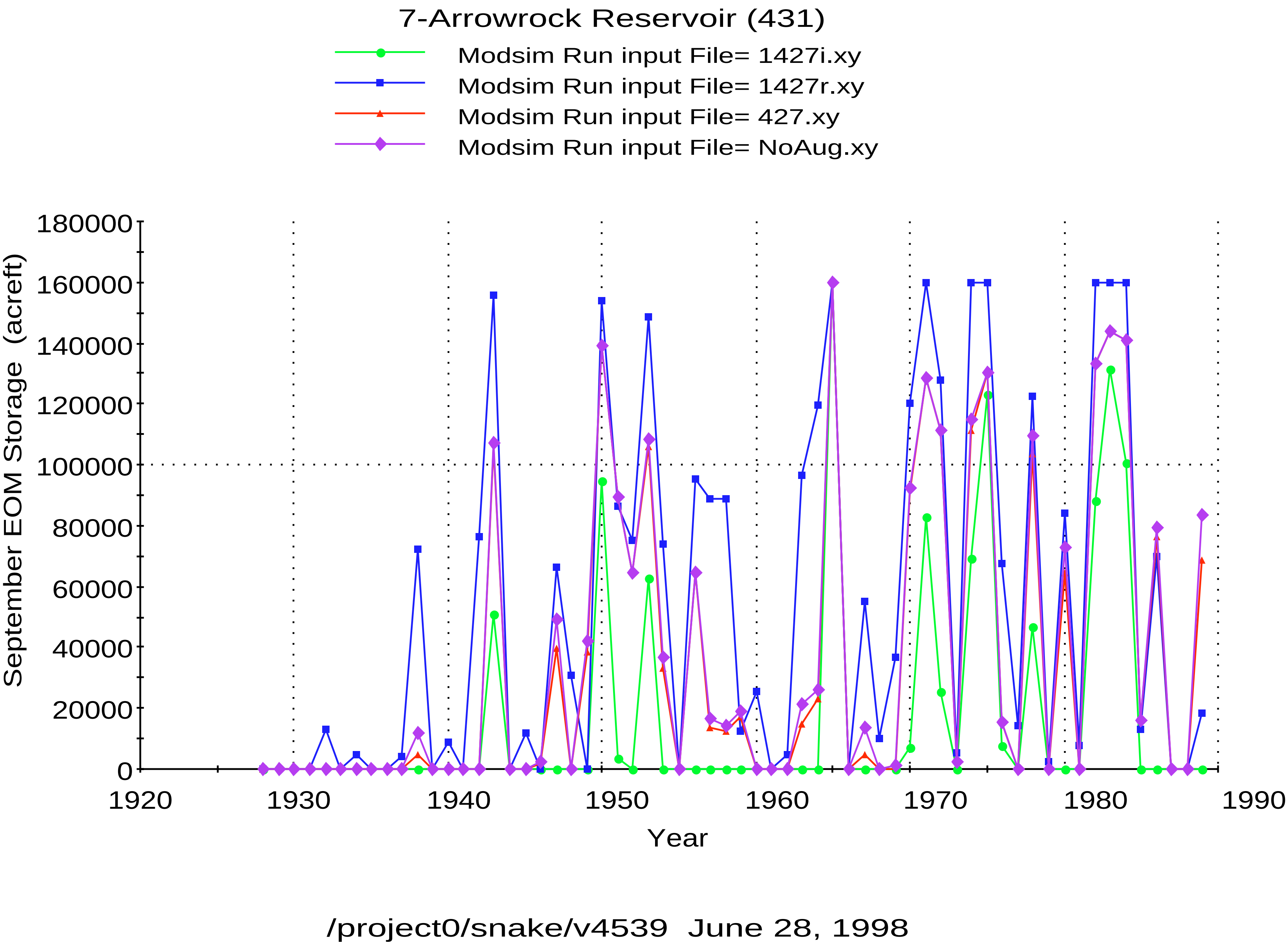
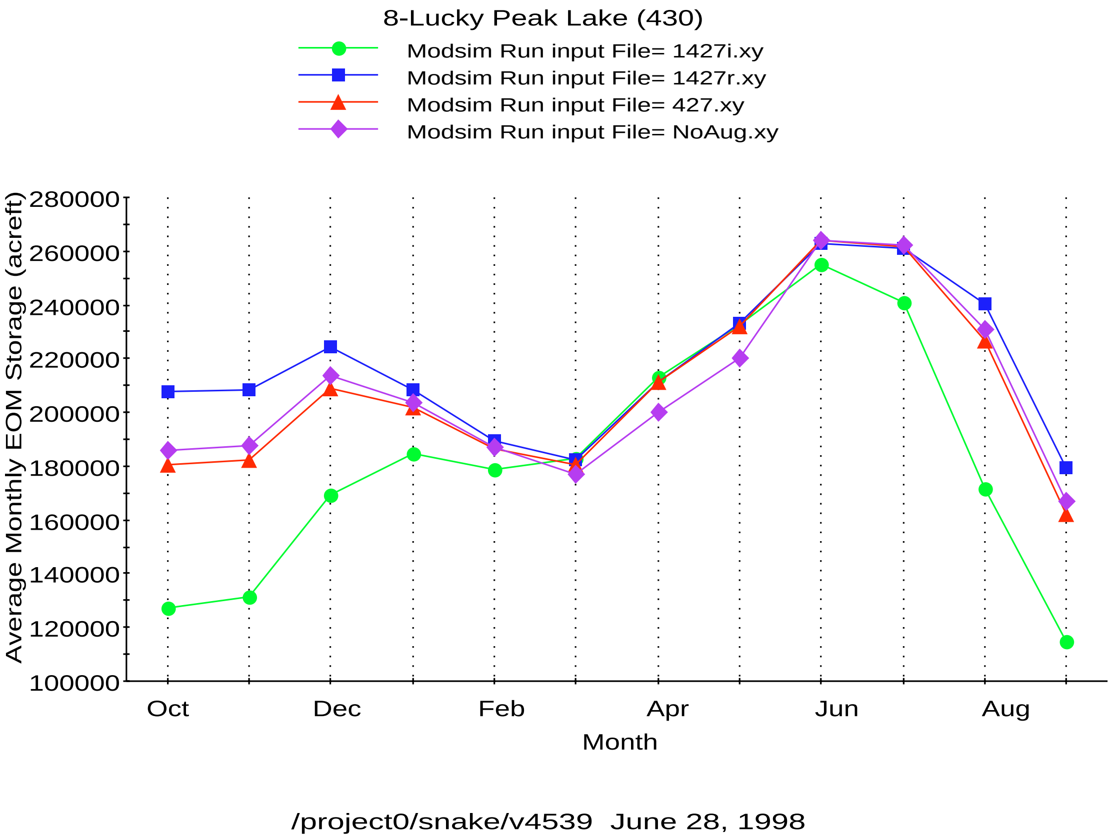


Figure 5-15 Arrowrock Reservoir End of Season Content (1928-1989)



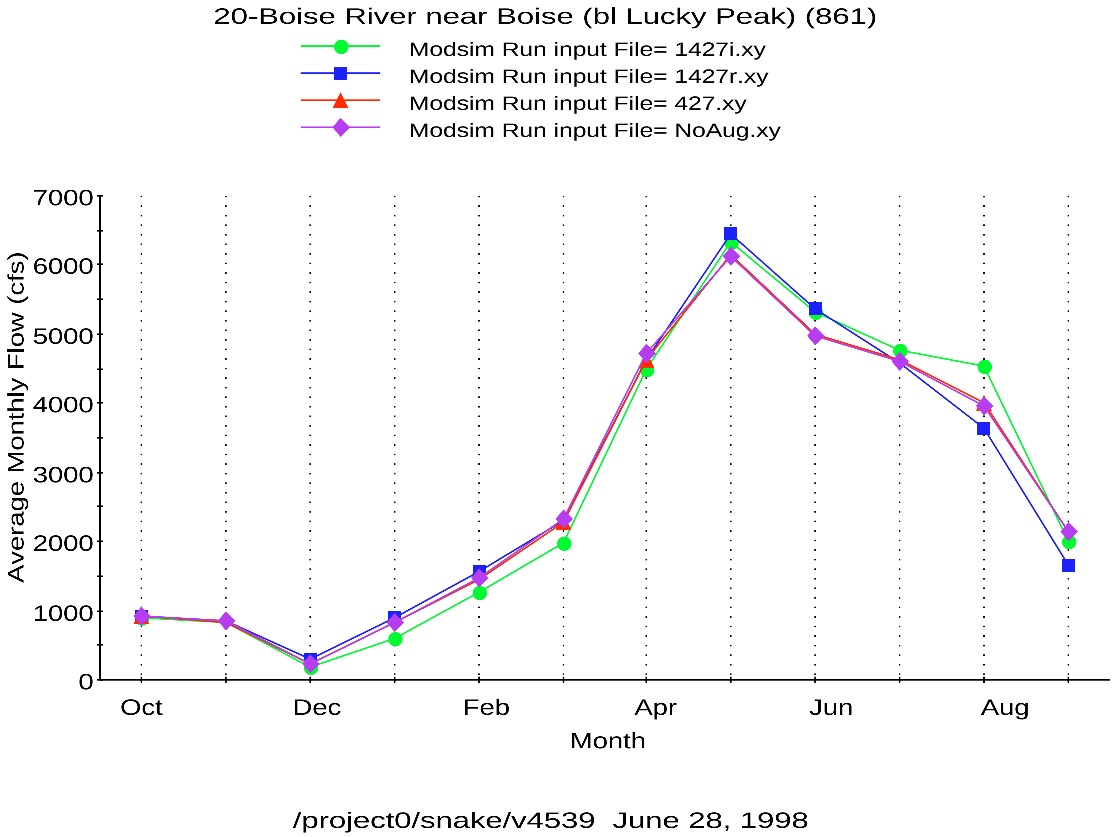


Figure 5-16 Lucky Peak Lake Average End of Month Content and Average Monthly Release

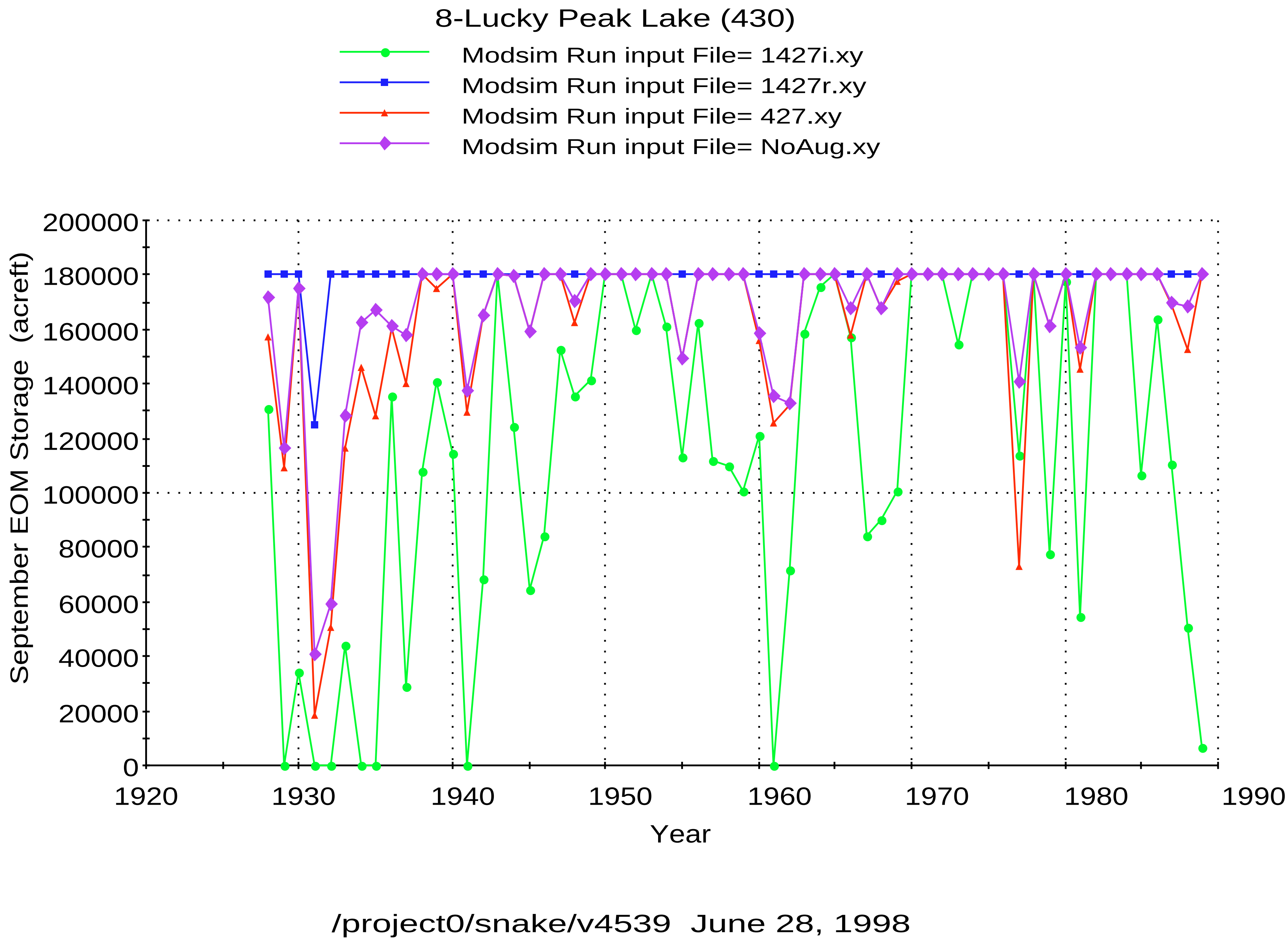
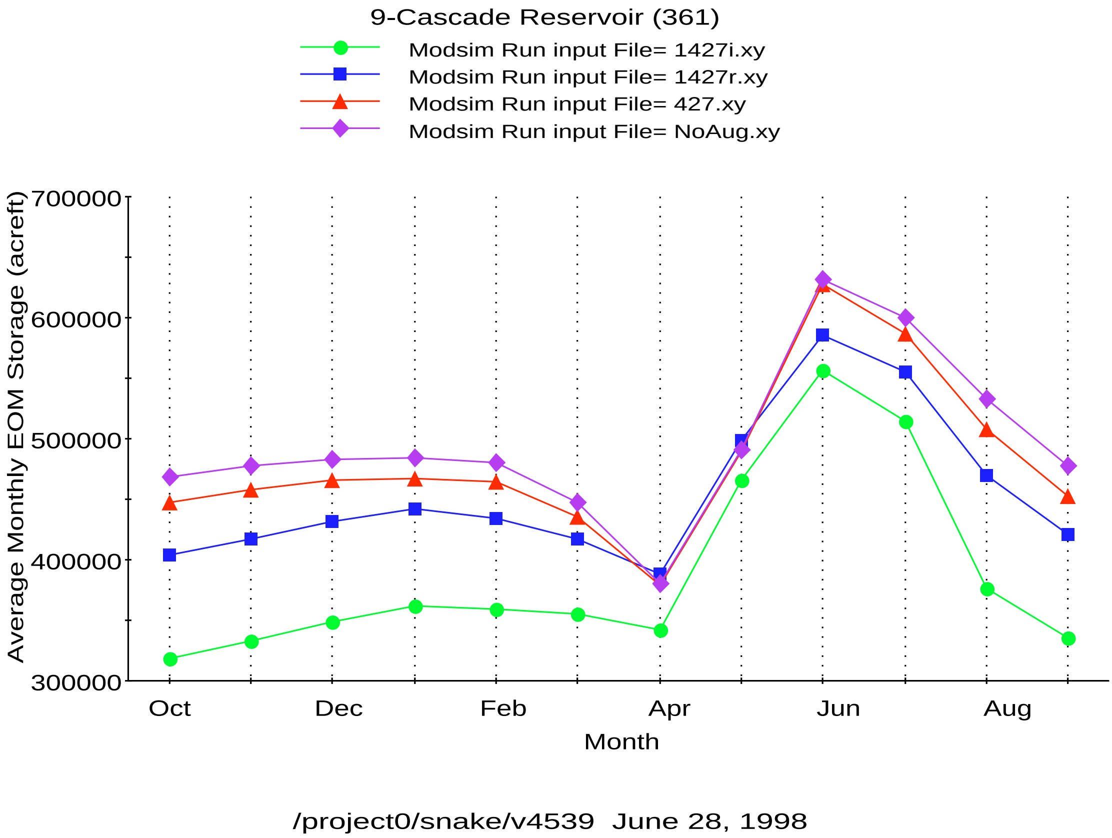


Figure 5-17 Lucky Peak Lake End of Season Content (1928-1989)



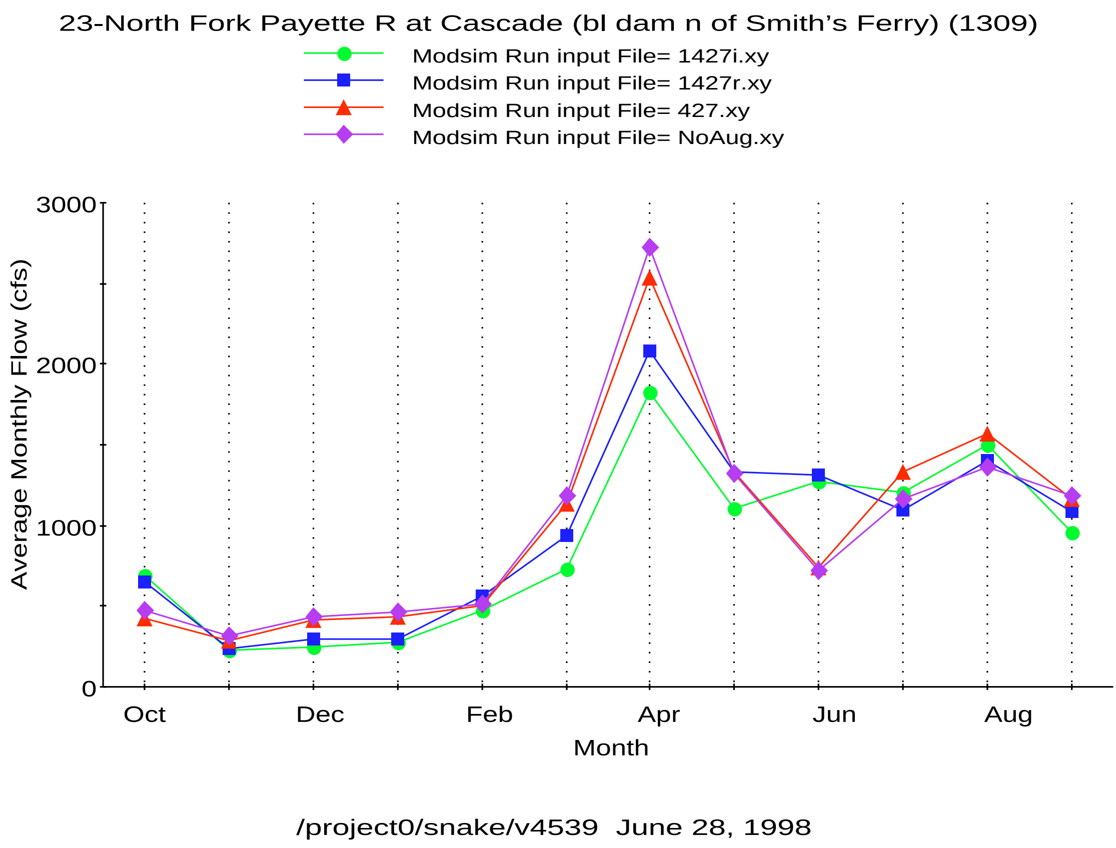


Figure 5-18 Cascade Reservoir Average End of Month Content and Average Monthly Release

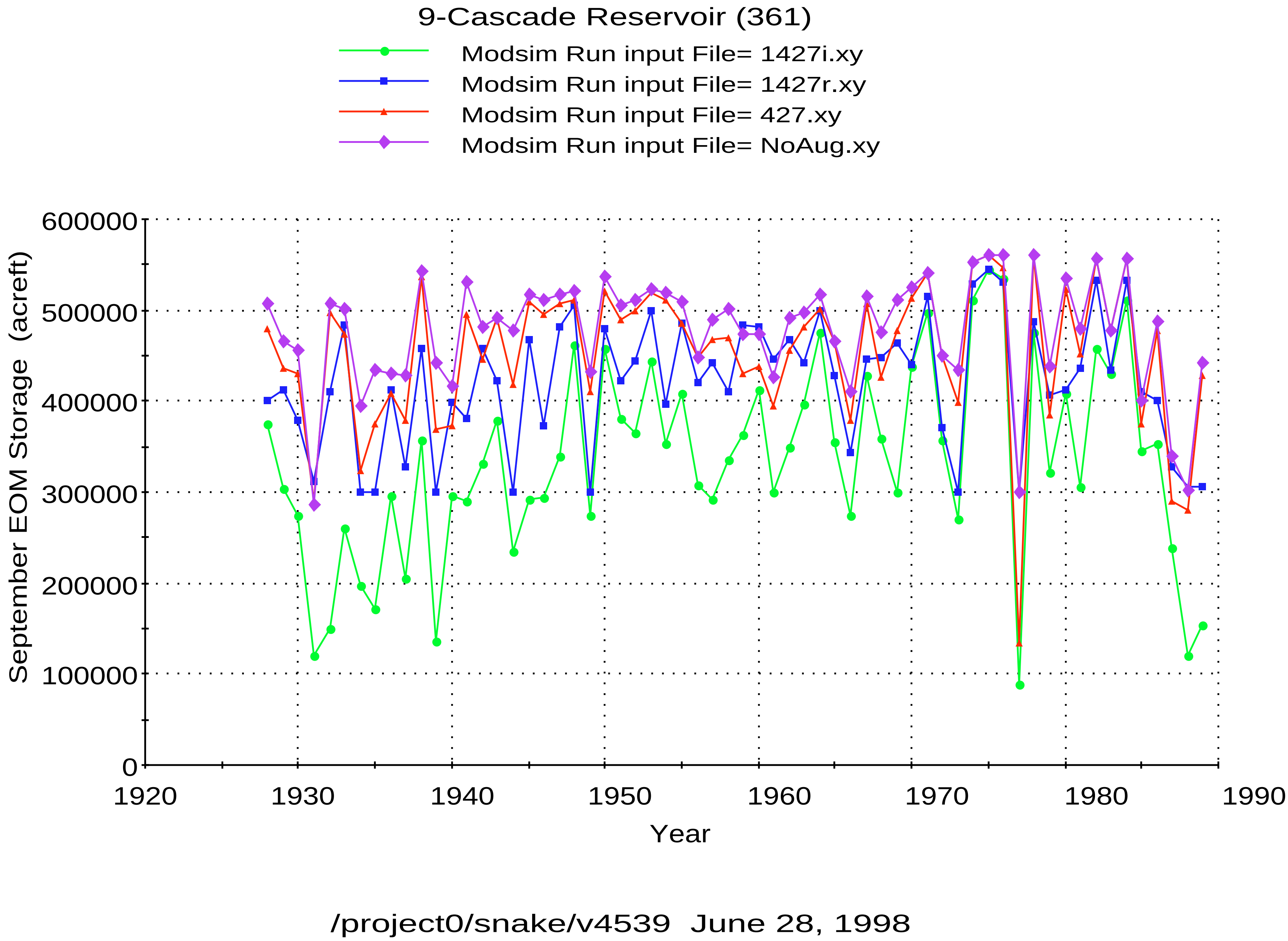
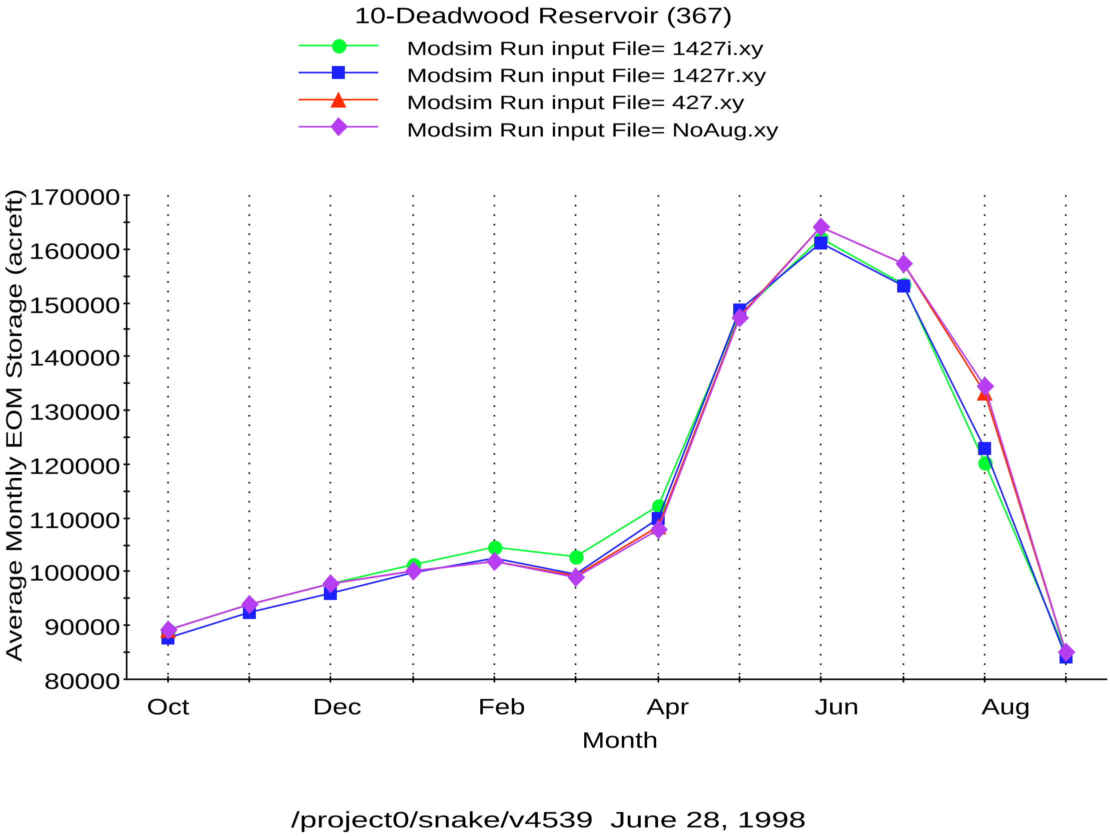


Figure 5-19 Cascade Reservoir End of Season Content (1928-1989)



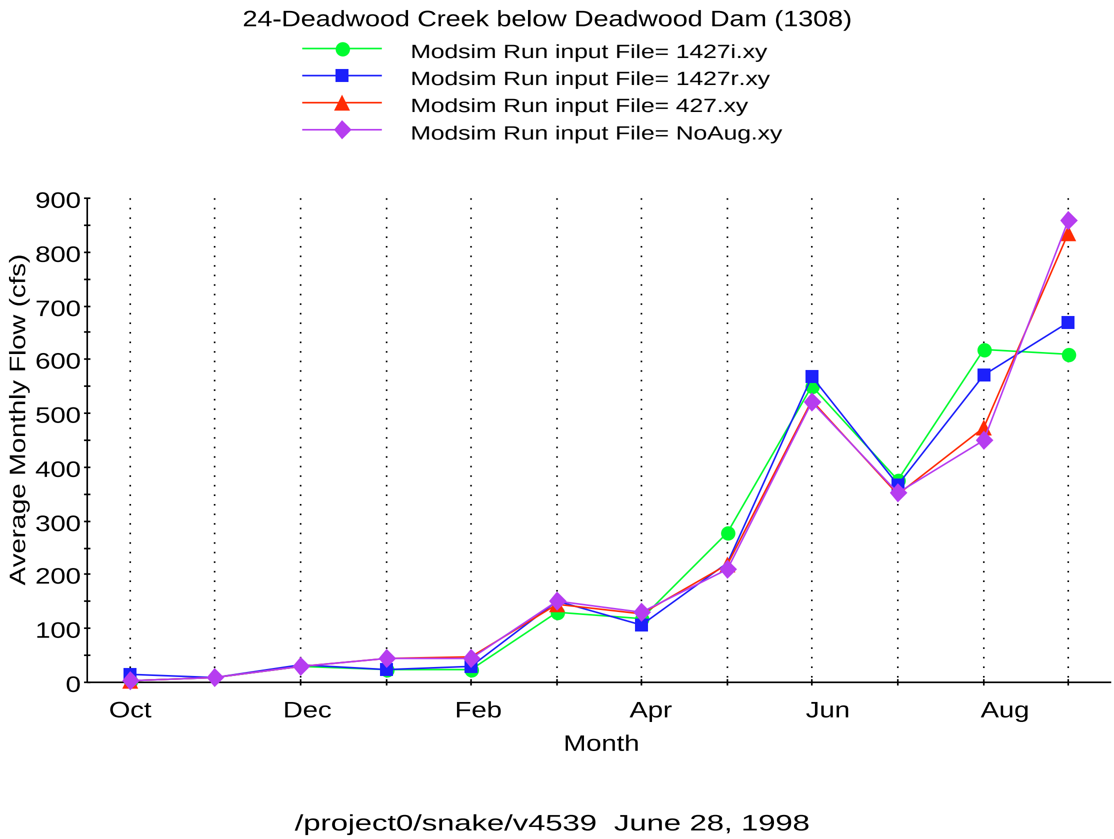
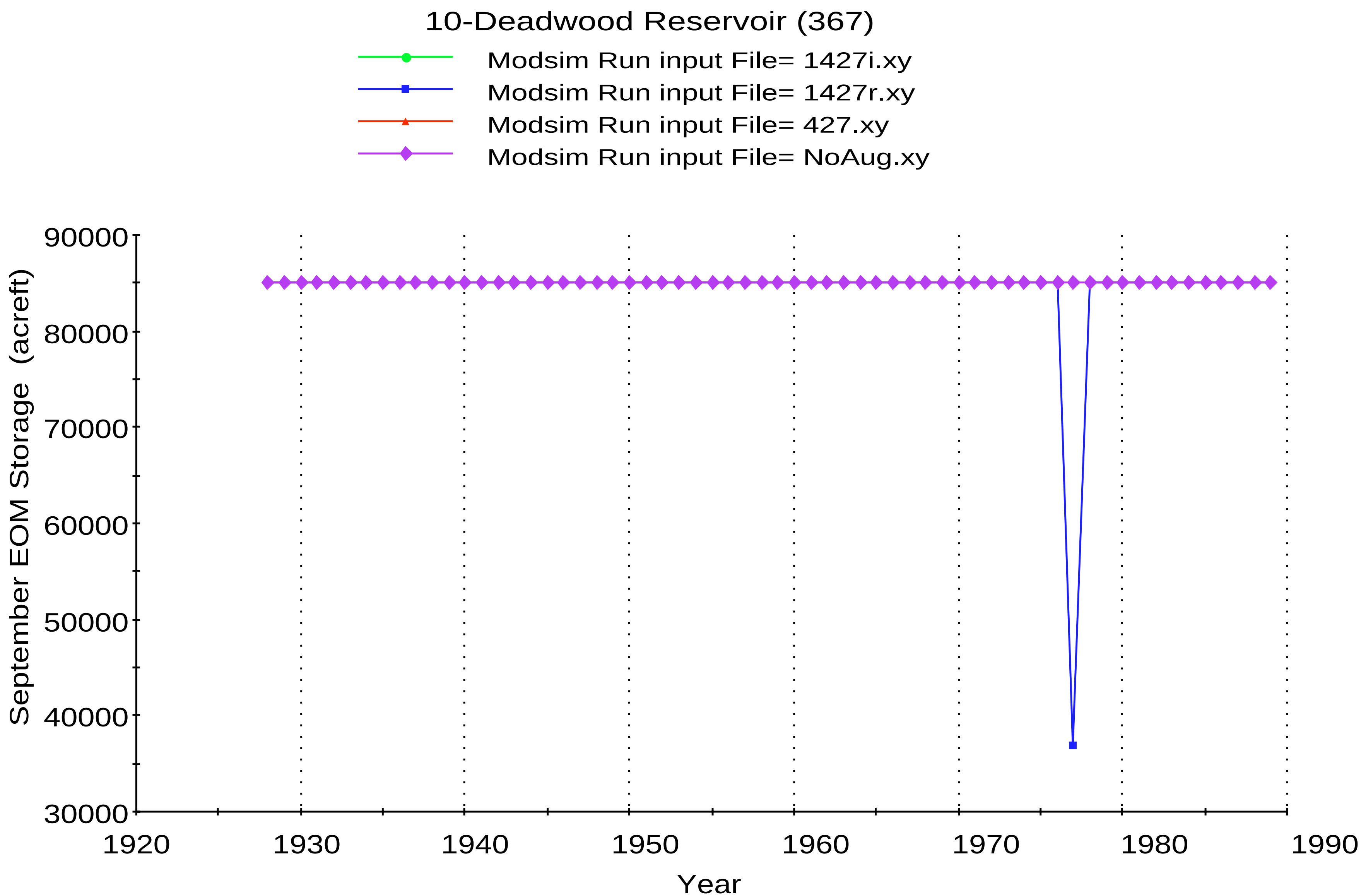
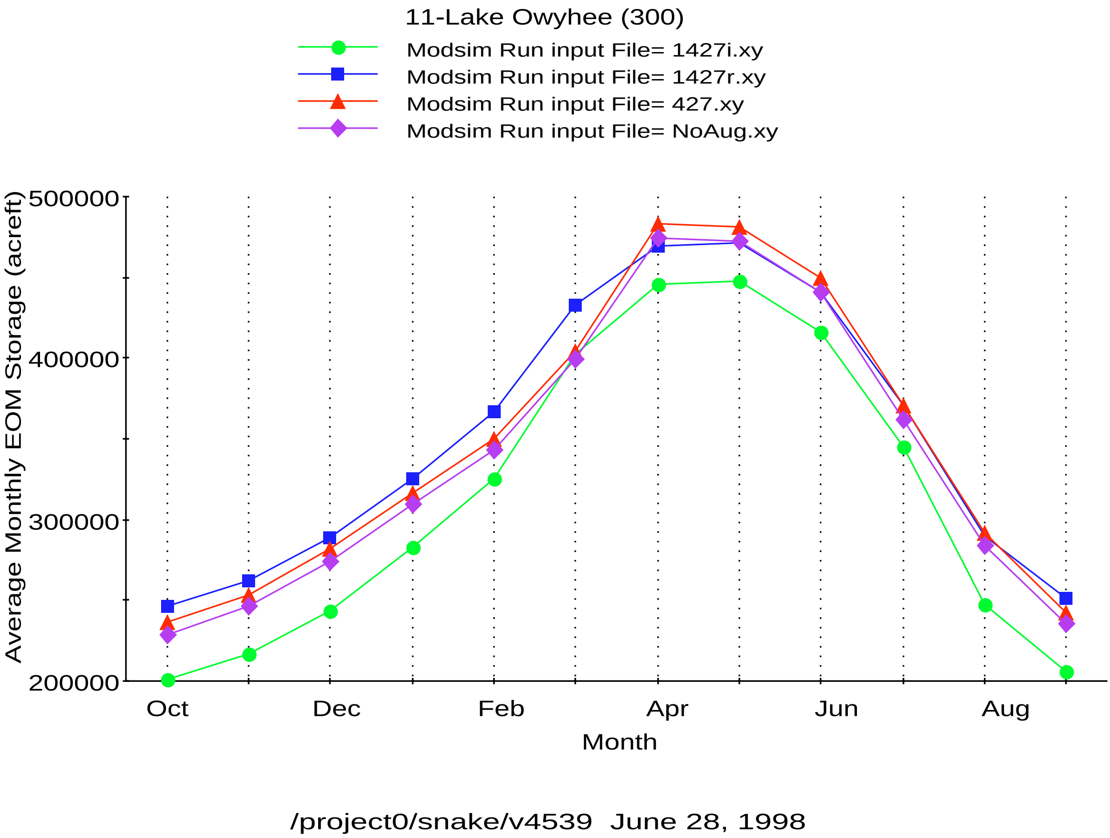


Figure 5-20 Deadwood Reservoir End of Season Content (1928-1989)



/project0/snake/v4539 June 28, 1998

Figure 5-21 Deadwood Reservoir Average End of Month Content and Average Monthly Release



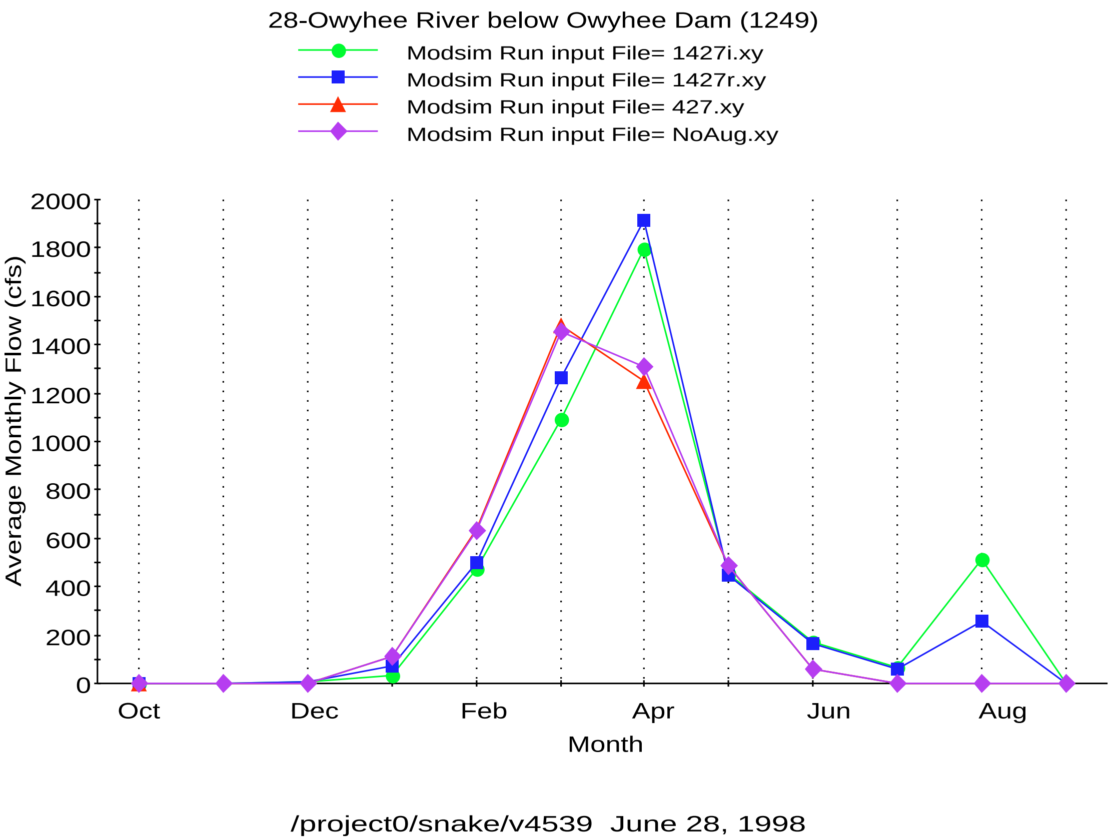


Figure 5-22 Lake Owyhee Average End of Month Content and Average Monthly Release (Owyhee River)

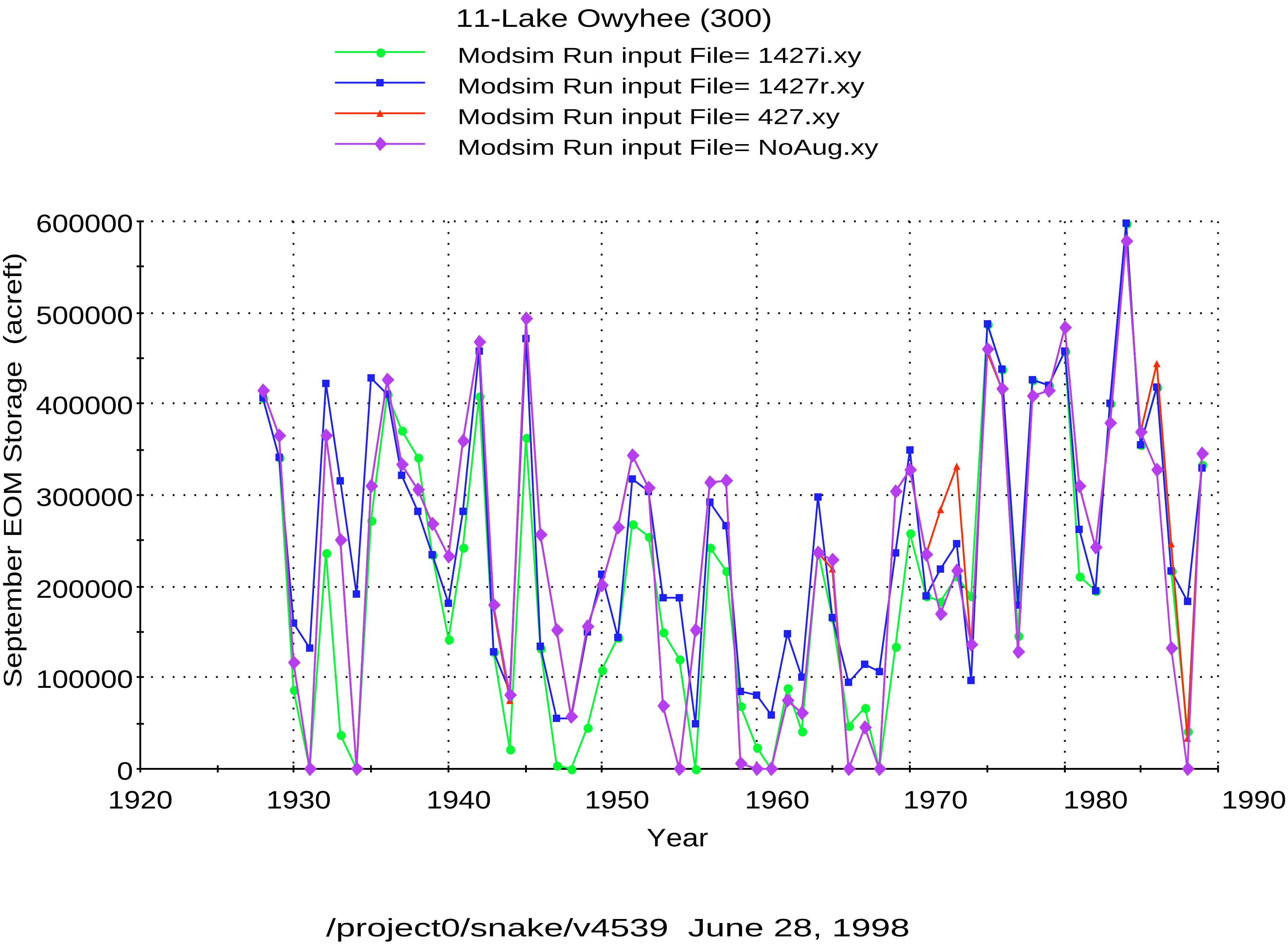


Figure 5-23 Lake Owyhee End of Season Content (1928-1989)

5.2.4.2 Boise River Basin

Table 5-11 Percent of Time Selected Operating Considerations Are Met in the Boise River Basin

Reservoir and Consideration	Base Case	No Augmentation	1427i	1427r
Anderson Ranch release				
600 cfs minimum (April-September)	77	77	77	76
300 cfs minimum (September-March)	78	77	77	77
Lucky Peak Lake release				
80 cfs minimum (November-February	80	80	72	85
150 cfs minimum (October-March)	78	81	71	85
240 cfs minimum (July-March)	81	81	76	84
1,500 cfs maximum at Glenwood Bridge (May-Sep)	75	75	50	48

5.2.4.3 Payette River Basin

Table 5-12 Percent of Time Selected Operating Considerations are Met in the Payette River Basin

Reservoir and Consideration	Base Case	No Augmentation	1427i	1427r
Cascade				
300,000 acre-foot minimum pool (all months)	95	95	70	100
Cascade release				
200 cfs minimum (all months)	100	100	100	95
Deadwood				
50,000 acre-foot minimum (all months)	100	100	100	99
Deadwood release				
50 cfs minimum (all months)	51	52	49	51

5.2.4.4 Owyhee River Basin

Table 5-13 Percent of Time Selected Operating Considerations Are Met in the Owyhee River Basin

Reservoir and Consideration	Base Case	No Augmentation	1427i	1427r
Lake Owyhee release				
10 cfs minimum (October-March)	15	15	10	10
100 cfs minimum (April-September)	14	14	31	28

5.3 Groundwater Modeling and Analysis

Preliminary MODSIM simulations of the 1427r scenario identified irrigation water shortages necessary to provide streamflow to meet the target flow augmentation goal. These shortages would require fallowing about 130,000 acres of lands currently surface-water irrigated in the eastern Snake River Plain. The locations of canal service areas associated with the shortages (fallowed lands) were chosen in the MODSIM simulations to be (1) the Twin Falls North Side and Milner Gooding Canals, (2) the Twin Falls South Side Canal, and (3) the Minidoka Irrigation District.

Elimination of irrigation diversions of about 490,000 acre-feet per year to the three areas was assumed to reduce aquifer recharge by about 205,000 acre-feet per year. For this analysis, it was assumed that of the eliminated diversions, 45 percent would have been consumptively used, 13 percent would have returned to the river as surface flows, and 42 percent would have percolated to recharge the aquifer. Shortages simulated with MODSIM and calculated reductions to recharge in the eastern SRPA for each of the three areas described above are listed in table 5-14.

Table 5-14 Modeled Irrigation Diversion Shortages and Groundwater Recharge Reductions

Zone	Canal Service Area	Irrigation Shortage (Acre-Feet per Month)	Recharge Reduction (Acre-Feet per Month)
1	Twin Falls and Northside/Milner-Gooding	39,411	16,553
2	Twin Falls Southside	951	399
3	Minidoka Irrigation District	446	187
	Total	40,800	17,100

The effect of reduced recharge in these areas on groundwater discharge to springs and groundwater levels was evaluated using unit response functions (Maddock and Lacher, 1992) in conjunction with a groundwater flow model of the eastern SRPA (Garabedian, 1992). Response functions were generated by applying a unit stress that represents reduced recharge to a single 16 square-mile cell in the groundwater model located within each of the three service areas. The response from the unit stress applied to each cell was manifested as a reduction in groundwater discharge to each cell that represented the Snake River between Blackfoot and King Hill in the groundwater model. These responses were normalized from a response to a unit stress from each of the canal service areas to the full amount of recharge reduction from all three service areas, aggregated for each of seven individual reaches, and converted into a percent of response for each reach in a separate computer program. Reaches and percent responses to the recharge reductions are shown in table 5-15.

Table 5-15 Response to Reduced Groundwater Recharge (Percent)

River Reach	King Hill-Hagerman	Hagerman-Buhl	Buhl-Kimberly	Kimberly-Milner	Milner-Minidoka	Minidoka-Neeley	Neeley-Blackfoot
Percent response	5	15	41	10	15	7	7

Although reductions in groundwater discharge would be expected to vary somewhat seasonally, reductions were simulated as a constant that was applied to each month of the year to simplify the analysis. Reductions in groundwater discharge for each reach were represented in the final MODSIM simulation of the 1427r scenario by setting a demand of 17,000 acre-feet per month multiplied by the percentages listed in table 5-15.

Groundwater level declines in the eastern SRPA associated with the reduction in recharge described above were evaluated with response functions in a fashion similar to that described above for groundwater discharge to the Snake River. Declines were estimated at model cells that were 8-10 miles down the hydraulic gradient from the point where the reduction in recharge was applied. Water level declines after 50 years of simulation are summarized in the table 5-16.

Table 5-16 Project Water Groundwater Decline After 50 Years

Canal Service Area	Groundwater Decline (Feet)
Twin Falls North Side/Milner Gooding	46
Twin Falls South Side	44
Minidoka Irrigation District	28

The presence or absence of irrigation by highlift pumping from the Snake River between Twin Falls and Murphy was assumed to have no significant effect on groundwater. Those operations were assumed to deliver an amount of water close to crop consumptive use requirements. Thus, a reduction of irrigation in this area would have no effect on groundwater.

Changes in irrigation in the Salmon, Grande Ronde, and Owyhee River basins and in Wyoming upstream from Palisades Reservoir would not significantly affect the overall basin water budget. Reduced irrigation in these areas would reduce groundwater recharge and affect groundwater storage and dynamics locally. Although these impacts could be locally significant and could warrant further investigation, groundwater yield in these areas are minor relative to the overall basin water budget and was not modeled for this analysis.

Reallocation of reservoir storage in the Boise and Payette River systems was considered to affect groundwater conditions and groundwater and surface water relations in these river basins. As described for the eastern Snake River Plain, storage reallocation would result in less water diverted to irrigate crops. Hence, less groundwater recharge and less groundwater discharge to streams were assumed to occur. Irrigation shortages that would result from reallocation of reservoir storage to meet target surface water yields from the Boise and Payette River basins were identified in preliminary MODSIM runs. Recharge to the underlying aquifer in these basins was assumed to be 50 percent of the irrigation shortages. All of this recharge was assumed to return to the rivers as groundwater discharge. The returns were lagged over 3 months with 4/7ths returning in the same month that the shortage was simulated, 2/7ths in the next month, and 1/7th in the last month. The returns obtained by this method were applied to the MODSIM model as an incremental demand or river loss at specified locations where local gains were represented in the Base Case.

Groundwater recharge from irrigation has historically resulted in a significant rise in groundwater levels in the Boise River basin and likely contributes to high groundwater levels in the Payette River basin. Under the 1427r scenario reduced recharge likely would lead to groundwater level declines in these basins. However, magnitude of anticipated declines was not quantified.

6 Economic Analyses

6.1 Introduction

This chapter discusses existing economic conditions, the methodology used for the economic analysis, and the projected economic effects of the flow augmentation scenarios. The major sections include:

- Agricultural Economics
- Hydropower Economics
- Recreation Economics
- Regional Economics

The economic analyses of flow augmentation scenarios measures impacts from two perspectives: (1) the Federal or national view considers the net effects to the nation and (2) the regional analysis identifies economic gains and losses to specific functional economic regions in the Snake River basin. In addition to the economic analyses, the social analysis presented in chapter 8 discusses how selected communities and groups within the regions would be affected by the scenarios.

The first perspective identifies those gains or losses at the national level. Economic gains or losses achieved by one region when offset in another region do not represent a change in the national economy. Conversely, a scenario showing less water available to irrigation, would have the potential to reduce farm income which would result in a negative effect to the national economy. Estimates of changes in the national economic value are included in the Environmental Consequences sections of this chapter, under irrigation, hydropower, and recreation.

The second perspective presents the economic consequences of the scenarios on sales, employment, and income. Regional impacts represent the change in the economy of a community or region. For example, a change in the water supply to irrigation, in addition to the direct impact to irrigated farming, may also affect those industries or sectors supplying inputs to irrigated farming located within the particular region. Regional impacts are commonly referred to as secondary, indirect, or multiplier effects, but also include the direct affect in the region being analyzed.

Impacts on agricultural and regional economics are shown by economic regions that best fit that analysis; these regions are explained within the appropriate sections. Agricultural effects to the nation are based on five irrigated agricultural regions (see figure 6-1). In contrast, regional impacts were developed by preparing a regional input-output model for four regions in the Snake River basin. The four regions are shown in figure 6-2. The regional impact analysis, including methodology and results, is presented in section 6.5 of this chapter.

Fiscal impacts, potential impacts to the receipts and expenditures of political jurisdictions, were briefly examined and are discussed but not estimated in attachment E at the end of this report.

No attempt was made to disaggregate or separately analyze the economies of the two Indian Reservations located within the area of analysis. If a large scale flow augmentation program were to be implemented, a separate analysis of tribal economic impacts would be necessary.

6.2 Agricultural Economics And Land Use

6.2.1 Affected Environment

This section describes the affected environment with respect to agricultural production in the Snake River basin. For analysis, the affected agricultural area is divided into five regions–the Northeast, Southeast, South-Central, Southwest, and Grande Ronde regions (see figure 6-1). This discussion of agricultural economic and land use focuses on the following key agricultural indicators that were used to assess potential impacts of the flow augmentation scenarios:

- Irrigated and harvested acres
- Cropping patterns and the value of agricultural production
- Cost of production and net income
- Agricultural water use and water pricing
- Farm structure and characteristics

The Base Case scenario is the existing condition. Crop acres, prices, yields, and production costs are described. Water supplies are based on the results of the hydrologic model of a simulated 62-year sequence of delivery and consumptive use given the 1990s level of agricultural water demands.

6.2.1.1 Sources of Information

Agricultural economics and land-use data from 1920 to 1995 were collected to develop an historical perspective and to describe recent trends and conditions in agricultural production and land use. The primary data sources for the discussions are:

- Idaho Crop Production Reports. These reports are published annually and are available from the 1930s to the present for some counties. They provide detailed data on harvested acreage, yield, and value of production for the principal crops produced in each county. These data are collected from county records and visual surveys. The reports record all harvested acreage (irrigated and dry land).

- U.S. Department of Commerce Census of Agriculture. These agricultural census reports provide information by county. The data include the number and size of farms, extent of farmlands, cropland acreage, irrigated acreage, types of farm ownership, market value of production, production expenses, and acreage of principal crops. The Census of Agriculture is a legally required report that is sent to each farmer in an area. The data were collected in 1964, 1969, 1978, 1987, and 1992.

- University of Idaho Cooperative Extension Service (CES) Crop Budgets. The CES has developed budgets for representative crops in many counties and regions in Idaho. These budgets can be used by farmers as guides for making production decisions and determining potential returns. The budgets are based on typical production practices for the area and are detailed and documented.

- Bureau of Reclamation AGRIMET Information Service. This service provides estimates of daily, monthly, and average annual crop consumptive use of water and precipitation by region.

6.2.1.2 Regions

The five regions which cover 31 counties in Idaho, 4 counties (Baker, Union, Wallowa, and Malheur) in Oregon, 2 counties (Lincoln and Teton) in Wyoming, and 1 county (Elko) in Nevada. Figure 6-1 shows the five regions and table 6-1 summarizes the counties included in each region.

Table 6-1 Economic Regions and County Groupings

Economic Region	Counties Included
Northeast	Clark, Custer, Fremont, Jefferson, Lemhi, Madison, and Teton in Idaho. Teton in Wyoming.
Southeast	Bannock, Bingham, Bonneville, Butte, Caribou, and Power in Idaho. Lincoln in Wyoming.
South-Central	Blaine, Camas, Cassia, Gooding, Jerome, Lincoln, Minidoka, and Twin Falls in Idaho.
Southwest	Ada, Adams, Boise, Canyon, Elmore, Gem, Owyhee, Payette, Valley, and Washington in Idaho. Malheur in Oregon. Elko in Nevada
Grande Ronde	Baker, Union, and Wallowa in Oregon.

6.2.1.3 Historical Perspective

Idaho has been predominantly rural from the time it was a territory until the 1960s and 1970s. The economy has been based on agriculture, timber, and mining, with agriculture providing the stable base. Although manufacturing, services, and other sectors began challenging the lead role of agriculture in the 1970s, Idaho remains an agricultural state. Eastern Oregon is also rural with an economy based primarily on agriculture, including livestock, food processing, and timber.

Agriculture, and the related infrastructure, is heavily influenced by the irrigation of land along the crescent of the Snake River and its tributaries in southern Idaho and southeast Oregon. Nearly two-thirds of Idaho’s farm land is located in this crescent. Irrigation is generally essential to intensive agriculture in this area due to the high summer temperatures and the lack of rainfall during much of the growing season.

The discovery of gold in the 1860s spurred the irrigation of the Boise Valley to provide food for miners and those employed in supporting businesses. By 1865, most of the river bottom land in the Boise Valley was under irrigation. Mining booms in other parts of southern Idaho led to similar developments of irrigated agriculture.

Irrigated agriculture in Idaho was initiated as private developments by diversion of the natural flow of surface waters. When this resource was fully appropriated, further irrigation required development of storage and delivery systems. All significant storage for irrigation in Idaho and eastern Oregon was developed through Federal projects. Irrigation water from federally developed storage is controlled by contracts with the Federal Government. Private irrigation was also developed based on groundwater pumping, including supplementing natural flows with groundwater. Irrigated acres in Idaho can be traced from about 217,000 in 1890 to about 3,260,000 acres as reported in the 1992 Census of Agriculture.

6.2.1.4 Crop Categories

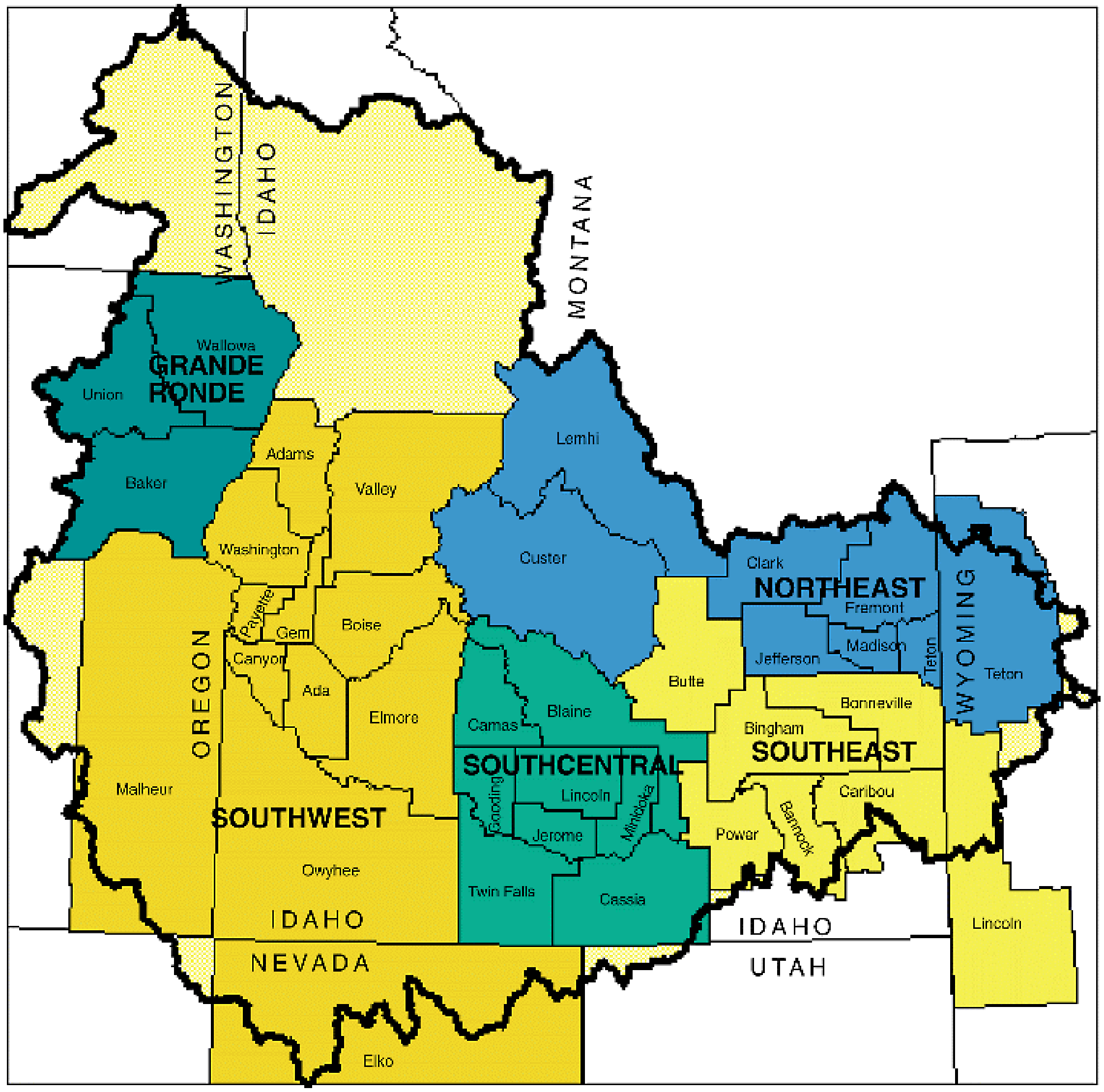
Data on crop acreage, yield, price, and production cost for the basin were collected and grouped into crop categories as shown in table 6-2.

Table 6-2 Crop Categories

Crop Category	Main Crops
Alfalfa	Alfalfa hay, other hay
Pasture	Irrigated pasture
Potatoes	Chipping potatoes, russet burbank potatoes
Wheat	Soft white spring wheat, soft white winter wheat, hard red spring wheat
Barley	Barley
Corn	Field corn, silage corn
Beans	Dry beans
Oats	Oats
Sugar Beets	Sugar beets
Specialty Crops	Onions, peppermint, spearmint, sweet corn, vegetable seed
Orchards	Apples, cherries, apricots, peaches, grapes

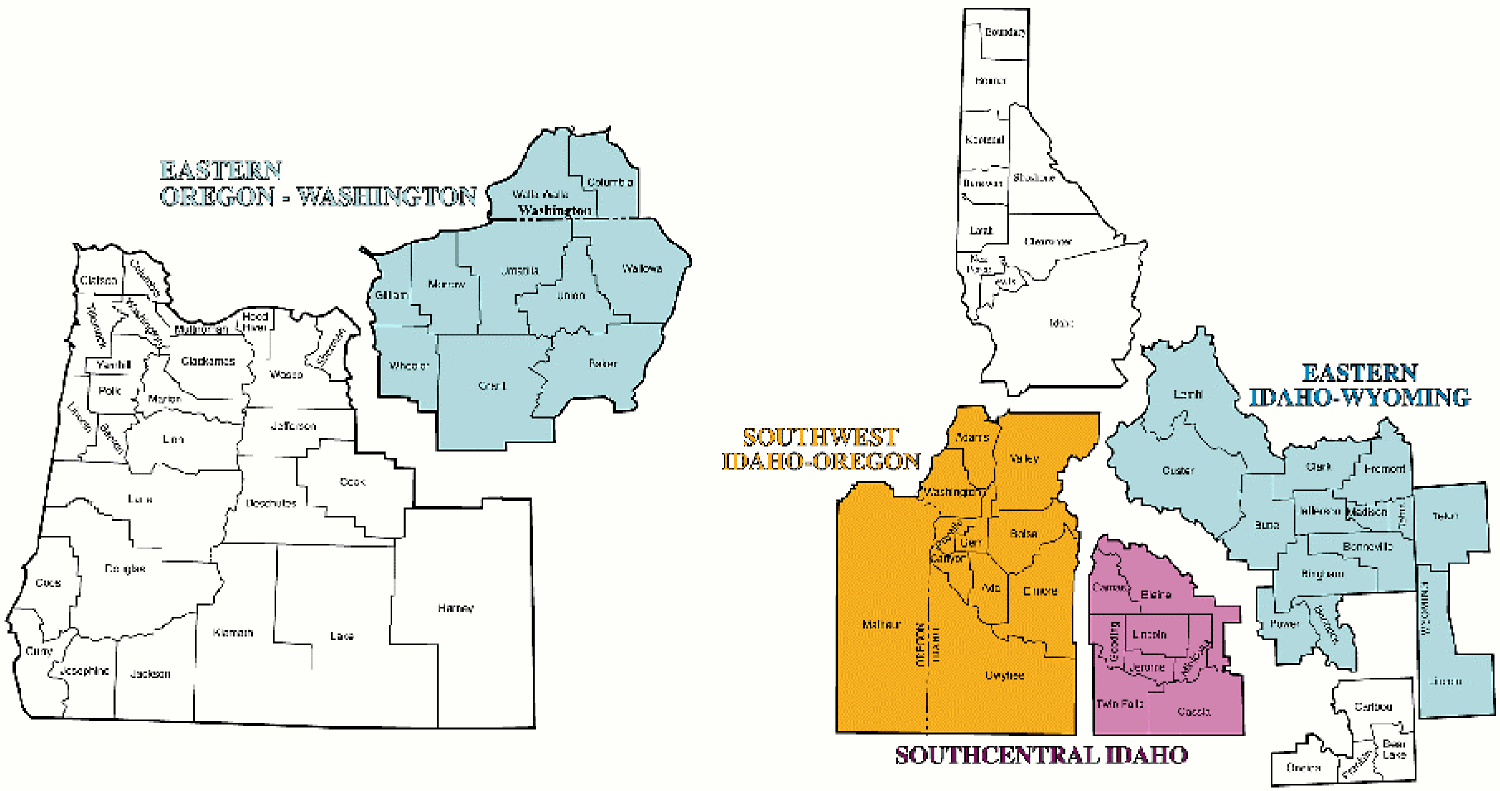
6.2.1.5 Agricultural Water Use

Table 6-3 presents the average annual consumptive use of irrigation water for the Snake River basin between 1993 and 1996 and is arranged by crops for the five economic regions. Total water use in a region is determined by irrigated acreage and the crop mix. Water usage was greatest in the South-Central region (more than 2 MAF), followed by the Southwest region (more than 1.6 MAF). The Northeast and Southeast region each used more than 1.2 MAF of water per year. Total average annual consumptive water use for all five regions was nearly 6.7 MAF.



Irrigated Agriculture Economic Regions Within the Snake River Basin	
Economic Region	Counties
Northeast	Clark, Custer, Fremont, Jefferson, Lemhi, Madison, and Teton in Idaho; Teton in Wyoming.
Southeast	Bannock, Bingham, Bonneville, Butte, Caribou, and Power in Idaho; Lincoln in Wyoming.
South-Central	Blaine, Camas, Cassia, Gooding, Jerome, Lincoln, Minidoka, and Twin Falls in Idaho.
Southwest	Ada, Adams, Boise, Canyon, Elmore, Gem, Owyhee, Payette, Valley, and Washington in Idaho; Malheur in Oregon; Elko in Nevada.
Grande Ronde	Baker, Union, and Wallowa in Oregon.

FIGURE 6-1



MAF - Functional Economic Impact Regions

Figure 6-2

Table 6-3 Average Annual Consumptive Use of Irrigation Water for 1993-1996 (Acre-Feet)						
Crop Category	Northeast	Southeast	South-Central	Southwest	Grande Ronde	Total
Alfalfa	456,000	331,000	601,000	466,000	283,000	2,137,000
Pasture	246,000	134,000	269,000	426,000	188,000	1,263,000
Potatoes	161,000	228,000	182,000	54,000	0	625,000
Wheat	144,000	365,000	332,000	208,000	36,000	1,085,000
Barley	210,000	186,000	208,000	64,000	18,000	686,000
Corn-grain	0	0	26,000	64,000	0	90,000
Corn-silage	5,000	2,000	50,000	55,000	0	112,000
Dry Beans	0	0	115,000	37,000	0	152,000
Oats	7,000	9,000	7,000	8,000	1,000	32,000
Sugar Beets	0	36,000	230,000	139,000	0	405,000
Specialty Crops	0	0	0	87,000	0	87,000
Orchards	0	0	0	14,000	1,000	15,000
Total	1,229,000	1,291,000	2,020,000	1,622,000	527,000	6,689,000
Source: AGRIMET Information Service. AGRIMET provides total evapotranspiration use by crops. The numbers reported in this table are the total minus the effective precipitation.						

6.2.1.6 Irrigated And Dry Land Crop Acreage

Table 6-4 shows irrigated and dry land crop acreage by regions from 1988 through 1995, excluding pasture.

Table 6-4 Irrigated and Dry Land Acreage (1988-1995)[1]									
Economic Region	1988	1989	1990	1991	1992	1993	1994	1995	Average
Northeast									
Irrigated (acres)	580,000	607,000	604,000	637,000	651,000	629,000	635,000	623,000	621,000
Dry land (acres)	117,000	138,000	129,000	123,000	120,000	119,000	101,000	103,000	119,000
Percent irrigated	83	81	82	84	84	84	86	86	84
Southeast									
Irrigated (acres)	736,000	797,000	798,000	837,000	820,000	813,000	813,000	825,000	805,000
Dry land (acres)	411,000	421,000	375,000	305,000	296,000	340,000	350,000	357,000	357,000
Percent irrigated	64	65	68	73	73	71	70	70	69
South-Central									
Irrigated (acres)	824,000	921,000	964,000	928,000	944,000	990,000	1,003,000	1,006,000	947,000
Dry land (acres)	86,000	82,000	84,000	83,000	63,000	91,000	82,000	82,000	82,000
Percent irrigated	91	92	92	92	94	92	92	92	92
Southwest									
Irrigated (acres)	529,000	597,000	585,000	583,000	558,000	621,000	567,000	546,000	573,000
Dry land (acres)	36,000	46,000	41,000	37,000	30,000	48,000	34,000	36,000	39,000
Percent irrigated	94	93	93	94	95	93	94	94	94
Grande Ronde									
Irrigated (acres)	**Not Available**								
Dry land (acres)									
Percent irrigated									
Source: Idaho, Wyoming, and Oregon Agricultural Statistics.									
[1] Does not include irrigated and dry land pasture.									

Table 6-4 indicates that the crop acreages and the percent irrigated remained fairly stable in each of the five regions over the 1988-1995 period. Slightly lower irrigated acreage during the first part of the period is probably the result of drought during between 1987 and 1992. Irrigation acreage accounts for a considerably higher percentage of agriculture land in the South-Central and Southwest regions than in the other three regions.

6.2.1.7 Cropping Patterns And Production Value

The cropping pattern is the share of acres planted to individual crops or categories of crops within a region. Table 6-5 summarizes the average irrigated-harvested acres, and table 6-6 summarizes gross production value between 1988 and 1995 by crop categories for the five economic regions. Estimates in these tables include irrigated pasture data from the Census of Agriculture.

Table 6-5 Average Irrigated-Harvested Acres (1988-1995)						
Crop Category	Northeast	Southeast	South-Central	Southwest	Grande Ronde	Total
Alfalfa	197,000	137,000	227,000	154,000	94,000	809,000
Pasture[1]	106,000	55,000	102,000	141,000	62,000	466,000
Potatoes	109,000	149,000	102,000	29,000	0	389,000
Wheat	105,000	254,000	224,000	129,000	23,000	735,000
Barley	144,000	121,000	136,000	44,000	12,000	457,000
Corn-grain	0	0	14,000	35,000	0	49,000
Corn-silage	3,000	1,000	28,000	30,000	0	62,000
Dry edible beans	0	0	103,000	28,000	0	131,000
Oats	5,000	6,000	4,000	6,000	0	21,000
Sugar beets	0	19,000	109,000	63,000	0	191,000
Specialty crops	0	0	0	46,000	0	46,000
Orchards	0	0	0	8,000	0	8,000
Total	669,000	742,000	1,049,000	713,000	191,000	3,364,000

Source: Idaho, Wyoming, and Oregon Agricultural Statistics; Census of Agriculture for 1987 and 1992.
[1]Irrigated pasture estimates from Census of Agriculture.

Table 6-6 Gross Production Value for 1988-1995 (Thousand Dollars)						
Crop Category	Northeast	Southeast	South-Central	Southwest	Grande Ronde	Total
Alfalfa	65,878	64,243	88,971	64,399	39,197	322,688
Pasture[1]	28,759	17,493	45,871	89,056	40,682	221,861
Potatoes	159,081	226,719	200,850	67,329	0	653,979
Wheat	30,813	85,017	78,532	46,896	8,220	249,478
Barley	29,703	28,787	32,276	9,968	2,773	103,507
Corn-grain	0	77	4,441	11,327	0	15,845
Corn-silage	1,329	1,056	14,211	16,645	0	33,241
Dry Edible Beans	0	0	43,816	12,685	0	56,501
Oats	618	743	539	726	61	2,687
Sugar Beets	0	19,108	102,089	71,097	0	192,294
Special Crops	0	0	0	135,392	0	135,392
Orchards	0	0	808	30,412	1,866	33,086
Total	316,181	443,243	612,404	555,932	92,799	2,020,529

Source: Idaho, Wyoming, and Oregon Agricultural Statistics; Census of Agriculture for 1987 and 1992.
[1]Irrigated pasture acreage estimates are from Census of Agriculture. Value per acre is estimated as the equivalent forage value of alfalfa hay/

There is considerable variation in cropping pattern and gross production value among the regions. On the basis of crop acreage, alfalfa is a major crop in all regions, as is pasture in all regions except the Southeast. Potatoes are a major crop in all regions except for the Southwest and the Grande Ronde, while wheat is a major crop in all but the Grande Ronde region. Sugar beets are found in the Southeast, South-Central, and Southwest regions while specialty crops and orchards are confined to the Southwest.

On the basis of gross crop production value, the Southeast, South-Central, and Southwest regions are the major producers. The crop with the greatest production value is potatoes followed by sugar beets; however, potato production is not found in the Grande Ronde region, and sugar beet production is a major source only in the South-Central and Southwest regions.

Alfalfa and pasture are the most important crops only in the Grande Ronde region. It should be recognized that in all regions, pasture, hay, and alfalfa are often marketed through livestock production. The complementary relationship between forage production and livestock enhances the total income.

6.2.1.8 Farm Structure

The number and size of farms and ownership patterns describe the general structure of agriculture within a region. Table 6-7 summarizes the number of farms, farm sizes, and farm ownership for the five regions for 1987 and 1992.

Table 6-7 Farm Structure for 1987 and 1992

Region/Year	Farms			Ownerships		
	Farms (Number)	Acres	Average Size (Acres)	Full Owner	Partnership	Tenant
Northeast						
1987	3,514	2,465,000	701	2,146	1,062	306
1992	3,321	2,289,000	689	1,939	1,048	334
Southeast						
1987	5,478	4,273,000	780	3,251	1,670	557
1992	4,856	4,101,000	844	2,861	1,532	463
South-Central						
1987	5,621	2,423,000	431	3,316	1,435	870
1992	5,133	2,324,000	453	2,923	1,432	778
Southwest						
1987	8,128	5,162,000	635	5,019	2,121	988
1992	7,663	5,068,000	661	4,688	2,127	848
Grande Ronde						
1987	1,843	2,038,000	1,106	1,108	564	171
1992	1,803	1,986,000	1,102	1,089	629	185

Sources: Census of Agriculture data for 1987 and 1992.

Between 1987 and 1992, the total number of acres in farms and the number of farms declined in all regions, due largely to urbanization and industrial use. Along with the decline in the number of farms, full ownerships declined in all regions, while partnerships tended to remain stable. Tenant farmers decreased in the Southeast, South-Central, and Southwest regions but increased in the other two regions.

6.2.1.9 Irrigation Methods and Land Value

The two primary irrigation methods used in the regions are surface gravity irrigation and sprinkler irrigation as shown on table 6-8.

Table 6-8 Method of Irrigation and Land Value

Region	Irrigated Acreage[1] (Acres)			Percentage of Irrigated Acreage		Average Land Value ($/Acre)
	Surface	Sprinkler	Total	Surface	Sprinkler	
Northeast	174,000	496,000	670,000	26	74	562
Southeast	193,000	550,000	743,000	26	74	578
South-Central	357,000	692,000	1,049,000	34	66	885
Southwest	392,000	320,000	712,000	55	45	598
Grande Ronde	106,000	86,000	192,000	55	45	382

[1]Includes irrigated pasture data from the Census of Agriculture.
Source: Census of Agriculture, 1994; Idaho Food and Agriculture, 1996.

Sprinkler irrigation dominates the Northeast, Southeast and South-Central regions while lands in the Southwest and Grande Ronde regions are about equally sprinkler and surface water irrigated. The average land value varies from $382 per acre in the Grande Ronde region to $885 per acre in South-Central region. The value of land is determined by location, the suitability for irrigation, and the ability to grow relatively high-value crops.

6.2.1.10 Agricultural Production Costs And Net Revenues

Net returns are determined by subtracting costs from revenue. Higher costs reduce farm profits, but some costs also represent farm expenditures in the regional economy. Table 6-9 presents farm income and production expenses for the five economic regions for 1987 and 1992.

From 1987 to 1992, the value of crop production increased in all regions and the value of livestock increased in all regions except the Grande Ronde. Other revenue decreased in all regions primarily due to decreased government payments. In total, farm income increased in all regions except the Grande Ronde where it remained about the same.

Total production costs increased in all regions. The only production costs which did not increase in all regions were fertilizer and chemical costs and livestock related costs. Fertilizer and chemical costs decreased in the Southwest region, remained stable in the Grande Ronde region, and increased substantially in the other three regions. Livestock related costs remained essentially unchanged in the Northeast and Grande Ronde regions, decreased in the Southwest, and rose substantially in the other two regions. Hired and contract labor increased substantially in all regions as did other costs.

The percent change in net cash return during the period from 1987 to 1992 was positive for four regions and ranged from about 39 percent increase for the Northeast region to a 3 percent increase in the Southwest; the Grande Ronde region suffered a 26 percent decrease in net cash return.

Table 6-9 Total Farm Income and Production Expenses for 1987 And 1992 (Million Dollars)										
Region/Year	Total Farm Income				Total Production Expenses					Net Cash Return
	Value of Crop Production	Value of Livestock	Other Revenue[1]	Total	Livestock Related	Fertilizer and Chemicals	Hired and Contract Labor	Other[2]	Total	
Northeast										
1987	144	136	17	297	57	29	26	119	231	66
1992	233	141	7	381	58	43	40	154	295	86
Southeast										
1987	267	169	43	479	69	55	42	192	358	121
1992	368	202	25	595	95	68	51	232	446	149
South-Central										
1987	323	393	33	749	207	56	68	239	570	179
1992	461	570	14	1,045	348	74	94	328	844	201
Southwest										
1987	323	564	18	905	355	77	82	217	731	174
1992	407	681	10	1,098	334	73	105	407	919	179
Grande Ronde										
1987	28	82	7	117	34	10	7	39	90	27
1992	32	81	2	115	32	10	9	44	95	20

Sources: Census of Agriculture, 1987 and 1992.

[1] Other revenue is in addition to the agriculture product value and included government payments, direct sales, custom work, and other farm services.

[2] Includes payment for family labor, management, returns to land and water, risk, and other uncounted costs of farming.

6.2.1.11 Aquaculture

Aquaculture is the growing and harvesting of fish for commercial sale and restocking. The Idaho aquaculture industry is the third largest animal product industry in the State. Sale of fresh-market and processed trout is by far the largest segment of the aquaculture industry. In 1991, Idaho produced an estimated 40 million pounds or about 65 percent of the Nation's processed trout. Annual value of production was estimated at $60 million at that time with the industry directly employing from 750-900 people.

Trout production requires a reliable source of cool, good-quality water. The natural spring flows in the Twin Falls/Buhl area (South-Central region) and the American Falls/Pocatello area (southeast region) are ideal to meet this need. IDWR estimates that about 40 percent of the spring flow in this reach of the Snake River is diverted for use in fish production. Very little of this water is used consumptively and most flows back into the Snake River. This industry relies on natural aquifer recharge and recharge from upstream irrigation diversions for its continued water supply.

6.2.2 Environmental Consequences

6.2.2.1 Introduction

This section describes the assumptions, methods, and results of the analysis of flow augmentation and is limited to the direct impacts on irrigation. Analysis of agricultural impacts is closely coordinated with hydrologic analysis because the direct cause of agricultural changes in this study are changes in water delivery. Details of this coordination are described in Methods and Assumptions below. Key measurement variables used to assess agricultural production impacts are: irrigated land use, crop water use, and value of irrigated production (gross revenue of products sold). Other economic measures such as net return, risk and financial effects, and land values are briefly discussed.

Results from the agricultural impacts analysis form an important part of the analysis of regional economic impacts. Changes in direct production in the agricultural sector affect many related sectors of the economy including livestock, food processing, materials and equipment sales, and trucking. Changes in regional income and employment that take account of all related sectors are described in the Regional Economics section. Social implications of changes in income and employment patterns are discussed in chapter 8.

6.2.2.2 Methods and Assumptions

The estimate of agricultural impacts is based on the water supply impacts that are described in chapter 5. As indicated in chapter 3, improvement in carriage system and onfarm efficiency do not provide additional water at the lower end of the basin. Therefore, this analysis assumes consumptive use of irrigation water must be reduced by fallowing some existing irrigated land.

6.2.2.2.1 Willing Seller Assumptions

The mechanism for obtaining water for flow augmentation has a substantial effect on agriculture. If water were reallocated from junior water right holders, shortages would be imposed on existing users according to water rights priorities. Lands and crops affected by water shortage would be largely determined by the kinds and location of land served by different water rights. Alternatively, if water were purchased from willing sellers, economic principles suggest that lower quality land and less profitable crops would be affected. In a willing-seller market, water would tend to be purchased in locations with crop patterns that cost the least, in terms of foregone crop revenue. This analysis assumes that water for flow augmentation is purchased from willing sellers.

6.2.2.2.2 Crop Reduction Methods

Three approaches to reducing crops with a reduced water supply were identified:

- Least-cost reduction of crops–crops are fallowed in order of increasing net revenue per acre.
- Modified proportional reduction of crops–high profit specialty crops, potatoes, sugarbeets, orchards, and vineyards would be relatively unaffected and cut backs would focus on grains, forages, and other field crops.
- Strict proportional reduction of crops–all crops, not just field crops, would be reduced proportionately to the reduced water supply.

After considering the issue, Reclamation adopted the modified proportional approach for analysis of both direct and regional effects. This does not discount the possibility that a specific flow augmentation program might result in other patterns of crop reduction. If flow augmentation in the range analyzed here were adopted, care would need to be exercised in implementation to assure that water purchases would not exacerbate economic impacts. To show the possible range of impacts on agriculture, all three crop reduction approaches were calculated to show direct effects on agriculture.

The decision to use the modified proportional reduction has been controversial. The economic theory view is that farmers would optimize their income in the event of a water shortage by reducing the lowest value crops first. However, discussions with potentially affected water users reveal that they have a very different view. Their view is that the uncertainties associated with a reduced water supply would cause farmers to avoid high profit crops which involve greater risk because they require late season water and cost more to establish and nurture. A failure of a high valued crop such as potatoes or beets would create more severe economic problems for a farmer than a failure of a lower valued crop. In addition, some low value crops such as small grains do not require a late season water supply. Water users suggest that these factors would lead irrigators to plant low risk, low profit crops and to avoid high risk crops such as potatoes and beets.

This method of reducing water usage in this analysis is of particular concern since significant volumes of storage space are included in the 1427i and 1427r scenarios. Stored water is typically diverted for use later in the irrigation season after natural flows recede. Some of the reservoir storage serves as "insurance" water supply in case of a drought. Many of the most valuable crops grown in Idaho, including potatoes, orchards, and other specialty crops, require a reliable supply of water during the late-summer irrigation season. Natural flow rights generally can be relied on to supply water throughout the spring and early summer. Water released from storage during the late summer and fall provides the insurance growers need to reduce the risk of planting high-valued, high-cost crops. Figure 6-3 shows the monthly consumptive use pattern of major crops in the South-Central region and illustrates the need for a reliable, late-season irrigation supply for some crops.

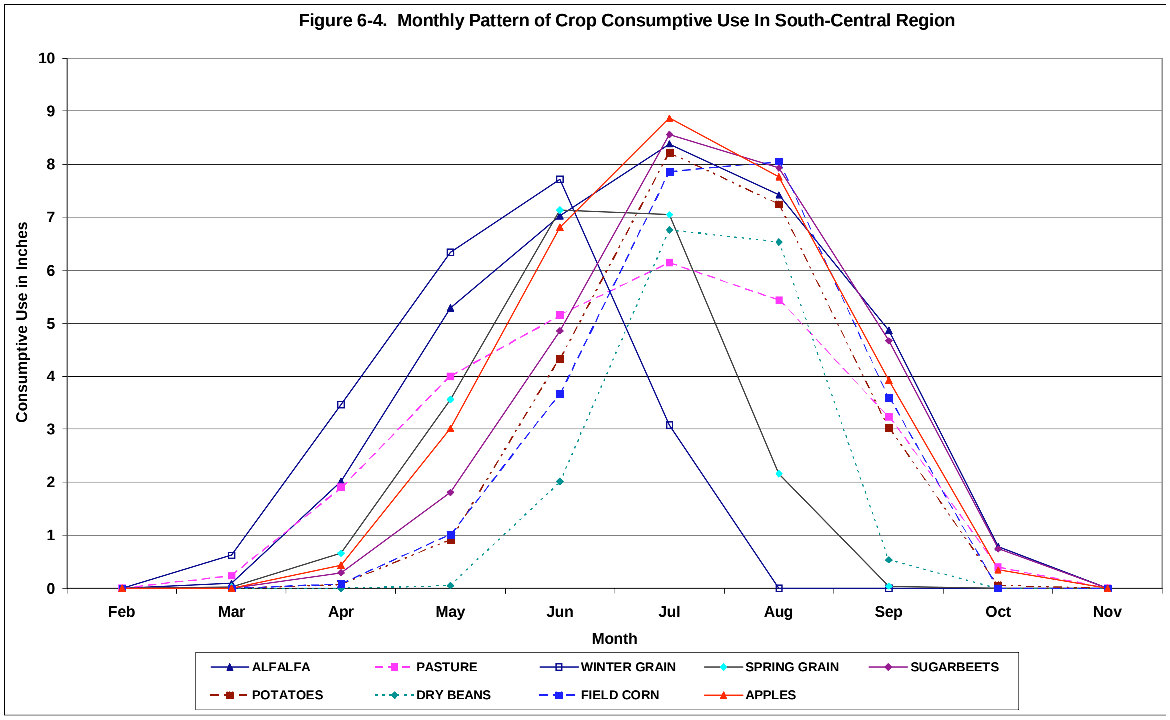


Figure 6-3 Monthly Pattern of Crop Consumptive Use in the South-Central Region

If a water acquisition program were implemented in a way that disproportionately reduces late-season water supply, the impact on crops requiring late-summer irrigation would be magnified and economic impacts, both direct and secondary, could be severe. Acquiring only storage rights would increase the likelihood of a late-summer water shortage and impose significant risk for crops requiring late-season irrigation. Because of the willing-seller assumption, the cost to implement such a program would also be extremely high. Rough estimates suggest that this type of acquisition program could have a direct impact on the value of irrigated production that could be almost twice as great as for the modified proportional approach.

6.2.2.2.3 Crop Consumptive Use and Estimated Crop Reduction

The number of acres taken out of production and the consumptive use changes associated with natural flow rights are summarized in chapter 5 (table 5-2). The hydrologic analysis also identifies irrigation shortages from storage supplies for average years, a dry year, and a wet year (see tables 5-11, 5-12, and 5-13) for four of the five economic regions (Reclamation storage water is not used in the Grande Ronde economic region). Irrigation shortages were then converted to consumptive use changes based on returnflow fraction used in MODSIM. For agricultural diversions, consumptive use comprises crop evapotranspiration of applied water (ETAW), canal and other water surface evaporation, and water consumptively used by stream-side and canal-side vegetation. For purposes of this analysis, it was assumed that these last two categories of water use do not change significantly among the scenarios, i.e., canals would still have water in them so evaporation and canal-side vegetation use would occur at the same rate under all scenarios.

After computing the estimated reduction in consumptive use, the portion of consumptive use that is met from applied irrigation water is calculated. Consumptive use is met by irrigation water (ETAW) and effective precipitation (EP). EP is defined as the amount of precipitation that is consumptively used by crops and was estimated using a procedure that accounts for monthly precipitation. Total consumptive use minus EP equals ETAW, which is the set of numbers (by crop and by region) used to allocate changes in crop acreage that would result from a reduced water supply.

The decrease in ETAW is allocated among the crops using the three crop reduction approaches described previously. Impacts by crop and region were summarized, showing changes in irrigated acres, gross revenue (i.e., value of production), and net revenue. Direct gross revenue changes to agriculture are used in the Regional Economic analysis to estimate total regional impacts on value of output, income, and employment.

Results are summarized for average water supply, defined as annual average over the 1928-1989 hydrologic record and for a dry-year, 1977.

6.2.2.2.4 Prices, Yields, and Costs

All estimates of prices, yields, and costs are based on recent information, and impacts are estimated on an annual basis for average and dry water supply conditions. Historically, crop yields have tended to rise and real prices fall; whether or not this trend will continue is speculative. No attempt was made to forecast future crop prices, yields, and production costs.

6.2.2.2.5 Irrigated Land and Water Use

Total impact on irrigated land and water use includes the lands idled by natural flow and storage purchases. The mix of crops idled will be determined by market forces, institutional restrictions, and physical conditions (including land productivity and district operational rules). Because the interaction of these factors is difficult to assess prior to more specific program information, ranges of results using three crop reduction approaches are presented.

6.2.2.2.7 Value of Irrigated Production

Value of production, also called gross revenue, is measured as the total production of an irrigated crop multiplied by its market value. Reductions in the value of production provide an estimate of the total direct loss in economic activity resulting from the water acquisition program. Value per acre for irrigated pasture is estimated using the equivalent forage value of alfalfa hay.

6.2.2.2.8 Other Direct Economic Effects

Because the water acquisition program is assumed to rely on willing sellers, direct financial impacts such as changes in net returns, land value, or risk would be compensated–water users would not agree to sell water unless they believed they were being fully compensated. Economic impacts on farm workers and others who rely on the farm economy are estimated and discussed in the Regional Economics section of this chapter and the Environmental Justice section of chapter 8.

One category of growers potentially harmed financially are tenants. If the owner of land with a water allocation decided to sell some or all of that water, a tenant leasing the land may not receive compensation for the lost net return.

6.2.2.3 No Augmentation Scenario

The No Augmentation scenario would return river/reservoir operations to the pre-1991 conditions. The MODSIM results estimate no material difference in agricultural water supply from the Base Case. Consequently, it was assumed that there would be no change in agricultural economics and no economic analysis was made of the No Augmentation scenario.

6.2.2.4 1427i Scenario

Key features of this scenario include: (1) acquisition of natural flow rights serving a total of 221,500 acres of agricultural lands in the basin; (2) substantial change in reservoir operations to increase average annual basin outflow; and (3) acquisition of additional water from Reclamation storage to achieve the 1427i flow augmentation goal. The regional distribution of lands irrigated by natural flow purchases for this analysis is: 101,500 acres in the northeast and southeast regions combined, 34,000 acres in the south-central region, 49,000 acres in the southwest region, and 37,000 acres in the Grande Ronde region.

Impact estimates were summarized to reflect the modified proportional approach. Changes in regional irrigation water use, measured as a reduction in crop consumptive use of applied water, are shown in table 6-10. These changes were interpreted as net irrigation water use changes on lands served by both natural flow and storage rights. Average reduction in total crop consumptive use of applied water was estimated to be about 346,000 acre-feet per year.

Table 6-10 Average Reduction in Crop Consumptive Use of Irrigation Water by Economic Region for the 1427i Scenario (Acre-Feet)

Northeast	Southeast	South-Central	Southwest	Grande Ronde	Total
119,250	4,789	85,598	114,463	21,680	345,790

The total decrease in irrigated acreage using the modified proportional approach is estimated at 243,000 acres. The mix of crops idled would be determined by market forces, institutional restrictions, and physical conditions (including land productivity and district operational rules). Table 6-11 summarizes the range of impacts on irrigated acres estimated using the three crop reduction approaches for average water years and dry years. The different crop reduction approaches have similar estimates of total land taken out of production which range from 243,000 to 249,000 acres for an average water supply year and over 375,000 acres in a low water supply year. The three estimation methods produced virtually identical results. On average, about 7.5 percent of irrigated land in the regions would be idled; however, the effects in the southeast region, both in actual acres and percentage, would be insignificant. Because of the assumed pattern of water acquisition used for analysis, the percentage of affected land within the economic regions ranges from less than 1 percent in the southeast region to about 20 percent in the Grande Ronde region. This represents a significant change in land use within the Snake River basin.

Table 6-11 Change in Irrigated Acres by Economic Region 1427i Scenario Compared to Base Case Scenario (Thousand Acres)						
Item	Northeast	Southeast	South-Central	Southwest	Grande Ronde	Total[1]
Base Case	670	743	1,049	712	192	3,366
Average Water Supply Year						
Least Cost	-104	-3	-41	-64	-37	-249
Modified Proportional	-103	-2	-42	-58	-37	-243
Strict Proportional	-104	-3	-43	-60	-37	-247
Low Water Supply Year						
Least Cost	-115	-21	-87	-117	-37	-378
Modified Proportional	-112	-18	-108	-101	-37	-376
Strict Proportional	-113	-18	-107	-103	-37	-379
[1]Numbers may not add do to rounding.						

The information provided in table 6-11 is displayed in graphic form in figure 6-4.

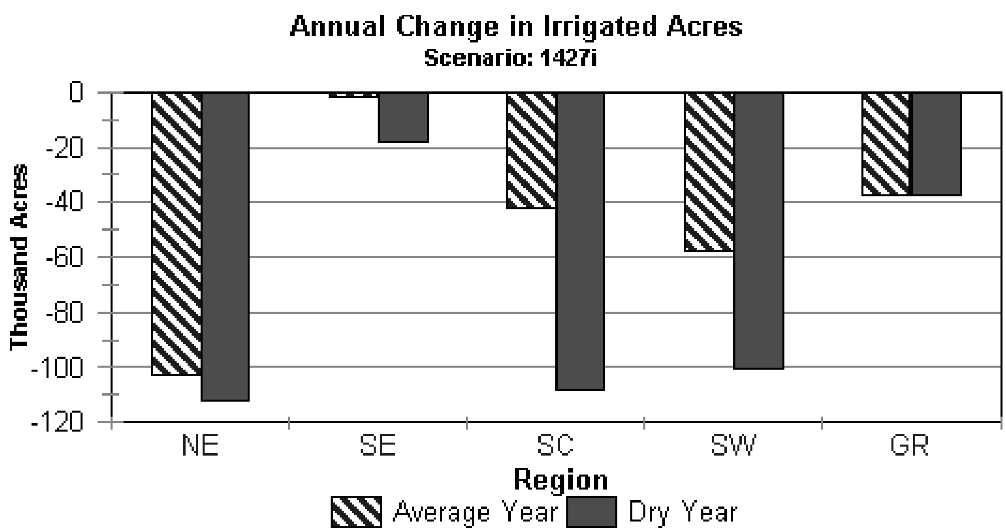


Figure 6-4 Annual Change in Irrigated Acreage Under the 1427i Scenario

Value of production, or gross revenue, was measured as the total production of an irrigated crop multiplied by its market value. Changes in value of production provided an estimate of the total direct loss in economic activity resulting from the water acquisition program. Secondary changes in economic activity, including those potentially induced by spending money received for selling water, were estimated in the Regional Economics section. Table 6-12 summarizes the range of direct impacts on value of production by region and type of water supply year.

Table 6-12 Change in Value of Irrigated Production by Economic Region–1427i Scenario Compared to Base Case Scenario (Thousand Dollars)						
Item	Northeast	Southeast	South-Central	Southwest	Grande Ronde	Total
Base Case	316,182	442,619	612,404	555,931	92,798	2,019,934
Average Water Supply Year						
Least Cost	-30524	-800	-18,032	-17,574	-12,296	-79,228
Modified Proportional	-30,548	-777	-15,568	-25,700	-17,610	-90,204
Strict Proportional	-31,227	-1,623	-25,308	-52,346	-17,610	-128,113
Low Water Supply Year						
Least Cost	-32,739	-5,012	-37,045	-40,069	-12,296	-127,160
Modified Proportional	-33,036	-6,117	-39,634	-44,805	-17,610	-141,202
Strict Proportional	-35,716	-10,948	-62,580	-85,476	-17,610	-212,330

The three crop reduction approaches produce substantially different estimates of impact on the value of production in some regions. The type of crops differs more in the value of production per acre than in the amount of water use per acre, so different mixes of crops idled result in larger variations in gross revenue. For an average water supply year, the reduction in gross revenue would range from $80 million to more than $128 million, depending on how the mix of crops was estimated. Impacts could be even greater for a crop mix that requires late-season irrigation. In the low water supply year, gross revenue was estimated to decline by $127 to $212 million per year relative to the base case scenario.

For the northeast and the Grande Ronde regions, there is virtually no difference in the estimated value of production among the three methods used and there is essentially no difference between average years and dry years.

Figure 6-5 displays the average annual impacts on value of production by region using the modified proportional method of crop reduction.

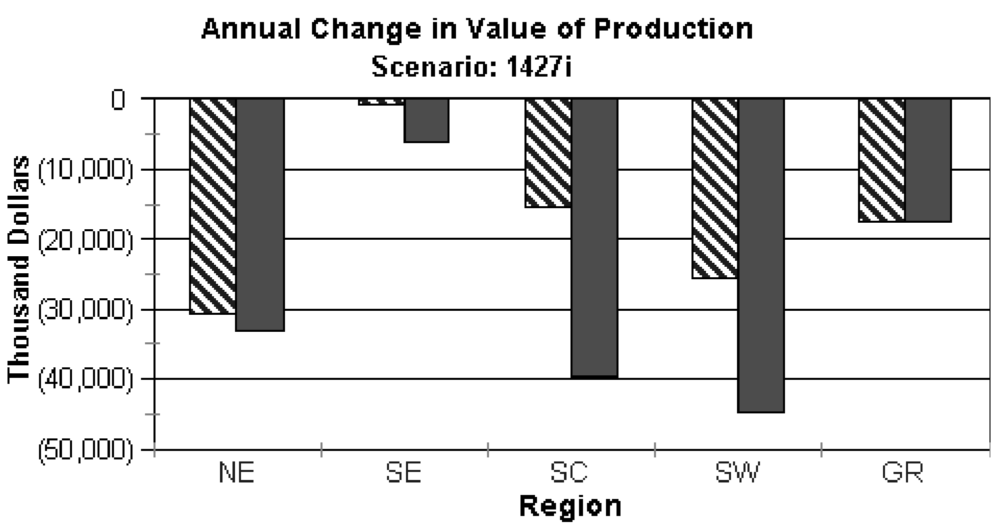


Figure 6-5 Annual Change in value of Production Under the 1427i Scenario

6.2.2.5 1427r Scenario

Key features of this scenario include: (1) acquisition of natural flow rights serving a total of 221,500 acres of agricultural lands in the basin, (2) substantial acquisition of storage water, and (3) change in reservoir operations to achieve the 1427r flow augmentation goal.

Impact estimates were summarized to reflect the modified proportional approach. Changes in regional irrigation water use, measured as a reduction in crop consumptive use of applied water, are shown on table 6-13. These changes were interpreted as net irrigation water use changes on lands served by both natural flow and storage rights. The average reduction in total crop consumptive use of applied water was estimated to be about 622,000 acre-feet per year. Impacts in storage rights delivery areas in the Northeast and Southeast regions would be substantially smaller than in the South-Central and Southwest regions and smaller than the impacts shown for the 1427i scenario. This results from the modeled interactions between reservoir carryover and deliveries are based on water rights. Higher reservoir carryover resulting from changes in operations allows for greater deliveries in the southeast and northeast regions in some years, based on the way water rights deliveries were modeled in the hydrology analysis.

Table 6-13 Average Reduction in Crop Consumptive Use of Irrigation Water by Economic Region for 1427r Scenario (Acre-Feet)

Northeast	Southeast	South-Central	Southwest	Grande Ronde	Total
116,574	1,694	260,053	221,185	21,680	621,186

The average land out of production was estimated at 360,000 acres under the modified proportional approach (natural flow and storage). Total impacts on irrigated land and water use would include the lands idled by natural flow and storage purchases. The mix of crops idled would be determined by market forces, institutional restrictions, and physical conditions (including land productivity and district operational rules).

Table 6-14 summarizes the range of impacts on irrigated acres for the 1427r scenario estimated using the three crop reduction approaches. Impacts were estimated for average water supply and low water supply years and are shown as changes compared to the Base Case. The different crop reduction approaches were fairly similar in the estimates of total land removed from irrigation and ranged from 360,000 to 381,000 acres for an average water supply year and from 570,000 to 645,000 to 471,000 acres in a low water supply year. On average, this represents over 10 percent of irrigated land in the affected regions. However, the three estimation methods did not produce different results in the northeast, southeast, and Grande Ronde regions for average water years and there was little change between average water years and dry years in these regions. The percentage of affected land within regions ranges from less than 1 percent in the southeast region to about 20 percent in the Grande Ronde region. This represents a significant change in land use within the Snake River basin.

Table 6-14 Change in Irrigated Acres by Economic Region–1427r Scenario Compared to Base Case Scenario (1,000 Acres)						
Item	Northeast	Southeast	South-Central	Southwest	Grande Ronde	Total
Base Case	670	743	1,049	712	192	3,366
Average Water Supply Year						
Least Cost	-102	-1	-107	-120	-37	-368
Modified Proportional	-102	-1	-122	-98	-37	-360
Strict Proportional	-102	-1	-134	-107	-37	-381
Low Water Supply Year						
Least Cost	-114	-12	-244	-163	-37	-570
Modified Proportional	-112	-11	-323	-160	-37	-643
Strict Proportional	-112	-11	-322	-163	-37	-645

The information in table 6-14 on the modified proportional approach is displayed in figure 6-6.

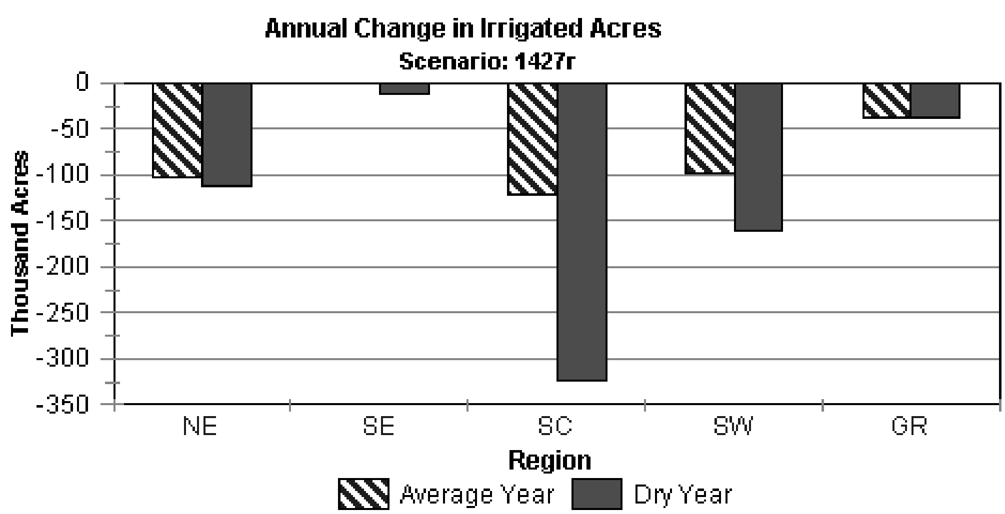


Figure 6-6 Annual Changes in Irrigated Acres Under the 1427r Scenario (Modified Proportional Approach)

Table 6-15 summarizes the range of direct impacts on value of production by region and the type of water supply year.

Table 6-15 Change in Value of Irrigated Production by Economic Region–1427r Scenario Compared to Base Case Scenario (Thousand Dollars)						
Item	Northeast	Southeast	South-Central	Southwest	Grande Ronde	Total
Base Case	316,182	442,619	612,404	555,931	92,798	2,019,934
Average Water Supply Year						
Least-Cost	-30,137	-332	-47,920	-41,920	-12,296	-132,604
Modified Proportional	-30,206	-280	-44,873	-43,464	-17,610	-136,433
Strict Proportional	-30,441	-585	-78,137	-88,476	-17,610	-215,248
Low Water Supply Year						
Least-Cost	-32,553	-3,025	-101,173	-63,632	-12,296	-212,679
Modified Proportional	-32,836	-3,658	-118,891	-70,741	-17,610	-243,737
Strict Proportional	-25,595	-6,549	-187,595	-131,857	-17,610	-369,207

For an average water supply year, gross revenue was estimated to decline by about $133 million to $216 million per year, depending on the crop reduction method. Impacts could be even greater if water were acquired primarily from storage rights which would disproportionately affect high-value crops requiring late season irrigation. In the low water supply year, gross revenue was estimated to decline by $213 million to $369 million. The three estimation methods resulted in similar estimates in the Northeast and Grande Ronde regions and resulted in similar results for average and dry years. The three methods produced different estimates for the Southeast, South-Central, and Southwest regions.

The 1427r scenario would have the greatest percentage of change in the Grande Ronde region and the least percentage of change in the Southeast region. In terms of actual dollar decreases, the South-Central and the Southwest regions would be affected the most.

The data in table 6-15 using the modified proportional approach is displayed graphically in figure 6-7.

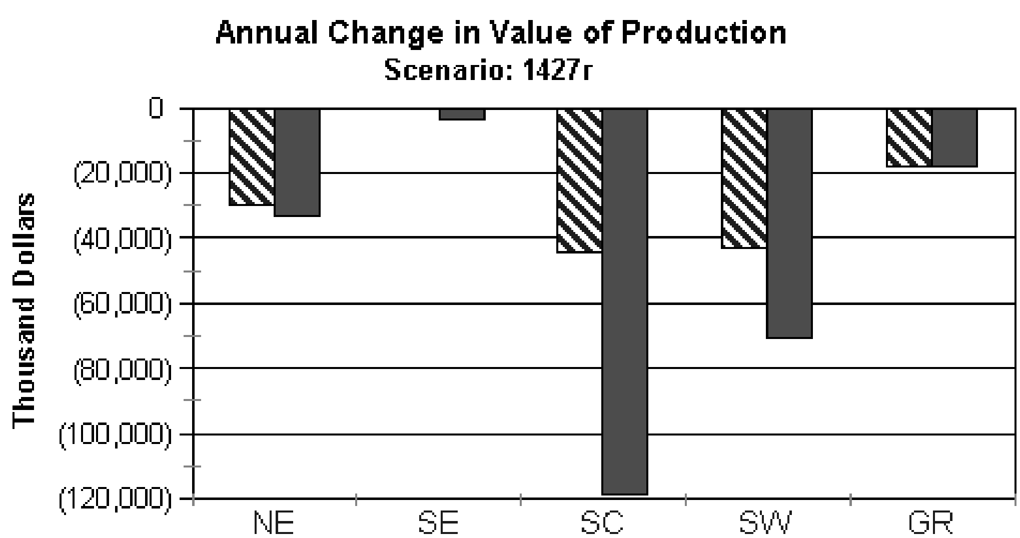


Figure 6-7 Annual Change in Value of Production Under the 1427r Scenario

6.2.2.6 National Economic Value–Irrigation

The impacts to agriculture discussed in the previous sections include an estimate of changes in gross crop revenues and acreage out of production under 1427i and 1427r in an average water year and a dry year. The change in gross crop revenue is further utilized in the regional impact analysis (using IMPLAN) to estimate regional impacts, measured as a change in regional income, sales, and employment.

For several reasons, including the fact that under the willing seller concept, water sellers would receive offsetting compensation (called a transfer payment), a traditional estimate of the net loss in farm income was not made. However, as discussed below, an estimate of reduced farm income was developed using the IMPLAN model. From a national perspective, the net loss or gain from a proposal is measured as the difference between the with and without situation utilizing traditional representative crop enterprise or farm budgets or other related techniques for measuring change in farm income. The resulting estimates of net farm income gained or lost (sometimes called the irrigation benefit or cost) are then appropriate for use in a national benefit-cost context.

Economic impacts are different from economic costs or benefits. Economic costs and benefits reflect a change to the nation as a whole (net farm income or irrigation benefits in this case), while economic impacts measure a change in the regional economy, due, in this case, to a reallocation of water resources. The change to the regional/local economy (income, sales, and employment) is the important indicator to local planners, officials, and the people who live and work in these regions.

An alternative and independent estimate of the change in economic cost to the national economy was derived by estimating "farm proprietors and other farm property income" from the IMPLAN based regional input-output model. The return to labor, land, water, and capital is included in the "income" figure. The values represent the lost returns to land, water, and agricultural capital before taxes.

Table 6-16 shows the annual income changes based on the IMPLAN regional input-output model. The estimates are shown for the four defined functional economic impact regions in the Snake River basin: Eastern Idaho-Wyoming, South-Central Idaho, Southwest Idaho-Oregon, and Eastern Oregon-Washington (also called Grande Ronde). The table shows a range of income loss for the 1427i scenario of $57.2 million annually, while the 1427r scenario shows a loss of $81.3 million annually.

Table 6-16 Annual Proprietors and Other Farm Property Income Loss by Economic Impact Region–Average Water Year (Thousand Dollars)

Region	1427i	1427r
Eastern Idaho-Wyoming	20,570	20,151
South-Central Idaho	7,076	20,397
Southwest Idaho-Wyoming	16,266	27,546
Eastern Oregon-Washington	13,263	13,263
Total[1]	57,175	81,357

[1]May not add due to rounding

6.2.2.7 Cost of Water for Acquisition

It should be noted that it is impossible to predict the market price of water if an additional 1 MAF of water were to be acquired. However, experience indicates that a significant increased demand tends to push market prices higher. There is no guarantee that any of the estimated values discussed below would reflect actual market prices.

This analysis assumes that water for flow augmentation would be acquired from willing sellers. As a result, there would be reduced farm income from reduced irrigation water use but at the same time the agricultural sector would also experience an infusion of money paid for the water acquired. Accordingly, the complete analysis of impacts on agriculture and related economic activity would include an estimate for a reasonable range of prices paid to acquire water.

Since actual acquisition cost would depend on the negotiated price from the willing seller program, three approaches to estimate the cost of acquiring water were developed to provide a range of possible costs for this analysis. The first two approaches utilize, as the starting point, the current costs for recent acquisitions in the Snake River basin while the third approach is based on estimated reduction in farm proprietor and other farm income. Acquisition costs are expressed as annual costs as well as lump sum (one time) acquisition cost.

The first approach uses recent acquisitions of permanent supplies in the Snake River basin as a basis and adjusts the amount upward to account for an expected price response. A price response to acquisition is expected because the more valuable lands and crops are affected and higher prices are demanded for selling water as water acquisition amounts increase. Water acquisition costs were put on a consumptive uses basis to be consistent with hydrologic studies which estimates consumptive use shortages for the 1427i and 1427r scenarios.

The second approach utilizes portions of the first approach but also recognizes that substantial volumes of storage space would need to be acquired to provide flow augmentation with a fairly high degree of certainty, even though the model indicates that the change in consumptive use would be relatively small for the total basin.

The third approach, which results in values between the first two reflects the IMPLAN estimates of the reduction in farm proprietor and other farm property income from the regional input-output model.

6.2.2.7.1 Estimates Based on Recent Water Acquisitions and Reductions in Consumptive Use

Recent acquisitions of reliable storage supplies in the Snake River basin have ranged between $150 and $300 per acre-foot. This represents a one-time cost for a permanent right. Applying the current Federal discount rate of 6.875 percent for water project evaluation to a project life of 100 years would result in an annual equivalent cost of $10-21 per acre-foot. Since the consumptive use fraction of water ranges from 35 percent in the eastern Snake River Plain to 50 percent in the southwest, the annual cost for water that could be used for flow augmentation would be approximately $20-60 per acre-foot.

The target amount of water to acquire for the 1427r scenario would be roughly 10 percent of total consumptive use in the basin (622,000 acre-feet of about 6.6 MAF). According to an analysis of large scale water acquisition for the Central Valley Project Improvement Act (CVPIA), acquiring 10 percent of total surface water use in the Sacramento Valley of California raised the price by about 140 percent over the base (Reclamation, 1997). Although crop mix and other conditions are different in the Snake River basin, the CVPIA experience provides a reasonable sense of how large the price effect might be when purchasing a significant portion of the irrigation water supply. Applying that price increase to the base estimate of $20-60 per acre-foot gives a range of $50-140 per year per acre-foot of consumptive use acquired. A smaller percent of irrigation water is purchased in the 1427i scenario, so an assumed price increase of 50 percent is used, resulting in a price range of $30-90 per acre foot. For purposes of analyzing the regional economic impact of money paid for water acquisition, a value of $75 per acre foot per year was used for both scenarios.

Based on the range of acquisitions cited above, the annual cost for water acquisition would range from $10.4 million to $31.2 million under the 1427i scenario and from $31.1 million to $87.2 million under the 1427r scenario. The capitalized, or lump sum, values of the annual costs would range from $151 million to $454 million for 1427i and from $452 million to $1.27 billion for 1427r. The actual acquisition cost would depend on the negotiated results from the willing seller program. Table 6-17 displays both acquisition costs by subregion in the basin for the average year situation, and the capitalized, or lump-sum, value of the estimate.

Table 6-17 Annual and Lump Sum Water Acquisition Costs Based on Recent Water Acquisitions (Average Water Year)

1427i Scenario			
Region	Water Volume (Acre-Feet)	Low Cost[1] (Dollars)	High Cost[2] (Dollars)
Northeast plus Southeast	144,110	4,323,300	12,969,900
South-Central	63,400	1,902,000	5,706,000
Southwest	90,350	2,710,500	8,131,500
Grande Ronde	49,280	1,478,400	4,435,200
Annual total	347,140	10,414,200	31,242,600
Lump-Sum Cost	--	151,283,000	453,848,000
1427r Scenario			
Region	Water Volume (Acre-Feet)	Low Cost[3](Dollars)	High Cost[4](Dollars)
Northeast plus Southeast	138,340	6,917,000	19,367,600
South-Central	237,860	11,893,000	33,300,400
Southwest	197,070	9,853,500	27,589,800
Grande Ronde	49,280	2,464,000	6,899,200
Annual total	622,550	31,127,500	87,157,000
Lump-Sum Cost	--	452,177,000	1,266,096,000

[1]$30 per acre-foot; [2]$90 per acre-foot; [3]$50 per acre-foot; [4]$140 per acre-foot

6.2.2.7.2 Estimate Based on Recent Water Acquisitions and Storage Space to be Acquired

Water acquisition consists of obtaining natural flow rights as well as storage rights. This approach recognizes the fact that although the change in consumptive use is relatively small, the amount of storage needed to control or provide the consumptive use for the storage portion for flow augmentation with a fairly high degree of certainty is significant. The water sales price estimates described above can be used to estimate the lump-sum, or one-time, payment for acquiring storage rights and natural flow diversion rights. Based on implementation assumptions made for hydrologic analysis, 1,445,000 acre feet of additional storage space is required for the 1427i scenario and 3 million acre feet of additional storage space is required for the 1427r scenario. In both scenarios, 293,640 acre feet of consumptive use water would be acquired from natural flow diverters.

For the 1427i scenario, the assumed price effect results is a 50 percent increase over the observed price range of $150-300 per acre foot. Purchasing 1,445,000 acre feet of storage rights at $225 to $450 per acre foot would require a lump-sum payment of $325-$650 million.

The 1427r scenario requires much greater storage right purchase, so the price effect was assumed to be 140 percent. Purchasing 3 million acre feet of storage at $360 to $720 per acre foot would require a lump-sum payment of $1,080 to $2,160 million. These purchases could be staged over a number of years rather than all at once, which could moderate the price effect to some degree. This approach represents the "high end" of the acquisition cost spectrum.

The lump-sum cost acquisition is summarized in the table 6-18.

Table 6-18 Lump Sum Water Acquisition Based on Cost to Acquire Storage Rights (Dollars)

Water Source	1427i		1427r	
	Low Cost	High Cost	Low Cost	High Cost
Storage Rights	325,125,000	650,000,000	1,080,000,000	2,160,000,000
Natural Flow	127,968,000	383,903,000	213,280,000	597,183,000
Total	453,093,000	1,033,903,000	1,293,280,000	2,757,183,000

6.2.2.7.3 Estimate Based on Compensating Reductions in Farm Income

Based on information in the economic model used for regional economic impact analysis, reductions in growers net income can be estimated. The regional economic impact model (IMPLAN) included an estimate of farm proprietors income and other farm property income. This estimate was used to provide an estimate of the change in net farm resulting from a loss of crop production under the 1427i and 1427r scenarios.

Using the average annual reduction in consumptive use for each scenario, the annual reduction in proprietors and other farm income of $57.2 and $81.4 million would require compensation of $130 to $165 per acre foot annually to acquire water. The lump-sum values would be $830.9 million under the 1427i scenario and $1,182 million under 1427r scenario. Annual and lump sum costs are summarized in table 6-19.

Table 6-19 Annual and Lump Sum Costs of Water Acquisition Based on Compensating Reductions in Farm Income

Cost	1427i	1427r
Annual	$57,200,000	$81,400,000
Lump Sum	$830,922,000	$1,182,446,000

6.2.2.7.4 Other Acquisition Cost Considerations

The three cost estimates described in the previous sections account for water revenue that would be received by sellers, but do not account for transaction costs that would be incurred by the buyer (Federal

Government) and possibly by other involved entities including the states, irrigation districts, and others. Transaction costs are discussed in the following section, while other implementation issues are discussed in Chapter 9.

6.2.2.8 Transaction Costs

In addition to the water acquisition cost, which is income paid to the water seller, there are other potential costs associated with implementation that may be borne by Federal or state governments or by private interests.

The potential measures where additional expenditures may be required include, but are not limited to: (1) water right identification, change of use, and monitoring; (2) negotiation, contracting, and legal costs for purchases and leases of water; (3) revegetation costs for lands no longer irrigated; (4) in lieu irrigation district operation and maintenance charges and property taxes; (5) erosion, weed, and insect control on idled lands; (6) environmental compliance requirements prior to water sale and lease; (7) mitigation costs for environmental impacts; (8) new water measurement/control facilities; and (9) other potential cost items.

Some of the above measures would be the responsibility of the landowner selling the water and essentially included in the negotiated price agreed to by the seller. Applicability and cost for some measures would vary by region or by the size of the acquisition. For example, revegetation would probably not be required in the “high elevation” pasture/hay situations. These areas would continue to be in hay and pasture and due to runoff would remain “green “ in the spring. Summer and fall production would be reduced, however.

Transaction costs are difficult to identify and quantify given a water acquisition program that has not been implemented before on a scale equivalent to the assumptions made for this study. The only other resource retirement programs even closely analogous to a program of this magnitude would be the Dairy Buyout Program and the Conservation Reserve Program (CRP). The CRP currently has approximately 700,000 acres enrolled in Idaho under the CRP; landowners receive annual payments for placing land in non-commercial agricultural conditions. At the time of initial enrollment, landowners were eligible to receive up to one-half the cost to establish ground cover.

The estimated transaction costs are approximations of the potential costs based on the previously mentioned list of measures. It would be expected that certain economies of size would prevail, especially in the areas of legal, negotiation, water right identification, and administration cost. Transaction costs would be concentrated as up-front costs in the years when specific water acquisitions were completed. As the program became better known and developed, costs per unit of water would likely decline. After full acquisition, program costs would remain for administration and monitoring.

An estimate was made of potential annual transaction costs for the 1427i and 1427r scenarios. Transaction costs were developed assuming certain measures for the areas under consideration and a percentage of annual acquisition cost; an estimate of about 23 percent of acquisition costs for the estimate based on recent water acquisitions was used. Accordingly, annual transaction costs were estimated at $2.4 million to $7.3 million for 1427i scenarios and $7.3 million to $20.5 million for 1427r scenario.

6.2.2.9 Impacts on Aquaculture

Lack of specificity about response functions of springs to changes in surface water conditions prevents any quantitative estimate of potential economic impacts to Idaho’s aquaculture industry at this time.

6.2.2.10 Summary of Agricultural Impacts

In both scenarios, changes in irrigated land use would exceed 5 percent. Five percent variations in irrigated crop land use have not been uncommon in the past, largely due to variations in Federal farm program set-aside requirements. The land use changes resulting from either scenario would be in addition to the underlying year-to-year variation.

If spread evenly over a very large area, land use changes of this magnitude would perhaps not be significant. However, actual implementation is likely to result in concentrated areas of fallowing. Irrigation water is distributed by open canals which need to be run near capacity in order to provide sufficient head to deliver water to the end of the canal. Partial use of canals is usually not feasible. Therefore, implementation of a large-scale water acquisition program might necessitate concentrated fallowing in areas served by some canals or on some reaches of canals.

Impacts directly associated with concentrated fallowing can include blowing dust, reduced groundwater recharge affecting wells, reduced surface return flow affecting riparian habitat, and nuisances (weeds and rodents) to lands remaining in production.

A category of impacts not included in this section is the effect of the scenarios on receipts and expenditures of cities, counties and states. To be able to analyze these fiscal impacts would require highly specific information on water sources and the method of obtaining the water source. That type of analysis is not possible with the present level of information. Attachment E provides more information on the possible methodology and some background information.

Total impacts on agricultural land, production, and revenue would be substantially greater in scenario 1427r than under 1427i. Direct economic effects would be similar in nature to those for the 1427i scenario, but could be larger in magnitude as a result of the greater amount of water acquired to meet the goals of the 1427r scenario. Figure 6-8 shows the magnitude of changes in the value of production using the three methods of crop reduction. While the least cost and modified proportional methods produce similar results, the strict proportional method results in a much greater estimate of the loss of production.

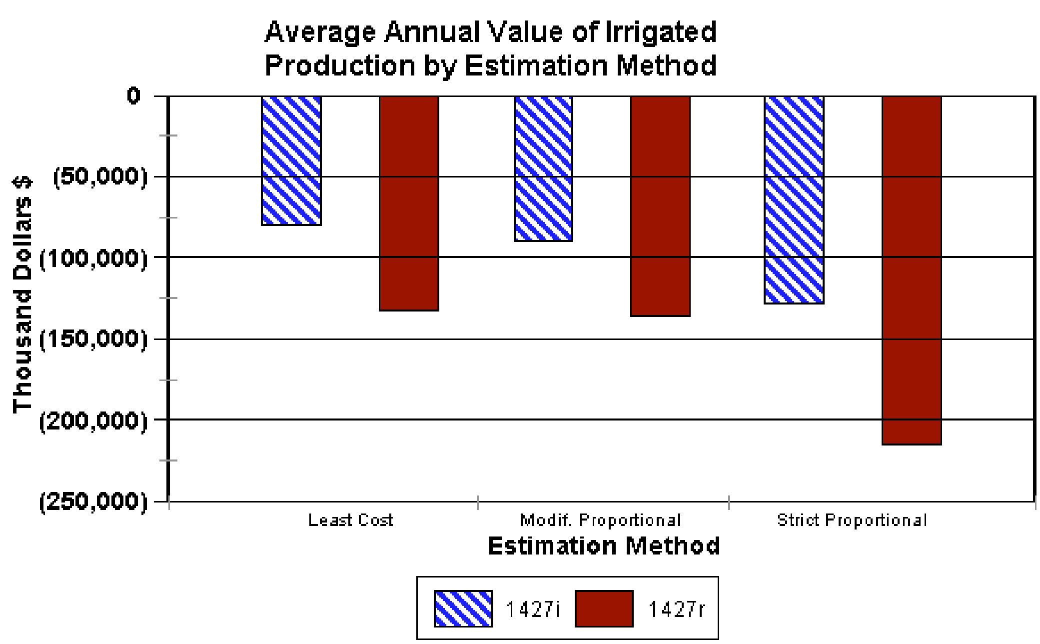


Figure 6-8 Comparison of 1427i and 1427r Scenario Effects on Value of Production by the Three Crop Reduction Methods

6.3 Hydropower

This section discusses existing hydropower generation capabilities and the effect of increased flow augmentation on hydropower generation, Federal irrigation pumping rates, and the economic value of power generation at 20 hydroelectric plants located on the main stem Snake, Boise, Payette, and Owyhee Rivers in the Snake River basin upstream of Brownlee Dam.

6.3.1 Methodology

The Economic and Environmental Principles and Guidelines for Water and Related Land Resource Implementation Studies (U.S. Water Resources Council, 1983) suggests a 100-year period of analysis. Consistent with that guideline, a 100-year period of analysis was used and composed of a 20-year price escalation period and an 80-year extension period in which prices are held constant. It was assumed that flow augmentation would be implemented in 2002. All estimates of economic costs and benefits were calculated in real 1998 dollars and the applicable Federal discount rate of 7.125 percent. A water year is defined as October 1 through September 30. Although the MODSIM hydrology modeling was for the 62-year period of 1928-1989, avoided costs (prices) were available only from 1929 through 1977. As a result, this economic analysis is based on the MODSIM output for the 49-year period of 1929-1977.

Power production figures were developed from MODSIM output by applying standard power equations using the power utility WRD212PB as developed by IDWR and modified by Reclamation.

The costs of constructing and operating a hydropower plant are typically determined by the size of the plant. Additional water can be released through the plant to produce peaking energy at very little added expense; therefore, the variable cost of operating a hydropower plant was assumed to be $0.00/megawatt-hour.

For consistency with the hydrologic modeling, this programmatic level economic analysis is based on a monthly time step. MODSIM results were used to simulate monthly hydropower generation data for 1929 through 1977 at 20 powerplants within the Snake River basin for the Base Case, 1427i, and 1427r scenarios. The hydrologic model results were used in the hydropower economic spreadsheet model which calculates the difference in generation between the Base Case and the 1427i and 1427r scenarios, powerplant change in generation by month, and total system change in generation. The economic value of the difference in generation from the Base Case was calculated by multiplying change in generation by the appropriate avoided costs of electricity. The data for simulated water years 1929-1977 were aggregated into three groups for reporting purposes: (1) all modeled hydropower plants, (2) non-Federal hydropower plants, and (3) Reclamation hydropower plants.

The avoided cost data used in this analysis were estimated using the Aurora model (a proprietary production-cost and market simulation model employed by the NPPC to investigate a number of scenarios relative to BPA’s financial and economic well-being). The Aurora model estimates the hourly market clearing electricity price and the total cost of operating the Pacific Northwest power system. A detailed description of this model, the input data used, and a detailed treatment of fuel price assumptions can be found in (NPPC, 1998). Monthly avoided cost data for the mean price escalation assumption (real 1998 dollars) for each operational year from 2002 through 2021 for each augmentation scenario for water years 1929-1977 were used in this analysis (see attachment F). The present and annualized value in 2002 of hydropower effects were then calculated.

Avoided costs in this part of the country are typically higher in the fall and winter and lower in the spring and summer. Electricity prices are projected to remain relatively constant, or decrease, over the forecast period 2002-2021. These price trends largely reflect the fuel price assumptions used in the Aurora model.

The approach used in this analysis neither captures the potentially mitigating effects of excess capacity in the interconnected system, nor characterizes the effects, if any, of the1427i or 1427r scenario operational regimes on dependable capacity. As with any long-term study, the results reported here are sensitive to the underlying hydrologic assumptions and projections of long-run avoided costs (prices). This analysis does not capture the effects, if any, outside the Snake River basin or downstream of Brownlee Reservoir.

Since generation from Reclamation hydropower plants is used in part to provide pumping power for authorized projects, an analysis of the possible rate changes was made. The Southern Idaho Irrigation Pumping Rate (SIIPR) is set for a 5-year period and is a function of capital and operating costs and annual generation. The current 5-year period started in 1997 and runs through 2001. For this analysis, changes in the pumping rate were determined as a function of changes in generation and the cost of generation at five Reclamation powerplants: Anderson Ranch, Black Canyon, Minidoka, Palisades, and Boise River Diversion Dam. Although Boise River Diversion Dam powerplant has not been in operation in recent years, annual operation and maintenance costs at this facility remain assigned to power generation. The SIIPR was projected from the present (1998) through the end of the current 5-year period (2001) and the rate impact was determined.

6.3.2 Affected Environment

Hydroelectric powerplants make up approximately 10 percent of installed generation capacity nationally, compared with coal fired plants which make up about 40 percent. In the Pacific Northwest, hydropower plays a much larger role where it comprises about 68 percent of all generation capacity (Driver, 1998). Hydroelectric and other generation facilities in the Snake River basin upstream of Brownlee Reservoir are linked to other Pacific Northwest facilities through a system of interconnected electric power transmission lines. Operation of any generation unit affects, and are affected by, operations of the other interconnected units in the system.

The focus of this programmatic level analysis is larger hydropower facilities in the Snake River basin upstream of Brownlee Reservoir that are directly affected by changes in the operations of Federal reservoirs at which data is available. Changes in reservoir operations within the basin would result in changes in the timing and the quantity of electric energy generated by those powerplants which are hydrologically or directly affected by such changes. Changes in operations of these facilities would, in turn, indirectly affect the operations of other interconnected units in the system. However, estimation of these indirect effects is beyond the scope of this analysis.

Electricity cannot be efficiently stored on a large scale using currently available technology. It must be produced as the need arises. Consequently, when a change in demand (referred to as load) occurs, such as when an irrigation pump is turned on, the production of electricity must be increased somewhere in the interconnected power system to satisfy this demand. Load varies on a monthly, weekly, daily, and hourly basis. During the year, the aggregate demand for electricity is highest when heating and cooling needs, respectively, are greatest. During a given week, the demand for electricity is typically higher on weekdays, with less demand on weekends and particularly on holiday weekends. During a given day, the aggregate demand for electricity is relatively low from midnight through the early morning hours, rises sharply during working hours, and falls during the late evening. Electric energy is most valuable when the demand is highest (referred to as the on-peak period). In the West, the on-peak period is defined as the hours from 7:00 a.m. to 11:00 p.m., Monday through Saturday. All other hours are considered to be off-peak.

Capacity, the maximum amount of electricity that can be produced by a powerplant, is usually measured in megawatts. In contrast to thermal powerplants that have a fixed capacity, the capacity of hydropower plants is a function of reservoir elevation, the amount of water available for release, and the design of the facility. Because the capacity at hydropower plants varies, the amount of dependable or marketable capacity is of particular significance. Dependable or marketable capacity is determined using various probabilistic methods (Ouarda et al., 1997).

There are two principle types of hydropower plants, run-of-river and peaking. Run-of-river plants typically have little water storage capability and simply pass the river flow. Consequently, generation at these plants is proportional to water inflow and there is little variation in electrical output during the day. Peaking hydropower plants, such as Hells Canyon, have significant water storage capability and are designed to rapidly change output levels to satisfy changes in the demand for electricity. Peaking hydropower plants are particularly valuable because they can be used to generate power during on-peak periods, avoiding the cost of operating more expensive thermal plants such as gas turbine units. Another characteristic of hydroelectric powerplants is that they are more reliable than thermal plants and they do not generate airborne emissions.

6.3.2.1 Powerplants Included in the Analysis

There are 36 hydroelectric powerplants greater than 5 MW capacity located in the Snake River basin upstream of Brownlee Reservoir. Twenty-four of these would be directly affected by potential changes in the operations of Federal reservoirs. Available data allows 20 of the 24 potentially affected plants to be modeled for this analysis. These include four Reclamation powerplants with a combined capacity of 254.7 MW and 16 non-Federal hydropower plants with a combined capacity of 704.5 MW. The non-Federal plants include 11 IPC facilities with a combined capacity of 542.2 MW and 5 other facilities with a combined capacity of 162.3 MW. Data used in modeling the 20 powerplants is included attachment G.

Powerplant owners and nameplate capacities are summarized in table 6-20 which lists the powerplants in order from upstream to downstream.

Table 6-20 Modeled Hydropower Plants

Powerplant	Owner	Capacity (MW)
Palisades	Bureau of Reclamation	176.5
Idaho Falls	City of Idaho Falls	23.5
Gem State	City of Idaho Falls	24.0
American Falls	Idaho Power Company	112.4
Minidoka	Bureau of Reclamation	28.0
Milner	Idaho Power Company	57.5
Twin Falls	Idaho Power Company	52.1
Shoshone Falls	Idaho Power Company	12.5
Upper Salmon Falls A	Idaho Power Company	18.0
Upper Salmon Falls B	Idaho Power Company	19.5
Lower Salmon Falls	Idaho Power Company	60.0
Bliss	Idaho Power Company	80.0
C.J. Strike	Idaho Power Company	89.0
Swan Falls	Idaho Power Company	27.2

Table 6-20 Modeled Hydropower Plants		
Powerplant	Owner	Capacity (MW)
Anderson Ranch	Bureau of Reclamation	40.0
Lucky Peak	Four Boise Project Irrigation Districts	101.2
Cascade	Idaho Power Company	14.0
Black Canyon	Bureau of Reclamation	10.2
Owyhee	Owyhee Irrigation District	5.5
Owyhee Tunnel Outlet	Owyhee Irrigation District	8.1

These powerplants not only furnish capacity and energy, but also contribute greatly to system reliability through the Automatic Generation Control system that adjusts the generation, second by second, to match changes in load in the interconnected electrical power system. These powerplants provide extra energy during extreme hot or cold weather periods and help maintain transmission stability during system disturbances. The powerplants also fulfill part of the Western Systems Coordinating Council reserve requirements and provide backup generation in the event of unexpected outages.

6.3.2.2 Southern Idaho Irrigation Pumping Rate

Generation from Reclamation powerplants in the basin, in part, provides irrigation pumping power for certain irrigation districts within Reclamation projects in the basin: Minidoka, Boise, and Owyhee Projects. Approximately 25-30 percent of the annual generation from these powerplants is used for irrigation pumping. Generation that is surplus to project use is delivered to and marketed by BPA.

6.3.3 Environmental Consequences

6.3.3.1 National Economic Value of Hydropower

The economic value of operating an existing hydropower plant is measured by the avoided cost of doing so, or the difference between the cost of satisfying the demand for electricity with operation of the hydropower plant versus without operating the hydropower plant. Conceptually, avoided cost is the savings realized by supplying electricity from a low-cost hydropower source rather than a higher-cost thermal source. These savings arise because the variable cost of operating a hydropower plant is relatively low in comparison to thermal units. The variable costs of operating an average hydropower plant in 1995 was $5.89 per megawatt-hour. In contrast, the variable cost of operating the average fossil-fuel steam plant was $21.11 per megawatt-hour and the variable cost of operating the average gas turbine peaking unit was approximately $28.67 per megawatt-hour (Energy Information Administration, 1996).

The economic value of operating an existing hydropower plant varies considerably with time of day. The variable cost of meeting demand varies on an hourly basis, depending on the demand for electricity and the mix of plants being operated and their output levels. Base demand is typically satisfied with low-cost units, such as coal, run-of-river hydropower, and nuclear units that operate more or less continuously during off-peak periods. During on-peak periods, the additional load is met with sources that can be efficiently turned on and off and facilities that are progressively more expensive to operate. The economic value of hydropower is consequently greatest during the hours when the demand for electricity and the variable cost of meeting demand are highest. Hydropower plants associated with storage reservoirs are a valuable resource to meet peak demands.

If the variable cost of purchasing an additional megawatt of electricity from a least-cost source were observable in the market, the economic value of producing hydroelectricity could be readily determined. For example, assume that the cost of purchasing a megawatt of electricity from the least-cost source were $30.00 in a particular hour and the cost of producing a megawatt of hydroelectricity were $6.00. Then, the avoided cost or economic value of producing an additional megawatt of hydropower at that time would be ($30.00-$6.00) or $24.00.

Avoided cost data used in this analysis were estimated using the Aurora model as explained in the Methodology section.

6.3.3.2 Effects on Generation and Economic Value of Generation

The results obtained with the MODSIM hydrology model suggest that all four scenarios would result in about the same amount of annual generation. Table 6-21 summarizes annual generation for the selected 20 powerplants. Figure 6-9 displays the same information for all of the powerplants and just the four Reclamation plants.

Table 6-21 Average Annual Generation of the Selected 20 Powerplants (1929-1977) (Megawatt-Hours)				
Hydropower Plants	Base Case	No Augmentation	14127i	1427r
All Plants	4,745,253	4,748,269	4,649,455	4,827,067
Reclamation	1,131,400	1,165,200	1,073,100	1,151,700
Non-Federal	3,613,853	3,583,069	3,576,355	3,675,367

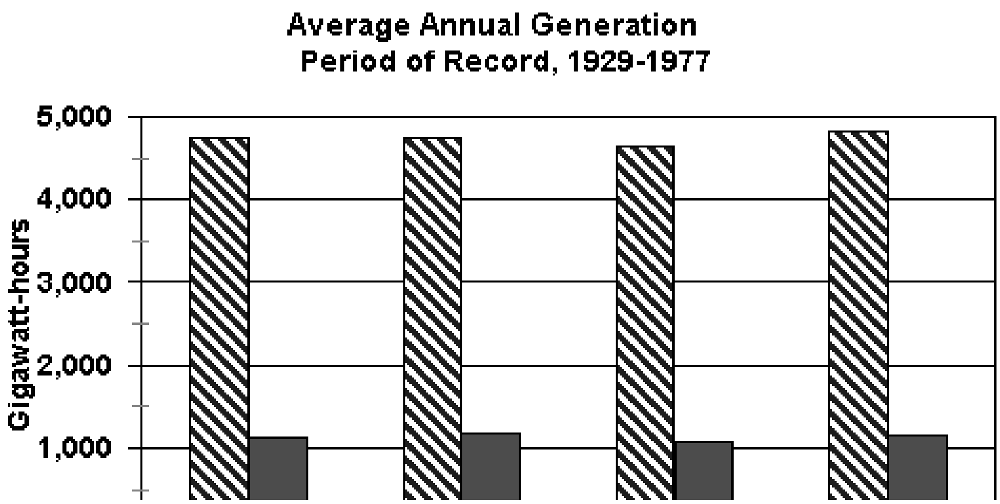


Figure 6-9 Average Annual Generation (Gigawatt-Hours)

Monthly generation changes are significant. Figures 6-1-, 6-11, and 6-12 illustrate the monthly percentage change in generation for the No Augmentation, 1427i, and 1427r scenarios respectively. Both positive and negative effects on hydropower generation would occur depending on the month.

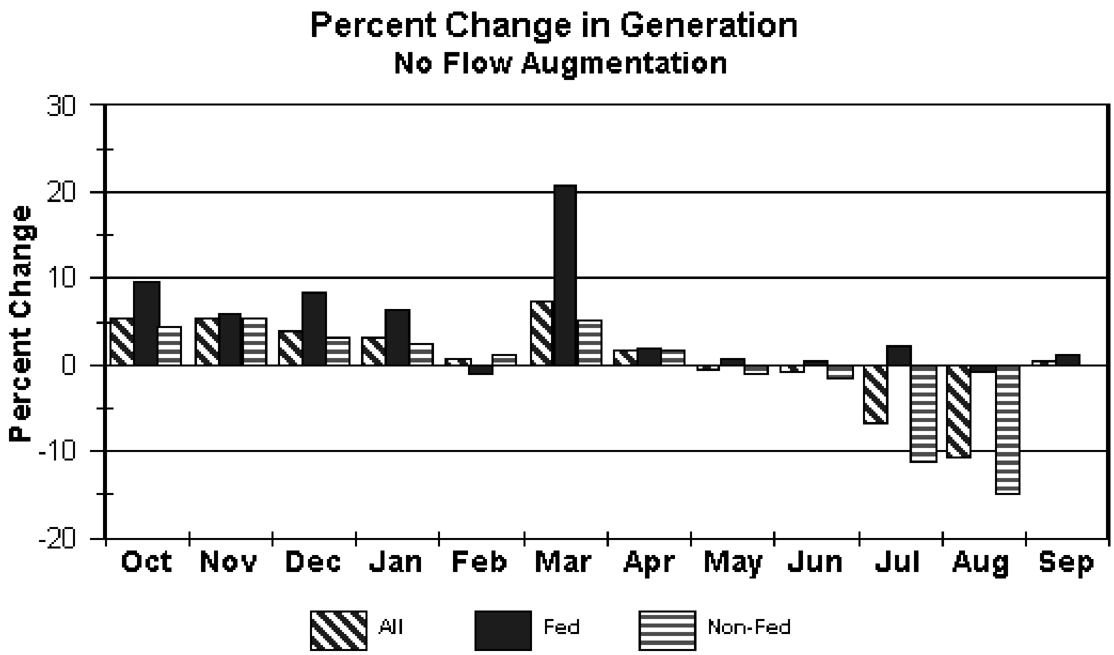


Figure 6-10 Monthly Percent Change in Generation for the No Augmentation Scenario

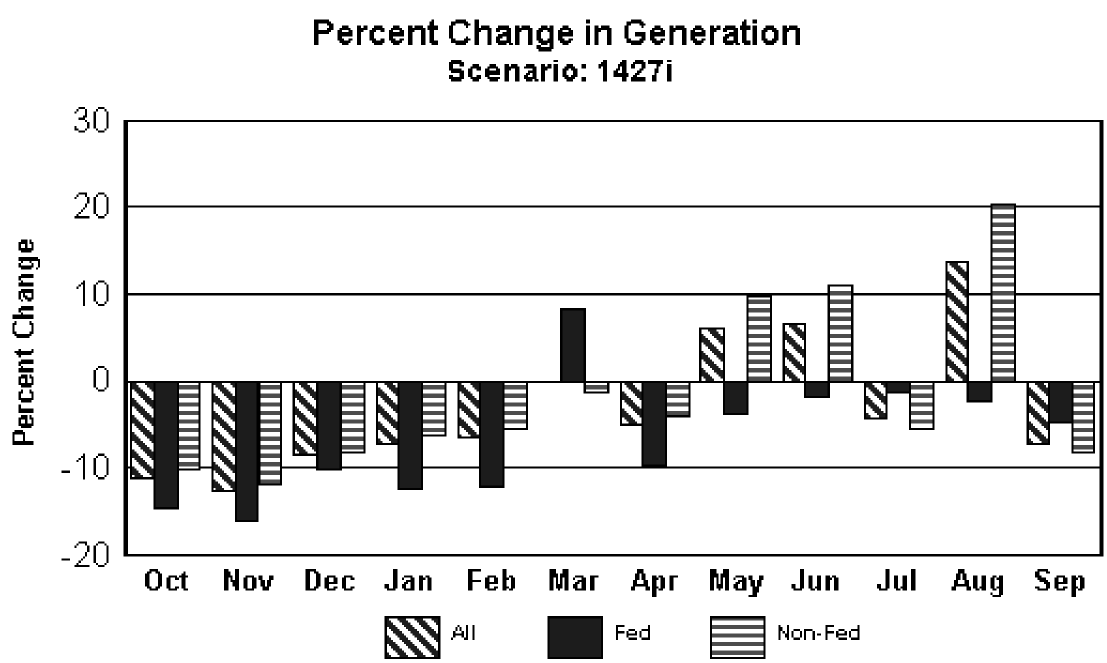


Figure 6-11 Monthly Percent Change in Generation of the 1427i Scenario

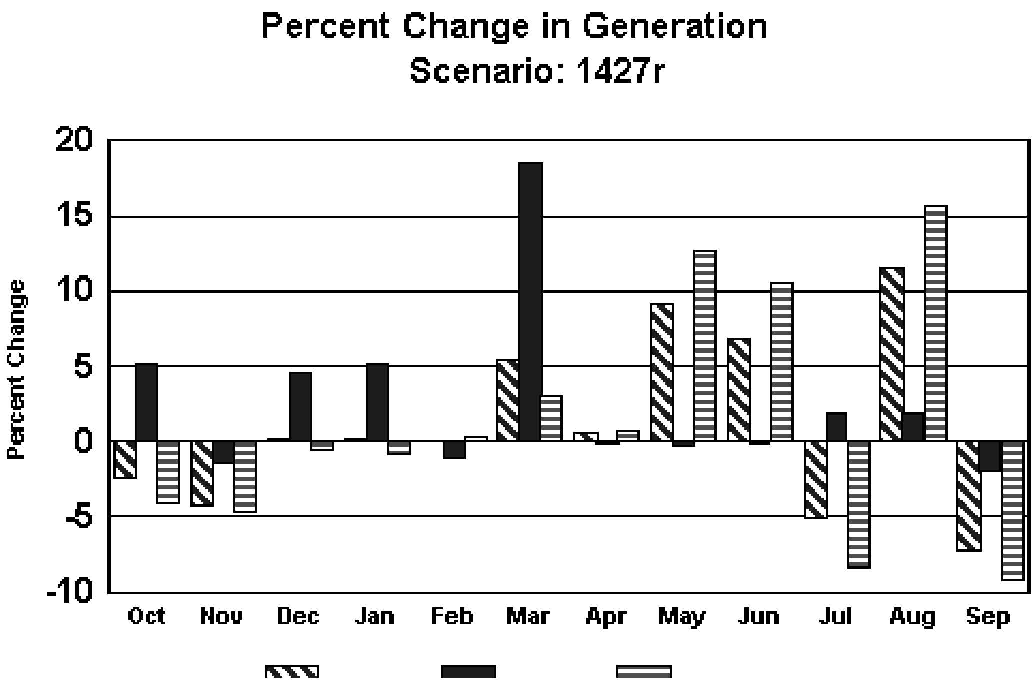


Figure 6-12 Monthly Percent Change in Generation of the 1427r Scenario

Relative to the Base Case, the total annual generation for the modeled plants would decrease by 95,798 MWh (a loss of 2.02 percent) for the 1427i scenario. The Federal facilities would generate less energy because Federal reservoirs would be drafted heavily to meet irrigation demands. Generation would decrease by 5.16 percent at Federal facilities and by approximately 1.04 percent at non-Federal facilities.

Relative to the base case, the total annual generation for the modeled plants would increase by 81,814 MWh (1.72 percent) for the 1427r scenario. Generation would increase by 1.8 percent at Federal facilities and approximately 1.7 percent at non-Federal facilities.

Table 6-22 illustrates the net present value of economic effects estimated for the 1427i and 1427r scenarios.

Table 6-22 Net Present Value in 2002 of Economic Hydropower Effects Relative to the Base Case (Real 1998 Dollars (7.125 Percent Discount Rate))

Hydropower Plants	1427i	1427r
All Plants	-38,078,000	25,301,000
Reclamation	-22,479,000	7,004,000
Non-Federal	-15,599,000	18,297,000

Lower reservoir levels of the 1427i scenario would reduce hydraulic head for powerplants. Consequently, less electricity would be generated for each acre-foot of water released. Additionally, more generation would occur during months when the value of the electricity is lower and less generation would occur during high value months. The net present economic value (at 7.125 percent) of the electricity produced at the 20 hydropower plants would fall by 2.31 percent under the 1427i scenario. The net economic value would decrease by 5.86 percent for Federal facilities and by 1.24 percent for non-Federal facilities.

Reservoirs would be maintained at higher levels during the summer with the 1427r scenario. As a result, the amount of head available for generation would be greater and more electricity would be generated for each acre-foot of water released. As shown in table 6-22, the net present economic value (at 7.125 percent) of the electricity generated by the 20 hydropower plants would rise by 1.6 percent. The net economic value would increase by 1.9 percent for Federal facilities and by 1.5 percent for non-Federal facilities.

Table 6-23 illustrates the change in annual equivalent value of the two scenarios. The annual equivalent value is the amount of money which, if received each year, would yield an amount equal to the net present value shown in table 6-19.

Table 6-23 Annual Equivalent Value in 2002 of Economic Hydropower Effects Relative to the Base Case (Real 1998 Dollars (7.125 Percent Discount Rate))

Hydropower Plant	1427i	1427r
All Plants	-2,716,000	1,876,000
Reclamation	-1,603,000	519,000
Non-Federal	-1,113,000	1,357,000

The 1427i and 1427r scenarios would affect the economic value of the electricity produced. Given the range of potential economic effects of these two scenarios, the tradeoff between hydropower production and other economic activities needs close scrutiny and must be carefully weighed by decisionmakers.

6.3.3.3 Effects on Southern Idaho Irrigation Pumping Rate

Generation at Reclamation powerplants was estimated for each scenario. Table 6-24 summarizes average annual generation and the change from the Base Case scenario for the four active Reclamation powerplants. The analysis indicates that annual generation would increase with the No Augmentation and 1427r scenarios and decrease with the 1427i scenario.

Table 6-24 Average Annual Generation At Four Reclamation Powerplants 1929-1977 (Thousand Megawatt-Hours)

Scenario	Anderson Ranch	Palisades	Minidoka	Black Canyon	Total	Total Change
Base Case	138.6	781.9	149.2	61.6	1,131.3	0.0
No Augmentation	142.4	797.5	150.6	74.6	1,165.1	33.8
1427i	140.7	726.2	129.6	76.5	1,073.0	- 58.3
1427r	146.2	796.1	132.4	77.1	1,151.8	20.5

Table 6-25 shows the projected SIIPR along with the percentage of change from the base case scenario for fiscal years 1998 through 2001.

Table 6-25 Southern Idaho Irrigation Pumping Rate and Percent Change From the Base Case (Mills

per Kilowatt-hour and Percent Change from the Base Case)							
Fiscal Year	Base Case	No Augmentation		1427i		1427r	
	Rate	Rate	Change (Percent)	Rate	Change (Percent)	Rate	Change (Percent)
1998	12.50	12.22	-2.2	13.03	4.2	12.33	-1.4
1999	12.51	12.22	-2.2	13.04	4.2	12.33	-1.4
2000	12.41	12.12	-2.3	12.93	4.2	12.23	-1.4
2001	12.70	12.41	-2.3	13.25	4.3	12.53	-1.3

The SIIPR, under the No Augmentation and 1427r scenarios would incur respective rate decreases of approximately 2.2 percent and 1.4 percent. The 1427i scenario would incur a rate increase of approximately 4.2 percent. Any policy decision that would change the annual generation at these plants would have the potential to influence the pumping rate.

6.4 Recreation

This section identifies economic impacts on recreation activities at 11 sites, representing both a geographic and recreational use cross section. These sites are: Jackson Lake, Palisades Reservoir, Snake River near Moran, Snake River near Irwin, American Falls Reservoir, Cascade Reservoir, Payette River at Horseshoe Bend, North Fork Payette River at Cascade, Lucky Peak Lake, Boise River downstream of Boise River Diversion Dam, and Lake Owyhee. These sites were selected as representative of the types of potential recreation economic impacts that might be expected under the flow augmentation scenarios.

Defendable, consistent recreation use information is not available for the entire Snake River basin; therefore, a comprehensive recreation economic impact analysis was beyond the scope of this analysis. The economic impacts identified in this analysis apply only to the 11 identified sites and do not represent the total magnitude of recreation economic impacts that may result throughout the entire basin from the flow augmentation scenarios. A more comprehensive analysis would likely reflect far greater recreation economic impacts than this analysis indicates.

If a flow augmentation proposal is seriously considered in the future, a more detailed and comprehensive analysis of the recreation economic impacts would be conducted prior to implementation.

Social effects related to recreation economic impacts are discussed in chapter 8.

6.4.1 Methodology

The preferred method for determining economic value for recreation is to conduct site-specific studies; however, this method was beyond the scope of this analysis. The method used in this flow augmentation analysis was use of other studies to estimate the economic benefits for various recreation activities by matching characteristics at sites in the Pacific Northwest where recreation economic studies have been done, with the 11 sites in the Snake River basin. This correlation or “benefits transfer” approach has been utilized in various other studies of recreation impacts. Impacts on recreation usage and the resulting economic values were measured as changes from the Base Case scenario. The change in recreation activity (such as boating, fishing, camping, etc.) resulting from limited access to facilities due to changes in operations at each of the 11 sites was multiplied by the value (benefit value per recreation day) for each activity. The resulting total change in annual economic value, or benefit loss, by activity was then computed for each recreation site and for each scenario. Benefit values are in 1998 dollars.

The change in recreation activity due to changes in river/reservoir operations under the 1427i and 1427r scenarios would, in reality, probably occur proportionately over time, coinciding with the acquisition of additional water for flow augmentation. However, the uncertainty associated with acquisition makes it difficult to identify an exact time frame for implementation. For this analysis, a 1-year implementation period was assumed. Accordingly, the economic estimates were computed at full implementation and were not presented as annual equivalent values to account for time of implementation.

Economic recreation impacts under the No Augmentation scenario were assumed to be similar to the Base Case scenario; therefore, no analysis of the no augmentation scenario was completed.

6.4.2 Affected Environment

Recreation activities and usage are discussed chapter 7.

6.4.3 Environmental Consequences and National Economic Value of Recreation

Changes in visitation and the factors affecting visitation are described in chapter 7. These changes were allocated among activities at each site and a value per day was applied to estimate the economic value. The monetary values for recreation user-day activities are shown in table 6-26. The average value for each activity was used for this analysis.

Table 6-26 Monetary Values of Recreation Activities (Average Net Economic Value per Household in 1998 Dollars)				
Activity	McCollum et al.[1]	Walsh et al.[2]	Reclamation	Average
General recreation	7.18	NA		7.18
Sightseeing	13.15	28.76*		20.95
Camping	13.27	27.62		20.45
Fishing (cold water)	11.11	42.91		27.01
Fishing (trout)		98.49		98.49
Fishing (warm water)	15.95	41.36		28.65
Picnicking	11.72	12.72*		12.22
Nonmotorized Boating		69.00*	66.85	67.93
Motorized Boating		44.73*		44.73
Trails-hiking	40.01	41.22*		40.62
Swimming	12.98	32.56*	25.22*	23.58
Wildlife observation	12.91	42.18	39.89	31.66

[1]McCollum, D., G. Peterson, J. R. Arnold, D. Markstrom, D. Hellerstein. 1990. The Net Economic Value of Recreation on the National Forests: Twelve Types of Primary Activity Trips Across Nine Forest Service Regions. Rocky Mountain Forest and Range Experiment Station, Research Paper RM-289, U.S. Department of Agriculture. Ft. Collins, CO.
[2]Walsh, R. G., D. M. Johnson, and J. R. McKean. 1988. Review of Outdoor Recreation Demand Studies with Nonmarket Benefit Estimates, 1968-1988. Tech. Rep. 54, Colorado Water Resources Res. Inst., Colo. State Univ., Ft. Collins, CO.

6.4.3.1 1427i

Table 6-27 shows the effects of the 1427i scenario which results in a loss of about $13.7 million annually in benefits based on a loss of about 504,000 recreation-days. Tubing on the Boise River provides the single greatest negative impact with a loss of 126,000 visitor days. Other recreators would be greatly affected in aggregate, including motorboaters at Cascade Reservoir and Lucky Peak Lake, anglers at Lucky Peak Lake, and persons floating the Snake River below Moran, Wyoming.

Table 6-27 Change in Recreation Benefits with the 1427i Scenario				
Site	Visitation Loss (Visitor-Days)	Activity Affected	Distribution of Impacts (Percent)[1]	Reduction in Value (1998 Dollars)
Jackson Lake	1,500	Fishing, cold water	100	40,000
Palisades	6,700	Fishing, cold water	50	90,000
		Motorized boating	50	149,000
American Falls	43,000	Fishing, warm water	33	406,000
		Motorized boating	33	634,000
		Camping	33	290,000
Cascade	111,000	Fishing, cold water	8	226,000
		Fishing, warm water	23	718,000
		Motorized boating	33	166,100
		Camping	37	835,000
Lucky Peak	157,000	Fishing, warm water	40	180,500
		Motorized boating	40	2,817,000
		Swimming	10	371,000
		Picnicking	10	192,000
Owyhee	11,000	Fishing, warm water	40	126,000
		Camping	60	135,000
Snake River near Moran	17,000	Fishing, high quality/trophy	20	339,000
		Nonmotorized boating	80	936,000
River near Irwin	16,000	Fishing, high quality/trophy	20	319,000
		Camping	80	265,000
Boise River downstream of Diversion Dam	140,000	Fishing, cold water	10	378,000
		Tubing	90	905,000
NF Payette River at Cascade	300	Fishing, cold water	50	15,000
		Nonmotorized boating	50	10,000
Payette River at Horseshoe Bend	0			0
Total	504,000			13,664,000

[1]Distribution of impacts among activities affected, e.g., the only activity affected at Jackson Lake is fishing, so 100 percent of the impact is on fishing.

6.4.3.2 1427r

Table 6-28 shows the effects of the 1427r scenario on recreation which results in a loss of about $4.1 million annually in benefits based on a loss of about 212,000 recreation-days.. The largest impact is due to the loss of summer tubing on the Boise River with a loss of 129,600 visitor-days. While this activity has a low value relative to other activities, many participants will be affected due to changes in streamflows leading to a large total dollar value. On the Snake River near Moran, Wyoming, many persons float and fish this portion of the river who would be affected by changes in flow levels. The annual loss of about 5 percent of current visitation would lead to an annual loss in economic value of about $1.2 million.

Table 6-28 Reduction in Recreation Benefits with the 1427r Scenario

Site	Visitation Loss (Visitor-Days)	Activities	Distribution of Impacts (Percent)[1]	Reduction in Value (1998 Dollars)
Jackson Lake	0			0
Palisades Reservoir	0			0
American Falls Reservoir	15,000	Fishing, warm water	33	141,000
		Motorized boating	33	221,000
		Camping	33	101,000
Cascade Reservoir	30,000	Fishing, cold water	8	62,000
		Fishing, warm water	23	196,000
		Camping	37	228,000
		Motorized boating	33	453,000
Lucky Peak Lake	0			0
Lake Owyhee	7,000	Fishing, warm water	40	84,000
		Camping	60	90,000
Snake River near Moran	24,000	Fishing, high quality/trophy	20	311,000
		Nonmotorized boating	80	858,000
Snake River near Irwin	0			0
Boise River downstream of Diversion Dam	144,000	Fishing, cold water	10	389,000
		Tubing	90	931,000
NF Payette River at Cascade	100	Fishing, cold water	50	3,000
		Nonmotorized boating	50	2,000
Payette River at Horseshoe Bend	0			0
Total	212,000			4,069,000

[1]Distribution of impacts among activities affected, e.g., at American Falls Reservoir, three activities are equally affected so 33 percent of the impact is on each activity.

6.4.3.3 Summary

The 1427i and 1427r both result in the net loss of water based recreation activity in the basin. Because of the way the reservoirs would be operated, the loss of recreation under 1427r is less than under 1427i. The benefit loss is greater under 1427i because reservoirs would be drawn down to a great extent to meet flow augmentation demands. This results in lower end-of-month reservoir levels than under 1427r, and in some cases it also results in less desirable streamflows below reservoirs, both of which are less conducive for recreation activity.

The net annual economic loss in water-based recreation activity for the 11 sites was estimated at $13,664,000 million under 1427i and $4,069,000 under 1427r. Table 6-29 summarizes the annual loss in recreation benefits for the 11 sites by recreation activities.

Table 6-29 Annual Monetary Loss of Water Based Recreation (1998 Dollars)

Scenario	Activity				
	Boating & Rafting[1]	Camping and Picnicking	Fishing[2]	Other Water Activities[3]	Total
1427i	6,207,000	1,717,000	4,462,000	1,276,000	13,664,000
1427r	1,534,000	419,000	1,186,000	931,000	4,069,000

[1] Includes motorized and non-motorized boating, rafting, kayaking, and canoeing.
[2] Warm and cold water fishing.
[3] Includes swimming, tubing, and general recreation activities.

The figure 6-13 demonstrates the results graphically.

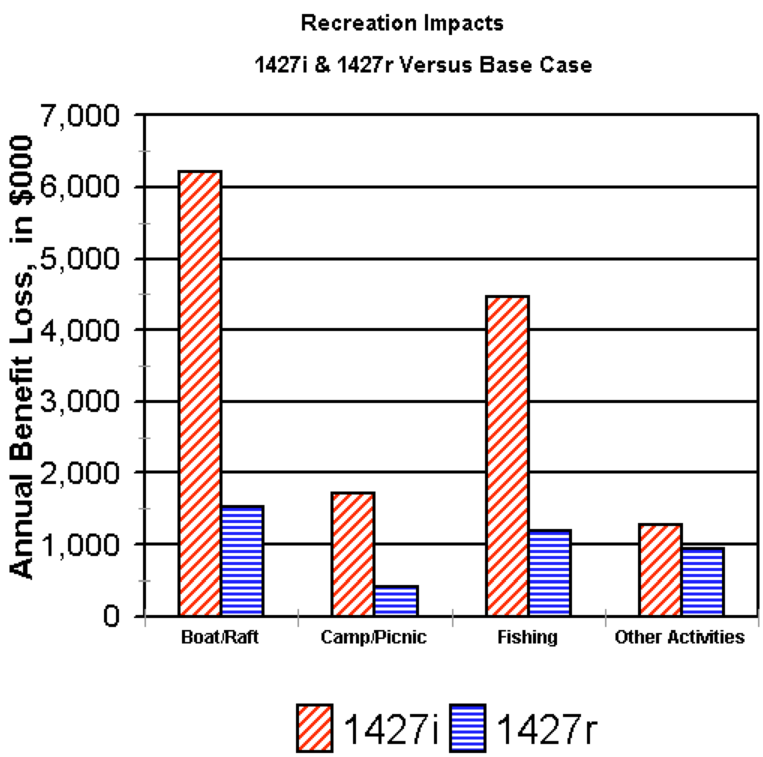


Figure 6-13 Annual Loss in Water-based Recreation (1998 Dollars)

6.5 Regional Economics

6.5.1 Regional Economic Areas

To facilitate regional economic analysis, the U.S. Department of Commerce, Bureau of Economic Analysis (BEA) has mapped principal trading regions into functional economic areas. These functional economic areas provide the geographic boundaries of somewhat self-contained regional economies. The main factor in determining regional boundaries are the labor commuting patterns within a region where goods and services are obtained. These economic areas are characterized by an urban central place and a surrounding rural periphery. After determining the geographic coverage of the four flow augmentation scenarios, four economic functional areas were mapped with the assistance of the BEA data. These four areas are shown in figure 6-2.

Regional economic model construction involves completing four regional input-output (I-O) models to represent the economy of the basin as shown in Figure 6-2. A set of IMPLAN accounts describe the baseline economy in each of the four regions and forms the basis for the regional economic models. These accounts describe the baseline economy in each region in terms of total sales, employment, and regional income and form the structure for the regional economic models that are the basis for subsequent economic impact studies. The analysis identifies agriculturally and recreation dependent sales, income and jobs throughout the economy that stem from the existence of irrigated agriculture and water based recreation. This work highlights the relative economic importance of irrigated agriculture in relation to the rest of the economy in the basin. The analysis also depicts the regional economic importance of water-based recreation found within these regional economic areas.

6.5.2 Benchmarking the Regional Input-Output Model

Special attention was given to assuring that the data in the regional input-output is in agreement with other sources of regional economic information. In particular, the IMPLAN data on agricultural output was adjusted to be consistent with value of production figures based on the Idaho Agricultural Statistics as compiled by the Idaho Agricultural Statistics Service. Crop yields and prices are the same as the estimates from Idaho Agricultural Statistics. The input-output accounts represent calendar year 1994.

6.5.3 Methodology

Regional I-O models are prepared to provide a detailed picture of a regional economy and predict the economic impacts of potential shocks to a regional economy. This study has chosen IMPLAN, an I-O modeling framework. I-O models are ordinarily used to estimate changes in employment and income brought on by changes in final demand. I-O analysis is based on the interdependence of production and consumption sectors in a regional area. Industries must purchase inputs from other industries for use in the production of outputs which are sold either to other industries or final consumers. Thus, a set of I-O accounts can be thought of as a picture of a region's economic structure. Flows of industrial inputs can be traced via the I-O accounts to show linkages between the industries composing the regional economy. The accounts are also transformed into a set of simultaneous equations that permit the estimation of economic impacts (changes in sales, employment, income, etc.) resulting from changes in sales to final demand. The model represents an economy where supply (sales) is assumed to respond to demand changes (final demand). I-O models are often described as demand driven models.

6.5.3.1 Irrigated Agriculture

To estimate the importance of irrigated agriculture to the region, both the forward and backward linkages associated with irrigated crop production in the region must be measured. Some industries such as fuel, machinery, and fertilizer in the region provide input to the irrigated crop sectors. These industries are commonly called backward linkages. Other industries in the region use irrigated crops as an input to their production process. These industries are often referred to as forward linked industries. An example of a forward linkage is a plant which processes potatoes. This is important to consider in a regional economy because without production of potatoes, the potato processing would diminish or disappear. Another example of forward linkage is a feed lot which buys input from local farms in the form of hay and grain.

Fortunately, there are several examples of how demand driven regional I-O models may be used to estimated the economy-wide impact of a reduction in the supply of some key natural resource. Petkovich and Ching (1978) used an I-O model to examine the impact of mining ore exhaustion in western Nevada; they used differing assumptions about the substitutability of imported replacement ore. Martin et al.(1998) used an I-O approach to model the impact of a reduction in agricultural supply stemming from the CRP in north central Oregon. Waters et al. (1994) used an inter-regional I-O model to examine the impact of supply reductions in logs from U.S. Forest Service land on the regional economies of western Oregon.

The methodology used to estimate the dependence of the forward linked industries is based on several assumptions. The first assumption is that loss of irrigated crops in a region cannot be replaced with imports. Without this assumption, import substitution would reduce the estimated impact of the forward linkage and the secondary impacts to the economy would be reduced. It is also assumed that there is no point were a plant would cease to operate because it cannot replace regionally produced irrigated inputs (threshold effect). With a threshold effect it is possible that selected forward linkage impacts would be larger than estimated in this analysis.

After the direct impacts are calculated for irrigated agriculture production (the value of irrigated crops in the region) and the forward linked industries, IMPLAN is used to calculate indirect and induced effects. Indirect effects are defined as the changes in inter-industry purchases by industries directly affected by changes in irrigated crop supply. Induced effects are the result of changes in spending by employees of industries directly and indirectly affected by changes in irrigated crop supply. Additional detail relating to the methods used to determine affected environment may be found in Engel and Holland (1998).

6.5.3.2 Recreation

The regional economic analysis of recreation impacts considers only those expenditures made by recreationists residing outside the functional economic area. Expenditures made by local residents are typically ignored under the assumption that local expenditures for recreation are considered as substitutes for expenditures on other goods and services within the functional economic area, i.e., a change in recreation opportunities would be reflected by an equal but opposite change for other regional goods and services. The net change in regional income and employment stemming from local residents would be zero. Another way of stating this is that there are no regional impacts resulting from changes in local expenditures for recreation. Expenditures by out of region recreationists are assumed to change with changes in recreation opportunities. The estimated change in recreation expenditures by out of region consumers drives the estimate of regional economic impact.

This analysis relies on knowledgeable recreation specialists to determine the percentage of resident and non-resident visitation. These percentages are applied to estimates of existing visitation (see chapter 7). Table 6-30 summarizes estimates of the percentage of non-resident visitation used in this analysis

Table 6-30 Recreation Visitation and Percent and Percent by Non-Residents

Economic Area	Recreation Focus Reach	Visitation	Percent Visitation by Non-Residents
Eastern Idaho– Wyoming	Jackson Lake	298,000	90
	Palisades Reservoir	62,000	25
	American Falls Reservoir	185,000	25
	Snake River near Irwin	428,000	75
	Snake River near Moran	281,500	75
South-Central Idaho	None	0	
Southwest Idaho-- Oregon	Owyhee Reservoir	98,000	30
	Cascade Reservoir	450,000	25
	Lucky Peak Reservoir	787,260	5
	Boise River below Diversion Dam	350,000	3
	North Fork Payette River near Cascade	8,200	25
	Payette River near Horseshoe Bend	13,500	25
Eastern Oregon-Washington	None	0	
Total		2,961,460	

The next step was to determine recreator expenditures by activity. Expenditures are defined as daily expenses measured in dollars of a given activity. For example, the camping activity creates an average daily expenditure of $15.95 per day. For the purpose of this analysis, activities are summarized in four categories: fishing, water-based recreation, general day use, and camping. Limited data in the regional economic areas required the use of 1993 expenditure data estimated for outdoor recreation in Oregon (Johnson et al.,1995). These values were indexed to 1994 dollars, the base level used in this regional economic analysis. Table 6-31 summarizes expenditure by category of recreation used for this study.

Table 6-31 Recreation Activity Expenditures

Recreation Activity defined in IMPLAN	Activities Included	Expenditure per Visitor-Day	Eastern Area Total	Southwest Area Total
Camping	Camping	$15.95	$1,741,142	$583,132
Fishing	Warm-water fishing, cold-water fishing	$26.80	$4,722,495	$1,180,265
Water Based Recreation	Swimming, motorized and non-motorized boating, sailing, water skiing, tubing	$25.30	$7,690,884	$1,711,807
General Recreation	Picnicking, viewing	$37.08	$6,190,970	$3,900,071
Total			$20,345,491	$7,375,275

After expenditures by activity are determined, an expenditure profile for each activity is established. An expenditure profile separates the expenditures by type of expenditure, e.g., lodging, food, gas, etc. This is necessary as IMPLAN calculates sales, regional income and employment based on these expenditure profiles. This analysis uses expenditure profiles for camping, fishing, general recreation, and water based recreation developed by Johnson et al. (1995).

6.5.4 Affected Environment–Base Condition

The following sections describe the current regional economies of the four functional economic regions identified for the flow augmentation analysis.

6.5.4.1 Eastern Idaho-Wyoming Region

Agriculture is broadly defined to include livestock and crop production activities, agricultural services and food processing industries. Agricultural activities, so defined, rank second in sales and regional income to other activities in the Eastern region. Agriculture accounts for 15 percent of sales and 16 percent of regional income. Crop production and agricultural processing make up the largest portion of this broadly defined agricultural sector. Agriculture contributes approximately 12 percent of total regional employment which ranks it fourth in this region behind retail trade and the government sector.

These figures account for both forward and backward linkages that stem from irrigated agriculture. These estimates imply that if all irrigation were to cease in the region, the Eastern regional economy would lose 21,500 jobs and $942 million in regional income. Major sectors whose income is dependent on irrigated agriculture are the crop production sector (89 percent), agricultural processing (72 percent), agricultural services (50 percent), and livestock (22 percent). Roughly 16 percent of the transportation and wholesale industries income is dependent on irrigated agriculture. The service, communication, and retail industries have between 7 and 9 percent of their income tied to the existence of irrigated agriculture.

Recreation expenditures of approximately $20 million generate $16 million (0.15 percent of the regional economy) in sales, $7 million (0.13 percent) of regional income, and 321 jobs (0.19 percent of the regional economy). The majority of this activity is generated in the retail and service sectors.

The service sector contributes the largest amount to this region's economy in terms of employment, regional income, and sales. Service sector jobs account for 19 percent of sales, 27 percent of employment, and 22 percent of regional income. Tourism related activities comprise a large portion of the activity in this sector; this economic region includes Jackson, Wyoming and other popular tourist areas. Healthcare and business service related activities also make up a portion of this sector.

Other important sectors in the Eastern region economy include the government sector which contributes 17 percent of total employment and 13 percent of regional income. Government jobs and income stem from government purchases, transfers, and grants made to universities and government agencies as well as direct employment of labor by local, state, and Federal governments. The Idaho National Engineering and Environmental Laboratory (INEEL) and Idaho State University are major government employers in this region.
The retail sector accounts for 18 percent of the regions employment. These jobs and sales are generated in eating and drinking establishments, food stores, general merchandise establishments, auto dealerships, and building and garden supply stores.

6.5.4.2 South-Central Idaho Region

The agricultural sector contributes a greater amount of employment, regional income, and sales in the South-Central (Twin Falls) region than in any of the other three economic regions. Agriculture directly generates 24 percent of employment, 31 percent of regional income, and 32 percent of sales. Agricultural processing activities generate the largest portion of the jobs, income and sales. Livestock and crop production are also important, contributing respectively 6 and 11 percent of total regional income.

Irrigated agriculture generates about one-third of regional income and sales and about 22 percent of all jobs in the region. This amounts to 21,500 jobs and $937 million in regional income. Roughly 93 percent of crop production income comes from irrigated agriculture. About 74 percent of agricultural processing income is dependent on irrigated agriculture, and 33 percent of the transportation sector income and 35 percent of the wholesale trade is driven by irrigated agriculture. Roughly 14 percent of all retail trade and services income is generated by irrigated crop production.

The service sector ranks second in employment, income, and sales in the South-Central Idaho region. The service sector accounts for 19 percent of employment, 13 percent of regional income, and 11 percent of sales in this region. Retail trade is also an important contributor to employment in this region, making up 17 percent of employment. The Finance, Investment, and Real Estate (FIRE) sector contributes largely to sales and regional income in the region.

6.5.4.3 Southwest Idaho-Oregon Region

Agriculture plays a lesser role in the Southwest Idaho-Oregon (Boise) region which is dominated by the manufacturing, service, and government sectors in the Boise metropolitan area. The broadly defined agricultural sector contributes 10 percent of regional employment and 11 percent of regional income.

However, irrigated agriculture accounts for roughly 9 percent of regional income and 8 percent of regional employment. These estimates account for both forward and backward linkages that stem from irrigated agriculture. These estimates imply that if all irrigation were to stop in the region, the Southwest Idaho-Oregon regional economy would lose 22,100 jobs and $982 million in regional income. Major sectors whose income is dependent on irrigated agriculture are the crop production sector (96 percent), agricultural processing (62 percent) and livestock (24 percent). Roughly 9 percent of the transportation and wholesale industry incomes are dependent on irrigated agriculture. The service, communication, and retail industries have between 3 and 4 percent of their income tied to the existence of irrigated agriculture.

Approximately $7 million of recreation expenditures are generated in the Southwest region. These expenditures generate about $7.5 million of sales (0.03 percent of regional economy), $3.5 million of regional income (0.03 percent of regional economy), and 127 jobs (0.04 percent of regional economy). Like the Eastern region the activity occurs mainly in the retail sales and service industries.

Manufacturing makes up 24 percent of sales and 19 percent of regional income. The electronics industry make up a large portion of the manufacturing sector in this region. The government sector accounts for 22 percent of the region’s economy. State government and Mountain Home Air Force Base generate a large portion of the government sector activities. The service sector generates 22 percent of employment and 14 percent of regional income.

6.5.4.4 Eastern Oregon-Washington Region

The broadly defined agricultural sector accounts for 25 percent of total sales, 19 percent of employment, and 22 percent of regional income, making it the largest contributor to sales and income in the Eastern Oregon-Washington region. About 11 percent of regional income comes from crop and livestock production with another 8 percent from agricultural processing. Data were not available to determine irrigated agriculture’s contribution to this region’s economy.

The service sector makes up the largest portion of regional employment at 20 percent but contributes only 14 percent of regional income. Government is a very important contributor to jobs and in this region accounting for 20 percent of total employment.

6.5.4.5 Summary of Base Case Regional Economy

Table 6-32 summarizes total sales, employment, and regional income of the four functional economic regions identified for this analysis.

Table 6-32 Summary of Base Case Regional Economies (1994 Dollars)

Region	Employment (Jobs)		Regional Income (Thousand Dollars)		Sales (Thousand Dollars)	
	Regional	Irrigated Agriculture	Regional	Irrigated Agriculture	Regional	Irrigated Agriculture
Eastern Idaho-Wyoming	172,381	21,519	5,870,546	941,869	11,275,215	1,691,392
South-Central Idaho	89,332	21,581	3,015,552	936,910	6,544,256	2,121,644
Southwest Idaho-Oregon	293,105	22,146	10,832,523	982,297	21,835,164	2,052,953
Eastern Oregon-Washington	103,725	([1])	3,591,402	([1])	7,122,877	([1])
Total	658,543		23,310,023		46,777,512	

[1]Data insufficient to determine contribution of irrigated agriculture

6.5.5 Environmental Consequences

The regional analysis of agricultural impacts measures the change in regional sales, employment, and income. The regional economic impacts include the direct and secondary effects stemming from lost irrigated agricultural production. Secondary effects are usually separated into (1) indirect effects that would stem from industries supplying inputs to the agricultural production process and (2) induced effects that result from changes in payrolls and subsequent changes in household consumption.

Three alternative estimates of regional impacts were made based on the following:

- Reduced Irrigation. This estimate is of impacts stemming from the reduction in irrigated agricultural production only.
- Reduced Irrigation With Payments to Farmers. This estimate adds the impacts of a hypothetical water acquisition program to those of a reduction in irrigated agriculture production.
- Reduced Irrigation With Forward Linkages. This estimate adds the effect of forward linkages to those of a reduction in irrigated agriculture production. That is, it adds the ripple effects to industries such as livestock and agricultural processing that use irrigated crops as a part of their production process.

Reclamation considers that the second estimate–Reduced Irrigated Agriculture Production With Water Payments–would be the best estimate of likely regional economic impacts. The third estimate–Reduced Irrigated Agricultural Production With Forward Linkage–would shows the largest regional economic impact and represents the upper end of the possible range of economic impacts based on the water sources evaluated.

6.5.5.1 Impacts from Reduced Irrigation

This estimate focuses on direct and secondary impacts that would stem from the reduction in irrigated agricultural production under the 1427i and 1427r scenarios. The analysis assumes that agriculture and its input suppliers are affected from reduced production of the specified irrigated crops. Industries supplying input to the agricultural production process are part of the indirect effects. Changes in payrolls and subsequent changes in household consumption are included in the induced effects. The regional economic impact is based on the total of direct effects and secondary effects without consideration of forward linkages or possible payments to farmers. Potential impacts are shown in table 6-33.

Table 6-33 Potential Losses from Reduced Irrigation

Region	1427i			1427r		
	Employment	Income	Sales	Employment	Income	Sales
Eastern Idaho-Wyoming	920 jobs	$26,300,000	$38,400,000	923 jobs	$26,600,000	$30,000,000
South-Central Idaho	388 jobs	$11,000,000	$20,000,000	1,120 jobs	$31,600,000	$57,800,000
Southwest Idaho-Oregon	890 jobs	$22,000,000	$31,600,000	1,500 jobs	$37,000,000	$53,500,000
Eastern Oregon-Wyoming	660 jobs	$17,000,000	$23,500,000	660 jobs	$17,000,000	$23,500,000
Total	2,859 jobs	$76,300,000	$113,500,000	4,203 jobs	$112,200,000	$164,800,000

6.5.5.2 Impacts of Reduced Irrigation With Payments to Farmers

This estimate includes the impacts estimated for Reduced Irrigation (see section 6.5.5.1) along with the effect of payment to farmers for acquisition of water for the 1427i and 1427r scenarios. The value of the water payment to farmers was estimated at $75 per acre-foot of water consumed; this is the midpoint of acquisition costs based on recent water acquisitions and reduction in consumptive use (see section 6.2.2.7.1). Estimates using this method result in the lowest acquisition costs of the three estimating methods. The water acquisition payment is assumed to be made to farm households selling the water and is treated as household income.

Farm households tend to be elderly with strong regional and community ties therefore this analysis assumes that the income payment accrues to farm households in the region. However, it should also be noted that much of that income would not be spent on regionally produced goods and services. In order to estimate regional consumption generated by the income payment, it is necessary to estimate the leakage of that income to household savings and to Federal and state income taxes.

The IMPLAN Social Accounting Matrix for each of the four regions was used to estimate the rate of household savings and Federal and state income tax payments. The average saving and tax rates from the regional Social Account Matrix assumed to apply to the marginal change in household income represented by the income payment. Disposable household income is determined as the net after household saving and Federal and state income tax payments.

For this analysis, the pattern of household consumption in each regional input-output model is used to determine the consumption bundle and household expenditure. It is assumed that the marginal change in income results in the same pattern of regional household consumption as reflected in regional average consumption function in the input-output model. With this information, the mix of household consumption of goods and services is estimated. The proportion of regional consumption coming from regional production versus imported from outside the region is determined by using the regional purchase coefficient from the regional input-output model. In other words, some of the household consumption comes from regional production while some of the consumption is based on goods and services imported from outside the region. These commodities may be produced in other parts of the state, other states, or other countries. Only goods and services produced in the region have a ripple effects on the regional economy in terms of induced effects.

In summary, the direct effect of household spending of payments for water purchased is determined after accounting for leakage for imported consumption, household saving, and household Federal and state income tax payments. This direct effect of household spending of the income payment drives the induced effect of the income payment. The total regional impact of the Federal income payment to households is the sum of the estimated direct and induced effects of the associated regional household consumption. In this analysis, the income payment effects have been added to the irrigation loss effects. The result is the net loss in regional activity due to the reduction in irrigation. Potential impacts are shown in table 6-34.

Table 6-34 Potential Losses from Reduced Irrigation with Payment to Farmers

Item	1427i			1427r		
	Employment	Income	Sales	Employment	Income	Sales
Eastern Idaho-Wyoming	800 jobs	$12,000,000	$31,600,000	804 jobs	$12,900,000	$23,500,000
South-Central Idaho	323 jobs	$4,400,000	$16,400,000	873 jobs	$6,900,000	$44,300,000
Southwest Idaho-Oregon	800 jobs	$12,300,000	$26,200,000	1,315 jobs	$16,176,000	$41,600,000
Eastern Oregon-Washington	620 jobs	$16,000,000	$21,000,000	620 jobs	$16,000,000	$21,000,000
Total	2,543 jobs	$44,700,000	$95,200,000	3,612 jobs	$51,976,000	$130,400,000

6.5.5.3 Impacts of Reduced Irrigation With Forward Linkages

This estimate includes the impacts estimated for Reduced Irrigation (see section 6.5.5.1) along with the effect of forward linkages (see section 6.5.3.1).

If a reduction in crop production would result in a corresponding reduction in output of those industries using the crop as an input to their production process, then it is proper to include forward linkages as a part of a regional impact. The strength of the forward linkage between a crop and a given processing industry depends on the crop geographic specialization, the supply of the crop compared with regional demand, and the possibilities for importing a substitute input crop. When the crop is very specialized and there are no importable substitutes, forward linkages are more likely.

There are several reasons for believing that there will be little forward linkage impacts in the 1427i and 1427r scenarios. The crops that would be reduced are lower valued crops that exist in excess supply in each of the economic areas. Further, the estimates in this analysis indicate that the reduction of those crops under the 1427i and 1427r scenarios would be small compared to the total regional supply of affected crops. This means that an adequate supply of crops would continue to exist under the 1427i and 1427r scenarios. In addition, the crops that are most likely to be reduced are not highly specific to the economic regions considered in this analysis and alternative sources of these crops are likely available from other regions.

However, the issue of forward linkage as it applies to this analysis is controversial. Representatives of the water users have expressed the view that the effect of forward linkages might be magnified by a reduction in crop production due to the 1427i and 1427r scenarios. They contend that at least some forward linked plants operate on the economic margin and only a slight disruption in supply could entice the owners of such plants to relocate. They also contend that just the uncertainty that would be introduced by a decision to adopt a 1,427,000-acre-foot flow augmentation could be sufficient cause for processors to relocate facilities outside the region. However, there is also a possibility that 1,427,000 acre-feet could be provided without disrupting the water supply to high value crops like potatoes, but that the water supply to potato processors in the basin might be disrupted for a variety of reasons including additional flow augmentation.

Arguments for and against inclusion of forward linkages have a solid basis. The models suggest that there should continue to be sufficient supply of key agricultural crops. However, it is recognized that agriculture dependent economies are highly competitive, in a constant state of change and adjustment, and seemingly small changes can tip the economic balance in a different direction. Rather than judge between the two views, an estimate that adds forward linkages was made. Potential impacts are shown in table 6-35.

Table 6-35 Potential Losses from Reduced Irrigation with Forward Linkages						
Item	1427i			1427r		
	Employment	Income	Sales	Employment	Income	Sales
Eastern Idaho-Wyoming	1,200 jobs	$38,500,000	$67,700,000	1,130 jobs	$36,000,000	$63,000,000
South-Central Idaho	700 jobs	$24,000,000	$58,000,000	2,000 jobs	$67,600,000	$164,000,000
Southwest Idaho-Oregon	1,500 jobs	$48,000,000	$96,000,000	2,500 jobs	$83,800,000	$167,500,000
Eastern Oregon-Washington	900 jobs	$22,500,000	$37,000,000	900 jobs	$22,500,000	$37,000,000
Total	4,300 jobs	$133,000,000	$258,700,000	6,530 jobs	$209,900,000	$431,500,000

6.5.5.4 Impacts of Reduced Recreation

Recreation visits would be reduced in the Eastern and Southwest regions under the 1427i and 1427r scenarios. Reductions in non-resident spending associated with recreation would result in direct and secondary impacts to the regions. Table 6-36 summarizes lost expenditures by activity for each region.

Table 6-36 Lost Recreation Visitation and Associated Expenditures					
Activity	Expenditure per Visit	1427i Losses		1427r Losses	
		Visits	Expenditure	Visits	Expenditure
Eastern Region					
Camping	$15.95	13,148	$209,703	1,238	$19,738
Fishing	$26.80	10,685	$286,358	3,638	$97,485
Water-based recreation	$25.30	14,585	$369,001	10,838	$274,189
Total		38,418	$865,062	15,714	$391,412
Southwest Region					
Camping	$15.95	12,248	$195,348	4,035	$64,358
Fishing	$26.80	13,520	$362,336	3,610	$96,735
Water-based recreation	$25.30	16,900	$427,570	6,376	$161,300
General day use	$37.08	785	$29,108	0	
Total		43,453	$1,014,362	14,021	$322,393

6.5.5.4.1 Eastern Region

Lost expenditures for the 1427i scenario would be $865,000. With this level of impact, 14 jobs (0.008 percent of the regional economy), $315,000 of regional income (0.005 percent of the regional economy), and $684,000 in sales (0.006 percent of the regional economy) would be lost. These losses are very small relative to the total Eastern region economy.

Lost expenditures for the 1427r scenario is about $391,000. Six jobs (0.004 percent of the regional economy), $148,000 of regional income (0.003 percent of the regional economy), and $326,000 of sales (0.003 percent of the regional economy) would be associated with this level of impact.

6.5.5.4.2 Southwest Region

Lost expenditures for the 1427i scenario would be $1 million. With this level of impact, 19 jobs (0.007 percent of the regional economy), $509,000 in regional income (0.005 percent of the regional economy), and $1 million in regional sales (0.005 percent of the regional economy) would be lost.

Lost expenditures for the 1427r scenario would be $322,000. Six jobs (0.002 percent of the regional economy), $163,000 of regional income (0.001 percent of the regional economy), and $335,000 of sales (0.002 percent of the regional economy) would be lost.

7 Resource Analyses

The analyses in this chapter are based on the selection of specific water sources for flow augmentation (see chapter 5) and should be considered representative rather than definitive for the flow augmentation scenarios. Selection of water sources from other subbasins would result in environmental effects in other areas. However, the magnitude of effects is likely to be similar regardless of the subbasin or water sources selected.

This chapter discusses the affected environment and the projected environmental consequences of the scenarios. Discussion of the affected environment is not meant to be all encompassing but is limited to those physical areas that would be affected by a flow augmentation scenario. The reader is directed to Reclamation (1996a and 1997a) for descriptions of Snake River tributary basins not fully covered in this analysis.

Native Americans frequently find descriptions of natural resources to be too narrow. They view their entire heritage, including beliefs, traditions, customs, and spiritual relationship to the earth and natural resources as sacred cultural resources. Natural resources are viewed holistically, not as separate components. Reclamation acknowledges this view point, but for the sake of analysis has evaluated natural resource components separately. Relationships between resources are identified where possible.

This chapter is divided into the following major sections:

- Water quality
- Fish
- Wildlife and Vegetation, Including Wetlands and Riparian Habitat
- Threatened and Endangered (T&E) species (listed under the ESA)
- Cultural Resources
- Indian Trust Assets
- Recreation
- Wild and Scenic Rivers

An additional section–state rare species–was considered, but dropped from this analysis. Several states comprising the Snake River basin have identified species of concern. These species are quite numerous, widely scattered, and selected under different criteria by each state (see Reclamation, 1998). For this analysis, Reclamation determined that discussion of federally listed threatened and endangered species would be sufficient to illustrate the potential effects of the flow augmentation scenarios. This same approach has been adopted with respect to Federal Wild and Scenic Rivers versus rivers which fall under state protection. Only Federal Wild and Scenic River designations are addressed in this analysis.

Each major section is further subdivided into (1) a subsection on the affected environment that includes current conditions and (2) a subsection on the environmental consequences or the effects projected to occur with each scenario. Because effects are highly specific to river reaches and reservoirs, each section on affected environment and environmental consequences is usually subdivided into sections based on stream reaches and reservoirs. For this analysis, discussion under the Affected Environment sections constitutes current conditions (Base Case). Thus, the Environmental Consequences sections are confined to the No Augmentation, the 1427i, and the 1424r scenarios. Preliminary analysis of the effects of the No Augmentation scenario were determined to be not measurably different from the Base Case for some categories of analysis. In these categories, the No Augmentation scenario was assumed to be the same as the Base Case and no further analysis was made. Where applicable, effects of the scenarios are presented in a single graphic form or in a single table so that comparisons are readily evident.

The level of detail in the analysis of each resource varies from qualitative to quantitative depending upon available information. To facilitate the development of this data within the time constraints for study completion, Reclamation based much of the analysis on information developed through its ongoing SR^3 program which covers the Snake River basin upstream of Brownlee Dam. Since the geographic extent of this flow augmentation analysis extends to Lower Granite Lake, there is a difference in the geographic scope. Information about the basin between Brownlee Dam and Lower Granite Dam is not presented at an equivalent level of detail as the SR^3 area. However, the areas of greatest potential impact of the four scenarios is in the SR^3 area.

7.1 Water Quality

The Clean Water Act (CWA) was enacted with the objective of identifying water quality problems and setting water quality standards throughout the Nation. The EPA is the Federal agency charged with implementing provisions of the CWA and subsequent amendments. In response, the EPA directed the states to develop water quality programs to assess water quality and to identify stream reaches and lakes that would not support fish and swimming.

Water quality goals have been identified on a national level pursuant to the 1998 Clean Water Action Plan, identifying water quality standards to meet these goals. These water quality standards are based on the requirements for a healthy aquatic biota and for full body contact recreation which typically require the highest instream and reservoir water quality to achieve fishable and swimmable waters for all Americans.

Water quality is an important issue to Native Americans as all life - - plant and animal - - depends on abundant, clean water. Water quality which negatively affects aquatic life, would have a negative effect on Native Americans. Declining water quality affects not only the abundance and health of aquatic life, but would be perceived as an ecosystem that is out of balance.

Water quality factors critical to meeting national water quality goals include: water temperature, nutrients, dissolved oxygen (DO), bacteria and pathogens, and toxic substances. Instream flows directly affect water quality by increasing or decreasing (diluting) the concentration of nutrients, bacteria, pathogens, and toxic substances. Flow rates can also affect DO, i.e., the greater the turbulence, the greater the DO and temperatures. Reservoir levels impact water quality not only within the reservoir, but downstream when releases are made.

The water quality of Reclamation reservoirs and the downstream reaches that may be affected are included in the compilation of Section 303 (d) of the CWA. A listing by hydrologic unit codes (HUC) originally developed by the U.S. Geological Service (USGS) and further subdivided by prominent landmarks or towns is included as attachment G.

The furthest upstream reaches where there is little development or human influence tend to have little or no water quality problems. Water quality problems tend to increase downstream as streams flow through irrigated areas and other developments and include not only introduced substances but also temperature increases and flow changes or fluctuations that may have adverse effects on aquatic organisms. Sediments, high temperature, bacteria, and low DO have the greatest impact on water quality within the basin.

The following discussion is limited to those reservoirs and river reaches that would be affected by the flow augmentation scenarios. For this analysis, threshold minimum reservoir pools and minimum streamflows at which significant adverse water quality problems can be expected were obtained from existing reports covering Reclamation facilities within these reaches (see references).

Riverflow in cubic feet per second and end-of-month reservoir content in acre-feet from the hydrologic model were compared to the threshold minimums to determine changes in water quality. The number of instances which fell below threshold minimums was counted for each scenario. The percentage of time these minimums were met or exceeded was calculated and compared to the Base Case scenario and positive and/or negative impacts to water quality were determined.

The BETTER (Box Exchange Transport Temperature Ecology Reservoir) water quality model provided a two-dimensional simulation of dissolved oxygen levels in Cascade Reservoir. These levels were correlated to IDFG reports on winter fish kill to determine how the augmentation scenarios would impact water quality and the fishery in Cascade Reservoir. This is the only reservoir in the Snake River basin for which the BETTER water quality model was used.

7.1.1 Snake River Basin Upstream of Milner Dam

7.1.1.1 Affected Environment–Base Case Scenario

Jackson Lake, the reach from Jackson Lake to Palisades Reservoir, and Palisades Reservoir currently meet the water quality standards. However, flow levels in the Snake River downstream of Palisades Dam to Heise are at times harmful to some aquatic organisms. Peak flows for this reach of the Snake River occur in June and July; low flows, which typically exceed 1,000 cfs, occur in November and December. Further downstream, from Heise to the confluence with the Henrys Fork, water quality standards are met.

Sediment discharge at American Falls Dam reduces downstream water quality whenever reservoir content falls below 50,000 acre-feet (based on sediment and turbidity samples collected during the 1994 drawdown). This is projected to occur in 5 years of the 62-year period of record or 7 percent of the time under the Base Case. Critical months of low reservoir volumes most often occur between July and October.

7.1.1.2 Environmental Consequences

7.1.1.2.1 No Augmentation Scenario

Slight changes in the pool volume of Jackson Lake, Palisades Reservoir and Lake Walcott would not be expected to have significant water quality effects.

The water quality of American Falls Reservoir would be improved slightly due to a slight increase in pool volume and this would somewhat decrease the risk of releasing sediment from the reservoir. These slight effects would be difficult to measure.

7.1.1.2.2 1427i Scenario

On average, Jackson Lake content would be about 8 percent less and Palisades Reservoir would be 11 percent less compared to the Base Case. These lower pool volumes would reduce the volume of cold water available for downstream release.

American Falls Reservoir would be drawn down below 50,000 acre-feet about 14 percent of the time. More frequent low reservoir pools would increase sediment discharge which would further impact downstream water quality.

Lake Walcott would not change compared to the Base Case.

7.1.1.2.3 1427r Scenario

Slight changes in the pool volumes of Jackson Lake, Palisades Reservoir, and Lake Walcott would not be expected to have a significant water quality effect. American Falls Reservoir would be drawn down below 50,000 acre-feet 8 percent of the time with some impact on downstream water quality.

7.1.2 Snake River Basin From Milner Dam to Brownlee Dam

7.1.2.1 Affected Environment–Base Case Scenario

In the past, nearly all flows in the Snake River were diverted at Milner Dam during the irrigation season to meet irrigation demands. Under the Base Case, a flow of 1,500 cfs past Milner Dam is maintained nearly to October. Flows are ramped down during the end of September to normal low releases. The Snake River downstream of Milner Dam is heavily impacted by nutrient and sediment loads and flow modifications. Under the FERC license for the Milner Powerplant, a minimum flow of 200 cfs must be released if available; however, under occasional low flow conditions water is not available for releases and there are no flow releases. Drought conditions reduce the capacity of the river to assimilate nutrient loads. Concurrent years of low flow conditions allow sediments to accumulate and facilitate nuisance algal growths. Periods of elevated instream flows are necessary to move accumulated sediment out of this reach of the river.

Between Milner Dam and King Hill, flow of the Snake River is augmented by groundwater flows, agricultural returnflows, tributaries, and geothermal sites. The Thousand Springs area provides an average annual discharge of more than 4,000 cfs.

Snake River flows downstream of King Hill were not considered in the water quality analysis.

7.1.2.2 Environmental Consequences

7.1.2.2.1 No Augmentation

Flows past Milner Dam during the irrigation season would be considerably less due to cessation of upstream releases for flow augmentation. Flows of less than 200 cfs would be experienced more often than with the Base Case, resulting in slightly worse conditions immediately downstream.

7.1.2.2.2 1427i Scenario

Flows past Milner Dam would be greater in most summer months with improved water quality during those months. However, flows past Milner Dam from September to April would allow for more sediments to remain in the river, reducing downstream water quality.

7.1.2.2.3 1427r Scenario

Flows past Milner Dam would be greater in most summer months with improved water quality during that time. Downstream water quality would be improved by an increase in the number of higher flow months which would continually move sediments downstream.

7.1.3 Boise River Basin

7.1.3.1 Affected Environment–Base Case Scenario

The target minimum discharge from Lucky Peak Dam set in agreements with the city of Boise and IDFG is 150 cfs during the nonirrigation season. This target includes 80 cfs from Lucky Peak space to provide flows for water quality and an additional 70 cfs from space reassigned to the IDFG for stream maintenance. This target flow should provide sufficient flow to assimilate discharge from wastewater treatment facilities without negatively impacting downstream water quality. This target may not be met between December and February if severe drought conditions occur. Concurrent years of drought conditions may reduce reservoir volumes to the point that the target flow would not be met prior to December.

7.1.3.2 Environmental Consequences

7.1.3.2.1 No Augmentation Scenario

Slight changes in pool volumes of Anderson Ranch Reservoir, Arrowrock Reservoir, and Lucky Peak Lake would not be expected to have a significant effect on water quality.

7.1.3.2.2 1427i Scenario

Anderson Ranch Reservoir volume would be 12 percent less on average compared to the Base Case. The lower pool elevation would reduce the volume of cold water available for downstream release. Arrowrock Reservoir volume would be 34 percent less on average compared to the Base Case, and the amount of habitat available for fish during periods of ice cover would be reduced. The risk of sluicing sediments downstream would increase. Lucky Peak Lake would have 13 percent less volume on average, reducing available habitat for fish.

Flows past Lucky Peak Dam on the Boise River from December through March would drop below 150 cfs more often than under the other scenarios. During April through August, flows would be consistently higher than the 150 cfs target minimum.

7.1.3.2.3 1427r Scenario

Slight changes in the pool volumes of Anderson Ranch Reservoir and Lucky Peak Lake would not be expected to have a significant effect on water quality. On average, Arrowrock Reservoir volume would be 21 percent larger compared to the Base Case. The increased pool elevations might provide additional fish habitat and reduce the probability of downstream sedimentation and turbidity during dry years.

Flows past Lucky Peak Dam would drop below the 150 cfs target flow during October and November. However, flows would be improved over other scenarios and would exceed the 150 cfs target during December through February. As with the other scenarios, flows would exceed the minimum target during

March through August. The increased flows in the Boise River could help alleviate water quality problems further downstream through dilution of nutrient and bacterial loads.

7.1.4 Payette River Basin

7.1.4.1 Affected Environment–Base Case Scenario

Cascade Reservoir has a target conservation pool of 300,000 acre-feet to reduce the risk of depleting dissolved oxygen during periods of ice cover. At this pool size, it can be expected that 11 percent of the time winter stagnation conditions may last long enough to affect salmonids; however, the reservoir would not become anoxic (Reininger and Horner, 1982). With the fall turnover of reservoir water layers, nutrients that were released from the sediments during anaerobic conditions are mixed throughout the water column providing additional nutrients for nuisance algal growth.

Water quality of the Payette River downstream from Black Canyon Dam is affected by flow volumes. Water quality degradation is typical during low flow periods when irrigation return flows comprise a large portion of lower Payette River flows. This reach was not evaluated quantitatively.

7.1.4.2 Environmental Consequences

Deadwood Reservoir volume would on average be the same for all scenarios; no change in water quality from the Base Case would be expected.

7.1.4.2.1 No Augmentation Scenario

Water quality in Cascade Reservoir would be slightly improved with a slight reservoir content increase; the risk of winter fish kills would be reduced somewhat. Average reservoir content would be slightly higher under the No Augmentation scenario than under the Base Case. Water quality of the Payette River downstream of Black Canyon Dam would improve slightly due to increased flow releases.

7.1.4.2.2 1427i Scenario

Cascade Reservoir would be drawn down below the 300,000-acre-foot conservation pool much more often than under other scenarios. Figure 7-1 summarizes the average end-of-month content of Cascade Reservoir over the 62-year period of record and reflects less winter carryover. With a smaller pool, reservoir turnover should be earlier in the fall and would distribute available nutrients and dissolved oxygen throughout the pool. Increased algal growth would occur; but, the dissolved oxygen levels available in the winter would not increase. A pool of 300,000 acre-feet would have oxygen-limiting conditions approximately 11 percent of the time, and a 200,000-acre-foot pool would have oxygen-limiting conditions approximately 42 percent of the time. The risk of reaching oxygen-limiting conditions in these smaller pools would increase substantially. Salmonid survival is dependent upon temperatures below 69.8 °F (21 °C) and dissolved oxygen greater than 3 mg/L. Figure 7-1 indicates that a 400,000-acre-foot pool would contain about 35,000 acre-feet that would meet these conditions due to anaerobic conditions from August until fall turnover. Figure 7-1 was developed through use of the BETTER water quality model of Cascade Reservoir to demonstrate the change in pool volume available for fish under different operations; 400,000 acre-feet and 200,000 acre-feet. For a more complete discussion of fish, see the Fish section of this chapter. A pool of 200,000 acre-feet would contain only 20,000 acre-feet that would meet these conditions from July through fall turnover.

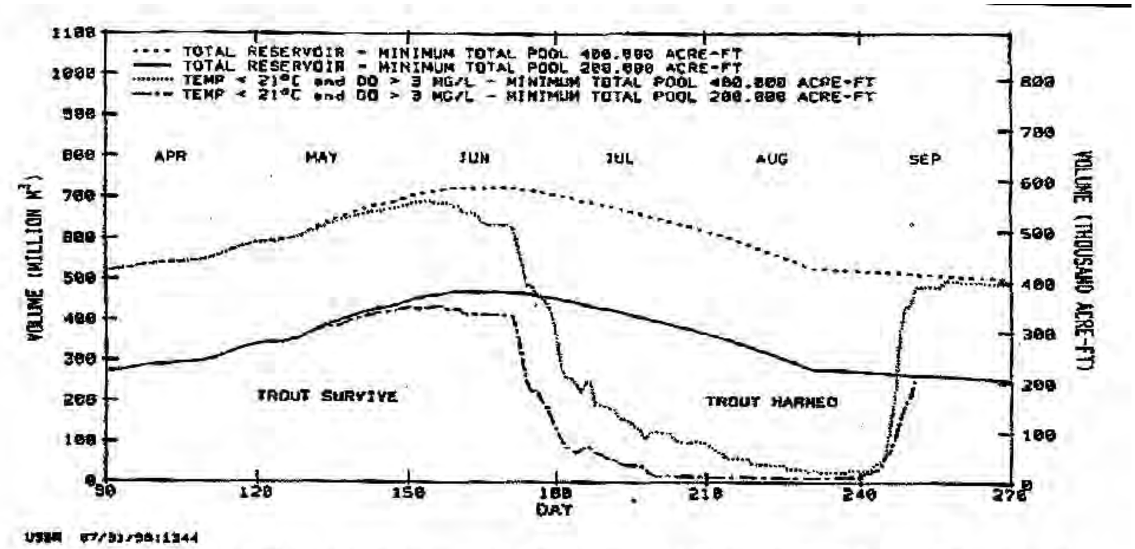


Figure 7-1 Modeled Cascade Reservoir Minimum Trout Habitat During a Low-Water-Supply

Figure 7-1 Modeled Cascade Reservoir Minimum Trout Habitat During a Low-Water-Supply Year

7.1.4.2.3 1427r Scenario

Under the 1427r scenario, Cascade Reservoir would not be drawn down below the 300,000-acre-foot conservation pool (compared with 5 percent of the time for the Base Case). With a larger winter pool, reservoir turnover would occur later in the fall, allowing greater dissolved oxygen content to be carried further into the winter. The risk of winter fish kill would decrease significantly, and drought conditions would have less effect on the reservoir temperature and dissolved oxygen levels. In contrast, average reservoir content would be somewhat lower compared to the Base Case.

7.1.5 Owyhee River Basin

7.1.5.1 Affected Environment–Base Case Scenario

Most irrigation discharges from Lake Owyhee are released through a diversion tunnel, so downstream releases are limited primarily to meeting instream flow rights for irrigation, which average about 200 cfs. There is no minimum flow requirement below the dam; however, about 15 to 20 cfs is released for instream flow maintenance during the nonirrigation season in good water supply years. Seepage of 3-4 cfs provides the only instream flow below the dam in low water supply years. As a result, dissolved oxygen is limited in the river downstream of Owyhee Dam and varies throughout the river.

7.1.5.2 Environmental Consequences

Lake Owyhee would on average have a volume that was 2 percent less compared to the Base Case; water quality would not be expected to change significantly.

7.1.5.2.1 No Augmentation

The No Augmentation scenario would have no effect on the Owyhee River.

7.1.5.2.2 1427i Scenario

Although the reach upstream of Lake Owyhee was not modeled, acquisition of natural flow rights upstream from Lake Owyhee would clearly increase spring and summer streamflows by decreasing irrigation diversions. Decreased irrigation return flows would reduce the nutrient, bacteria, and sediment concentrations in the river upstream of Lake Owyhee. The amount cannot be quantified.

Lake Owyhee content would be 10 percent less on average compared to the Base Case, but water quality would not be expected to change significantly.

Discharge from Owyhee Dam under the 1427i scenario would continue through the later summer months; therefore, dissolved oxygen levels below the dam would be increased over the Base Case scenario.

7.1.5.2.3 1427r Scenario

The effects on water quality would be same as for the 1427i scenario; Lake Owyhee content would be only 3 percent less on average compared to the Base Case.

7.1.6 Snake River Downstream of Hells Canyon Dam and the Grande Ronde and Salmon Rivers

7.1.6.1 Affected Environment–Base Case Scenario

Tributaries draining into the Snake River between Hells Canyon Dam and Lower Granite Lake are affected by natural water supply, irrigation diversions, and return flows. These stream reaches were not modeled for this analysis.

7.1.6.2 Environmental Consequences

7.1.6.2.1 No Augmentation Scenario

This scenario would have no measurable effect.

7.1.6.2.2 1427i Scenario

Although not modeled, water quality of the Snake River downstream of Hells Canyon Dam would improve due to increased flow. The amount cannot be quantified.
The acquisition of natural flow rights (and reduction of diversions for irrigation) in the Salmon and Grande Ronde River basins would increase streamflows in the spring and summer months and would likely reduce nutrient, sediment, and bacteria concentrations in those streams. The amount cannot be quantified.

7.1.2.1.3 1427r Scenario

The effects on water quality would be the same as for the 1427i scenario.

7.2 Fish

It is important to recognize that rivers and reservoirs within the area of analysis are operated to meet contractual obligations and water rights. Environmental considerations including flows for fish maintenance and propagation are typically secondary to meeting other obligations. In response, fish and wildlife agencies now manage some river reaches for warm water species and non-native species that have replaced cold water and native species. Fish are managed in declining environmental conditions, and any further deterioration of conditions can only add more stress to biotic systems.

In addition to the recreation opportunities that healthy fish populations provide, fish are an important traditional food source for many Native Americans. Native Americans in this region once relied heavily on anadromous fish for food, tradition, and ceremonies. They also utilized fresh water, native fish when available.

Fish of the Snake River basin are comprised predominantly of cold-water species in the families Salmonidae (trout), Cottidae (sculpins), Cyprinidae (minnows), and Catostomidae (suckers). Warm-water species are also present at the lower elevations where warmer water temperatures are encountered.

Aquatic ecosystems and native fish populations have been severely altered by human activities since the mid-1800s. Human alteration of hydrology and water quality by dams, diversions, forestry, ranching, agriculture, mining, municipal uses, and over harvest of fish have caused the extirpation of salmon, decline of native species, and invasion by nonnative fish (Armour et al., 1991; National Research Council, 1992, 1995, 1996; Nehlsen et al., 1991; Sheldon, 1988).

Fish communities in rivers altered by the construction and operation of storage facilities are considerably different from communities found in free-flowing rivers (Reclamation, 1997b) where species diversity or biomass typically increase in downstream reaches and in complex habitats. Fish communities also have a predictable succession from cold-water-tolerant species in the headwaters to warm-water-tolerant species in the lower reaches. Species diversity and community composition in the Snake River basin are segmented by impoundments and low-flow reaches downstream from water diversions. The result is a disjunct distribution of fish communities favoring those species that benefit from or tolerate impoundments, low flows, and other related hydrologic and water quality changes (Maret, 1997). Human influences have changed the aquatic biota from one dominated by native species to the current conditions which favors nonnative species.

The distribution of key nonanadromous salmonids such as bull trout, Yellowstone cutthroat trout, and redband trout has also been reduced. Introduced salmonids, centrarchids, and percids (trout, sunfish, bass and perch) now support most of the sportfishing opportunities throughout the basin. These species tend to be less sensitive to disturbance. Common fish species found under current Snake River basin conditions are listed in table 7-1. More than one-half of these species are not native to the drainage.

Biological requirements of fish include water quality, food, escape cover, passage, and reproduction. Extremes in flows can severely limit or completely remove any or all of the above requirements essential to the survival of fish populations. Reservoir operations may result in substantial drawdown during drought years. Reduced reservoir volume may directly impact the size of the aquatic environment for all organisms in the food chain. When reservoir volume is greatly reduced, bull trout and other fish species may be forced into riverine habitats.

Table 7-1 Common Aquatic Species

Common Name	Species	Origin
Family - Acipenseridae		
White sturgeon	*Acipenser transmontanus*	Native
Family - Catostomidae		
Bluehead sucker	*Catostomus discobolus*	Native
Bridgelip sucker	*Catostomus columbianus*	Native
Largescale sucker	*Catostomus macrocheilus*	Native
Mountain sucker	*Catostomus platyrhynchus*	Native
Utah sucker	*Catostomus ardens*	Native
Family - Centrarchidae		
Black crappie	*Pomoxis nigromachirus*	Introduced
Bluegill	*Lepomis macrochirus*	Introduced
Largemouth bass	*Micropterus salmoides*	Introduced
Pumpkinseed	*Lepomis gibbosus*	Introduced
Smallmouth bass	*Micropterus dolomieui*	Introduced
Warmouth	*Lepomis gulosus*	Introduced
White crappie	*Pomoxis annularis*	Introduced
Family - Cichlidae		
Tilapia	*Tilapia sp.*	Introduced
Family - Cottidae		
Mottled sculpin	*Cottus bairdi*	Native
Paiute sculpin	*Cottus beldingi*	Native
Shorthead sculpin	*Cottus confusus*	Native
Shoshone sculpin	*Cottus greenei*	Native
Torrent sculpin	*Cottus rhotheus*	Native
Wood River sculpin	*Cottus leiopomus*	Native
Family - Cyprinidae		
Carp	*Cyprinus carpio*	Introduced
Chiselmouth	*Acrocheilus alutaceus*	Native
Fathead minnow	*Pimephales promelas*	Introduced
Goldfish	*Carassius auratus*	Introduced
Leatherside chub	*Gila copei*	Native
Leopard dace	*Rhinichthys falcatus*	Native
Longnose dace	*Rhinichthys cataractae*	Native
Northern squawfish	*Ptychocheilus oregonensis*	Native
Peamouth	*Mylocheilus caurinus*	Native
Redside shiner	*Richardsonius balteatus*	Native
Speckled dace	*Rhynichthys osculus*	Native

Table 7-1 Common Aquatic Species		
Common Name	Species	Origin
Tui chub	*Gila bicolor*	Introduced
Utah chub	*Gila atraria*	Native
Family - Ictaluridae		
Black bullhead	*Ameiurus melas*	Introduced
Brown bullhead	*Ameiurus nebulosas*	Introduced
Channel catfish	*Ictalurus punctatus*	Introduced
Flathead catfish	*Pylodictis olivaris*	Introduced
Tadpole madtom	*Noturus gyrinus*	Introduced
Family - Percidae		
Walleye	*Stizostedion vitreum*	Introduced
Yellow perch	*Perca flavescens*	Introduced
Family - Poeciliidae		
Mosquitofish	*Gambusia affinus*	Introduced
Family - Salmonidae		
Atlantic salmon	*Salmo salar*	Introduced
Brook trout	*Salvelinus fontinalis*	Introduced
Brown trout	*Salmo trutta*	Introduced
Bull trout	*Salvelinus confluentus*	Native
Coho salmon	*Oncorhynchus kisutch*	Introduced
Cutthroat trout	*Oncorhynchus clarki sp.*	Introduced/Native
Fall chinook salmon	*Oncorhynchus tshawytscha*	Native
Kokanee salmon	*Oncorhynchus nerka*	Introduced
Lake trout	*Salvelinus namaycush*	Introduced
Mountain whitefish	*Prosopium williamsoni*	Native
Rainbow trout	*Oncorhynchus mykiss sp.*	Introduced/Native

Trout and other salmonids need a relatively stable water flow and a silt-free, rocky substrate for optimal spawning and rearing conditions. Optimal feeding occurs in areas with low water velocity (streamside margins), a plentiful food supply, and escape cover nearby. During winter, rainbow trout and other salmonids tend to move into deeper water or find sufficient cover to avoid damage from ice scouring. Higher, more stable streamflows released during the summer months as a result of flow augmentation would increase aquatic insect production, decrease egg mortality, and increase fish spawning and rearing habitat in various riverine environments.

One of the salmonids most sensitive to habitat degradation and sedimentation is bull trout which was listed in June 1998 by the USFWS as a threatened species.

The relationship of streamflows and reservoir pools to fish populations can be highly variable depending on the exact sequence of events, the length of those events, and the life cycle of the fish. For example draining a reservoir every 2 years may essentially decimate the fish population and could be just as adverse as draining the reservoir every year, depending on the species of fish and life stage. In addition to the sequence and frequency of drawdown, timing during the year is also important. For example, reservoir drawdown that occurs for only a short period after fish spawn along the shore line may dewater redds and kill the eggs, eventually eliminating the population. Conversely, a greater amount of annual drawdown that leaves a stable pool during the egg incubation period may still provide a good fish population.

For this analysis, streamflow and reservoir pool targets for fish maintenance were identified from a variety of sources. Many of the target streamflows and pool elevations were developed by the fishery Technical Work Group (TWG) as part of the SR^3 program. Others were developed by state fish and game agencies. These target flows and reservoir pool sizes are based on the biological needs of the fish, not operational constraints that may be present in the system. In this analysis, it is assumed that fish populations would be proportionately larger if target flows and target reservoir pools are met more often. However, it is not possible to directly correlate these averages of flows and reservoir pools with fish population changes for the reasons discussed above. Furthermore, the analysis is based on end-of-months reservoir content and average monthly streamflow while the targets are instantaneous targets. Instantaneous values could often be well below the target during a month when the average was well above the target. The analysis in this section is restricted to identifying how often the target minimums or preferred levels are met under each scenario.

The effects of the scenarios are based on the hydrologic analysis (see chapter 5) of reservoir content and riverflows and are expressed as the percentage of time that streamflow and reservoir targets are met. These percentage are based on the number of years a target is met compared to the 62-year period of record.

Unless stated otherwise, minimum streamflows and/or reservoir pools identified in this analysis were developed by the SR^3 fishery TWG based on the biological needs of the fish. These minimum streamflows and reservoir pools do not represent state recognized stream flow minimums or legally protected minimum reservoir levels. In some cases, the fishery developed criteria correlate with operational requirements and/or considerations.

7.2.1 Snake River Basin Upstream of Milner Dam

7.2.1.1 Affected Environment--Base Case Scenario

Most low streamflow problems in the Snake River upstream of Milner Dam occur between October and March when flows at most locations are affected by reservoir refill. Reservoir releases at this time are inversely proportional to the risk of not refilling the reservoir. Overwinter survival of fry may be one of the major limiting factors to trout populations on both the main stem and the Henrys Fork (IDFG, 1992).

7.2.1.1.1 Jackson Lake

Lake trout are the primary fish of concern from a management perspective. The Wyoming Game and Fish Department (WGFD) determined that the critical management period for lake trout is from December through March. Drawdown during this period should not exceed 5 feet to avoid dewatering redds and exposing eggs to adverse conditions such as freezing and drying. This is especially important because the fishery is supported almost entirely by natural recruitment. Drawdown during the critical period does not exceed 5 feet under the Base Case.

7.2.1.1.2 Snake River From Jackson Lake Dam to Palisades Reservoir

Snake River fine-spotted cutthroat trout are the species of concern in this river reach. Low flows present management problems for this reach. Winter releases from Jackson Lake Dam in the past 25 years have often reduced the riverflow to levels that limit the survival of native Snake River cutthroat trout and other organisms (Annear, 1987). WGFD (Annear, 1987) identified a minimum release from Jackson Lake Dam of 280 cfs during the October 1 through March 31 period and a preferred flow release of 400 cfs. March is the most critical month. A maximum release of 600 cfs during the period should not be exceeded as higher releases would be detrimental to the fishery.

7.2.1.1.3 Palisades Reservoir

Palisades Reservoir provided 22,500 angler hours of bank, boat, and ice fishing in 1993. The primary fish caught, 85 percent of which are hatchery fish, is the Snake River fine-spotted cutthroat. Lake trout and kokanee have been introduced, but only small natural populations have developed.

Large fluctuations in the water level (up to 80 vertical feet) may affect the open-water species. Increased outmigration of fish occurs at levels below 500,000 acre-feet (Elle, 1998). Studies have not been conducted to establish a conservation pool for the fishery; however, the SR^3 fishery TWG identified significant fish entrainment likely when levels fall below 500,000 acre-feet. Most of the entrained fish are cutthroat trout which then take up residence in the main stem downstream.

7.2.1.1.4 Snake River Main Stem From Palisades Reservoir to Henrys Fork

The Snake River downstream of Palisades Dam provides a blue-ribbon trout fishery and is becoming an increasingly popular recreation area (Schrader and Griswold, IDFG, 1994). This reach has quality wild Yellowstone cutthroat trout and brown trout fisheries. The stream reach also contains Idaho’s most unique riparian ecosystem which includes the largest continuous cottonwood ecosystem in the State. The USFWS considers this stream reach to be the most important fish and wildlife habitat in Idaho.

Cutthroat trout downstream from the dam are a mixture of both fine-spotted and Yellowstone races. Wild, native cutthroat trout supported 90 percent of the catch in the reach below Palisades Dam during 1981. Approximately 25,000 angler days downstream of Palisades Dam produced a catch rate of 0.53 game fish/hour that same year. Brown trout provided only a small portion of the catch (9 percent), but offer the opportunity to catch a trophy fish.

Habitat in this reach is generally in good condition; however, flows do not always support fish needs. Winter releases, regulated to manage Palisades Reservoir storage, have resulted in periodic dewatering of secondary channels and major losses of juvenile salmonids. Dewatering during the late 1980s resulted in reduction of cutthroat populations which temporarily offset gains made through harvest regulation. A multi-agency study completed in 1992 defined a minimum winter streamflow of 1,500 cfs below Palisades Dam and a preferred streamflow of 2,200 cfs between October and March to provide for juvenile salmonid habitat and to prevent important habitat from drying or freezing (Schrader and Griswold, IDFG, 1994). Irrigation releases provide sufficient fish flows the remainder of the year.

Implementation of this minimum winter streamflow was initiated to enhance long-term population stability. This reach was modeled at three separate locations: Irwin, Heise, and Lorenzo.

The hydrologic model of the main stem at Lorenzo indicates that the lower 20 miles are impacted under current operations by low flows and reduced releases from Palisades Dam during the late fall and winter.

7.2.1.1.5 Snake River From Henrys Fork to Idaho Falls

The main stem Snake River from the mouth of the Henrys Fork downstream to the upper Idaho Falls Powerplant produces occasional catches of large rainbow and cutthroat trout. Brown trout are caught in this reach as well. This fishery declined due to silt deposits and loss of habitat after the failure of Teton Dam in 1976 and has improved little in recent years.

Minimum streamflows for fish in this reach of the Snake River were identified by the SR3 fishery TWG and include 3,300 cfs from April through September and 1,650 cfs from October through February. A minimum flow was not identified for March.

7.2.1.1.6 Island Park

Island Park Reservoir is managed for rainbow trout, cutthroat trout, kokanee, Snake River fine spotted cutthroat trout, cutthroat hybrids, among other fish. Rainbow trout and kokanee provide an important reservoir fishery with catch rates of up to 0.6 fish/hour. The fishery has been affected by loss of fish downstream through the dam and by other unknown factors since 1992. The result of these constraints on the Island Park Reservoir fishery has been a decline in catch rates and angler satisfaction.

At Island Park Reservoir, drawdown below 40,000 acre-feet flush significant numbers of fish out of the reservoir (Reclamation, 1998). A preferred pool of 135,000 acre-feet year round is desired to maximize fish production.

7.2.1.1.7 Snake River From Idaho Falls to American Falls

The fishery within this reach consists essentially of a put-and-take hatchery rainbow trout fishery. The hydropower impoundments block upstream migration of spawning brown and cutthroat trout and provide less-productive trout habitat than free-flowing reaches. A minimum year-round flow of 2,000 cfs was identified by the SR3 fishery TWG.

7.2.1.1.8 American Falls Reservoir

American Falls Reservoir has nearly 56,000 surface acres and is a popular fishing reservoir. An estimated 26,000 rainbow trout are harvested during seasons with sufficient water volume (IDFG, 1992). The reservoir is stocked early each spring with catchable-size trout. Growth of these trout is significant. Trout planted in the reservoir migrate downstream annually in midsummer for three reasons: 1) the water temperature in the reservoir becomes too warm, 2) the volume of water in the reservoir may become too low, and 3) the water may lack sufficient oxygen to sustain trout (IDFG, 1992). The reservoir also contains a dense population of nongame fish comprised of suckers, carp, and chubs.

The SR3 fishery TWG identified a minimum year-round reservoir conservation pool of 170,000 acre-feet for fish. A maximum 1,000,000 acre-foot pool for the months of May and June was identified to prevent inundation of trout spawning habitat at upper locations of the reservoir.

7.2.1.1.9 Snake River Downstream of American Falls Dam

The reach immediately downstream of American Falls dam is considered to be a blue-ribbon fishery. Rainbow trout, cutthroat trout, and brown trout are found in this reach.

7.2.1.1.10 Lake Walcott

Lake Walcott is part of the Minidoka National Wildlife Refuge. Fish targeted for management include rainbow trout and cutthroat trout. A minimum reservoir storage of 40,000 acre-feet and a preferred storage of 95,200 acre-feet have been recommended to optimize trout habitat.

7.2.1.2 Environmental Consequences

Release of flow augmentation water would decrease reservoir carryover and reduce annual minimum pools in some years. Reduced pools can lead to increased fish emigration at American Falls, Palisades, and Island Park Reservoirs. Reduced pools and increased fluctuations would reduce total available habitat and fish productivity in affected reservoirs (IDFG, 1992). Additional reservoir drawdowns would affect angler success and access.

Unless stated otherwise, minimum streamflows and reservoir pools identified in this analysis were developed by the SR^3 fishery TWG based on the biological needs of the fish species. These minimum streamflows/reservoir levels do not represent state recognized, legally protected minimum water levels.

7.2.1.2.1 Jackson Lake

The recommendation to limit drawdown to 5 feet or less between December and the end of March would not be met under the No Augmentation, 1427i, or 1427r scenarios; this compares with the Base Case which does meet this recommendation.

7.2.1.2.2 Snake River From Jackson Lake Dam to Palisades Reservoir

Table 7-2 compares how often the recommended winter releases are met or exceeded under the four scenarios. There are slight differences among scenarios with the exception of 1427i which shows a significantly reduced level in the amount of time minimum flows are met during the full period.

Table 7-2 Winter Releases From Jackson Lake Dam (October 1-March 31)

Release	Percent of Time Met or Exceeded			
	Base Case	No Augmentation	1427i	1427r
Minimum: 280 cfs for full period	90	93	84	91
Minimum: 280 cfs for March only	73	71	71	71
Preferred: 400 cfs	43	44	43	43
Maximum: 600 cfs exceeded	26	28	28	29

7.2.1.2.3 Palisades Reservoir

A pool greater than 500,000 acre-feet for the entire year would be maintained at the following percentages for each scenario:

Base Case	95 percent
No Augmentation	97 percent
1427i	86 percent
1427r	97 percent

The 1427i scenario, as compared to the Base Case, would result in lower overall pool levels causing a greater potential for entrainment of fish through the dam. The other scenarios would result in slightly higher pool levels.

7.2.1.2.4 Snake River Main Stem from Palisades Dam to Henrys Fork

Table 7-3 shows how often the minimum and preferred winter streamflows (based on the work by Schrader and Griswold (1994)) would be met. Minimum and preferred streamflows would not be consistently met under any of the scenarios; this limits winter habitat for juvenile cutthroat and brown trout. Minimum streamflows would be met less often at Lorenzo than at Irwin under all four scenarios. The No Augmentation and 1427r scenarios would generally meet the minimum flows at a greater rate than the Base Case; whereas, the 1427i scenario would meet them at a significantly reduced rate.

Table 7-3 Winter Streamflows Downstream of Palisades Dam (October-March).

Streamflow	Percent of Time Met			
	Base Case	No Augmentation	1427i	1427r
Irwin				
Minimum: 1,500 cfs	74	81	67	80
Preferred: 2,200 cfs	64	71	56	68
Heise				
Minimum: 1,500 cfs	79	85	73	84
Preferred: 2,200 cfs	71	79	63	75
Lorenzo				
Minimum: 1,500 cfs	72	79	62	77
Preferred: 2,200 cfs	64	71	55	70

7.2.1.2.5 Snake River From Henrys Fork to Idaho Falls

None of the scenarios would continuously meet the minimum for either of the two identified periods shown in table 7-4. All scenarios would be very similar to the Base Case in meeting the minimum flow recommendations.

Table 7-4 Minimum Streamflow for the Snake River From Henrys Fork to Idaho Falls

Streamflow	Percent of Time Flow is Met or Exceeded			
	Base Case	No Augmentation	1427i	1427r
October through February: 1,650 cfs	88	91	86	91
April through September: 3,300 cfs	89	84	87	85

7.2.1.2.6 Island Park Reservoir

The four scenarios would be roughly equal to the Base Case in ability to meet or exceed the minimum drawdown recommendation of 40,000 acre-feet (93-94 percent of the time) and the preferred recommendation of a 135,000 acre-feet (full pool) (12-13 percent of the time).

7.2.1.2.7 Snake River from Idaho Falls to American Falls

A minimum year-round flow of 2,000 cfs would not be met 100 percent of the time under any of the scenarios. Success in meeting the minimum flow would be:

Base Case	75 percent
No Augmentation	77 percent
1427i	76 percent
1427r	78 percent

All scenarios are very close to the Base Case; however, the 1427i scenario would result in meeting the minimum flow most often in the summer while meeting the minimum less often in the winter compared to other scenarios.

7.2.1.2.8 American Falls Reservoir

The identified conservation pool of 170,000 acre-feet would not be met 100 percent for the entire year under any of the scenarios; however, the Base Case and No Augmentation scenarios would meet this recommendation at a higher rate than the 1427i and 1427r scenarios. The maximum pool recommendation of 1,000,000 acre-feet would be exceeded in both May and June for more than 73 percent of the time under all of the scenarios; the 1427i and 1427r scenarios would exceed the maximum pool less often than the Base Case and No Augmentation scenarios. Exceeding the maximum pool recommendation would cause reservoir water temperatures to rise and could inundate upstream channel habitat allowing non-native fish to access native species spawning and rearing areas. Table 7-5 shows how often the recommended minimum and maximum pools at American Falls Reservoir would met or exceeded.

Table 7-5 Pool Levels at American Falls Reservoir				
Pool	Percent of Time Pool is Exceeded			
	Base Case	No Augmentation	1427i	1427r
Year-round minimum pool met or exceeded: 170,000 acre-feet	90	93	82	87
Months minimum pool met or exceeded 100 percent of time	November-June	November-July	December-June	November-June
Maximum pool exceeded during May: 1 MAF	95	97	81	89
Maximum pool exceeded during June: 1 MAF	82	85	81	73

7.2.1.2.9 Snake River Downstream of American Falls Dam

This reach was not evaluated.

7.2.1.2.10 Lake Walcott

A minimum reservoir storage of 40,000 acre-feet and the preferred storage of 95,200 acre-feet would be met 100 percent of the time under all scenarios; there would be no change from the Base Case.

7.2.2 Snake River Main Stem From Milner Dam to Brownlee Dam

7.2.2.1 Affected Environment–Base Case Scenario

7.2.2.1.1 Snake River From Milner Dam to Buhl

Rainbow trout, cutthroat trout, and mountain whitefish are found in this reach. Trout habitat is good throughout most of the free-flowing reaches. However, lack of flows downstream of Milner Dam, especially during the irrigation season, cause water quality deterioration and result in a loss of spawning habitat which significantly affects fish production.

Minimum flows between Milner Dam and Buhl were determined by the SR^3 fishery TWG. The flows identified for July through September would improve water quality conditions. If the flow recommendations were met, algae beds may decrease, creating an increase in fish habitat and slowing oxygen depletion (IDFG, 1992). Increased summer flows would also scour the substrate and aid in prevention of sediment accumulation. Seasonally stable water levels would increase salmonid spawning and rearing habitat by preventing the dewatering of side channels which are important to sustaining a naturally reproducing fishery.

7.2.2.1.2 Snake River From C.J. Strike Reservoir to Brownlee Reservoir (Flows at C.J. Strike)

The Snake River between Walters Ferry and Brownlee Reservoir flows through a broad, flat, low-gradient plain. The river has few rapids or riffles, but many large islands. This reach supports a diversity of warm-water game species, including smallmouth bass, channel catfish, largemouth bass, crappie, bluegill, sunfish, and flathead catfish. Rainbow trout, mountain whitefish, and white sturgeon are also found in this reach. Between Swan Falls Dam and Walters Ferry, the Snake River primarily supports smallmouth bass, channel catfish, and white sturgeon.

A 1984 study by IPC and the USFWS evaluated the effects of flow changes on resident fish habitat in the Snake River from C.J. Strike Dam to Brownlee Reservoir. The priority management species through this reach is the native white sturgeon. The biology and habitat requirements of white sturgeon are poorly understood; however, sturgeon have extreme longevity (over 100 years) for fish. Other target species for this analysis included smallmouth bass, channel and flathead catfish, rainbow trout, and mountain whitefish (USFWS, 1992a). An array of desirable flows between C.J. Strike and Brownlee have been recommended to enhance fish habitat.

7.2.2.2 Environmental Consequences

7.2.2.2.1 Snake River From Milner Dam to Buhl

The quality of trout habitat is largely dependent on the rate that minimum flow recommendations are met in this reach. Table 7-6 summarizes the identified recommended flows and the percent of time those flows would be met under the four scenarios. In general, the No Augmentation scenario would meet the recommended flows at a greater rate than the others, followed by the 1427r and Base Case, with 1427i meeting the recommendations at the lowest rate.

Table 7-6 Minimum Flow Identified for the Snake River Between Milner Dam and Buhl

Flow	Percent of Time Flow is Met			
	Base Case	No Augmentation	1427i	1427r
October: 4,850 cfs	31	31	18	21
November: 4,075 cfs	40	52	29	37
December: 3,500 cfs	63	71	55	63
January: 3,250 cfs	54	56	47	53
February: 3,125 cfs	55	58	48	58
March: 4,752 cfs	42	45	40	44
April: 7,227 cfs	34	39	32	34
May: 12,300 cfs	6	6	8	8
June: 13,525 cfs	0	0	0	2
July: 8,400 cfs	2	3	6	6
August: 5,600 cfs	0	0	61	50
September: 5,050 cfs	6	8	0	6

7.2.2.2.2 Snake River From C.J. Strike Reservoir to Brownlee Reservoir (Flows at C.J. Strike)

The identified desirable flows would be met so infrequently that fish benefits (based on habitat needs) would be limited under all scenarios. Table 7-7 summarizes the flows and the frequency that they would be met under the scenarios. In general, the Base Case and No Augmentation scenarios would be very similar except in December when No Augmentation would less often meet the flow recommendation. The 1427i and 1427r scenarios would meet the recommended flows less often than the other scenarios except in the early summer months.

Table 7-7 Flows of Snake River Between C.J. Strike Reservoir and Brownlee Reservoir

Flow	Percent of Time Flow is Met			
	Base Case	No Augmentation	1427i	1427r
October: 12,500 cfs	34	34	19	23
November: 16,000 cfs	13	10	11	6
December: 16,000 cfs	56	45	31	37
January: 16,000 cfs	18	19	18	18
February: 16,000 cfs	23	16	15	16
March: 16,000 cfs	23	27	27	27
April: 15,000 cfs	37	39	32	35
May: 12,000 cfs	40	37	45	48
June: 9,000 cfs	24	23	45	44
July: 12,500 cfs	6	6	11	10
August: 12,500 cfs	0	0	6	5
September: 12,500 cfs	11	11	2	11

7.2.3 Boise River Basin

7.2.3.1 Affected Environment–Base Case Scenario

7.2.3.1.1 Anderson Ranch Reservoir

Anderson Ranch Reservoir is a popular fishing location within the Boise River basin. This reservoir provides a two-story fishery with smallmouth bass occupying the warm, inshore waters and rainbow trout and kokanee dominating the cold midwater areas (IDFG, 1992). Good spawning conditions in tributary streams provide a continuous supply of kokanee in the reservoir. Recent studies indicate that populations of bull trout in (a species listed as threatened) Anderson Ranch Reservoir migrate up tributary streams annually to spawn and later return to the reservoir. More information on bull trout at Anderson Ranch Reservoir is included under the Threatened and Endangered Species section (7.4).

Maintenance of a year-round conservation pool of at least 70,000 acre-feet in Anderson Ranch Reservoir would protect resident fish habitat within the reservoir (IDFG, 1992). Dropping below this level would likely stress fish by reducing water quality, habitat, food sources, and increasing the water temperature.

7.2.3.1.2 South Fork Boise River

The South Fork Boise River from Anderson Ranch Dam downstream to Arrowrock Reservoir was designated a quality trout stream segment in 1978, the first such designation in southwestern Idaho (IDFG, 1995). Wild rainbow trout, bull trout, and mountain whitefish make up the majority of the fish caught in the South Fork. Anglers caught an estimated 18,400 rainbow trout in 1988 and released 99 percent of the catch (IDFG, 1995).

Minimum flow targets were selected for this reach through consultation with IDFG and interest groups and are outlined in Reclamation's Operations Manual (Reclamation, 1997c). These targets are 300 cfs from September through March and 600 cfs from April through August. The South Fork Boise River fishery benefits from releases during the winter months when flows are low. Maintenance of stable flows of at least 300 cfs increases aquatic insect production, decreases egg mortality, and provides suitable fish spawning and rearing habitat in the South Fork.

7.2.3.1.3 Arrowrock Reservoir

There are two main tributaries to Arrowrock Reservoir, the South and Middle Forks of the Boise River. Arrowrock Dam blocks upstream fish passage and the South Fork is further blocked by Anderson Ranch Dam, 49 river miles upstream of Arrowrock Dam. Arrowrock Reservoir is often severely drawn down by late October as a result of meeting downstream irrigation demands while maintaining Lucky Peak Lake at a high level during the recreation season. Releases from Arrowrock Dam provide nearly all the inflow to Lucky Peak Lake.

Arrowrock Reservoir offers about 3,150 surface acres of fishing at full pool and contains a variety of fish species including smallmouth bass, yellow perch, rainbow trout, bull trout, and mountain whitefish. More information on bull trout at Arrowrock Reservoir is included under Threatened and Endangered Species section (7.4).

Drawdowns and low reservoir levels in the winter negatively impact development of the fish food base, limit spawning conditions for warm-water fish, expose nests, and kill the eggs, reducing the capacity to carry a sport fishery and forcing fish to migrate into Lucky Peak Lake (IDFG, 1992). A conservation pool of 28,700 acre-feet year round has been identified for Arrowrock Reservoir to increase fish habitat and winter carryover of rainbow trout (Wolfin and Ray, 1984).

7.2.3.1.4 Lucky Peak Lake

Lucky Peak Lake provides good habitat for cold-water fish species such as smallmouth bass, yellow perch, rainbow trout, bull trout, kokanee, mountain whitefish, and many nongame species. Spawning conditions for warm-water fish are better in Lucky Peak Lake than in Arrowrock Reservoir because water levels are generally maintained at a constant level throughout the summer (Wolfin and Ray, 1984). The unofficial conservation pool for Lucky Peak Lake is 28,767 acre-feet (Reclamation, 1997c).

7.2.3.1.5 Boise River From Lucky Peak Dam Downstream to Star

The upper reach of the Boise River supports several cold-water fish species. Mountain whitefish is the most abundant game fish present. Hatchery reared rainbow trout, wild rainbow trout, and brown trout comprise the remaining fishery (IDFG, 1992).

Reclamation manages 102,300 acre-feet of storage space in Lucky Peak Lake for minimum streamflows in the Boise River. The use of this storage for purposes other than winter instream flow maintenance would jeopardize the resident fisheries, recreation, and reservoir pools in the entire Boise Project (IDFG, 1992). Low winter flows displace fish, limit winter carryover, and reduce spawning habitat. Lower winter flows would cause a loss of sufficient cover and deeper water to protect fish from ice scouring, and incubating eggs would be deprived of oxygen and frozen if flows are so low that the river freezes.

Sedimentation has rendered spawning gravels unusable and limits trout reproduction downstream of Lucky Peak Dam. Water-quality problems are worsened under low flow conditions by industrial discharges and sewage treatment plants that discharge effluent directly into the Boise River. Low fall and winter flows reduce habitat quality for fish and aquatic organisms, limiting the winter carryover and growth of game fish.

From Lucky Peak Dam to Glenwood Bridge, the ideal flows for a healthy, productive fishery is bank full. High flushing flows are necessary to move silt and sand from suitable spawning gravels and increase aquatic insect production. The SR3 fishery TWG identified a variety of minimum and preferred streamflows for the Boise River downstream of Lucky Peak Dam.

7.2.3.2 Environmental Consequences

7.2.3.2.1 Anderson Ranch Reservoir

The conservation pool of 70,000 acre-feet would not be maintained for the entire year under any scenario. Success in maintaining the recommended conservation pool is summarized below:

Base Case	95 percent
No Augmentation	95 percent
1427i	88 percent
1427r	94 percent

While the No Augmentation and 1427r scenarios are similar to the Base Case, the 1427i scenario would meet the conservation pool less often.

7.2.3.2.2 South Fork Boise River

The target flows of 300 cfs and 600 cfs would not be fully met under any scenario. Table 7-8 summarizes the percent of time that the targets would be met under the scenarios. The 300 cfs winter fishery flow would be met slightly more often under the No Augmentation and 1427r scenarios than under the Base Case and slightly less often under the 1427i scenario. The 600 cfs summer fishery flow would be met similarly under all scenarios.

Table 7-8 Flow of South Fork Boise River Downstream of Anderson Ranch Dam

Flow	Percent of Time Flow is Met			
	Base Case	No Augmentation	1427i	1427r
September-March: 300 cfs	94	96	92	96
April-August: 600 cfs	91	91	91	90

7.2.3.2.3 Arrowrock Reservoir

Table 7-9 shows that the conservation pool of 28,700 acre-feet would not consistently be maintained under any scenario. The No Augmentation scenario would maintain the pool similarly to the Base Case; the 1427r scenario maintains it at a higher rate and the 1427i at a much reduced rate.

Table 7-9 Conservation Pool for Arrowrock Reservoir

Pool	Percent of Time Pool is Maintained			
	Base Case	No Augmentation	1427i	1427r
All months	67	69	51	73
August-January	42	45	24	54

7.2.3.2.4 Lucky Peak Lake

The unofficial conservation pool for Lucky Peak Lake is 28,767 acre-feet (Reclamation, 1997c). The 1427r scenarios would meet this target 100 percent of the time, while the 1427i scenario would meet the target 96 percent of the time.

The 1427r and No Augmentation scenarios would meet the unofficial target of 28,767 acre-feet 100 percent of the time; the Base Case which would meet the target slightly less often and the 1427i scenario would meet the target 96 percent of the time.

7.2.3.2.5 Boise River– Lucky Peak Dam to Glenwood Bridge

Table 7-10 lists the minimum and preferred streamflows, which range from 510 cfs to 2,950 cfs, and shows that only the minimum flow for November would be met <u>100 percent</u> of the time under all scenarios; other flows would be fractionally met under all scenarios. In general, the No Augmentation and 1427r scenarios would provide the minimum and preferred flows about as often as the Base Case, while the 1427i scenario would provide the flows generally left often.

Table 7-10 Flows of Boise River Downstream of Lucky Peak Dam				
Flows	Percent of Time Flow is Met			
	Base Case	No Augmentation	1427i	1427r
October				
Minimum: 680 cfs	89	90	84	89
Preferred: 970 cfs	45	42	44	45
November				
Minimum: 510 cfs	100	100	100	100
Preferred: 1,150 cfs	2	2	0	2
December				
Minimum: 540 cfs	13	13	13	16
Preferred: 1,110 cfs	23	6	5	8
January				
Minimum: 660 cfs	31	31	18	31
Preferred: 1,240 cfs	18	18	15	18
February				
Minimum: 925 cfs	37	37	34	40
Preferred: 1,300 cfs	34	34	32	39
March				
Minimum: 1,390 cfs	50	50	44	55
Preferred: 2,950 cfs	35	37	29	57

7.2.3.2.6 Boise River at Glenwood Bridge

The minimum and preferred flows for the Boise River from the Glenwood Bridge to Star were identified and are the same as for the reach above. Table 7-11 lists the flows and shows that some flows would never be met under all scenarios and other flows would only fractionally be met by any scenario. The No Augmentation and 1427r scenarios would meet the minimum and preferred flows about as often as the Base Case, while the 1427i would generally provide those flows less often.

Table 7-11 Flow of Boise River At Glenwood Bridge				
Flows	Percent of Time Flow is Met			
	Base Case	No Augmentation	1427i	1427r
October				
Minimum: 680 cfs	0	0	0	0
Preferred: 970 cfs	0	0	0	0
November				
Minimum: 510 cfs	0	0	0	2
Preferred: 1,150 cfs	0	0	0	0
December				
Minimum: 540 cfs	15	15	11	18
Preferred: 1,110 cfs	6	6	6	8
January				
Minimum: 660 cfs	31	31	18	31
Preferred: 1,240 cfs	18	18	15	18
February				
Minimum: 925 cfs	37	37	34	40
Preferred: 1,300 cfs	34	34	32	39
March				
Minimum: 1,390 cfs	50	50	44	55
Preferred: 2,950 cfs	32	37	24	31

7.2.4 Payette River Basin

7.2.4.1 Affected Environment--Base Case Scenario

7.2.4.1.1 Cascade Reservoir

Cascade Reservoir is the second most heavily fished water in Idaho. Yellow perch have been the most abundant game fish present with rainbow trout, coho salmon, smallmouth bass, channel catfish, and black crappie making up the rest of the reservoir fishery. However, perch numbers have declined drastically in recent years. A multi-year analysis was initiated in 1998 to determine the cause and the possible role that reservoir operations may have in this decline.

Water quality is a primary concern at Cascade Reservoir. The reservoir is shallow and the direct link between water of sufficient quality to support a healthy fishery and the role of that fishery as a major prey base for resident bald eagles is of particular importance (IDFG, 1992). Bacterial contamination, algal blooms, and winter and summer fish kills have occurred in the reservoir.

In 1985, Reclamation administratively set aside 250,000 acre-feet of uncontracted storage space and 50,000 acre-feet of inactive storage space as a year-round conservation pool of 300,000 acre-feet to protect the reservoir fishery and other recreational uses. Additionally, 69,600 acre-feet have been assigned to flow augmentation. In recent years irrigation carry-over storage and Reclamation's administrative storage designation have resulted in a minimum winter content of about 400,000 acre-feet. Even with this content, water-quality conditions have apparently deteriorated. This suggests that a 300,000-acre-foot conservation pool may no longer be sufficient to protect the reservoir fishery from the risk of a winter fish kill. IDFG now recommends that a conservation pool of 425,000 acre-feet be maintained from October through March and that there be no reservoir drawdown between April 15 and May 15 to prevent yellow perch eggs from being exposed along shoreline areas.

7.2.4.1.2 North Fork Payette River From Cascade Dam Downstream to Smiths Ferry

A high quality fishery which produces large, wild rainbow trout is located between the Cabarton Bridge and Smiths Ferry. This section of the North Fork provides good rearing and adult holding habitat for wild rainbow trout. It provides good cover and has a low gradient with a few long pools and sandy/gravel substrate. Other fish species present include coho salmon, yellow perch, brown trout, whitefish, and bullhead.

Reclamation is required to release reservoir inflow up to 200 cfs year round to satisfy hydropower water rights owned by IPC. The IDWR has approved instream flows of 400 cfs from October through February on the North Fork between Cabarton Bridge and Smiths Ferry. The minimum streamflow is 600 cfs from March through June for the same reach. These minimum streamflows are for fish spawning and egg incubation.

A minimum flow requirement of 1,400 cfs, subject to existing water rights, was established in 1992 for this reach from July through September to maintain flows for recreational purposes and fish habitat maintenance (Condition #6, IDFG Water Right Application License #65-12822).

7.2.4.1.3 Deadwood Reservoir

Deadwood Reservoir supports a popular kokanee fishery. Cutthroat trout support a secondary fishery, and landlocked Atlantic salmon were introduced in 1990. Other fish species present include rainbow trout, bull trout, rainbow/cutthroat hybrid trout, and mountain whitefish. Logging activities and natural erosion have caused extensive sediment deposition in nearby tributary streams, thus degrading some spawning and rearing habitat.

An interim conservation pool of 50,000 acre-feet at Deadwood Reservoir was administratively established by Reclamation in 1985 to protect resident fish and wildlife pending development of a more comprehensive study to determine an adequate minimum pool.

7.2.4.1.4 Deadwood River

The Deadwood River downstream of Deadwood Dam supports cold-water fish populations of rainbow trout, bull trout, and mountain whitefish. Spawning conditions for rainbow trout are excellent and rearing conditions are good, but food production is poor (IDFG, 1992). Tributaries contribute a significant portion of the sediments in the river and nutrient fertility is relatively low due to the infertile soils within the basin (Wolfin and Ray, 1984). Reclamation has reserved 30,000 acre-feet of uncontracted storage in Deadwood Reservoir to provide a winter release of 50 cfs to the Deadwood River. A year-round minimum instream flow of 125 cfs was identified for maintenance of trout rearing and spawning habitat (Pruitt and Nadeau, 1978).

7.2.4.1.5 Middle Fork Payette River to Main Stem Payette River

The reach from where the Middle Fork Payette River flows into the South Fork Payette River and continues to the Main Payette River (North Fork) supports a quality fishery for trout and mountain whitefish. Minimum flows of 407 cfs (September) and 1350 cfs (May-August) were identified for the Middle Fork to increase aquatic insect production, decrease egg mortality, and increase fish spawning and rearing habitat.

7.2.4.1.6 Payette River Main Stem From Black Canyon Dam to Snake River

Mountain whitefish are the most abundant game fish in this section of the Payette River. Other fish species include smallmouth bass, largemouth bass, channel catfish, black crappie, bluegill, pumpkinseed, yellow perch, rainbow trout, and brown trout. The Payette River does not support cold-water aquatic species or provide for salmonid spawning below the dam.

Flows downstream of Black Canyon Dam are usually low during the irrigation season due to large irrigation diversions. Significant streamflow fluctuation has contributed to the degradation of fish habitat in this reach with sand and silt deposits and poor water quality. Minimum flows varying from 1,165 cfs to 3,500 cfs were identified by the SR3 fishery TWG for maintenance of trout, bass, catfish, and mountain whitefish habitat in this reach.

7.2.4.2 Environmental Consequences

7.2.4.2.1 Cascade Reservoir

The percent of the time that each scenario would maintain the 425,000-acre-foot conservation pool from October through March is summarized below:

Base Case	66 percent
No Augmentation	78 percent
1427i	25 percent
1427r	52 percent

Under the No Augmentation scenario, the recommended conservation pool would be maintained more often than under the Base Case; while the 1427r scenario would maintain the pool slightly less often and the 1427i would maintain the pool much less often.

7.2.4.2.2 North Fork Payette River From Cascade Dam to Smiths Ferry

The minimum flows of 400-1,400 cfs for this reach would not be met 100 percent of the time under any scenario as shown in table 7-12. The No Augmentation and 1427r scenarios would be similar to the Base Case with the No Augmentation maintain flows slightly more often, and the 1427r scenario maintaining flows slightly more often in the spring months. The 1427i scenario would differ only slightly from the Base Case.

Table 7-12 Minimum Flows of North Fork Payette River Between Cascade Dam and Smiths Ferry				
Flows	Percent of Time Flow is Met			
	Base Case	No Augmentation	1427i	1427r
October - February: 400 cfs	24	29	22	26
March - June: 600 cfs	57	60	56	65
July - September: 1,400 cfs	36	17	42	34

7.2.4.2.3 Deadwood Reservoir

The administrative conservation pool of 50,000 acre-feet would be maintained at all times under all scenarios with possibly one exception. Under extreme drought conditions the conservation pool might not be maintained under the 1427r scenario.

7.2.4.2.4 Deadwood River

All of the scenarios would meet this minimum flow recommendation of 125 cfs less than 50 percent of the time as shown below:

Base Case	47 percent
No Augmentation	48 percent
1427i	45 percent
1427r	46 percent

All scenarios would vary slightly from the Base Case; the No Augmentation scenario would meet the minimum flows most often and the 1427i scenario would meet the flow least often.

7.2.4.2.5 Middle Fork Payette River to Main Stem Payette River

Table 7-13 lists recommended minimum flows and the success of the scenarios in meeting those flows. The fall through spring recommended flow (407 cfs) would be met similarly under all scenarios, including the Base Case. The summer flow (1,350 cfs) would generally be met more often under the 1427i and 1427r scenarios than under the Base Case and No Augmentation scenarios.

Table 7-13 Minimum Flows for the Middle Fork to Main Stem Payette River				
Flow	Percent of Time Flow is Met For the Entire Period			
	Base Case	No Augmentation	1427i	1427r
September - April: 407 cfs	98	98	99	99
May - August: 1,350 cfs	74	73	83	78

During May and June, the 1,350-cfs minimum flow would be met 97 to 98 percent of the time by all of the scenarios.

7.2.4.2.6 Payette River From Black Canyon Dam to Snake River

None of the scenarios would meet the recommended flows more than 65 percent of the time as shown in table 7-14. All scenarios would meet the winter minimum flows (1,165 cfs) slightly more often and the summer minimum flows (1,800 cfs) much more often than the Base Case. Spring minimum flows (3,500 cfs) would be met about the same by all scenarios. The 1427r scenario would meet all minimum flow recommendations more often than the Base Case or other scenarios.

Table 7-14 Minimum Flows of the Payette River From Black Canyon Dam to Snake River

Flows	Percent of Time Flow is Met			
	Base Case	No Augmentation	1427i	1427r
October - February: 1,165 cfs	48	51	54	56
March - May: 3,500 cfs	65	62	61	65
June - September: 1,800 cfs	26	41	60	64

7.2.5 Owyhee River Basin

7.2.5.1 Affected Environment--Base Case Scenario

7.2.5.1.1 Lake Owyhee

Introduction of largemouth bass, crappie, and yellow perch began soon after reservoir impoundment in the 1930s. Channel catfish and smallmouth bass have persisted in the reservoir after being stocked in the 1960s and 1970s. Black crappie are the most common game fish found in Lake Owyhee and most prevalent from the dam upstream to Leslie Gulch. Crappie typically spawn between Dry Creek and Three Fingers Gulch in shallow bays with a gravel or rock bottom.

Largemouth bass inhabit areas of submerged broken rocks and other locations, with spawning areas located on shallow gravel points between Dry Creek and Leslie Gulch. Smallmouth bass prefer similar habitat to largemouth bass.

Channel catfish occur throughout the reservoir largely due to stocking efforts. Yellow perch and brown bullhead occur throughout the reservoir as well. Rainbow trout are likely from redband stock from the Owyhee River and tributary streams such as Dry Creek. Although few in number, trout inhabit most areas of the reservoir. There are several nongame fish species, including northern squawfish, carp, largescale suckers, bridgelip suckers, chiselmouth, speckled dace, redside shiners, and others.

Populations of bass and crappie have decreased in recent years. Some analysis has been done to determine factors which contribute to the decline. Fluctuating reservoir levels, particularly in June during spawning, can impact fish production. Drops in water level can force fish off nests, or expose nests to predation or dessication. Changes in water temperature can also affect spawning. In addition, bass tournaments held during the spawning season reduce fish propagation. (Reclamation, 1994a)

7.2.5.1.2 Owyhee River Downstream of Owyhee Dam

The Oregon Department of Fish and Wildlife (ODFW) manages the lower 16 miles of the Owyhee River from Owyhee Dam to the Owyhee ditch diversion as a trout fishery (Reclamation, 1994a). Cold-water releases from Lake Owyhee provide suitable temperatures for trout development and rearing. This section of the Owyhee River is popular with anglers as the ODFW stocks the river annually with 20,000-40,000 fingerling rainbow trout which provide a quality trout fishery. A catch-and-release fishery exists for brown trout where trophy-sized brown trout are frequently sought by anglers.

The major limiting factor to trout production downstream of Owyhee Dam is low streamflow during the nonirrigation season (mid-October to mid-April) when reservoir releases are discontinued to store water for the next irrigation season (Reclamation, 1994a). Any flow downstream of Owyhee Dam during the nonirrigation season comes from seepage and natural springs and amounts to about 8 to 10 cfs. The ideal winter minimum flow for the lower Owyhee River is estimated between 50-75 cfs (Reclamation, 1994a); however, ODFW has indicated that an Instream Flow Incremental Methodology analysis is needed to verify the most appropriate flow. The river below the Owyhee ditch is managed for warm-water fish since water temperatures are not favorable for trout.

7.2.5.2 Environmental Consequences

7.2.5.2.1 Lake Owyhee

Although precise data are not available, a reasonable effects analysis may be made by reviewing figures 5-22 and 5-23. In general, the No Augmentation and 1427r scenarios would be similar in effect on reservoir elevations to the Base Case; whereas the 1427i scenario would result in overall lower elevations.

7.2.5.2.2 Owyhee River Downstream of Owyhee Dam

Again, although precise data may not be available, a reasonable effects analysis may be made by reviewing figure 5-22 and table 5-13. Flow releases from Owyhee Dam would be similar for the Base Case and No Augmentation scenarios while there would be significantly increased flows during the spring and late summer months under the 1427r and 1427i scenarios. Minimum flows (10cfs) during the October-March period would be met less often with the 1427r and 1427i scenarios than with the Base Case and No Augmentation scenarios. Minimum flows (100cfs) during the April-September period would be met more frequently under 1427r and 1427i scenarios than under either the Base Case or No Augmentation scenario.

7.2.6 Snake River Main Stem Downstream of Hells Canyon Dam, Salmon River Basin, and Grande Ronde River Basin

7.2.6.1 Affected Environment–Base Case Scenario

7.2.6.1.1 Snake River Main Stem From Hells Canyon Dam to Lower Granite Lake

Spring, summer, and fall chinook salmon; steelhead; sockeye salmon; Pacific lamprey; smallmouth bass; crappie; trout; white sturgeon; redband trout; bull trout; channel catfish; and bullheads are found in this river reach. This reach is a migration corridor for adult and juvenile anadromous fish which have greatly declined in numbers (see Threatened and Endangered Species).

Resident game species caught by anglers include smallmouth bass, crappie, and rainbow trout which are stocked annually. White sturgeon also inhabit this basin; however, harvest is no longer permitted below Hells Canyon Dam due to depressed populations. Redband trout are the native trout species between Brownlee and Hells Canyon Dams. Bull trout have been documented in several tributaries of the Snake River within this reach and some evidence exists that bull trout may use the reservoirs when temperature conditions are favorable (IPC, 1971).

Operational practices of hydroelectric facilities, destruction of habitat, reduced food production, over harvest, disease, and predation have had adverse effects on the fish species in this reach. Daily and weekly water fluctuations cause shoreline erosion and turbidity, reducing food production and availability. All of these factors have contributed to the decline of fish numbers in this reach.

7.2.6.1.2 Salmon River Basin

The lower Salmon River basin includes spring and summer chinook, steelhead, sockeye, redband trout, cutthroat trout, bull trout, smallmouth bass, sturgeon, white sturgeon, and whitefish. It is a migration corridor and wintering area for adult and juvenile anadromous fish (see Threatened and Endangered Species section). Fishing opportunities exist for cutthroat trout and smallmouth bass. Sturgeon and bull trout are present in this reach.

Resident cutthroat trout, bull trout, and mountain whitefish are located in the South Fork. Bull trout, which now have statewide harvest closures, have declined due to over harvest, competition, and land management activities.

The North Fork supports a small number of white sturgeon as well as steelhead spawning and rearing. Native resident trout include redband, bull, and cutthroat. Trout densities at some locations have declined consistently.

Most of the Middle Fork Salmon River lies in a pristine wilderness area with good to excellent habitat quality; but, some important spawning and rearing habitat lies outside the wilderness area and has been degraded by mining, grazing, and logging. The Middle Fork has predominantly a native resident game fishery which includes bull trout, cutthroat trout, and whitefish.

Factors which affect the fishery include siltation; ranching and grazing practices; unscreened irrigation diversions; water quality; low flows and dewatering; channel alterations; and migration limitations associated with dams on the Salmon River (removed in 1934), lower Snake River, and Columbia River.

7.2.6.1.3 Grande Ronde River Basin

The Grande Ronde River basin includes spring chinook salmon, fall chinook salmon, summer steelhead, bull trout, Pacific lamprey, redband trout, whitefish, and smallmouth bass (see Threatened and Endangered Species section). Redband trout are widely distributed throughout the basin and inhabit many diverse types of habitat. Hatchery supplementation programs of rainbow trout have affected many of the native redband populations through inbreeding and habitat competition. Small populations of bull trout are present in headwater portions of tributaries and in portions of the lower basin. Bull trout and brook trout co-exist, interbreed, and produce sterile hybrid offspring. The Pacific lamprey populations have become severely depressed and may be absent (under consideration as a candidate for threatened or endangered status).

Factors which affect these species include quality of the riparian habitat, consistent streamflows, abundance and diversity of riparian vegetation, and stable water temperature.

7.2.6.2 Environmental Consequences

A quantitative analysis of flows in these stream reaches was not made for this analysis. However, any increase in flows in the main stem Snake River would be beneficial. Removing irrigation lands from production in the Salmon and Grande Ronde River basins (1427i and 1427r scenarios) would increase streamflows during the irrigation season as there are no storage facilities to regulate streamflow in these basins. Any increase of flows in these streams would be beneficial to fish and other aquatic organisms.

7.2.7 Summary

On an overall ranking for the river and reservoir system upstream of Brownlee Dam, the No augmentation scenario would be better than or similar to the Base Case, the 1427r scenario would be about equal to the Base Case. The 1427i scenario would be worse than the Base Case for fish maintenance and production in reservoirs. Flow augmentation under the 1427r and 1427i scenarios would not necessarily improve (i.e., not necessarily meet flow recommendations more often) habitat conditions for resident fisheries in most river reaches. However, this overall ranking and summary does not hold true for specific river reaches and reservoirs.

It is important to recognize that rivers and reservoirs within the area of analysis are operated to meet contractual obligations and water rights. Environmental considerations including flows for fish are typically secondary to meeting other obligations. In response, fish and wildlife agencies now managed some river reaches for warm water species and non-native species that have replaced cold water and native species in some river reaches. Fish are managed in declining environmental conditions and any further deterioration of conditions can only add more stress to biotic systems.

Fishery interests continue to ask for operations that would optimize fish resources, while recognizing that irrigation demands control reservoir releases and diversion of water. Reclamation continues to seek to balance desires to maintain and improve fish resources as it honors the contract obligations.

7.3 Wildlife and Vegetation, Including Wetlands and Riparian Habitat

There are many wildlife and plant species of concern within the Snake River basin which would be affected by the flow augmentation scenarios. Potential effects of the scenarios on fish in general are discussed in the Fish section, while effects on plants and animals that are listed under the ESA are discussed in the Threatened and Endangered Species section. This section discusses general categories of wildlife and plants and their habitats that may be affected by flow augmentation scenarios.

Wildlife rely heavily on riparian zones for food, water, cover, and travel corridors in the arid West. Riparian zones also provide important vegetation types not found elsewhere. Changes in river and reservoir system operations that reduce wetlands, open islands to predation, and reduce forage habitat would generally have a negative impact on wildlife and/or vegetation. River system operations which ameliorate or eliminate these conditions would have a positive impact. The key is understanding when these conditions occur relative to river system operations. There has been very little empirical research done to identify how wildlife and vegetation are affected by river system conditions and operational changes.

The SR^3 wildlife and vegetation TWG worked to uncover existing research on riverflows and reservoir elevations critical to wildlife and vegetation in the Snake River basin. Due to the absence of such information, the TWG explored other methods for identifying potential effects of riverflows and reservoir elevations on wildlife and vegetation. Those methods are still under development and evaluation and not available for use in this analysis of potential effects. Therefore, Reclamation could not develop a defensible analysis which adequately represents potential impacts of the flow augmentation scenarios to the general class of plants and animals.

Therefore, in this report, Reclamation has limited its evaluation to a subjective analysis of potential impacts of the flow augmentation scenarios to the general class of plants, animals, and their affected habitats. If the flow augmentation scenarios are considered in the future, it would be necessary to conduct a detailed, site-specific analysis of potential impacts related to all plant and animal species and their respective habitats.

Many Native Americans continue traditional practices of harvesting wildlife and vegetation for all or portions of their sustenance. Changes in access to, or abundance of wildlife and vegetation could affect Native American opportunities to hunt and gather these resources.

7.3.1 Affected Environment

7.3.1.1 Snake River Main Stem Upstream of Brownlee Dam

Many species of wildlife are found in the Snake River basin. Only those species that may potentially be affected by flow augmentation are addressed in this discussion. Most wildlife depends in one way or another on riparian or wetland vegetation communities. River and reservoir operations that affect these habitat types may also affect wildlife. Vertebrates that either reproduce or feed in water may be totally dependent on riparian zones for their survival and would be most affected by flow augmentation. Species that depend upon riparian and wetland vegetation for nesting habitat, escape cover, feeding zones, or travel corridors would also be affected.

Another habitat component addressed in this section is agricultural lands. Many of the same species of wildlife that rely on riparian corridors to fulfill life requirements also frequent or inhabit adjacent agricultural lands. Plant communities on agricultural lands provide seasonal food and cover for upland wildlife as well.

7.3.1.1 Wetlands and Riparian Zone Vegetation, Including Cottonwood Forests

Wetlands in the Snake River basin are located along the major streams and rivers. Additional wetlands are found along smaller tributaries, at seeps and springs, at higher elevation wet meadows, and along the shorelines of natural lakes. Most of the wetlands in the study area are either palustrine herbaceous (emergent marsh, aquatic bed), or palustrine woody (shrubs and trees) wetlands consisting of wet meadows, seeps, small shallow ponds and lakes, marshes, and riparian wetlands along streams. More specifically, there are several primary vegetative associations within the general category of wetlands along the river systems and on lands within the basin:

(1) Remnant "gallery" or floodplain forest with large cottonwoods and tree-form brittle willows in the overstory and a very diverse understory of willow, alder, and annual and perennial herbaceous vegetation–Presentative sites in the basin are found on the South Fork Snake River downstream of Palisades Dam, the Fort Hall Bottoms, the McTucker Island area of American Falls Reservoir, the Thousand Springs area, and on the Snake River near the confluence of the Boise River. Upper reaches of the Snake River, Henrys Fork, Boise River, and Salmon River also contain remnant

cottonwood forests. Regeneration of these floodplain forests is dependent on periodic, large scale disturbance through flooding. Absence of such flood events is adversely affecting regeneration of these remnant forests, especially on the Snake River.

(2) Riparian association of woody and herbaceous species along small streams, seeps, and runoff channels, and at the outer periphery of reservoirs, lakes and ponds–These generally are dense growths of willow, hawthorn, and/or alder in association with wet meadow grasses, sedges, and stands of emergents such as cattail and bulrush.

(3) Emergent wetlands associated with reservoir drawdown zones–These types are not necessarily associated with active streamflows or bank seepage. The thousands of acres of mudflats exposed during seasonal drawdowns constitute an ephemeral wet meadow community extremely important as feeding areas for migrating shorebirds and waterfowl. For example, as the water level recedes in American Falls Reservoir, upper portions of the mudflats are colonized each year by cockleburs, goosegrass, beggar's ticks, and knotweed. Where inundation is longer and water withdrawal slower, Mediterranean annual grass is the dominant species; associates are blunt-leaved yellow-cress and marsh cutweed. The Alpine Meadows area at the upper end of Palisades Reservoir is managed to encourage wetland vegetation and associated wildlife.

(4) Riparian association along high or steep riverbanks–There is little floodplain development for hundreds of miles where the Snake River and other streams flow through narrow valleys or deep gorges. In these reaches, riverine riparian woody species are restricted to a few species such as Russian olive, black and common cottonwood, and water birch with an understory of squawbush, currant, and Wood's rose. Islands and promontory backwaters along the Snake River maintain small scattered stands of rushes, cattails, sedges, and common reed.

(5) Wetlands associated with agricultural practices–Wetlands created as a result of agricultural practices may include farm ponds, wet pastures, drainage channels, tailwater accumulation sites, and groundwater seeps. Vegetation vigor and types vary at these sites depending on the reliability and amount of water available for wetland sustenance. Associations may range from grass/sedge pastures and cattail/bulrush fringed ponds to willow-choked draws.

In the semiarid lowland, wetlands are critical to many species of wildlife because they provide diverse habitats with good vegetative growth for food and cover, water, and invertebrate production. A wide variety of wildlife inhabit these wetlands, including waterfowl, shore and wading birds, furbearers, reptiles and amphibians, song birds, and other aquatic and semiaquatic species. Native and introduced fish species also thrive in the wetlands which provide backwater areas for spawning, feeding, and rearing of young.

Based on information provided in the 1991 Cascade Reservoir Resource Management Plan (Reclamation, 1991) wetlands extend along all but a short section of the west shoreline of the reservoir near Tamarack Falls Bridge. They provide important cover and feeding areas for wading birds and ducks.

Portions of American Falls Reservoir, particularly the Fort Hall Bottoms and the McTucker Island area, represent remnant floodplain forests, with large cottonwood, willows and herbaceous vegetation (Reclamation, 1994b). The Alpine Meadows area at the upper end of Palisades reservoirs is managed to encourage wetland vegetation and associated wildlife.

The existence and maintenance of cottonwood forests and other riparian vegetation is dependent upon the size and timing of episodic flood events with seasonal timing of flow being critical. Large floods create the bare substrate needed for seeds to germinate. For greatest benefit, the flood event should occur prior to seed dispersal in late June and early July. Falling river stages should occur during seed dispersal so that bare substrates are moist. Besides the seasonal timing, the spacing in years between events can affect colonization. Large floods can remove very young seedlings. A longer time between floods should allow seedlings to withstand larger floods. After the flood event, declining stages must be gradual enough to insure seedling survival.

Operations which serve to sustain riparian vegetation would also meet associated needs of raptors, colonial nesting birds, and neotropical passerine birds. Actions which modify naturally fluctuating water regimes, eliminate or reduce channel and shoreline diversity, diminish vertical or horizontal vegetative structural complexity, or fragment and isolate riparian communities tend to lower habitat quality for species that are restricted to or are seasonally dependent on riparian habitats.

Many of the wetlands, both natural and created, have been modified, degraded, or destroyed over the last 100 years by land use practices and manipulation of water sources. The elimination and degradation of riparian ecosystems and wetlands, and the corresponding losses of wildlife habitats, can be attributed to: channel alteration, groundwater pumping, surface water diversion, impoundment, direct removal of riparian vegetation, alteration of flooding regimes, and urbanization. Contaminants, recreation, livestock grazing, and habitat fragmentation also contribute to the degradation of viable habitat for wildlife in riparian systems. Efforts have been made in the basin to protect and manage some natural and created wetland sites through incorporation into the National wildlife refuge system and into state wildlife management area programs.

In addition to fish and wildlife values, wetlands and woody riparian zones are important gathering areas for Native Americans. Wetlands may contain willows, reeds, grasses, and cottonwoods which are used in traditional practices or ceremonies. Aquatic furbearers, found in wetland environments are also a part of some traditional Native American uses.

7.3.1.1.2 River and Reservoir Shoreline Wetlands

Wetlands require inundation or saturation by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands along the river corridor are adversely affected by continuous low flow conditions which result in little or no overbank flooding and an absence of water supply to backwater slough areas. Wetland acreage is reduced along reservoirs where low reservoir water levels expose and dry shallow overbank substrates, leaving only deep water habitats. These conditions can be especially detrimental to wetlands during the growing season. The effects on aquatic macrophytes addressed below would also apply to wetlands since habitats that do not support hydrophytic vegetation are not considered wetlands even though the hydrology may be present.

7.3.1.1.3 Aquatic Macrophytes

The seasonal timing of a flood is of great importance to the survival of woody hydrophytic vegetation. Dormant seasonal flooding usually has no effect on woody plants and may even have a beneficial effect by increasing water available in the soil through the summer. Conversely, seedlings flooded after leaf flush are very susceptible to damage. Flood duration and depth during the growing season can affect survival of woody hydrophytes. In reservoirs, colonization of shorelines by woody plants is unlikely if flood duration exceeds 40 percent of the growing season. Evidence suggests some woody species that provide wildlife benefits could thrive in reservoir drawdown zones. The depth of flooding during the growing season can influence the degree of injury or survival of woody plants especially if completely inundated. Even woody species adapted to survive in wet or saturated soil conditions cannot survive complete submersion for more than 20 days.

The major factors affecting the establishment of floating and emergent aquatic vegetation are water depth, current fluctuation, wave action, temperature, transparency, substrate, and water chemistry. Waterfowl herbivory can also be a factor in the establishment of floating and emergent vegetation. Water level fluctuations can be managed on controlled reservoirs to encourage the growth of desirable aquatic macrophytes. Water management schedules that correspond to the natural life cycles would encourage the growth of desirable aquatic plants that provide food and cover for waterfowl and other species of wetland wildlife.

7.3.1.1.4 Riverine Islands

The most important island forming events are larger floods. During these larger events, gravel, cobble, and other materials are moved around and deposited to form islands. Smaller floods yield small islands. A study has shown that islands formed downstream from Palisades Dam after gate closure are smaller than those formed under the natural-flow regime, are less elevated, and may have formed more gradually.

The preliminary results of studies conducted on islands located within the Deer Flat National Wildlife Refuge (Lake Lowell) indicate that as flow volume increases, the number of islands that are adequately protected from predators also increases. Island isolation is measured as a function of water velocity and the distance a predator would have to swim and wade to cross the river to an island (IDFG, 1992).

7.3.1.1.5 Agricultural Lands

Current agricultural practices and cropping patterns are discussed in Chapter 6, Economic Analyses. The type of vegetation associated with agricultural lands along the Snake River Plain is dependent on whether the lands are irrigated or not. Irrigated lands may be planted in row crops, grains, orchards, hay, or pasture grasses. Dry lands are mostly grains or seeded grasslands. Other plant and habitat associations found in association with agriculture include windbreaks, weedy edges, fence rows, and farm ponds. Upland species such as song birds, pheasants, and quail depend on agriculture lands for food, nesting, and cover. Small rodents are generally attracted to farm grounds and adjacent lands. Raptors, waterfowl, and other water-oriented species visit agricultural areas to find prey and food.

7.3.1.1.6 Wildlife

7.3.1.1.6.1 Raptors

Two of the most important raptors in the area are the bald eagle and the peregrine falcon which are listed under the ESA and discussed in the Threatened and Endangered Species section. However, a wide variety of hawks, owls, and other raptors are found in the area. Most of these are dependent in some way on water courses and associated riparian vegetation for cover, food sources, and bathing. Various birds of prey, including ospreys, red-tailed hawks, Swainson's hawks, burrowing owls, and barn owls, nest along the Snake River. Many of these birds rely on abundant prey sources on adjacent native shrub-steppe uplands and on adjacent agricultural lands.

7.3.1.1.6.2 Waterfowl, Shorebirds, and Other Birds

Ducks are one of the most plentiful waterfowl in the area. The Snake River remains free of ice most winters and affords habitat for many species of waterfowl like common goldeneye. During the breeding and nesting season, increases in reservoir water levels and/or riverflows can flood nests established along the shorelines of riverine islands. This relationship is especially critical when water levels rise rapidly after the initiation of nesting activities, usually after May 1. Higher water levels can, however, be beneficial after the waterfowl broods hatch. Water levels that flood adjacent aquatic or terrestrial vegetation provide escape cover and foraging habitat. Operations which develop and support wetland habitats (up to 18 inches in depth) provide needed aquatic invertebrate food sources and support aquatic macrophytes which also provide important forage. Lower riverflows can form land bridges to nesting islands making nests susceptible to predation and human disturbance. Water levels should fluctuate during the winter period and prevent ice formation. The amount and distribution of open water, along with the availability of waste grains, are factors that determine duck usage during the winter.

Canada geese, like ducks, use islands in the Snake River for nesting purposes. The nests are subject to flooding from rapidly rising waters and are subject to nest predation and human disturbance when flows drop low enough to form land bridges. Geese benefit from fluctuating water levels in the winter as ice does not form on the river and reservoirs. On the Snake River downstream of Palisades Dam, flows between 8,000 and 16,000 cfs were found to increase Canada goose nesting success.

Aquatic macrophytes of the Henrys Fork can no longer provide enough winter food to support the increasing flocks of trumpeter swans, Canada geese, and ducks. Present management efforts are directed toward reducing the wintering population of trumpeter swans on the Henrys Fork and include increasing flows from Island Park Dam in early October to reduce foraging opportunities and force the swans to migrate out of the area before the onset of winter (IDFG and USFWS, 1994).

Flows have to be precisely managed; if too low in the fall and winter, optimum feeding conditions exist encouraging trumpeter swans to remain in the area. This results in the depletion of existing aquatic vegetation during the winter. Low flows late in the winter allow the stream to freeze and inhibit feeding activities resulting in increased winter mortality of swans.

Operation of the reservoirs on the Snake River has a significant impact on shorebirds that migrate through the corridor. If mud flats are inundated during the spring/fall migration season or exposed too early before migration, detrimental impacts on shorebird populations could occur. Shorebird abundance is anchored in seven key species, although there are 25 or more who regularly frequent American Falls Reservoir. These seven are the lesser yellowlegs, the killdeer, western sandpiper, Baird's sandpiper, long-billed dowitcher, Wilson's phalarope, and the avocet. Over 2,000 Franklin's gulls and up to 35,000 white-faced ibis use the reservoir mud flats as a migration staging area. Avocets breed at American Falls Reservoir, along with white-faced ibis, snowy and great egrets, black-necked stilts, snowy plovers, and California and ring-billed gulls.

Migratory shorebirds need staging areas to refuel and complete their migration. Several large reservoirs on the Snake River, particularly American Falls, fulfill this need. American Falls Reservoir is a "Waterfowl Habitat Area of Special Concern" in the North American Waterfowl Management Plan (Reclamation, 1994b). Many shorebirds remain in the area through the spring. The principal operational impact that affects shorebirds is the exposure of mudflat foraging habitats as the reservoirs are drawn down in the summer and fall. Food sources for the spring migration (peaks from mid-April to mid-May) require fall flooding approximately 1 month before the first heavy freeze and the continued maintenance of flooded conditions to enable invertebrates to lay eggs and to assure survival of larvae over winter. Rapid growth of annual grasses, followed by inundation and decay, are ideal conditions for building the base food chain and an array of species diversity. The deep, soft mud harbors midge larvae and worms. Shorebirds migrating from the Arctic to South America use the site by the tens of thousands. During the spring migration season, reservoirs drawn down slowly (1-1.5 inches per week) make invertebrates continuously available to shorebirds foraging on mudflats.

Fall migration (peaking from mid-July to mid-September) is considered to be the most important for shorebirds on the Snake River. Production of food supply for the fall migration requires similar conditions as for the spring migration; however, the timing is different. The mudflats must remain flooded through spring and early summer and then be slowly exposed during the migration season. Mudflats that remained dry during the early spring need to be shallowly flooded 2 to 3 weeks before the fall migration begins to allow time for invertebrates to repopulate the newly created habitat. Maintaining a full reservoir level through the fall eliminates any available shorebird habitat.

Colonial nesting birds (e.g. heron, egret, cormorant, pelican) stalk prey by wading in shallow water or ambush the prey from perches located in shrubs or trees hanging over the adjacent water body. An optimum habitat for colonial nesting birds is created by reservoirs that provide adequate habitat, have operational conditions that support a healthy riparian zone (especially the cottonwood forest adjacent to the Snake River), and provide a good fishery.

Flow conditions can affect foraging ability and success. Flows that are too swift or produce turbidity can have a negative impact on foraging success. Low flows can affect the heron group (great blue herons and black-crowned night heron) if water depths are too shallow for overbank feeding habitats or if water levels are far removed from adjacent vegetation.

Sandhill cranes nest in the province. Canyons of the Snake, Owyhee, and other streams support numerous species such as white-throated swifts and canyon wrens. The Snake River bottom lands at Adrian have been the most consistent site in Oregon for yellow-billed cuckoos. Merriams Turkey is also common in the riparian zone of the lower Boise River and Snake River confluence

Islands within the Snake River support nesting colonies of great blue and black-crowned night herons and California and ring-billed gulls. Over 600 bank swallow burrows in three colonies were found during a 1991 survey of the Snake River. There are also good populations of loggerhead shrikes, a species on the decline nationwide according to breeding bird surveys, and the area is used by long-billed curlews.

Agricultural lands along the river corridor provide feeding areas for migrating and wintering waterfowl. Shore and wading birds (i.e., gulls, herons, cranes, ibis) are also attracted to agricultural lands to feed, especially during flood irrigation of pasturelands, plowing of fields, and haying.

7.3.1.1.6.3 Aquatic Furbearers

Operational conditions that maintain a healthy riparian habitat and a good fishery would provide optimum habitat for most aquatic furbearers. These include otter and beaver. The best water levels or flows for this group are high enough to flood or remain adjacent to aquatic or riparian vegetation. This condition provides easy and safe access to cover, travel corridors, denning sites, and foraging habitat.

7.3.1.1.6.4 Mammals

Riverflows and reservoir levels which maintain abundant vegetative food sources and cover would support the mammals in this area. These include elk and moose at upstream sites and deer along most riparian areas. A variety of carnivores and small mammals also rely on riparian and farmland associations for their life requirements.

7.3.1.1.6.5 Amphibians

Snake River operations that affect adjacent river and reservoir wetlands by altering groundwater levels, soil saturation, or overbank recharge of wetlands due to low flows may have detrimental impacts on many species of amphibians especially if these wetlands are affected during the spring breeding season.

Additional information is needed to better understand the relationship between operations and amphibians.

7.3.1.2 Owyhee River And Lake Owyhee

The USFWS, ODFW, and the Oregon Natural Heritage Program have identified eight special status plant species within the Owyhee River and Lake Owyhee area. Shrub-steppe communities dominate the landscape surrounding Owyhee River and Lake Owyhee. Big sagebrush communities dominate nearly every vegetation mosaic. The alkaline soils on the flats just above the upper Owyhee River support a salt desert shrub mosaic. These communities are most common where interior drainage and old lake beds are typical. Cottonwood, coyote willow, hawthorn, chokecherry, juniper, and hackberry should be considered of special importance or interest that could be affected by changes in Owyhee River flows and Lake Owyhee elevations.

Agricultural communities in the lower Owyhee River drainage area are similar to those described in section 7.3.1.1.5.

7.3.1.2.1 Riparian Vegetation

Riparian vegetation grows along the major perennial streams as well as some intermittent streams within the basin. Riparian vegetation also grows in association with seeps, springs, meadows, and in isolated locations along the perimeter of Lake Owyhee. The presence of water and alluvial soils are the primary attributes that distinguish these ecosystems from upland communities.

Dominant tree and shrub species in the riparian zone are black cottonwood, coyote willow, hawthorn, alder, and chokecherry. Oases created by humans contain riparian species and exotics like Russian olive and Lombardy popular (ODFW, 1993). In isolated areas along the Owyhee River, juniper and hackberry also occur. Numerous species of meadow grasses, sedges, rushes, and forbes occupy the riparian under story. Greasewood dominates in the alkaline riparian areas. Riparian vegetation along the upper Owyhee River is limited by the periodic high volume of water during spring runoff. As a result of high flows, flexible herbaceous plants predominate. Alder, currant, mock orange, clematis, and willow occur in pockets in the Birch Creek riparian zone down to the Owyhee River. Riparian areas along the upper river are showing vegetative recovery from historically heavy livestock use.

In 1984, Congress designated 120 miles of the main stem Owyhee River from the Oregon-Idaho border downstream to Lake Owyhee as wild (see Wild and Scenic River section). The primary emphasis for wild river areas is to protect and enhance the values which make it remarkable while providing river-related outdoor recreation opportunities in a primitive setting. Congress recognized recreation, cultural, geologic, wildlife, and scenic values on the main Owyhee River to be remarkable.

7.3.1.2.2 Wildlife

USFWS, ODFW, and the Oregon Natural Heritage Program have identified 26 special-status wildlife species within the Lake Owyhee and Owyhee River area. Mule deer, California bighorn sheep, beaver, muskrat, river otter, mink, waterfowl (mainly diving duck species), Canada geese, neotropical birds, raptors, and amphibians should be considered of special importance or interest that could be affected by changes in river flows or lake elevations on the Owyhee River or Lake Owyhee.

7.3.1.2.2.1 Mammals

Lake Owyhee and the Owyhee River traverse 124 miles of ODFW's Owyhee Big Game Management Unit. The river and reservoir contribute greatly to wildlife diversity, carrying capacity, and distribution in the adjacent uplands of the Management Unit. Many species of wildlife indigenous to the Management Unit depend on the Owyhee River and Lake Owyhee as their primary source of water. Mule deer are well distributed throughout the area. Densities are influenced by the availability of water, later summer forage, and escape cover. The habitats influenced by both the Owyhee River and Lake Owyhee provide all these requirements. The management unit contains approximately 5,000 mule deer, approximately 1.7 deer per square mile.

California bighorn sheep, a Federal candidate species for listing under the ESA, were introduced to the Owyhee drainage in 1965 after being absent for over 50 years. The 1994 bighorn population in the Lake Owyhee area was estimated at 225 with an area of use extending for 19 miles on the east bank of Lake Owyhee. Bighorn sheep can frequently be spotted from Lake Owyhee; the best viewing opportunities occur in the summer and fall.

Pronghorn antelope occur in the area but generally inhabit the sagebrush plateaus beyond the zone of influence of Lake Owyhee and are not as dependent on the reservoir as are mule deer and bighorn sheep. Other mammals which occur in the reservoir area include Nuttal's cottontail, domestic wild horse, and several species of rodents and bats. Wild horse sighting is common along the reservoir's east shoreline from Wild Horse Creek to Cherry Creek.

Deer, small mammals, and small carnivores (i.e. coyote, fox, skunk) also inhabit the farmlands and adjacent upland sites.

7.3.1.2.2.2 Furbearers

A number of regulated and unregulated furbearers (beaver, river otter, muskrat, and mink) occur within the riparian habitats or uplands surrounding Lake Owyhee and the Owyhee River. Furbearers associated with both riparian and upland habitats include raccoon, bobcat, coyote, stripped skunk, spotted skunk, long-tailed weasel, and badger.

7.3.1.2.2.3 Upland Game Birds

Common upland game birds include chukar, California quail, and mourning dove. The chukar partridge, an exotic species, was introduced to eastern Oregon in 1951. The Owyhee drainage provides some of the best chukar habitat in the western United States where introduced populations have flourished. Ring-necked pheasant, quail, and dove inhabit the farmlands in the lower Owyhee River basin.

7.3.1.2.2.4 Waterfowl

A variety of waterfowl make sporadic use of Lake Owyhee. The species most commonly found on the reservoir are migrant diving ducks and the common merganser. Diving ducks that migrate and winter on Lake Owyhee include lesser scaup, common goldeneye, bufflehead, and ringneck duck. These ducks utilize ice-free areas on the reservoir feeding mainly on aquatic insects. Common mergansers can be found on the reservoir year round feeding on the abundant populations of fish. Dabbing ducks are less common due to the lack of shallow water and utilize the reservoir mainly for resting. A few Canada geese breed at the reservoir and others are attracted to the green feed available below the high-water line following reservoir drawdown. Migrating and wintering waterfowl also feed on adjacent agricultural areas.

7.3.1.2.2.5 Raptors

Raptors such as the red-tailed hawk, northern harrier, great horned owl, and turkey vulture are common in riparian and upland habitats surrounding the reservoir and river. The numerous rock cliffs, spires, and rimrock areas provide excellent nesting habitat for golden eagles and prairie falcons. Twenty to thirty northern bald eagles use the Owyhee River and Lake Owyhee for wintering; many others migrate through the area during the fall and spring. Resident and migrating raptors also find prey on adjacent farmlands.

7.3.12.2.6 Other Birds

Common birds associated with reservoir shoreline areas and riparian habitats along the river include great blue heron, killdeer, belted kingfisher, several species of swallows, American crow, American robin, black-billed magpie, brown-headed cowbird, European starling, northern flicker, western kingbird, western meadowlark, and white-throated swift.

7.3.2.2.7 Amphibians and Reptiles

Some of the more common amphibians occurring in moist habitats influenced by the reservoir and river include Great Basin spadefoot toad, western toad, and Pacific treefrog. Excellent and abundant reptile habitat occurs in the area and supports species such as western fence lizard, whiptail, collared lizard, horned lizard, side-blotched lizard, gopher snake, racer, and western rattlesnake.

The western ground snake is found along the Owyhee River. The Snake River population of the leopard frog is of interest because of its peripheral status. Species like the longnose leopard lizard, desert horned lizard, western whiptail, desert collared lizard, Woodhouse’s toad, and Great Basin spadefoot toad are common in the Owyhee River drainage.

7.3.1.3 Hells Canyon National Recreation Area

7.3.1.3.1 Riparian Areas

An important feature of the Snake River riparian zone is the dominance of hackberry which is the most common tree along the river and is a important source of browse for big game species. Its fruit is used by birds and small animals. Invasions of noxious weeds, including leafy spurge and knapweed, are encouraged by fluctuating flows which provide habitat for germination (Wallowa National Forest, 1998). The USFS has noted the following concerns for the Hells Canyon Natural Recreation Area (HCNRA):

- Effects caused by construction of impoundments and the change from a free-flowing riverine habitat to a large, slack-water impoundment.

- Habitat fragmentation caused by construction and operation of the project.
- Lack or loss of quality riparian habitats.
- Project operations involving water fluctuations which may maintain and spread the invasion of noxious weeds throughout the area.
- The loss of, or reduction in, some micro habitats from dewatering and flooding.
- The potential effects of recreation on sensitive species and other wildlife resources.

7.3.1.3.2 Wildlife

The HCNRA provides an outstanding diversity of habitats for wildlife. This diversity is enhanced by the abrupt changes in vegetation resulting from changes in aspect, elevation, temperature, moisture, geology, soil depth, and the effects of fire and management activities. Approximately 372 wildlife species have been confirmed to occupy HCNRA (fish-42, salamanders-3, frogs/toads-9, snakes-10, birds-239, mammals-69). Riparian habitats, both wetland and terrestrial, are important to all wildlife species, many of which are either directly dependent on riparian zones or utilize them more than other habitats. One of the wildlife management goals for all riparian species in HCNRA is to maintain forested riparian buffers on streams, seeps, and springs.

Owls, bald eagle, peregrine falcon, Yuma myotis, little brown myotis, Townsend's big-eared bats, spotted bats, California wolverine, gray wolf, river otter, mule deer, elk, Canada geese, neotropical birds, and mountain quail should be considered of special importance or interest that could be affected by changes in river flows or reservoir elevations in Hells Canyon.

7.3.1.3.2.1 Raptors

Nine species of owls have been recorded as occurring in HCNRA. Most nest in or frequent upland forest. The western screech owl, however, is a nonmigratory, cavity nester associated with deciduous riparian forests of black-cottonwood, white alder, and quaking aspen and could potentially occur in the riparian zones situated along the Snake River.

Bald eagles were once numerous in Hells Canyon, but populations have severely decreased after the demise of most of the returning salmon runs. Winter eagle counts along the Snake River and Hells Canyon Reservoir have ranged from 3 in 1989 to 16 in 1994 and the general trend for wintering bald eagles has continued to increase. There are no known bald eagle nests within the HCNRA. Bald eagles tend to concentrate below Oxbow Dam and Hells Canyon Dam, where an abundance of fish die when passing through the turbines. Primary use of the river corridor is from November through March. Large trees and large rock outcrops adjacent to the water along the Snake River are important for perching.

One peregrine falcon nest is active within Hells Canyon at present (Wallowa National Forest, 1998).

7.3.1.3.2.2 Bats

Thirteen species of bats have been identified in HCNRA and two more species may possibly reach this area. The HCNRA contains buffers of uninterrupted canopy and snags which provide nursery, foraging, and hibernating habitat. Systematic investigations in HCNRA since 1984 have identified many sites of concentrated use by a variety of bat species along the Snake River corridor including maternity colonies of Yuma myotis, little brown myotis, populations of Townsend's big-eared bats, and spotted bats. One of the six significant maternity colonies of Townsend's big-eared bat in Oregon lies entirely within the HCNRA. Bats are voracious insectivores and play an important role as natural insecticides. The importance of these animals is reflected by the listing of three species as sensitive by ODFW and five species by IDFG. Seven of the 13 species are considered as possible candidates for Federal listing. Bats are very sensitive to change or disturbance in their environment. Any destabilizing influence has the potential to impact them heavily. Bats have a very low reproductive rate and they recover slowly, if at all, from disturbance. Changes in river flows in the Snake River that would affect invertebrate production could have a profound affect on bat population within HCNRA.

7.3.1.3.2.3 Furbearers

Large important furbearers whose life history may be at least partly dependent on the riparian zone are wolverine, lynx, gray wolf, and river otter. California wolverines are considered rare throughout all of Oregon, Washington, and Idaho. They are known for their large territories and extensive traveling habits. Travel is generally along timbered ridges and stream bottoms such as the Snake River corridor. Surveys have shown that wolverines do exist in the HCNRA, but they are very rare.

Lynx are presently being considered for ESA listing by the USFWS. The USFWS and ODFW consider lynx populations in Oregon to be extirpated; however, recent surveys concluded that remnant populations may be present in the Wallowa National Forest and HCNRA. Wildlife management goals for the lynx include the maintenance of forested riparian buffers which the lynx may use as travel corridors.

In January 1995, gray wolves were transplanted from Canada to the Salmon River drainage in central Idaho. Because of that action, wolves and their habitats in central Idaho, including the Idaho portion of HCNRA, are now classified as experimental and nonessential to the recovery of wolves under the ESA. Gray wolf denning sites are usually located on moderately steep slopes with southerly aspects within close proximity to surface water. Wolves prey primarily on large ungulates such as elk and deer. The riparian zones along the Snake River corridor within the HCNRA could potentially provide both of these life history requirements and serve as a travel corridor.

River otter require a healthy riparian zone to provide cover, travel corridors, and denning sites as part of their life history requirements and can potentially be impacted by any changes in streamflows.

7.3.1.3.2.4 Mammals

Elk serve as a barometer of healthy habitats for big game species on the forest such as mule deer, white-tailed deer, bear, and cougar. Elk are native and were reported in the early 1800s in large numbers in the valleys around Baker, La Grande, and Enterprise, Oregon. Their numbers were seriously reduced during the late 1800s and reached a low by about 1910. Transplants from the Yellowstone area in 1912, and the introduction of hunting regulations, assisted in the recovery of elk in northeast Oregon. In 1980, ODFW established population objectives for elk management units: 3,800 for Snake River, 400 for Pine Creek, and 800 for Imnaha. Since then, elk numbers have been near these population objectives.

Habitat use by elk of the HCNRA starts in winter when elk are along the Imnaha and Snake Rivers or adjacent canyon rims. Some elk spend the entire year on the benches of Hells Canyon. IDFG estimates a current population of about 2,800 elk on the Idaho side that use HCNRA for at least part of the year. This herd of elk winters along the Snake River and summers in the high country between the Snake and Salmon Rivers. Mule deer also use the riparian habitats along the Snake River within HCNRA. Rocky Mountain big horn sheep are native to much of the mountain and canyon country in HCNRA and may occasionally utilize the riparian habitats for foraging activities. The sheep were exterminated in HCNRA by the early 1940's; however, reintroduction began in 1971 and continued through 1994. The reestablishment of bighorn populations has been subdued by reoccurring die offs due to pneumonia. Mountain goats are also present within HCNRA and may possibly frequent the riparian habitats for foraging activities.

7.3.1.3.2.5 Neotropical Migrants

A total of 114 species of neotropical migrants in the area have been identified. A preliminary assessment of the status and conservation priorities for Oregon neotropical migratory bird species identified 26 species in HCNRA that are known to have experienced long-term declines. This statewide assessment identified four priority habitats, including riparian zones, where species decline coexists with vulnerability to habitat loss. Special emphasis has been placed on mountain quail which is a game species whose population has been declining for unknown reasons. Research that includes using telemetry to determine movements and habitat requirements is presently ongoing. This research has shown a previously unknown periodic preference of mountain quail to the riparian habitats along the Snake River (Wallowa National Forest, 1998).

7.3.1.3.2.6 Waterfowl

Waterfowl in HCNRA mainly include diving duck species such as goldeneye and common merganser. Canada geese are the only nesting waterfowl species in HCNRA and are considered unique to this area. Canada geese have adapted to an unusual nesting habitat utilizing the sheer cliffs along the Snake River (Wallowa National Forest, 1998).

7.3.1.4 Grande Ronde River Basin

Riparian habitat degradation is a serious habitat problem in the Grande Ronde River basin. Approximately 379 degraded stream miles (main stem and tributaries) have been identified. However, riparian vegetation is well developed in valley areas where there is some protection from livestock grazing. Black cottonwood, white alder, several willows, and quaking aspen dominate these sites, but numerous shrubs also occur.

Private land along major streams in the Wallowa River valley where irrigation water and alluvial soils are present is devoted to farming or hay production. Marshes and ponds are small and scarce, but attract many migrating birds and some summer residents. Seasonally-flooded and subirrigated meadows make up the province's main wetland components. Some of these seasonally-wet meadows are rather extensive.

A wide range of wildlife species is known to regularly inhabit the basin. Riparian habitats support many eastern breeding neotropical birds that are otherwise rare in Oregon. Examples include veery, gray catbird, and redstart. These same areas also include black-chinned hummingbirds, broadtailed hummingbirds, and alder flycatchers.

The area also supports populations of elk and mule deer, as well as reintroduced populations of bighorn sheep and two introduced populations of mountain goats. Periodic sightings of wolverine, listed as threatened by ODFW, and the fisher, listed as sensitive by ODFW, are reported. Moose occasionally cross the Snake River from Idaho into Oregon.

7.3.2 Environmental Consequences

7.3.2.1 Base Case and No Augmentation Scenarios

There would be no significant effects on wetland associations from continuing flow augmentation at 427,000 acre-feet. No wetland effects have been evident as a result of this ongoing augmentation flow which causes minor fluctuations in reservoir water levels and streamflows. The vigor of emergent or riparian vegetative types has not been altered.

There would be no significant effects on wildlife or plant habitats (i.e. wetlands, riparian associations, and farmlands) from continuing the flow augmentation at 427,000 acre-feet. No wildlife, vegetation, or wetland effects have been evident as a result of this ongoing augmentation flow which causes minor fluctuations in reservoir water levels and streamflows. The vigor of emergent, riparian, and shoreline riparian vegetative types have not been altered, and there have been no significant changes to vegetative types and cropping patterns on agricultural lands.

7.3.2.2 1427i Scenario

Increased flows during the irrigation season resulting from an additional 1 MAF flow augmentation would improve the vigor of riparian woody and emergent vegetation along affected stream reaches. Some bank and backwater areas may be freshened by increased instream flows and experience improved growth and sustenance of wetland plants. Particular stream reaches which may benefit from these improved flows would be the Snake River downstream of Milner Dam, the lower Boise, Payette, Grande Ronde, and Salmon Rivers. Resident wildlife such as furbearers, amphibians, and waterfowl would benefit from improved habitat conditions. However, a measurable increase in total acres of riverine riparian wetland communities is not expected, nor would there be a significant increase in episodic flows to improve the regeneration of floodplain forests over the Base Case.

Under this scenario the water level fluctuations in affected reservoirs would be significantly altered from Base Case conditions. Some reservoirs would be drawn down more often and to lower levels than previously experienced to meet the demand for ongoing irrigation and increased streamflow. The probability for reservoir refill each year would also be decreased. Peripheral reservoir wetlands may be significantly affected in some reservoirs, especially those with large shallow areas and gradual, sloping bottoms. There may be a significant increase in exposed mudflats and the associated ephemeral wet meadow communities. There may be a decadence or loss over time of vigor and size in emergent and submergent wetlands and shoreline woody riparian species. Particular reservoir areas most affected may include Jackson Lake, Palisades, American Falls, and Cascade Reservoirs. Resident and migratory wildlife such as furbearers, amphibians, and waterfowl which depend on wetland and woody riparian habitats would be adversely affected. Migrating shorebirds may be benefitted by the increase in freshly exposed mudflats.

Under this scenario approximately 243,000 to 301,000 acres (table 6-11) of presently irrigated acres would no longer be irrigated. The affected lands would be fallowed or converted to dry land acres (i.e., grains or grazing lands). Fallow lands would be subject to weedy infestations until they were reseeded or, over many years, reverted back to native upland vegetation. Wildlife use of these affected lands would change significantly. There would be less overall wildlife use for nesting, feeding, and cover. There would be a change in species which would inhabit or frequent these lands depending on whether they remained fallow indefinitely or were reseeded and grazed by livestock.

Reductions in the basin of acres of irrigated agriculture may result in the loss or significant decadence of irrigation dependent wetlands, especially those associated with farm ponds, drainage channels, tailwater collection sites, and seepage sites dependent on groundwater fed by irrigation applications. These irrigation dependent wetlands would be in long established and concentrated flood irrigated tracts where there are more established wetlands. Such wetlands can be found in the middle Snake River basin and Grande Ronde River basin. Areas less affected per unit of irrigated agriculture taken out of production would be recently developed or isolated tracts, such as the highlift pump developments of the middle Snake River basin where few wetland types have been established or other areas where there is a concentration of sprinkler irrigation.

Irrigation applications improve plant growth and help plants recover from the impacts of grazing. Wet-pasture wetlands of the upper Snake, Salmon, and Grande Ronde River basins would suffer the least per unit of irrigated lands retired, but would be reduced in vigor and production.

Little opportunity would exist to mitigate for losses and adverse effects to wetland communities because available water sources would be extremely limited. This scenario would not meet the Federal goal for "no overall net loss" and it would be contrary to the Clean Water Action Plan's goal of achieving a net increase in wetlands each year.

7.3.2.3 1427r Scenario

Increased flows during the irrigation season resulting from an additional 1 MAF flow augmentation would improve the vigor of riparian woody and emergent vegetation along affected stream reaches in a similar manner as the 1427i scenario.

Fluctuations in reservoir water levels under the 1427r scenario would not be altered enough to significantly affect the vigor and size of peripheral or exposed wetland or riparian communities nor their dependent wildlife populations from the Base Case conditions.

The 1427r scenario would result in the reduction of 360,000 to 471,000 acres of irrigated agriculture (table 6-14). While this scenario would result in more acres of land taken out of irrigated agriculture in the middle Snake River than the 1427i scenario, impacts to other areas within the Snake River basin would be similar to those of the 1427i scenario. However, there would be significantly greater losses to wetlands and wildlife that are associated with irrigated agriculture along the middle Snake River.

There would be little opportunity to mitigate for losses and adverse effects to wetland communities because available water sources would be extremely limited. This 1427r scenarios would not meet the Federal goal for "no overall net loss" and would be contrary to the goal of the Clean Water Action Plan's to achieve a net increase in wetlands each year.

7.3.2.4 Summary

The No Augmentation scenario would have little effect on the wildlife, vegetation, or wetland communities of the affected area as compared to the Base Case. Scenarios 1427i and 1427r may result in improved streamside wetland and riparian habitat vigor due to improved downstream flows. Both scenarios would result in significant reductions of irrigated crops and increase in fallow lands and/or dry land crops and vegetation, with 1427r having the greatest effect--especially in the middle Snake River area.. There would be significant reductions in reservoir levels and carryover under the 1427i scenario, adversely affecting reservoir shoreline wetlands and riparian communities. More mudflats, used as feeding habitat by some animals, would be exposed.

7.4 Threatened and Endangered Species (ESA Species)

This section is arranged by species, rather than by stream reach, and discusses those species that are listed as threatened or endangered under the ESA. Salmon and steelhead are absent in the basin upstream of Hells Canyon Dam because the dam blocks upstream passage of these anadromous species. Salmon and steelhead are found in the Salmon River and Grande Ronde River basins and the current conditions are described. However, Reclamation chose to provide only brief subjective analysis of the scenarios for the Salmon and Grande Ronde River basins as those basins were not model.

A total of 21 federally listed T&E species have been identified as being present or possibly being present in the Snake River basin. In previous consultations with the USFWS, Reclamation eliminated several species from analysis after determining that they are: (1) not found within the areas influenced by Reclamation operations or (2) only occasionally found in these areas but not affected by Reclamation operations (Reclamation, 1998). The eliminated species are: gray wolf (*Canis lupus*), whooping crane (*Grus americana*), MacFarlane's four o'clock (*Mirabilis macfarlanei*), water howellia (*Howellia aquatilis*), Bruneau hot springsnail (*Pyrgulopsis bruneauensis*), and Banbury Springs lanx (*Lanx species*). In addition, Howell's spectacular thelypody *(Thelypodium howellia var. spectabilis*) and the Columbia spotted frog (Rana luteiventris), both candidate species, and the grizzly bear (*Ursus Arctos)* were eliminated from this analysis as not being affected by any of the flow augmentation scenarios. Reclamation (1998) found that project operations would not likely affect the Columbia spotted frog or grizzly bears, and Howell's spectacular thelypody is found only along the Powder River which is not included in this analysis of flow augmentation scenarios. Table 7-15 summarizes species, status, and location where found.

Table 7-15 ESA Federally Listed Species Found Within the Area and Considered in this Analysis

Common Name[1]	Scientific Name	Major Streams and Reservoirs Where Present
Federally Listed Endangered Species		
1 - American peregrine falcon	*Falco peregrinus anatum* and *Falco peregrinus tundrius*	Main stem and Henrys Fork including associated reservoirs, Lake Owyhee and downstream, Boise River and Payette Rivers including associated reservoirs.
2 - Snake River sockeye salmon	*Oncorhynchus nerka*	Lower Snake River downstream of Hells Canyon Dam; critical habitat designation, Salmon River
3 - Idaho springsnail	*Pyrgulopsis idahoensis*	Middle Snake River (Bancroft Springs to downstream of C.J. Strike Dam)
3 - Snake River physa	*Physa natricina*	Upper Snake River and middle Snake River (Jackson Bridge to Bancroft Springs)
3 - Utah valvata snail	*Valvata utahensis*	Upper Snake River and middle Snake River (from American Falls Dam to upstream of Lower Salmon Falls Dam)
Federally Listed Threatened Species		
1 - Bald Eagle	*Haliaeetus leucocephalus*	Main stem and Henrys Fork to Brownlee Dam including associated reservoirs; Ririe Lake/Willow Creek; Boise and Payette Rivers and associated reservoirs.
2 - Snake River spring/summer chinook salmon	*Oncorhynchus tshawytscha*	Lower Snake River (downstream of Hells Canyon Dam); critical habitat designation; Grande Ronde River, Salmon River
2 - Snake River fall chinook salmon	*Oncorhynchus tshawytscha*	Lower Snake River (downstream of Hells Canyon Dam); critical habitat designation, Clearwater River
2 - Snake River steelhead trout	*Oncorhynchus mykiss*	Lower Snake River (downstream of Hells Canyon Dam); Sweetwater Creek, Clearwater River
3 - Bliss Rapids snail	*Taylorconcha serpenticola*	Middle Snake River (Thousand Springs to King Hill/Clover Creek)
4 - Ute ladies' tresses	*Spiranthes diluvialis*	South Fork Snake River
2 - Bull trout	*Salvelinus confluentus*	Boise River; Payette River; Malheur River

Table 7-15 ESA Federally Listed Species Found Within the Area and Considered in this Analysis		
Common Name[1]	Scientific Name	Major Streams and Reservoirs Where Present
[1]Numbers indicate the following: 1 - Birds; 2 - Fish; 3 - Invertebrates; 4 - Plants		

Reservoir storage and riverflows are only two of many life history parameters that influence the presence of a threatened and endangered species at a particular body of water. Other factors may at times be more critical to a threatened and endangered species in selection of habitat. Therefore, classification of river/reservoir operations not conducive to a threatened and endangered species does not necessarily eliminate that species from that body of water.

For each species, one or more time periods in the life cycles were identified when the availability of water was deemed critical to the survival or life history maintenance. Minimum standards were identified for each species. The minimum standards and frequencies of occurrence were compared to the hydrologic modeling results for each scenario at locations identified to be occupied by a particular threatened or endangered species. The overall potential response of a species to changes in reservoir levels and/or riverflows was then evaluated for potential effect. Potential impacts were not determined for river reaches and reservoirs not included in the hydrologic model (see chapter 5).

7.4.1 American Peregrine Falcon

7.4.1.1 Affected Environment

The peregrine falcon remains listed as an endangered species; however, the comeback of the species has been so dramatic in recent years, that the species was recently proposed for delisting. The Peregrine Fund, Inc., instrumental in the artificial propagation program that led to the recovery of the species, has recommended that the species be delisted.

Peregrine falcon populations began a precipitous decline following World War II due to the widespread use of chlorinated pesticides, especially DDT and its metabolite DDE, which accumulated in peregrines because of feeding on contaminated prey. Adult mortalities increased, but the principal effect was damage to the reproductive potential through interference with calcium metabolism. The contaminants caused the thinning of eggshells, rendering them easily broken, and adversely affecting reproductive success. In 1973 the peregrine falcon was listed as an endangered species. Since the listing, the banning of harmful pesticides and the implementation of recovery efforts have gradually increased peregrine populations nationwide.

Other factors that have affected peregrine populations include shootings, natural predators (the great horned owl in particular), egg collecting, disease, collection by falconers, human disturbance at nesting sites, and loss of habitat to human encroachment.

7.4.1.1.1 Life History

Peregrine falcons generally reach sexual maturity at 3 years of age. Mating behavior and pair socialization have been classified into eight basic phases that occur over a courtship period lasting as long as 2 to 3 months. The bond between males and females is formed for the life of the pair. If one dies, the other often acquires a new mate and continues use of the nest site used by the original pair. This process may be repeated over many years, establishing a long period of historic use of traditional cliff nest sites.

Pairs usually establish nesting territories by March and lay a clutch of three or four eggs in late March and April. Incubation lasts about 33 days with a 2-day hatching interval between eggs. Young stay in the nest for 6 to 7 weeks and are not self-sufficient for several months. Hatching success in the wild is about 75 percent, with an average of one young reaching fledgling age per laying pair. Juvenile birds continue to be vulnerable during their first year as they learn to hunt and develop flying skills.

7.4.1.1.2 Nesting Habitat

Most nest sites are associated with water bodies and nests are generally located on a ledge or shallow cave on a cliff, which is the geographic and ecological center about which most of the mating behavior occurs. However, peregrines are also known to occasionally nest on slopes and river cutbanks, mounds, and occasionally sand dunes, flat bogs, and plains. They may sometimes nest in hollows of old and very large trees. Peregrines are also known to nest on manmade structures such as skyscrapers.

Rivers are significant to both the physical and biotic environment of the peregrine. Rivers may have created the nesting cliffs and provide ideal bathing areas, which are used frequently by peregrines. Gravel bars that slope gently into the river are the preferred bathing sites. Rivers also create conditions required by some prey species most frequently used by peregrines. Gravel bars and islands provide habitat for waterfowl and shorebirds, and shrubs on these sites provide habitat for passerine birds.

7.4.1.1.3 Foraging Habitat

Peregrines feed almost exclusively on birds captured in flight. These include ducks, upland game birds, shorebirds, and small perching birds. Prey species are usually hunted over open habitat types such as large rivers, reservoirs, fields, and wetland areas such as swamps and marshes. Peregrines have been known to prey on small mammals. Rock doves, mourning doves, and band-tailed pigeons are preferred prey, especially late in the nesting season.

Little information is available regarding habitat requirements of wintering peregrines. Migrant peregrines seem to be associated in areas where waterfowl are abundant. American peregrines remain within the Snake River basin states throughout the year and move locally on a seasonal basis in response to patterns of prey availability. Overwintering and migrant peregrines in the inland Northwest likely feed on concentrations of waterfowl and shorebirds near water bodies.

7.4.1.1.4 River System Factors Contributing to Species Decline

High water releases during the nesting season may inundate gravel bars, possibly reducing the attractiveness or suitability of nearby eyries. Storage of snowmelt runoff and the resulting attenuation of spring peak flows combined with the sediment-trapping properties of dams reduces the formation of new gravel bars and allows existing bars to become vegetated, possibly reducing the suitability of a river reach for nesting peregrines.

Waterfowl and shorebirds make up a large percentage of peregrine prey. Therefore, any operational features that negatively affect waterfowl or shorebird populations could have a detrimental effect on peregrine survival or reproductive success.

7.4.1.1.5 Base Case Conditions in Snake River Basin

Surveys for reestablishing pairs of breeding peregrines began in 1988. These initial surveys were conducted as part of a tristate cooperative project within that portion of Idaho referred to as the Greater Yellowstone Area (Levine, 1988). In 1990, the IDFG expanded surveys to other regions of Idaho.

In 1996, attempts were made to monitor nesting activities of all pairs of peregrine falcons discovered in Idaho (Levine and Melquist, 1996). Observations by personnel from the IDFG, the USFS, USFWS, and the BLM identified 17 occupied nesting territories in Idaho; 11 of the territories were in eastern Idaho. Four of the 11 pairs in eastern Idaho were successful in producing a total of 11 young. These productivity figures indicate a healthy, increasing population. With such a strong breeding population, the upper Snake River basin is a critical component in the recovery of Idaho's peregrine falcon population.

There are at least seven occupied territories in Wyoming that make use of the Snake River from Jackson Lake downstream to the Idaho State line. These eyries are regularly occupied and are some of the highest producing eyries in Wyoming. There are two to three peregrine nesting territories near Jackson Lake. Falcons from these territories forage at Jackson Lake and surrounding area. Little is known about winter use by peregrine falcons. In Teton National Park, breeding falcons begin to occupy nesting territories as early as April and leave sometime in October.

Three nesting territories have been documented along the main stem reach of the Snake River from the Wyoming border to the Henrys Fork. Surveys, although not always complete, have documented the production of more than 28 young from these sites since 1990. Two of the sites, both located on the river, have each produced a total of four young since 1990. The third site, located on Palisades Reservoir just north of Alpine, Wyoming, has produced over 20 young.

Two nesting territories along the Henrys Fork have been active since 1990. Since monitoring of these sites began in 1990, at least 21 young have been produced. One of these sites is a nesting tower erected as part of recovery efforts. Young were not successfully produced in 1995 and 1996. Information for 1997 and 1998 is not available. Nesting sites have not been found at Henrys Lake or Island Park Reservoir.

Nesting towers have also been erected at both the Camas National Wildlife Refuge and the Mud Lake Wildlife Management Area. Both sites are about 30 miles north, northeast of Idaho Falls, Idaho. Since their installation, these towers have seen only sporadic nesting attempts. In 1996, three young were produced at the Mud Lake site. Although not closely associated with the Snake River, a nesting tower at Market Lake, located about 20 miles north of Idaho Falls, has been periodically active since 1992, but has not successfully produced any young.

Peregrine falcons are found as occasional visitors and winter migrants in the American Falls area and up stream to the confluence with the Henrys Fork. While nesting has not been documented in the area, suitable habitat and food supply are present and adequate to support a nesting site (USFWS, 1993).

Peregrine falcons are occasional visitors and winter migrants throughout the reach from Milner Dam to American Falls Reservoir. While food supplies are probably adequate, suitable nesting habitat is lacking, and nesting has not been documented.

Peregrine falcons are winter migrants along the reach from Milner Dam to Brownlee Dam. Suitable cliffs for nesting are present, e.g., the Snake River Birds of Prey Natural Area, but other habitat factors such as availability of prey are evidently not suitable for nesting.

There are two known peregrine falcon nesting territories located in the Boise River basin. These are the Nampa Sugar Silo territory located about 5 miles south of the Boise River near Nampa, Idaho and the Key Bank nest located on an artificial platform atop a building in downtown Boise, less than 1 mile from the river (Levine and Melquist, 1996). The Nampa sugar silo territory has been very productive with

24 young produced since 1990. The Key Bank territory was first occupied in 1996 although a single adult female had been observed since 1994. This territory did not produce any young in 1996.

Although the Boise River is within foraging range of both nesting territories, monitoring of these birds indicate they rely mostly on prey such as rock doves and other upland birds in closer proximity to the nests (Beals, 1997).

Peregrine falcons are also found along the Boise River and its reservoirs as occasional migrants or wintering birds (USFWS, 1996a). These birds are most likely to be in areas where prey such as waterfowl and shorebirds are abundant.

There are no known peregrine falcon nesting territories near Cascade, Deadwood, or Black Canyon Reservoirs or river reaches downstream from those reservoirs (Levine and Melquist, 1996). Peregrine falcons were successfully released for several years from a site 6 miles east of Cascade Reservoir. Although nesting in the Cascade area has not been documented, sightings of adult birds at Cascade Reservoir in the summer provide evidence that a nesting territory may be nearby. USFWS (1996b) indicated that there was an historical nesting site located 19 miles south of Cascade at Tripod Peak.

The peregrine falcon is an occasional migrant visitor to the Cascade Reservoir area (Reclamation, 1991) and probably visits Deadwood and Black Canyon Reservoirs and river reaches downstream from these reservoirs.

Peregrine falcons are winter migrants at Lake Owyhee and along the Owyhee River downstream.

7.4.1.2 Environmental Consequences

Critical time periods for the peregrine falcon are: (1) the territory establishment period from January through March, (2) the breeding and incubation season from March through June, and (3) the hatchling/fledgling season from late April through September. Peregrine falcons feed on ducks, upland game birds, shorebirds, and small perching birds caught in flight. Factors that increase the abundance of prey species benefit the peregrine falcon.

Streamflows that create gravel bars are advantageous to peregrines which need suitable bathing habitat and adequate habitat for prey species. An increase of flows of 400 cfs or greater from January through June would be considered advantageous in creating and maintaining gravel bars. If riverflows decrease between January and June, vegetation would likely grow on existing gravel bars and new gravel bars may not be formed. It is not anticipated that any of the scenarios would significantly alter conditions in the upper reaches of the Snake River that would change the rate or amount of gravel bar creation or maintenance.

Current operations (Base Case) of Jackson Lake and Palisades Reservoir on the Snake River and reservoirs on the Henrys Fork may affect habitats and distribution of waterfowl and other prey populations but are not likely to adversely affect nesting peregrine populations. Operation and maintenance of project facilities have little or no effect on peregrine falcons because there are abundant or adequate prey populations to support migrant or wandering falcons.

Although there may be significant changes in reservoir pools under 1427i and significant reductions in irrigated agriculture under both the 1427i and 1427r scenarios, these impacts are not expected to significantly reduce prey base populations of waterfowl or shorebirds that nesting or migrant peregrine falcons rely on. Increase streamflows and more exposed mud flats at some reservoirs may, in fact, improve prey populations in some localities and seasons. Therefore, it is unlikely that any of the scenarios would adversely affect the peregrine falcon.

7.4.2 Salmon and Steelhead

7.4.2.1 Affected Environment

Three anadromous fish species found in the Snake River basin are now listed under the ESA. These are fall and spring/summer chinook salmon, sockeye salmon, and steelhead. One or more of these anadromous fish species is found in the main stem Snake River between Hells Canyon Dam and Lower Granite Lake, the Grande Ronde River basin, and the Salmon River basin. Construction of the Brownlee, Oxbow, and Hells Canyon Dams blocked the upstream migration of all anadromous fish. As a result, there are no runs of salmon and steelhead upstream of Hells Canyon Dam.

Adult and jack fall chinook salmon of ages 2-5 years enter the Snake River from the middle of August through October and spawn from October through November. Viable spawning populations are dependent on quality and quantity of habitat and water temperature. Fall chinook eggs require continual submergence. Snake River fall chinook fry emerge from the spawning gravel in March through April and begin downstream migration within several weeks of emergence. Juveniles migrate downstream to estuaries where they may spend several months feeding before exiting the Columbia River plume. The timing of fall chinook juvenile migration depends on water temperature. Active upstream fall chinook migration begins when fork lengths reach 3.35 inches (85 millimeters). Juvenile fall chinook migrate past Lower Granite Dam from June through the fall with the peak migration usually in July. Juveniles probably continue to feed through midsummer in cooler waters of the main stem below the confluences of the Salmon and Clearwater Rivers. Fall chinook spawn principally in a 100-mile reach of the main stem from Hells Canyon Dam to Lower Granite Dam and in the lower reaches of the Salmon and Grande Ronde Rivers. Although fall chinook salmon are indigenous to the Grande Ronde River basin and were once widespread, current spawning is limited to a few fish in the lower main stem, primarily below the Wenaha River.

Spring and summer chinook salmon are the same species and are differentiated principally by migration and spawning habits. Life history data for wild spring and summer chinook is sparse. Spawners have been in the ocean for 2-3 years. Spring chinook spawners pass Bonneville Dam prior to June 1 while summer chinook spawners pass the dam between June 1 and August 1. The elevation of spawning streams is the primary factor influencing the salmon run and spawn timing. Many of the headwater tributaries of the North Fork Salmon River are critical spawning and rearing areas for spring chinook. Spring chinook are widely distributed throughout Grande Ronde River basin, but are declining even in some subbasins where habitat remains largely unaltered. Most spring/summer chinook spawners enter tributaries from May through September. Where the two runs coexist, spring chinook spawn earlier in the upper reaches of the tributaries. Water temperature differences associated with elevation may be the primary segregating factor for spring and summer spawning runs. Spring chinook may return and spawn earlier because they are adapted to spawn in colder water with eggs that require a longer incubation time. Juvenile spring/summer chinook emerge from the spawning gravels between February and June. After juvenile fish rear in the Snake River basin for about 1 year, they begin the seaward migration as smolts in April and May and migrate swiftly to sea (Matthews and Waples, 1991).

Adult Snake River sockeye salmon enter the Columbia River as early as April and usually after 3 years in the ocean; adults returning to spawn are 4-5 years old (NMFS, 1995) and are known to spawn in only one location. Migration up the Snake and Salmon Rivers can continue through October; however, most adults arrive at Redfish Lake in the Stanley basin in mid-July through August and spawn in beach gravel during

October (Bjornn et al., 1968). Eggs hatch after incubating for 80-140 days, and the fry remain in the gravel for 3-5 weeks, emerging in April through May to feed on plankton in the lake. Under the current program all sockeye spawners are captured and the fertilized eggs are used to support a captive broodstock program. Juveniles reared in the program are released to rear in the lake; they rear for 1-2 years before migrating seaward in the spring. Juveniles generally migrate past Lower Granite Dam in late May to mid-June. Once the smolts reach the ocean, they remain near the shore or within the plume of the Columbia River during the early summer months before moving out into the northeast Pacific Ocean. The migration timing for sockeye adults and juveniles is similar to that of spring/summer chinook adults and juveniles.

Inland Snake River steelhead, the anadromous form of resident redband trout, are summer-run fish which enter fresh water 9-10 months prior to spawning and ascend the Columbia River from June through October. Most juvenile steelhead in Idaho drainages rear in freshwater for 2-3 years, depending on water temperature and growth rates. Snake River steelhead have been classified into two groups based on ocean age, migration timing, and adult size. A-run steelhead generally spend an average of 1 year in the ocean. Sexually immature A-run summer steelhead enter freshwater in the spring and summer. Several months pass while they mature prior to spawning (NMFS, 1996). Adults enter the Columbia River on or before August 25 and attain a size of 4-8 pounds. These A-run steelhead are found throughout the Salmon and Grande Ronde Rivers. Summer steelhead spawn and rear throughout the Grande Ronde River basin by wild stock and a developing hatchery stock. Summer steelhead returns, which declined significantly through the 1970s and early 1980s despite reductions in harvest, have improved somewhat since 1985 with the advent of the fish transportation system and good flow years on the Snake and Columbia Rivers.

B-run steelhead spend an average of 2 years in the ocean. B-run winter steelhead mature in the ocean and enter freshwater in the fall and winter ready to spawn (NMFS, 1996). The adults enter the Columbia River after August 25 and grow to 12-20 pounds. Their range is limited primarily to the Clearwater River basin and the South and Middle Forks of the Salmon River. In the South Fork Salmon River, steelhead fry emerge from redds in the middle to late summer when they usually move into shallow, slow-moving margins of the stream. As growth continues, they adapt to areas with deeper water, a wider range of velocities, and larger substrate.

7.4.2.2 Environmental Consequences

Hydrologic modeling did not include the basin downstream of Hells Canyon Dam where these species are located. Overall analysis of potential benefits of flow augmentation in the lower Snake and Columbia Rivers on salmon and steelhead is within the province of the Corps' analysis.

The Base Case and No Augmentation scenarios have no effect on flows of the Grande Ronde and Salmon Rivers. The 1427i and 1427r scenarios would increase spring and summer flows by the same amount and would most likely improve habitat for salmon and steelhead in these streams.

7.4.3 Aquatic Snails

7.4.3.1 Affected Environment

The USFWS (1992b) listed five species of freshwater snails of the Snake River as threatened or endangered under the ESA, effective January 13, 1993. The Banbury Springs lanx (*Lanx sp.*), the Idaho springsnail (*Pyrgulopsis idahoensis*), the Snake River physa (*Physa natricina*), and the Utah valvata (*Valvata utahensis*) were listed as endangered. The Bliss Rapids snail (*Taylorconcha serpenticola*) was listed as threatened. All five species are characterized as geographically limited and generally intolerant of pollution.

The USFWS (1992b) reported that four of the taxa had declined in all but a small fraction of their historical range. They further stated that the five species were currently restricted to a few isolated free-flowing reaches or spring alcove habitats in the middle Snake River characterized by cold, well-oxygenated, unpolluted water. They defined the middle Snake River as extending from C.J. Strike Reservoir upstream to Milner Dam.

Recent IPC and Reclamation studies have shown that two snails are more widely distributed than thought at the time of listing. The Idaho springsnail has been found in the Snake River at C.J. Strike Reservoir and 20 miles downstream from C.J. Strike Dam. The Utah valvata snail has been located throughout Lake Walcott and upstream to a point about 2 miles downstream from American Falls Dam. Additional investigations in October 1998 found the Utah valvata snail in American Falls Reservoir. IPC and Reclamation, within the last few years, have found ESA-listed aquatic snails throughout most of a 215-mile reach of the Snake River.

7.4.3.1.1 Bliss Rapids Snail

The Bliss Rapids snail is 0.1-inch high with three whorls and is ovoid in shape. Shell color variants include a pale (colorless) form and an orange-red form. The pale form is slightly smaller with rounded whorls and more dark brown or black pigment (melanin) on the body (Frest and Johannes, 1992).

The reproductive organs of this species are distinctive and individuals are either male or female. The snails mate in October-February in the main stem Snake River and in February-May in associated large springs. Eggs are laid within 2 months of mating and hatch within a month. Adult snails usually exhibit a strong die-off of older individuals in the late winter-early spring season following reproduction. Turnover following reproduction has been reported to be more pronounced in main stem river colonies.

The Bliss Rapids snail requires cold, clean, well-oxygenated, swiftly-flowing water with low turbidity. It prefers stable, cobble-to-boulder sized substrate, will not burrow, and avoids surfaces with attached plants. The USFWS (1992a) reported that known colonies are found only in areas associated with springs or at the edge of rapids and tend to flank shorelines. The snail is negatively phototaxic (avoids light) and resides on lateral and undersides of rocks during the daylight. It is often found grazing on algae and diatoms on the tops of rocks and is found at varying depths if dissolved oxygen and temperature conditions are favorable.

In 1993, a landslide caused water levels to rise and large amounts of sediment to be deposited in an area south of Bliss (RM 560). Known colonies of the Bliss Rapids snail were present in this area. However, the magnitude of impact to the Bliss Rapids snail in this area is unknown.

Current Reclamation operations are not likely to adversely affect the Bliss Rapids snail and IPC could not document any decline in snail population density and distribution or impaired reproduction (Reclamation, 1998).

7.4.3.1.2 Idaho Springsnail

The Idaho springsnail, also known as the Homedale Creek springsnail, has a narrowly elongated shell reaching a height of 0.2-0.25 inch and containing as many as six whorls. The empty shell has a pale, olive-tan color but can appear white at the apex. The body is gray with a reddish-brown aperture. Little is known of the general life history of this species; research is needed. The individuals are either male or female, and it is thought that the snails live up to 1 year. Based on typical patterns for many coldwater snails in the Pacific Coast states, the snails likely breed in February-May and eggs are laid and hatch in March-July. The eggs are laid in single capsules attached to the outside of the shell.

The population size of this species is not known. It has been reported that all samples of the Idaho springsnail represent a single population, based on similarities in glands among all samples.

Information collected by early investigators showed that in general, the Idaho springsnail requires cold, clean, well-oxygenated flowing water with low turbidity. The species occurs on mud or sand associated with gravel-to-boulder size substrate (USFWS, 1992a). It is often attached to vegetation (e.g. *Potamogeton*) in riffles.

Current operations appear to have no effect on the Idaho springsnail as habitat is not currently threatened and no decline in snail population density or distribution could be documented (Reclamation, 1998).

7.4.3.1.3 Snake River Physa

The shell of the adult Snake River physa is 0.2-0.25 inch in height with three to three and one-half whorls and is amber to brown in color (USFWS, 1992a).

Little is known of this species and research is needed. However, this snail, like all pulmonates, is hermaphroditic (possess both male and female sexual organs). Assuming this snail is similar to related species and other pulmonates, it lives for 1-2 years. Based on typical patterns for many coldwater snails in the Pacific Coast states, the snails probably breed in February-May and eggs are laid and hatch between March and July.

The Snake River physa requires cold, clean, well-oxygenated, swiftly flowing water with low turbidity. It occupies areas with rock and boulder substrate in deep water at the margins of rapids, where it occurs on the underside of the substrate. The snail is believed to inhabit deep water beyond the range of routine sampling (USFWS, 1995a).

The effects of current operations on the Snake River physa is unknown as the species remains reclusive and largely unsampled (Reclamation, 1998).

7.4.3.1.4 Utah Valvata Snail

The shell of the Utah valvata is turbinate and contains as many as four whorls, bordered by an angular ridge that fades toward the circular aperture. There are fine transverse, raised threads on the shell that is typically 0.2 inches in height.

This snail consumes diatoms, small plant debris, aquatic plants or other sessile organisms and resides among submerged aquatic vegetation.

The reproductive biology of the species has not been well documented and research is needed. Unlike some prosobranch snails, this species is hermaphroditic. This species is believed to have a maximum longevity of 2 years, based on age structure of sampled populations, although a majority are thought to survive only a single year. Eggs are likely laid in March-June in masses generally attached to macrophytes near the substrate.

Surveys at the Thousand Springs Preserve in 1991 revealed that only two areas contained colonies of the Utah valvata snail. The population estimate was 6,000 snails per colony with an average population density (in 1991) of six snails per square quarter meter. Subsequent surveys have discovered additional population at Lake Walcott and American Falls Reservoir.

The USFWS (1992a) reported that in the Snake River, the Utah valvata inhabit shallow shoreline waters, deep pools adjacent to rapids, and perennial flowing waters associated with large spring complexes. It generally avoids areas with heavy currents or rapids. The species prefers well-oxygenated areas of non-reducing calcareous mud or mud-sand substrate among beds of submergent aquatic vegetation. The species is absent from pure gravel-boulder bottoms. *Chara*, which concentrates both calcium and silicon dioxide, is a common associate.

Under current operations, normal drawdown of Lake Walcott is likely to adversely affect a portion of the population in the reservoir, but a large viable portion of the population appears to be thriving in deeper water not subject to dewatering. Populations downstream of Minidoka Dam should not be adversely affected, if recovery occurs and snails return to areas impacted by record flows of 1997. Routine operation of American Falls Dam is not likely to adversely affect the downstream population. IPC could not observe or document any decline in the snail population density and distribution downstream of Milner Dam (Reclamation, 1998).

7.4.3.2 Environmental Consequences

Critical time periods and minimum standards (flows, changes in flows, and drawdown of reservoirs) were developed based primarily on professional judgement to analyze potential effects of the scenarios. Standards for Lake Walcott and C.J. Strike Reservoir were based primarily on the amount of drawdown. Standards for releases from Milner Dam, flows at Hagerman, and releases from C.J. Strike Dam were developed based on the consistency of flows. These flow standards were developed for four levels–beneficial (enhancement), acceptable (current maintenance level), caution (adverse effect), and not good (very adverse).

For this analysis all of the aquatic snails were considered as a unit.

7.4.3.2.1 Lake Walcott

All of the scenarios were deemed to provide an acceptable level of effect.

7.4.3.2.2 Milner Dam Releases

Flows during the months of July, August, and September were rated as acceptable or beneficial to aquatic snails under all scenarios, and flows during the month of June were rated as not good under all scenarios. Overall the No Augmentation scenario achieves the steady flow condition suitable for snails. The higher augmentation flows that would be necessary to implement either the 1427i or 1427r scenario would make it very difficult, if not impossible to achieve the gradual ramp-down of flows that occurs under the base case.

7.4.3.2.3 Flow at Hagerman

Flows during June, July, and September were rated as beneficial for all scenarios, and flows during August were rated as beneficial for the Base Case and the No Augmentation. Flows during August were rated as not good for the 1427i and the 1427r scenario.

Flows during June, July, and September under all scenarios were rated as beneficial and flows during August under the Base Case and the No Augmentation were rated as beneficial. Flows during August would increase substantially under the 1427i and 1427r scenarios and were rated as not good; temporary habitat along shorelines would be created and later dewater after down ramping.

7.4.3.2.4 C.J. Strike Reservoir

Reservoir content data was not available, so an analysis of effects was not made.

7.4.3.2.5 C.J. Strike Releases

Flows during the months of June and July were rated as beneficial under all scenarios. Flows during the months of August and September were rated as cautionary for the Base Case, beneficial and cautionary for No Augmentation, not good and cautionary for the 1427i and 1427r scenarios. In summary, the 1427i and 1427r scenarios would likely be adverse to aquatic snails downstream of C.J. Strike Dam owing to the oscillation in flow releases.

7.4.4 Bald Eagle

7.4.4.1 Affected Environment

The bald eagle is currently listed as threatened in all of the lower 48 contiguous states. Historically, the bald eagle could be found nesting throughout most of the continent. However, reproduction in North America declined dramatically between 1947 and 1970 largely due to intake of DDT (USFWS, 1986). Habitat degradation, illegal harassment and disturbance, poisoning, and a reduced food base helped contribute to the decline. By 1978, the bald eagle was federally listed as a threatened species in 5 of the lower 48 states and as an endangered species in the remaining lower 43 states.

In establishing a recovery program for the species in the mid-1970s, the USFWS divided the bald eagles of the lower 48 states into five recovery regions. A recovery plan was prepared for each region by separate recovery teams composed of species experts in each geographic area. The teams set forth goals for recovery and identified tasks to achieve those goals. The Snake River basin lies within the Pacific recovery region that includes the states of Idaho, Oregon, Washington, Montana, Wyoming, California, and Nevada. The bald eagle recovery plan for the Pacific Region was approved in 1986.

In the 17 years since it was listed throughout the conterminous 48 states, the bald eagle population has clearly increased in number and expanded in range. The improvement is a direct result of banning DDT and other persistent organochlorides, habitat protection, a growing public awareness of the bald eagles' plight, and other measures. Due to the overall population increase, the bald eagle was reclassified from endangered to threatened in all of the lower 48 states in 1995 (USFWS, 1995b).

In 1990, bald eagles nested in all but 5 of the 50 states. However, most bald eagle nesting is limited to the Pacific Northwest, Alaska, Canada, the Great Lake states, Chesapeake Bay, Arizona, and Florida. Oregon and Washington have been strongholds for bald eagles with more than two-thirds of the nesting population and one-half of the wintering population of the Pacific recovery region occurring in these two states (USFWS, 1994). Occupied breeding territories surveyed in Oregon and the Washington portion of the Columbia River recovery zone have increased from less than 100 in 1979 to 330 in 1997 (Isaacs and Anthony, 1997). The number of known occupied nesting territories in Idaho have increased from 11 in 1979 to 90 in 1996 (IDFG, 1997). Delisting of the species is now a potential.

Delisting requirements under the Pacific Bald Eagle Recovery Plan include: (1) a minimum of 800 nesting pairs; (2) an average reproductive rate of 1.0 fledged young per pair with an average success rate per occupied site of not less than 65 percent; (3) breeding population goals met in at least 80 percent of the management zones; and (4) stable or increasing wintering populations. These goals have been met in the Pacific States, and bald eagle numbers are continuing to increase. In 1994, a total of 1,192 occupied territories were reported with 1.03 young per occupied territory. The number of occupied territories has consistently increased since 1986 and exceeded 800 for 5 years beginning in 1990 when 861 were reported. Productivity has averaged about 1.03 young per occupied territory since 1990. In 1994, 21 of the 37 specified management zones had met or exceeded their recovery goals for breeding, and five zones, that are in addition to the original 37 zones and are not part of the recovery goals for this region, also had nesting eagles. Delisting goals have been met in all categories except distribution in zones with nesting targets.

7.4.4.1.1 Life History

The bald eagle, like most birds of prey, exhibits sexual dimorphism with the females weighing more than the males. Males and females are thought to mate for life, returning to the same nesting territory year after year. A clutch of one to three eggs, is laid and incubated mostly by the female for about 35 days. The young fledge in 72-75 days. Often the younger, weaker bird is killed by its sibling in the competition for food.

Bald eagles require 4-5 years to reach sexual maturity and attain full adult plumage. Prior to that time, immature bald eagles are often confused with immature golden eagles.

7.4.4.1.2 Nesting Habitat

In the Pacific Northwest, bald eagles typically nest in multilayered coniferous stands with old growth trees within 1 mile of large bodies of water (lakes, reservoirs, large rivers, and coastal estuaries). Availability of suitable trees for nesting and perching is critical. Nest trees in the Pacific Northwest are found primarily in ponderosa pine, mixed conifer, Douglas fir, and Sitka spruce/western hemlock forests (USFWS, 1986). Species of trees used for nesting, however, vary among areas. In Idaho, nests are typically found in large cottonwoods, ponderosa pines, and Douglas firs (USFWS, 1986). Wyoming nests have been reported in a variety of forest types including old growth ponderosa pine and narrow strips of forest vegetation surrounded by rangeland. Nests are generally not constructed in areas with nearby human activity.

The nesting season for bald eagles in the Pacific Northwest generally extends from January 1 to mid-August (USFWS, 1994). Young are usually produced in March and fledged in July; however, they may stay near the nest for several weeks after fledging.

7.4.4.1.3 Wintering Habitat

More than 25 percent of the wintering bald eagles in the lower 48 states are present in the Pacific Northwest (USFWS, 1986). Bald eagles winter in the Northwest from approximately November through March and are primarily associated with open water near concentrated food sources. An important habitat feature is perch trees which provide an unobstructed view of the surrounding area near foraging sites (USFWS, 1986). Ponderosa pine and cottonwood snags are preferred perches in some areas, probably due to their open structure and height.

Bald eagles may also use communal night roost sites in winter for protection from inclement weather. Characteristics of communal winter roost sites differ considerably from those of diurnal perch sites (USFWS, 1986), although both are invariably located near concentrated food sources, such as anadromous fish runs or high concentrations of waterfowl. Roost sites tend to provide more protection from weather than diurnal perch sites. Communal roosts in the Pacific Northwest tend to be located in uneven-aged forest stands with some degree of old-growth forest structure. Conifers might provide a more thermally favorable microenvironment than dead or deciduous trees, which might explain their high use by wintering eagles. In eastern Washington, bald eagles have been observed roosting in mixed stands of Douglas fir and ponderosa pine and in stands of black locust and black cottonwood.

7.4.4.1.4 Foraging Habitat

Bald eagles are opportunistic foragers throughout their range. In the Pacific Northwest, bald eagles consume a range of food including a variety of fish, waterfowl, jackrabbits, and mammalian carrion (USFWS, 1994). Game and nongame fish species tend to be the preferred food, but diet is dependent on prey availability. Winter killed mammals can be important on big game winter ranges, while waterfowl are important where concentrations are significant. Fish are also taken as carrion, especially spawned out kokanee (USFWS, 1986).

7.4.4.1.5 Base Case Conditions

The Snake River basin upstream of Milner Dam supports a significant population of nesting and wintering bald eagles. It is the largest nesting population of bald eagles in the State of Idaho. The nesting population of bald eagles in this area has increased steadily since 1970 (Greater Yellowstone Bald Eagle Working Group, 1996). In 1979, there were an estimated 11 occupied nest sites in Idaho. Annual monitoring efforts indicate that the number of known occupied nesting territories in eastern Idaho has increased dramatically over the last 18 years. In 1996, there were 46 known occupied nesting territories in eastern Idaho alone and 90 sites Statewide (Beals and Melquist, 1996). On the Idaho portion of the Snake River upstream of Milner Dam, a series of 13 routes have been surveyed on an annual basis during the National Mid-Winter Bald Eagle Count. While wintering populations of bald eagles in Idaho have been monitored regularly since 1980, the information gained from this survey has limitations in its use. The total number of eagles for these 13 routes collectively has ranged from a low of 49 to a high of 241. Many variables, including weather conditions and inconsistency of route surveyors, make the interpretation of the data difficult. It is not possible at present to identify a clear trend of increasing or decreasing use of the Snake River in Idaho by wintering bald eagles.

The Snake River main stem from Milner Dam to Brownlee Dam includes only two nesting territories, but receives significant winter use. Complete counts conducted over the last 10 years show numbers ranging from 25 to 56 eagles on the river upstream of Brownlee Reservoir. Most of the wintering eagles are found in the reach from Milner Dam to Grandview. Brownlee Reservoir is heavily used by wintering bald eagles. Winter counts generally are 25 to 50 birds but have been more than 100 in a couple of years (Isaacs et al., 1992).

The Boise River basin includes only a few bald eagle nests but is considered an important wintering area from Anderson Ranch Reservoir to the lower Boise River, including Lake Lowell. As many as 50 eagles winter in the upper river area which include Anderson Ranch Reservoir, Arrowrock Reservoir, and Lucky Peak Lake. Up to 35 individuals can be found along the river reach downstream of Lucky Peak Dam and as many as 20 individuals can be found at Lake Lowell.
Cascade Reservoir in the Payette River basin is considered an important nesting area with six active nesting territories, and the South Fork and main stem Payette River are considered important wintering areas with respective population counts of up to 16 and up to 20 birds.

There are no known nesting sites at Lake Owyhee and along the lower Owyhee River; however, up to 30 eagles winter at the reservoir and lower river.

Bald eagles are found at ten reservoirs: Jackson Lake, Palisades, Island Park, American Falls, Anderson Ranch, Arrowrock, Lucky Peak Lake, Cascade, Deadwood, and Lake Owyhee. Bald eagles have also been identified in the following river reaches: Snake River downstream of Jackson Lake Dam, Snake River at Irwin, Heise, and Lorenzo; South Fork Boise River at Anderson Ranch Dam; Boise River downstream of Lucky Peak Dam; North Fork Payette River downstream of Cascade Dam; Deadwood River downstream of Deadwood Dam; and Payette River at Horseshoe Bend. Bald eagles are also found along the main stems of the Grande Ronde and the Salmon Rivers.

Current operation of Reclamation facilities has little or no adverse effects on bald eagles at most locations because there are abundant or adequate prey populations to support the current level of nesting and winter use (Reclamation, 1998). Flood control operations tend to limit cottonwood regeneration downstream of Palisade Dam, Anderson Ranch Dam, Lucky Peak Dam, and Owyhee Dam. However, there continue to be adequate perching and roosting sites.

7.4.4.2 Environmental Consequences

Successful bald eagle foraging may be more closely linked to the abundance of prey species than to reservoir levels. The bald eagle's dependency on fish and its association with large bodies of water has been well documented. Stable reservoir levels during the hatchling and fledgling period provide a secure food source on a day-to-day basis. As full reservoirs decline in size, prey fish are found either concentrated in shallow waters or perhaps trapped in shallow pools allowing for easier vulnerability to foraging and thus good fishing success by eagles. However, this condition is usually temporary in nature and if continually repeated, seasonally or annually, would have a net negative effect on the prey and the eagle.

Overall, an open body of water providing greater shoreline shallows for expanded foraging are of immense benefit to eagles in the spring. A larger water surface is more substantially affected by wind conditions allowing for better ice break up and a better mix of warmer surface waters with colder deep waters. Higher reservoir levels improve foraging conditions for predatory fish as well as for eagles. Eagles also benefit from trout spawning runs in April through June when these fish are more surface oriented at lakes or more readily exposed in clear, shallow streams. Decreasing reservoir levels may concentrate prey fish as the summer progresses, although these fish may tend to avoid surface waters being wary of avian predators, thus lowering foraging success rates.

For this analysis, three critical time periods–breeding (March and April), incubation/hatchling (April and May), and winter (November through March)–and minimum reservoir elevations (pool sizes) were identified. Riverflow standards were also identified. Based on how often the scenarios meet these levels, the scenarios were determined to be either conducive, not conducive, or at a cautionary level for bald eagles. Table 7-16 summarizes the ratings for 10 reservoirs based on pool size and 10 river reaches based on flow.

Table 7-16 Overall Rating of Scenario Effects on Bald Eagles				
Location and Benefit Level	Scenarios (number of locations (of 10 possible))			
	Base Case	No Augmentation	1427i	1427r
Reservoirs				
Conducive	4	3	1	3
Not Conducive	6	6	8	6
Cautionary	0	1	1	1
River Reaches				
Conducive	7	7	7	7
Not Conducive	2	2	2	2
Cautionary	1	1	1	1

Table 7-16 indicates that reservoir levels would be most favorable for bald eagles (conducive at 4 of 10 reservoirs) under the Base Case, slightly less favorable under the No Augmentation and 1427r scenarios and least favorable under the 1427i scenario (conducive at only one reservoir). Riverflow levels under all scenarios would be conducive (7 of 10 reservoirs) to bald eagles.

Other factors, including weather, food supply, and habitat availability (perching trees, nesting trees, and big game range foraging areas), have been documented to contribute significantly to the welfare of the bald eagles and may negate the single influence of the minimum reservoir storage or minimum riverflow standards. It has been further documented that weather-related factors may often have more influence on bald eagle reproductive success than fluctuations in reservoir levels.

7.4.5 Ute Ladies' Tresses

7.4.5.1 Affected Environment

Ute ladies' tresses was listed as a threatened species on January 17, 1992. Individual populations of this orchid are known to exist in Idaho, Colorado, Utah, Wyoming, and Nevada. The total known population is approximately 20,500 individuals. The population is probably declining due to limited habitat. The existing habitat is relatively small, potential habitat is being lost, and processes that cause new potential habitat to develop are impeded. Nonetheless, extensive searches of potentially suitable habitat have revealed a greater number populations and individual Ute ladies' tresses plants than was known when the plant was listed in 1992.

The number of plants present in any specific population may vary considerably from year to year and may lead to false estimates of the population size and vigor. Fluctuations in populations are the result of dormancy periods likely brought on by variation in environmental conditions. During dormancy periods, there may be limited above-ground growth and no floral development.

An approved recovery plan for the Ute ladies' tresses has not been developed.

7.4.5.1.1 Life History

The Ute ladies' tresses is a perennial, terrestrial orchid with stems arising from tuberously thickened roots. Its narrow leaves are about 11 inches long at the base and become reduced in size toward the apex. The flowers consist of few to many small white or ivory flowers clustered into a spike arrangement at the top of the stem.

This species usually flowers from the end of July until early September. Reproductively mature plants do not flower every year, probably because of variations in environmental conditions. Reproduction appears to be strictly sexual, with bumblebees as the primary pollinators. Each fruit contains thousands of very small seeds. Seeds disseminate primarily through water transport. After seeds reach suitable habitat, they must come in contact with the suitable species of mycorhizal endophyte. This fungus provides the developing plant with the nutrients necessary for further growth. Plants usually require 5 to 10 years before flowering.

7.4.5.1.2 Habitat Requirements

Ute ladies' tresses appears to be well adapted to, and perhaps dependent on, regular disturbances caused by water movement through floodplains. Natural fluvial processes create new habitat. Flooding also maintains the existing habitat by reducing colonization of gravel bars by trees and shrubs.

The orchid is endemic to moist soils in mesic or wet meadows nears springs, lakes, or perennial streams. The elevational range of known Ute ladies' tresses is 4,300 and 7,000 feet (Stone, 1993). The plant is found mostly along riparian edges, gravel bars, old oxbows, and moist to wet meadows along perennial streams. In some localities in the eastern Great Basin, Ute ladies' tresses are found near freshwater lakes or springs. The plant seems to require permanent sub-irrigation (Coyner, 1989), indicating a close affinity with floodplain areas where the water table is near the surface throughout the growing season. It grows primarily in areas where the vegetation is relatively open and not overly dense or overgrown (Coyner, 1989 and 1990; Jennings, 1989 and 1990), although a few populations in eastern Utah and Colorado are found in riparian woodlands. Plants usually occur in small scattered groups and occupy relatively small areas within the riparian system (Stone, 1993). These preferred habitat features seem to imply that the plant is most likely to occur in riparian habitats created and maintained by streams active within their floodplains.

Ute ladies' tresses appear to have a very low reproductive rate under natural conditions. This orchid is tolerant of a mix of herbaceous wetland, forb, and grass species but does not compete well with emergent or aggressive species that form dense monocultures, such as Canada thistle, purple loosestrife, whitetop, Russian olive, and reed canarygrass. Maturing riparian communities with an overstory of trees or shrubs do not provide suitable habitat conditions. The plants thrive in full sun or partial shade. It is not tolerant of long-term standing water throughout the growing season. Beaver dams that raise the water table to within 18 inches of the ground surface likely improve habitat conditions in adjacent areas.

Ute ladies' tresses are found in two types of plant communities in the project area. These communities consist of the wandering spike-rush and the silverberry/coyote willow communities. The wandering spike-rush community where Ute ladies' tresses have been found is nearly monotypic. The silverberry/coyote willow community is a mesic transition zone habitat between sedge dominated areas with standing water and habitats higher in elevation that have an overstory of narrow leaf cottonwood and an understory of Kentucky bluegrass. Habitat is commonly dominated by redtop, a non-native, rhizomatous grass, with an overstory of widely scattered silverberry and coyote willow (Moseley, 1996). Shrub canopy averages less than 10 percent. Soils are generally fine to coarse alluvium, with minimal soil development.

7.4.5.1.3 Base Case Condition

Ute ladies' tresses were found in Idaho in September, 1996 (Moseley, 1996). Extensive surveys in 1996 covered a wide area of eastern Idaho to assess the distribution of potential habitat. These surveys documented the existence of four separate occurrences of the plant in the floodplain along the main stem of the Snake River between Heise and Swan Valley. One population consisted of 12 individuals scattered over an area of about 1 acre while another population consisted of 15 individuals within an area of about 1 acre. The largest population was 173 plants within a 1 acre area, while the smallest population was one plant at another site.

The IDFG Conservation Data Center, Bureau of Land Management (BLM), USFS, and USFWS conducted more intensive surveys in 1997. Preliminary analysis of data indicates the existence of 20 occurrences along the Snake River between Swan Valley and the confluence with the Henrys Fork (Moseley, 1997). A total of 1,171 individuals (mostly flowering/fruiting plants) were counted. Non-flowering plants were not counted due to the difficulty of species identification.

Grazing and recreational use appear to be the most likely activities affecting the plant. However, adequate data is not available to determine what, if any, activities are affecting this species along the main stem Snake River. It is generally believed that any activity that degrades floodplain riparian or wetland habitats would also affect Ute ladies' tresses (USFWS, 1995c).

Reclamation is currently cooperating with BLM and other agencies in a study to document river morphology changes of the Snake River that may have resulted from 1997 floodflows downstream from Palisades Reservoir. This study is expected to provide some understanding of the effects of periodic flood events on the habitat of the Ute ladies' tresses.

Reclamation concluded that the Base Case operation is not likely to adversely affect Ute Ladies' Tresses (Reclamation, 1998).

7.4.5.2 Environmental Consequences

Critical time periods and minimum flow standards were identified based primarily on professional judgement. The critical time period for the Ute ladies' tresses is May through July and the minimum standard is that riverflows should average near 20,000 cfs or higher in the Snake River between Swan Valley and Heise in any one of three months (May, June, or July) and should occur at least 50 percent of the time or in 3 of 6 six-year periods. Four effect levels were developed based on how the standard was met–beneficial, acceptable, cautionary, and unacceptable.

Reclamation found that flow conditions at Heise would be acceptable (no effect) under all four scenarios. In contrast, flows at Irwin would be acceptable under the Base Case, but unacceptable under the No Augmentation,1427i, and 1427r scenarios because river flows in the latter three scenarios would not meet the minimum standard.

7.4.6 Bull Trout

7.4.6.1 Affected Environment

The Columbia River population segment of bull trout has been listed as threatened. Bull trout populations within this population segment have declined from historic levels and are generally considered to be isolated and remnant.

7.4.6.1.1 Historical Distribution

Bull trout were probably widely dispersed throughout the Snake River drainage, limited only by natural passage and thermal barriers. Bull trout were present in all of the Snake River basin (except the eastern section of Idaho) and tributaries of the upper Columbia River basin. In the Snake River basin, their historical range approximates that of spring, summer, and fall chinook salmon (Thurow, 1987; Rieman and McIntyre, 1993) and possibly included the Owyhee River basin and other Snake River tributaries upstream as far as Salmon Falls Creek. They are not known to have occurred in the Snake River upstream of Shoshone Falls, the Wood River system, Birch Creek, or any stream in Idaho that drains the Centennial Mountains between Henrys Lake and the Bitterroot Range. An isolated population exists in the Little Lost River near Howe, Idaho between the Lost River and Lemhi mountain ranges (Batt, 1996).

In eastern Oregon, bull trout were present in the Grand Ronde, Powder, and Malheur River systems, but were not known to occur in the Burnt River system.

7.4.6.1.2 Present Distribution

Current distribution is primarily in tributaries to the main stem Snake River upstream to and including the Boise River. Major tributaries of the Snake River in Oregon currently supporting bull trout populations include the Grande Ronde, Imnaha, and the Malheur. In Idaho, bull trout can be found in the Clearwater, Salmon, Weiser, Payette, and Boise River drainages.

Reclamation reservoirs in Idaho that are known to have bull trout associated with them are Arrowrock Reservoir, located on the main stem Boise River; Anderson Ranch Reservoir, located on the South Fork Boise River; and Deadwood Reservoir, located on the Deadwood River in the Payette River basin.

Survey work has recently documented bull trout in widely scattered segments of their known range in eastern Oregon, mostly in headwater areas where only remnant resident populations may be surviving (Batt, 1996). Bull trout are present in two headwater areas of the Malheur River. In the main stem, bull trout are confined to headwater areas several miles upstream of Warm Springs Reservoir. There are no documented populations of bull trout in Warm Springs Reservoir. The North Fork Malheur River basin supports bull trout from Beulah Reservoir upstream to and including headwater tributaries. Beulah Reservoir supports an adfluvial population of bull trout that migrates to headwater tributaries during spawning periods.

Isolated headwater populations of bull trout exist in the Powder River basin. However, there has been no documentation of bull trout associated with Reclamation facilities (Phillips Lake and Thief Valley Reservoir) in this basin. Bull trout have not been documented by ODFW in the Burnt River system (Zakel, 1997)

7.4.6.1.3 Life History

Bull trout exhibit two distinct life history forms in the Snake River basin–migrant and resident. Migrant fish emigrate from the small streams where the juveniles rear to larger rivers (fluvial) or lakes (adfluvial). Resident fish remain in the rearing streams. Table 7-17 (Knowles and Gumtow, 1996) summarizes the life history of bull trout.

Table 7-17 Bull Trout Life History Summary	
Life Conditions	**Criteria/Facts**
Age at first reproduction	4-5 years
Number of eggs produced	1,300 to 9,000
Maximum size	Greater than 30 pounds and 36 inches
Life span	Up to 10 years
Food habits	Juveniles are insectivorous. Adults are piscivorus
Incubation success (percent)	Water temperature critical: 32-36 °F = 80-95 percent 43 °F = 60-90 percent 46-48 °F = 0-20 percent Sediment size: 20 percent fines = 40 percent 30 percent fines = 20 percent 40 percent fines = 1 percent
Migration strategies	Resident, adfluvial, fluvial, and anadromous
Closely related species	Dolly Varden, lake trout, and brook trout
Optimal and maximum water temperature	Juveniles = 39-48 °F and 59 °F Adults = 39-48 °F and 64 °F
Spawning season	September through November

Bull trout can live up to 10 years and are sexually mature after 4 years. They spawn during September through November, in cold, flowing groundwater-fed streams that are clean and free of sediment. The incubation period for bull trout is extremely long, and young fry may take up to 225 days to emerge from the gravel. Juvenile bull trout mature slowly, often spawning for the first time in their fourth or fifth year.

Migratory bull trout live several years in larger rivers or lakes, where they grow to a much larger size than resident forms before returning to tributaries to spawn. Growth differs little between forms during their first years of life in headwater streams, but diverges as migratory fish move into larger and more productive waters (Rieman and McIntyre, 1993).

It appears that most bull trout, even those not ready to spawn, migrate upstream beginning in May-June and return in November-December. This migration may be in part to avoid high summertime water temperatures in some areas or insufficient flows or water levels. Variation in the timing of outmigration and in the timing and frequency of spawning also represents diversity in life history. Bull trout may spawn each year or in alternate years.

7.4.6.1.4 Habitat Requirements

Bull trout have some of the most demanding habitat requirements of any native trout species mainly because it requires water that is especially cold and clean. Eggs are extremely vulnerable to siltation problems and bed load movement during the long incubation period. Any activity that causes erosion, increased siltation, removal of stream cover, or changes in water flow or temperature affects the number of bull trout that hatch and their ability to survive to maturity (Knowles and Gumtow, 1996).

Water temperature is a critical habitat characteristic for bull trout. Temperatures above 59 °F are thought to limit bull trout distribution (Batt, 1996). Optimum water temperatures for rearing are thought to be 45-46 °F. Researchers recognized water temperature more consistently than any other factor influencing bull trout distribution. However, it is poorly understood whether the influence of temperature is consistent throughout life or whether a particular stage is especially sensitive.

Bull trout have voracious appetites and take full advantage of any and all food sources available to them. Fish are considered to be the major item in the diet of large bull trout. Adult bull trout that are adfluvial generally spend about one half of every year associated with a reservoir (generally November-May). These fish most likely forage in shallow areas where the majority of prey exist. Depending on water conditions, bull trout will occupy deeper areas of the reservoir where water temperatures are cooler (45-54 °F) and move to the surface when surface water temperatures drop to or below 54 °F.

7.4.6.1.5 Factors Contributing to Decline

Bull trout were formerly viewed as a “trash fish” by anglers–they consume juvenile salmon and other game fish so they were considered undesirable predators. In the past, many fish and wildlife agencies mounted active campaigns to eliminate bull trout, but even after these efforts ceased, populations continued to decline due to impacts of other human activities. Impacts on bull trout generally occur from three areas of resource management: (1) land management, (2) water management, and (3) fisheries management. Current recognized threats to bull trout include: habitat degradation, passage barriers and stream diversions, competition with exotic species (especially brook trout), reduced populations from overfishing or eradication efforts, and catastrophic events (fire, timber salvage, drought).

7.4.6.1.6 Baseline Conditions

7.4.6.1.6.1 Boise River Basin--Arrowrock Reservoir and Lucky Peak Lake

Telemetry and recapture studies from 1996-1998 have shown a healthy population of adult bull trout in Arrowrock Reservoir. These adult fish migrate into the upper Boise River tributaries from May to June, and return to Arrowrock from September to October.

It is apparent from these recent studies that bull trout are being entrained from Arrowrock Dam into Lucky Peak Lake where there are no tributaries that appear to be used for spawning by bull trout. It appears that entrainment occurs both during spill events and during operational releases through the dam. Bull trout recaptured in Lucky Peak have been in good condition, showing no abnormal signs from passing over the spillway or through the valves.

It is likely that sub-adult bull trout are present in Arrowrock Reservoir, where they reside until mature. Based on information from other river systems, it is most likely that these fish rear in their natal streams for 2-3 years before migrating downstream to Arrowrock Reservoir and stay there for 2-3 years. These fish subsequently migrated upriver as mature adults. It is speculated that these sub-adults are also vulnerable to entrainment.

7.4.6.1.6.2 Boise River Basin--South Fork Boise River to Anderson Ranch Dam

Electrofishing surveys have documented the presence of bull trout in the South Fork Boise River below Anderson Ranch Dam; although capture numbers have been small. It is not known to what extent these bull trout are adfluvial, migrating up the South Fork from Arrowrock Reservoir; fluvial, residing in the South Fork; or passed through Anderson Ranch Dam. Telemetry data has documented the movement of adult bull trout movement from Arrowrock Reservoir up the South Fork; however, spawning in the South Fork has not been documented. A resident population of bull trout exists in Rattlesnake Creek, tributary to the South Fork. It is not known whether any other bull trout migrate into Rattlesnake Creek to spawn or whether fish from the creek migrate downstream to Arrowrock Reservoir.

7.4.6.1.6.3 Boise River Basin--Anderson Ranch Reservoir

Sampling records for Anderson Ranch Reservoir show that significant numbers of an adfluvial population of bull trout resides for part of the year in the reservoir. A single years data from telemetry studies in 1998 indicate that these fish also migrate upstream to spawning grounds above the reservoir then return in the fall. However, there is no indication to date that there is entrainment of bull trout through the dam.

7.4.6.1.6.4 Payette River Basin–Deadwood Reservoir

There is a small adfluvial bull trout population in Deadwood Reservoir. Due to the small sample size, no conclusions can made at this time on the size, condition, or movement of bull trout in Deadwood Reservoir and its tributaries; although Trail Creek appears to be the main tributary utilized by spawning adults.

Populations of bull trout have been identified during stream surveys in several tributaries of the Deadwood River. Stream reaches having large woody debris and higher numbers of plunge and dam pools tend to have higher bull trout densities These populations are comprised of small bull trout that appear to be resident populations.

7.4.6.1.6.5 Malheur River Basin

An adfluvial population of bull trout has been documented in Beulah Reservoir and the North Fork Malheur River. Resident populations of bull trout also reside in headwater streams in the North Fork Malheur watershed. Telemetry data have shown that adult bull trout migrate from the reservoir to spawn in upper reaches of the North Fork and then return to the reservoir to winter. It is also probable that juvenile bull trout migrate into the reservoir after initial rearing in their natal streams. Anglers have also reported catches of bull trout downstream of Beulah Reservoir which indicates that bull trout are most likely being entrained through Agency Valley Dam.

7.4.6.1.6.6 Grande Ronde River Basin

Small populations of bull trout reside in headwater portions of tributaries and in portions of the lower Grande Ronde Basin.

7.4.6.2 Environmental Consequences

7.4.6.2.1 Boise River Basin

7.4.6.2.1.1 Arrowrock Reservoir and Lucky Peak Lake

Bull trout in Arrowrock Reservoir may be adversely affected by the base case reservoir operations. Early summer drawdowns and the low winter reservoir levels during drought periods or for flood control reduce the productivity of the reservoir discouraging growth and reproduction of aquatic invertebrates and plants. This limits the development of the food base for bull trout. When Arrowrock Reservoir is emptied or drawn down to very low levels, nutrients, food organisms, and fish (including bull trout) pass through Arrowrock Dam into Lucky Peak Lake. All of these cause the loss of a portion of the self-sustaining wild fish resource. If sub-adult trout reside in Arrowrock Reservoir for a 2-3 year period, there is a greater potential for sub-adult entrainment than for the migratory adult population that is absent from the reservoir during spawning periods. Large flood control releases in the winter, such as those made during the 1997 water year, may be a potentially significant factor for bull trout entrainment.

Based on little change to the recommended conservation pool in Arrowrock Reservoir it is likely that the No Flow Augmentation would not be significantly different from the Base Case in terms of providing overwintering habitat or entrainment of bull trout in Arrowrock Reservoir.

In comparison, the 1427i scenario would result in a lower conservation pool more often than in the Base Case scenario, resulting in poorer overwintering habitat for bull trout and possibility of increased entrainment to Lucky Peak Lake. In addition, lower pool levels in Lucky Peak during drought years would adversely affect habitat conditions for bull trout which may be entrained through Arrowrock Dam.

The 1427r scenario would be an improvement to the Base Case condition, and may improve overwintering habitat in the reservoir, but may result in additional spills which could counteract any reduction in entrainment caused by higher reservoir levels.

7.4.6.2.1.2 South Fork Boise River to Anderson Ranch Dam

Effects of Base Case reservoir operations on bull trout in the South Fork Boise River downstream from Anderson Ranch Reservoir are unknown. However, any adverse effects are most likely insignificant.

The slight differences in meeting recommended minium flows in the South Fork for all scenarios is not likely to significantly affect the quality of the habitat for bull trout.

7.4.6.2.1.3 Anderson Ranch Reservoir

The conservation pool at Anderson Ranch would be maintained similar to the Base Case condition for all but the 1427i scenario. Periodically reducing the conservation pool under this scenario may result in reduced habitat quality for overwintering bull trout.

Under all scenarios, releases over the spillway of Anderson Ranch Dam, with the exception of significant flood events, are made at the time that the reservoir is full and adult bull trout are more likely to be located near the upper end of the reservoir or have already started migrating from the reservoir into the South Fork. Spilling water in late spring or early summer is unlikely to cause any significant entrainment of bull trout.

7.4.6.2.2 Payette River Basin

Under all scenarios, operations at Deadwood Reservoir, for the most part, are not likely to significantly affect bull trout which inhabit the reservoir or the river downstream. The conservation pool would be maintained, with the exception of drought years when a portion of the conservation pool may be used to meet flow augmentation requirements. If this were the case, the potential for entrainment may increase at the same time. Flows in the Deadwood River would be similar under all scenarios.

7.4.6.2.3 Malheur River Basin

The Malheur River Basin is not included in this analysis of flow augmentation effect because none of the scenarios would affect the operation of reservoirs in the Malheur River system.

7.4.6.2.4 Grande Ronde River Basin

Increased streamflows resulting from water acquisition may would improve habitat conditions for any bull trout populations that may be present in the lower Grande Ronde basin.

7.6 Cultural Resources

"Cultural resources" is a broad term that includes prehistoric, historic, architectural, and traditional cultural properties. It includes such things as archaeological sites, districts, buildings, structures, and objects; standing historic structures or objects; locations of important historic events; and places or resources that are important to the cultural practices and beliefs of a living community. The National Register lists Traditional Cultural Property that is associated with cultural practices or beliefs of a living community that are rooted in that community's history and are important to maintaining the continued cultural and traditional religious identity of that community. Some archaeological sites qualify as traditional cultural properties. Indian Trust Assets are also included in cultural resources but are discussed separately in the Indian Trust Assets section.

Historic resources associated with westward expansion such as districts, buildings, structures, sites, etc are not expected to be affected differently by any of the flow scenarios. For that reason, the discussion in this section is confined to Native American cultural resources. Cultural and religious resources of significance to maintaining the continuing identity of a community were identified. This discussion is limited to those resources that would be affected by providing water for flow augmentation.

Indian tribes within the basin have a strong desire to protect their ancestors' graves, religious and cultural resource sites, and traditional cultural properties which are currently being used by tribes. Many tribal representatives claim ethnic ties to archaeological sites and graves currently lying beneath reservoir pools. Reclamation has a responsibility for protecting archeological and historical properties with confidentiality and has taken a proactive approach to identify the impacts that Reclamation river/reservoir operations would have on those properties. River and reservoir operations impinge on archaeological sites and traditional cultural properties around reservoirs and along the river channel and associated streams. A fundamental assumption for the future is that operations and actions can be directed to minimize impacts to the significant cultural resources by identifying archaeological sites, traditional cultural properties, and sensitive reaches.

7.6.1 Snake River Basin Upstream of the Hells Canyon Complex

7.6.1.1 Affected Environment

7.6.1.1.1 Prehistory

The Snake River was at the center of prehistoric and historic settlement in southern Wyoming, Idaho, and Oregon. As a crucial water source, a source of power, and the locus of abundant plant and animal resources, the Snake River drew people to its banks and tributaries. Although there are differences in the patterns of settlement and subsistence along the river, there are also striking similarities. The importance of fishing and riparian resources is one characteristic that links the prehistoric inhabitants of these areas. In historic times, the emphasis on ranching and farming and the development of irrigation systems that allowed these industries to expand into arid lands are also similar across the Snake River Plain. Differences in river use, however, are observed from east to west. For example, during the ethnohistoric period, the reliance on bison increased with the acquisition of the horse, whereas in central and southwestern Idaho and southeastern Oregon, fish were more important.

Differences over time in use of the river are reflected in site types and diagnostic artifacts. Paleo-Indian sites throughout the Snake River area are characterized by short-term campsites and large, lanceolate projectile point types such as Clovis and Folsom (Frison, 1991; Butler, 1986; Leonhardy and Rice, 1970). Early Archaic sites also show a resemblance across the region with small, short-term campsites and the introduction of notched projectile points. Later in the Archaic, regional differences are more marked in the artifact assemblage, with the appearance of specific point types such as corner-notched dart points in the upper Snake River (Frison, 1991; McNees et al., 1993), and Humboldt, Elko and Pinto series points in the middle and lower Snake River (Butler, 1986; Meatte, 1990; Leonhardy and Rice, 1970; Hanes ,1988; Oetting, 1994). While Archaic sites in southern Idaho and Oregon may include pithouses (Butler, 1986; Hanes, 1988; Oetting ,1994), upper Snake River Archaic sites are characterized by pit features and rock rings (Frison, 1991; Metcalf, 1987). Other distinctive elements of Archaic material culture may seem to have a limited distribution because of the varied conditions for preservation across the region. For example, Oregon has yielded fiber artifacts such as basketry, while such evidence has rarely been found in other areas. In the Late Period, all areas have ceramics of some sort; small, sometimes notched, projectile points, albeit of different styles; and ground stone. Site types vary within each area depending on site function. Upper Snake River Late Period sites are characterized by reoccupation, seed storage locations, stone circles and rockshelters, whereas middle Snake River sites tend to be small campsites or villages with collecting or foraging locations and lower Snake River sites are similar to the middle Snake River with the addition of large sites near wetlands and other resource locations (Reclamation, 1997d).

The Snake River region was one of increasing complexity in settlement and subsistence procurement through time, beginning with nomadic, big-game hunting as early as 12,000-14,000 years before present (B.P.), continuing with small foraging groups, and adding more sedentary collectors affiliated with Fremont and late Shoshone groups into historic times. Eastern Oregon prehistory, like that of southwestern Idaho, is defined by the overlap of Great Basin and Plateau cultures, and by the anadromous fishery of the lower Snake River basin. The historical development of the area parallels that of the arid lands of southwestern Idaho, as well.

The earliest evidence of human occupation in the region comes from the presence of Clovis fluted points in the eastern Snake River Plain and in buried deposits below Twin Falls. Folsom and Plano points, also a part of the Big Game Hunting Tradition, are abundant and widespread in the upper Snake River region (Butler, 1986). About 11,500 years B.P., the Big Game Hunting Tradition was succeeded by a period in which broad spectrum foragers occupied the region using a small range of tools (including ground stone) to exploit diverse food resources. From approximately 4,200 years B.P. to 250 years B.P., settlement and subsistence is characterized by semisedentary foraging. During this stage, larger groups occupied riverine villages during the winter months, relying on stored foods collected throughout the remainder of the year. Diverse tool assemblages, semisubterranean dwellings (i.e., pithouses), and greater reliance on salmon represent the indicators of this period. The final period, beginning about 250 years ago, involved intensive use of horses, permitting a dramatic increase in the efficiency and range of resource procurement activities (Meatte, 1989).

A considerable number of pedestrian archaeological surveys have been made throughout the upper and middle Snake River area. Most of the surveys have been in response to various land use projects, such as telephone cables, powerlines, dam construction, timber sales, rights of way, and access. Hundreds of archaeological sites have been reported, and some areas display high site densities (e.g., American Falls, Cascade Reservoir, Owyhee River basin, Malheur River area, and Jackson Lake). However, it is estimated that only 10-20 percent of the land surface adjacent to the upper and middle Snake River has actually been surveyed (for example, six Reclamation project areas have not been surveyed). It is expected that future surveys will encounter the same variety and abundance as found at previously recorded sites. The collection of sites reflects the full range of human occupation in the region, from the Paleo-Indian period through the historic era. A wide range of site types has been identified that appear to represent diverse cultural activities and functions. Site functions represented include: short-term, single-purpose camps such as hunting or fishing camps; resource collecting or processing campsites; substantial base camps, perhaps representing winter encampments of large groups of people; procurement stations not associated with a camp; and features associated with ceremonial activities.

7.6.1.1.2 Native Americans

Prior to European contact, southern Idaho and eastern Oregon were primarily occupied by three linguistically distinct groups: the (Snake River) Shoshone, Northern Paiute, and the Bannock. All three are Numic dialects (Madsen, 1980). The Shoshone and Bannock occupied lands from south of the Salmon River in southeastern Idaho across the Snake River Plain to western Idaho, and the Paiute lived primarily in southwestern Idaho and the western Snake River basin. The Snake River and numerous other drainages were the central locations for the populations (Steward, 1938). Shoshone and Bannock patterns of subsistence were well adapted to the requirements of mobility necessary for exploiting a wide range of resources over large expanses of terrain. Downstream of Shoshone Falls, the Shoshone and Bannock fished along the Snake River for salmon and other anadromous fish using spears, harpoons, traps, dip nets, seines, and weirs (Walker, 1978). After the Shoshone and Bannock acquired the horse in the early 1700s, some groups joined to hunt bison in Wyoming and Montana in late summer (Walker, 1978). Bison were also hunted on the upper Snake River Plain until about 1840, when most of the great herds were gone (Murphy and Murphy, 1960).

The Northern Paiute subsisted on seasonally available salmon, roots, bulbs (such as camas or bitterroot), and on large and small game). A wide variety of small mammals, birds, fish, and insects were eaten as well as various seeds, tuberous roots, and berries. In early May, people left their winter villages to search for edible roots. After the salmon run ended, family units would wander across the land taking deer, sage hens, and other birds, and collecting seeds and roots. In mid-July, women gathered crickets, and in August and September, currants and huckleberries, while the men hunted deer and elk in the mountain areas. Communal rabbit and antelope drives were activities in September, and by November, people were gathering foods from temporary cache pits and returning to their winter quarters. Big game were hunted with bow and arrow, traps, corrals, and dogs. Smaller game was taken with bow and arrow, snares, deadfalls, and in large cooperative drives where they were netted, shot, or clubbed. Fishing was done with dip nets or harpoons, hook and line, weirs, nets, baskets, and traps (Walker and Matthews, 1996).

7.6.1.1.3 Historic Period

The historical development of southern Idaho follows the broad patterns of development of the Northwest in general (Reclamation, 1997d). As such, it is represented by the following historical themes: Exploration and the Fur Industry (1805-1843); The Oregon Trail and Westward Migration (1836-1860); Mining (1860-1880); Farming/Ranching and Economic Development (1840-1940); and World War II and the Pre-Modern Era (1940-1960). The historical development of eastern Oregon roughly parallels that of southern Idaho, as follows: Exploration and Fur Trade (1805-1848); Settlement and Territorial Development (1848-1859); Early Statehood (1859-1904); Federal Reclamation and Irrigation (1904-1920); Interwar Years and the Great Depression (1920-1940); and World War II and the Pre-Modern Era (1940-1960). Artifacts, facilities, structures, and other remnants of the historic past associated with these themes can be found scattered throughout various locations of the upper and lower Snake River.

Early irrigation projects in the southern region were small-scale and were constructed with horse-drawn plows, shovels, and scrapers (Beal and Wells, 1959). The 1880s and 1890s saw an increase in large-scale irrigation canals aided by advances in technology, and by 1900 more than 600,000 acres were under irrigation in southern Idaho (Tucker et al., 1991). The twentieth century saw the involvement of the Federal government under the Reclamation Act of 1902 and the inauguration of major dam and canal projects.

7.6.1.1.4 Traditional Cultural Properties/Sacred Sites

A survey to locate and record properties that are of religious or cultural importance to current tribes has not been undertaken for the Snake River, and probably will not be, due to the sensitivity of such locations. The Shoshone-Bannock Tribes have indicated that there are places along the Snake River that still retain their natural integrity to permit conduct of traditional ceremonial functions (Reclamation, 1994b), and this is undoubtedly the case for the Shoshone-Paiute Tribes. Various natural and physical features on the landscape hold spiritual or religious significance to the aboriginal Snake River tribes. In Northern Shoshone-Bannock religion, spirits are believed to inhabit special places in the landscape, making these locations dangerous and sacred. Ritual precautions, such as bathing or offering gifts, must be performed before going to such places. These sacred places include mountains, foothills, buttes, springs, lakes, rivers, caves, burial places, petroglyph and pictograph sites, and others such as battle or massacre sites (Walker and Matthews, 1996). Human burial sites are expected to occur in talus slopes, the base of canyon walls, and other places. In addition, locations exist along the Snake River that have traditionally served and continue to serve as plant and other resource collection areas, and as such, would constitute places of traditional cultural importance to the Shoshone-Bannock, Shoshone-Paiute, Burns Paiute, and possibly other tribes.

7.6.1.2 Environmental Consequences

7.6.1.2.1 Base Case

Current Reclamation operations are affecting archaeological, historical, and TCP/sacred sites at all reservoirs. Changing water levels and flows cause wave action, innundation, and exposure of reservoir drawdown zones, all of which are adversely affecting cultural resources. Varying water levels or flow velocities associated with reservoir operations are causing erosion of banks around reservoirs (such as at American Falls Reservoir) and possibly along streams below reservoirs. At reservoirs with steep slopes (such as Black Canyon, or parts of Palisades or Anderson Ranch Reservoirs), damage to cultural resource sites would be more restricted than at Cascade, where the rise in elevation is gradual and is spread over a larger horizontal area. Erosion also occurs within a reservoir pool, well below the water surface.

Exposed archaeological deposits in the reservoir's bare littoral (exposed beach) zone are subject to direct mechanical impacts involving physical site damage, artifact movement, soil movement, and the movement of organic deposits such as bone. Because inundation removes vegetation, wind and water erosion deflate archaeological sites in this zone (removing archaeological soils and leaving heavier items and artifacts in place). In certain soils, rapid drawdown causes mass wasting (slumping or landslides) of slopes in or above the reservoir. (At Jackson Lake Dam it was determined that the most critical zone for site preservation is the area subject to shoreline fluctuation of the water level and wet/dry cycling, i.e., just below full reservoir level.) Direct impacts on archaeological deposits that occur underwater include erosion, chemical change, and accelerated decomposition. Horizontal and vertical provenance are adversely affected. Water running over bare slopes also causes erosional rills and gullies. Indirect impacts to archaeological, historical, and TCP/sacred sites result from reservoirs being made more attractive for recreation use, thereby increasing the potential for vandalism and artifact theft. These effects, which are generally unavoidable, occur at all reservoirs in the MAF study area during the annual cycle.

Informal discussions and coordination with tribes in the flow augmentation study area indicate strong interest by the tribes over the protection of their ancestors' graves, religious and cultural resource sites, including traditional cultural properties which are currently being used by tribes. Many tribal representatives claim ethnic ties to archaeological sites and graves currently lying beneath reservoir pools. Tribal representatives have expressed concern over exposure of cultural resource sites at reservoirs, as many of these reservoirs (for example, Unity, Owyhee, and Cascade Reservoirs) are still in active use by tribes as traditional use areas and locations where plants and other resources are collected. Reservoir drawdown operations can dessicate wetland plant populations, restricting their use during the year, and destabilize banks containing traditional use sites.

In the downstream channel, the extent and nature of damage to archaeological sites, historical sites, and TCP/sacred sites from reservoir operations upstream is difficult to determine and to distinguish from damage that would be occurring through natural stream flow. Rapid changes in downstream flows can cause banks to slump; therefore, at the empirical level, we can state that cultural sites situated on such banks would be adversely affected (at least more quickly than if there were not rapid changes in flows). However, without monitoring such effects to particular sites over a period of several years and correlating the changes in site integrity to particular reservoir operations upstream, generalized cause and effect statements are untenable. Although adverse changes to archaeological, historical, and TCP/sacred properties are probably occurring, the cause and nature of those changes remain to be verified and quantified.

Erosive forces acting on archaeological, historical, and TCP/sacred sites are accretional and cumulative from one annual operational cycle of the reservoir to the next. The impacts are not one time events, but coincide with the annual cycle of reservoir operations. Hence, each year, a given cultural resource property that is being affected by reservoir operations, is potentially worse off than the previous year. If the elements that contribute to a site's eligibility for the National Register are compromised, there reaches a point where the integrity of the site is so diminished that the site loses its potential eligibility.

The adverse effects occurring to archaeological, historic, and TCP/sacred sites as a result of Reclamation's and other agencies' reservoir operations are irreversible and irretrievable. Adverse effects to archaeological and historical properties that are of National Register quality can be mitigated through data recovery procedures, recordation, and other mitigation strategies. However, an archaeological or historical site is a unique creation from the past. It cannot be regenerated or regrown, even like an endangered plant can. Once the site or a portion of it is destroyed, it is essentially destroyed forever, and the damage is irreversible. For TCPs/sacred sites, adverse effects are even more troublesome, since disturbances to places such as tribal religious locations or resource collecting sites cannot be effectively mitigated in the sense that an archaeological site can.

7.6.1.2.2 No Augmentation

The No Augmentation scenario represents the historic operation before 1992. Reservoir levels and riverflows changes from historic levels to the Base Case are minuscule. Thus any change back to the No Augmentation scenario would have no effects, direct or indirect, to archaeological, historical, or TCP/sacred sites compared to the Base Case. There would be no irretrievable or irreversible commitments of resources above and beyond those identified under the Base Case.

7.6.1.2.3 1427i

Under this scenario, reservoirs would be drawn down more often. Effects to cultural resource sites under this scenario would be more severe than under the Base Case, although the effects are more of degree rather than kind. Water levels in some reservoirs would fall below existing pools and the reservoirs would be dry more often. The lowering of reservoir levels below existing pools would generally adversely affect archaeological resources by cutting new shoreline benches and exposing more land within the reservoir pools to wind erosion, sheetwash, and gullying. This would increase impacts to cultural properties not located on a stable shoreline in the past. In addition, new areas, previously protected by the reservoir pool, would be exposed to artifact collecting and vandalism. While some drawdown zone archaeological sites might be covered by siltation and are protected from erosion and vandalism, others would not be. If the drawdown is rapid (for example, more than 2 feet per day), then mass wasting (slumping or landslides) of slopes in and above the reservoir can be expected, burying or completely destroying archaeological sites. Historic above-the-ground sites or structures probably would not be affected by increased drawdown levels unless the levels resulted in a change in the integrity of "feeling" or "association" of a historic property, for example, lowering the pool to a level that compromises the visual integrity of the reservoir by introducing an element that is inconsistent with its historic character.

Greater drawdown and longer drawdown periods would negatively affect TCPs/sacred sites by desiccating wetland plant populations for longer periods, thereby reducing the availability of these resources during the year (although access to these areas would probably be improved). In addition, severe drawdown would result in bank destabilization of traditional use sites. While significant lowering of reservoir water levels might diminish reservoir use by recreationists, movement of their activities to other areas could affect TCPs/sacred sites in those areas. Some archaeological sites also qualify as TCPs; therefore, the damage potential to archaeological sites described in the previous paragraph, would also apply to TCPs that are archaeological sites.

Greater drawdowns would result in increased flow velocities and water levels along downstream banks (although not exceeding levels achieved during past spring runoff and flooding). Rapid changes in downstream flows can cause stream bank slumping by alternately saturating soils and then exposing them to air and stream currents. The resulting increased bank erosion could disturb or completely destroy blocks of ground in which archaeological sites are bedded, or in which historic sites or TCPs/sacred sites are located, or the place that is the setting or contextual landscape for such resource sites. Increased flow velocities and water levels could reduce use of riparian habitat and availability of plant species in traditional plant gathering areas. At the same time, access to these areas might be rendered more difficult. Other resources of traditional cultural or religious interest to tribes (such as sacred places used to communicate with spirits or make medicine, or established tribal fishing locations) could be diminished in size or completely covered with water during certain times of the year. The extent to which heavy drawdown would cause an increase in these adverse conditions above and beyond what would naturally occur, or what would occur through normal reservoir operations, is problematic. Theoretically, adverse effects from the drawdown would occur to cultural resources in the stream channel; however, our position is that such effects attributed to the drawdown cannot be determined, and if they could, would be negligible. Recreation potential would, however, likely decrease under greater flow velocities and water elevation, thus reducing indirect impacts to archaeological sites associated with artifact collecting and general disturbances from increased human traffic in an area.

Erosive action on archaeological, historical, and TCPs/sacred sites would be cumulative from year to year, from one annual operational cycle of the reservoir to the next. The impacts would not be one-time events, but would coincide with the annual drawdown, and would be of greater intensity than under the Base Case. Elements of a cultural resource property that contributed to that property's eligibility to the National Register, would be compromised annually, diminishing and eventually eliminating the site's ability to qualify for the Register.

Adverse effects to archaeological, historic, and TCP/sacred sites would be irreversible and irretrievable, and more severe than under the Base Case. Adverse effects to archaeological and historical properties that are of National Register quality could be mitigated through data recovery, recordation, and other mitigation strategies. However, once an archaeological or historical property or portions thereof are destroyed, the destruction is permanent, and the damage is irreversible. For TCPs/sacred sites, adverse effects would be more difficult to deal with, since disturbances to religious locations or plant gathering areas could not be effectively mitigated in the sense that an archaeological site can be. The loss to the original religious location or resource collection areas could not be mitigated or restored.

7.6.1.2.4 1427r

Under the 1427r scenario, reservoir water levels would not be affected beyond the normal annual cyclical fluctuations of the Base Case. Releasing water downstream for flow augmentation instead of diversion to irrigated lands would raise riverflow velocities and water levels to some extent. Rapid increases in flow and water levels can cause stream bank slumping with concomitant adverse effects on archaeological sites, historical sites, and traditional cultural properties/sacred sites. However, these increases would not exceed the year-to-year seasonal changes in hydrology due to variations in runoff. While it is possible that increased water flow and elevation resulting from reducing diversions could adversely affect cultural resource sites in the stream channel, it is not clear to what extent such effects would occur. Any correlation to the 1427r Scenario would be negligible.

If the land surface involved in 1427r remains with the private landowner, it would probably be converted to crested wheat grass. If the land surface is acquired by the Federal Government, it would probably be revegetated with native species. In either case, the destructive chemical and physical effects of water on archeological sites and materials from the annual irrigation cycle would be reduced. Thus, effects on previously irrigated lands would be positive for archaeological site preservation. For above-the-ground historic buildings and structures, major vegetation changes could alter the integrity of historic properties by introducing a visual element (e.g., native plant species) that is inconsistent with its historic character.

Increased riverflow velocities and water levels would occur along the downstream channel, and, although not at unprecedented levels, could, theoretically, physically impact properties of religious or cultural value situated adjacent to the stream channel. Traditional plant gathering areas or other areas of traditional cultural or religious interest could potentially diminish in size or be otherwise compromised. Access to these places might become more restricted. Adverse effects to TCPs or sacred sites, if they could be correlated to the 1427r scenario, would be negligible.

7.6.2 Salmon River Basin

7.6.2.1 Affect Environment

7.6.2.1.1 Prehistory

Indians have occupied the mountains of central Idaho for at least 10,000 years. The earliest inhabitants had an economic base centered on large mammals, molluscs, and plant resources, with settlements associated with a riverine environment. Between 8,000 and 5,000 years ago the climate was drier and warmer than present. Dependence on game, plant resources, and fishing continued, and settlement pattern is reflected in small camps found along the rivers and mountains. A hallmark of this period is the lanceolate Cascade projectile point. Between 5,000 and 2,500 years ago, the climate became cooler and moister. Permanent pit-house villages with semi-subterranean houses are first noted during this time, along with an increased use of root crops and river clams (possibly reflecting a diminishing salmon population). From 2,500 years ago to about A.D. 1750, the region was characterized by a heavy dependence upon salmon and root crops and occupation of permanent winter villages. The period coincided with the transition from atlatl (spear thrower) use to the use of bows and arrows. The last 250 years has been a time when the horse was introduced and when Indians were relegated to reservations (Leonhardy and Rice,1970).

Numerous archaeological investigations have occurred in the Salmon River Basin, revealing a rich array of sites and site types. On the Lower Salmon, which has a long history of surveys, approximately 200 sites have been recorded, consisting of lithic scatters, house features, burials, rock-rimmed depressions, talus pits, rock shelters, shell and bone middens, and pictographs. At least 300 sites have been documented between the North Fork and South Fork, indicating a prevalence of small corner-notched points on the surface of sites along the Middle Salmon River. Project specific surveys by the U.S. Forest Service have recorded sites along Panther Creek and the North Fork Salmon River. The mouth of the South Fork Salmon River has been identified as a major locus of housepit settlements (over 1,100 house features at several sites in this vicinity). The Upper South Fork, adjacent to Warm Lake, has yielded obsidian and basalt flakes, probably used for fishing tools. Sites on the Upper South Fork suggest a recurring pattern of seasonal use by aboriginal occupants, probably associated with fishing and hunting. House depressions, some with associated surface artifacts (such as small side-notched points), are common along the Middle Fork (Hackenberger and Meatte, 1995).

There appears to be an increase in site density as one approaches the Upper Salmon River and Snake River Plain. Quite possibly, the combined area of the Upper Salmon and the Big Lost River was a principal winter occupation area and pathway between the Salmon and Snake Rivers, and the valleys to the east were used for spring and fall hunting and gathering base camps. Site densities have been reported as one per half mile on the Upper Salmon, one per mile on the Pahsimeroi and Big Lost River, one every five miles on the Little Lost River, and one every eight miles on Birch Creek (Hackenberger and Meatte, 1995).

Water resources are an important consideration in location of most site types. For example, the Nez Perce only located permanent settlements along rivers, and Shoshone villages were also associated with water. Rockshelters and pictographs are associated with steep slopes near water. In addition, slope is an important aspect for determining where sites might be present. Lithic scatters are found on 15-30 degree slopes, in a relatively flat terrain (Matz, 1994).

Very little information exists for the prehistory of the Lemhi River basin in the far west of the Salmon River Basin. What does exist is primarily based on the site inventories conducted by Swanson, King and Chatters for the Bureau of Land Management in 1966 (Swanson et al., 1969). The Lemhi River Valley has been occupied for at least 10,000 years. It appears to have served as one of several travel corridors for millennia, linking the Upper Salmon River country of East-Central Idaho with the Eastern Snake River Plain to the south. It also afforded passage over several mountain passes across the Continental Divide onto the northwest Plains (Wright, 1998).

Sites reported along the Lemhi River Basin include rockshelters and caves, open camps without features, springs, and quarries. Site densities in the Basin were reported to be about one site every two miles. It is suspected that the Upper Salmon, the Pahsimeroi, and the Big Lost River zones were more intensively occupied by larger groups of people for longer intervals of time than were sites in the more easterly valleys. The suggestion is that those three western valleys may have been more heavily used in the winter while the more eastern valleys (such as Lemhi Valley) were used for spring and autumn hunting and gathering and for small group activity (Swanson et al., 1969).

7.6.2.1.2 Native Americans

The Salmon River basin was the aboriginal territory of the Nez Perce, Shoshone, Bannock, and Northern Paiute Tribes. The Indians of central Idaho, regardless of their linguistic or cultural affiliation, relied on hunting, gathering, and fishing for their subsistence. Winter villages, often occupied until early summer, were located in major river valleys, such as the Middle Fork of the Salmon River and Big Creek. Villages consisted of 2-40 extended families. The location of these villages corresponded with the winter range of big game animals and also with desirable fishing spots on the river that insured easy access to early summer anadromous fish runs. Winter villages were probably deserted in late spring or early summer for fields of camas, other important vegetable foods, and big game summer ranges at higher elevations. Summer camps were probably much smaller than winter villages, one band separating into groups composed of a few families in order to facilitate mobile hunting and gathering. The horse was responsible for major changes in subsistence activities of both Shoshone and Nez Perce Tribes. It enabled them to participate in buffalo hunts in western Montana and Wyoming (Rossillon, 1980).

Until around the 19th century, these groups existed as hunter-gatherers subsisting on locally available resources, and through trade were in contact with a much larger world. By the 19th century, and possibly earlier, significant change in their socioeconomic system had begun with contact by Euroamericans (Cannon et al., 1996).

7.6.2.1.3 History

Basic historic themes for the Salmon River basin are exploration, the fur industry, mining, ranching and farming, and recreation. Most of the early expeditions by Euroamericans into the mountains of central Idaho related to the fur trapping business. The Lewis and Clark expedition (1804-06) visited Lemhi Pass, the mouth of Twin Creek, the Continental Divide, the Salmon River, and Lost Trail Pass. Fur trapping was booming by the 1820s and 1830s, but by the 1840s, beaver had been trapped to near extinction. Hardrock and placer mining began by 1866 in what is now the Salmon National Forest. Almost every major stream was placer mined but hardrock mining was confined to specific mining districts. Ranching and farming by immigrants of northern European descent began in this area as early as the 1860's following the discovery of gold. The majority of these people subsisted on imported livestock and agriculture. In the late 1800s and early 1900s, communities such as Lemhi and Baker were established to serve a growing population. Before the economic depression of the 1930s the region had supported a mix of cattle and sheep ranches; however, the increasing cost of grazing permits coupled with range depletion made sheep raising unprofitable. Sheep were exchanged for cattle, and today cattle ranching and hay farming comprise the major economic activities in the region (Cannon et al., 1996). More recently, the Salmon River basin has become important for its various recreational opportunities available to the public, such as boating, fishing, hiking, and camping (Rossillon, 1980; Matz, 1994).

7.6.2.1.4 Traditional Cultural Properties/Sacred Sites

A diverse array of cultural resources exists within ceded areas. These resources include prehistoric Nez Perce resource procurement sites, hunting and gathering encampments, fishing stations, villages, open camp sites, battlefields, petroglyph and pictograph sites, historic mining sites, prehistoric trails and traveling routes. It is very likely that many of these sites are places of religious or cultural importance to the Nez Perce. In addition, the natural environment of the Nez Perce region provided a variety of resources, most of which were exploited to varying degrees (for example, 71 species of plants). It is probable that areas harboring such resources were used over a period of time by tribal members and would have served as traditional gathering areas. (Also see also discussion under Snake River Upstream of Hells Canyon Complex)

7.6.2.2 Environmental Consequences

Neither the Base Case nor the No Augmentation scenarios affect the Salmon River basin. The effects of the 1427i and the 1427r scenarios in the Salmon River basin are limited to elimination of irrigation of about 87,470 acres with retention of the water in the stream. Any effect that this would have on cultural resources would be minuscule.

7.6.3 Hells Canyon Complex

7.6.3.1 Affected Environment

7.6.3.1.1 Prehistory

The Hells Canyon Complex area of the lower Snake River, between its confluences with the Powder and Salmon Rivers, has been the focus of extensive human activity beginning over 7,000 years ago, and extending through historic times when it became the interest of early explorers, miners, and stockmen. The fertile bars and alluvial terraces within the canyon provided the living spaces for prehistoric and historic peoples. Subject to virtually no recent development, Hells Canyon today contains a unique array of prehistoric and historic sites, many of which have been affected only by the passage of time and natural forces due to the ruggedness and isolation of the canyon.

The Hells Canyon Archaeological District extends approximately 70 miles along both sides of the Snake River from Hells Canyon Dam to ½ mile south of the Cougar Rapids or about 4 miles south of China Gardens. These boundaries were chosen for the National Register nomination because of the intensive archaeological surveys that have been conducted in this area since the 1950's. In conjunction with the National Register nomination, 384 prehistoric archaeological sites (151 rockshelters and 233 open sites) have been reported in the archaeological district. Two thirds of the rockshelters display pictographs or red pigment stains, while over half had lithic remains on the surface. Features such as rock walls, rock alignments, rock and earth berms, and depressions were noted at 37 rockshelters. About 550 housepit depressions have been recorded for the National Register district, with an average density of about five structures per linear kilometer of river (Reid and Gallison, 1995).

At the Bernard Creek Rockshelter (about 10 miles downstream from Hells Canyon Dam), clear evidence of lanceolate projectile points was observed at the lowest levels of the site (about 7,250 B.P.), being replaced by large side-notched points about 6,700 B.P., and subsequently by a miscellany of stemmed, notched, and corner-notched points. Riverine foods were eaten in Hells Canyon by about 7,200 B.P., based on the Bernard Creek Rockshelter, and include varying frequencies through time of birds bones, fish remains, mammal remains, and mussel shell.

A fairly high density of sites has been reported for the Pittsburgh Landing area during the Corps of Engineers and Bureau of Reclamation River Basin Surveys including 39 sites (23 open camps, 2 rockshelters, 9 housepit clusters, 5 burial sites, 1 petroglyph site, and 4 cutbank exposures of buried features and midden lenses in side canyons). One of the cutbank exposures was a cache of 37 flaked basalt bifaces.

The Wallowa-Whitman National Forest sponsored excavations by Idaho State University at Hells Canyon Creek Village in the Inner Gorge in 1967. The Forest Service, in recent years, has conducted inventories of rock art and other sites. In 1989, housepit clusters and an open camp site and shell midden were investigated for Section 106 compliance actions in the Lower Canyon area.

The Forest Service has documented 177 rock art sites between Hells Canyon Dam and River Mile 176, about 71 miles downstream. The sites tend to occur more frequently on the east (Idaho) side of the Snake River, and greatest concentrations are in the southern (upstream) area, in the Inner Gorge locality between Hells Canyon Creek and Sheep Creek (Reid and Gallison, 1995).

7.6.3.1.2 Native Americans

(See previous discussion under Snake River Basin Upstream of Hells Canyon and Salmon River Basin).

7.6.3.1.3 History

There are 152 recorded historic sites in the National Register district, most representing several of the major themes for the region: mining and ranching/farming (including irrigation). Placer mines and hardrock mines were established in the Hells Canyon area, as evidenced by piles of waterworn cobbles, placer tailings, structures such as cabin ruins or foundations of walls, and mining equipment. Homesteads associated with agriculture and sheep ranching comprise most of the remaining historic sites. Some include intact dwellings, barns, sheds, and root cellars, and irrigation canals. Also present in the district are a number of cemeteries, roads, and trails. There is also an historic petroglyph, a unique irrigation flume, and a vertical test shaft for a dam proposed in the 1950's but never built (Hells Canyon NRHP Nomination).

7.6.3.1.4 Traditional Cultural Properties/Sacred Sites

(See previous discussion under Snake River Basin Upstream of Hells Canyon and Salmon River Basin).

7.6.3.2 Environmental Consequences

The effects of the Base Case and No Flow Augmentation scenarios would be indistinguishable. The results of both are to moderate flows in this reach of the Snake River. Implementation of the 1427i and 1427r scenarios would be identical in this river reach, increasing the annual flow volume and the average flow during the flow augmentation period. The significance of this flow increase would be difficult to determine or correlate with any possible adverse or beneficial effect on cultural resources or Traditional Cultural Properties.

7.6.4 Snake River to Lower Granite Dam

7.6.4.1 Affected Environment

7.6.4.1.1 Prehistory

Prehistory of the area is similar to elsewhere in the western United States and is conveniently discussed in terms of phases. The earliest (Windust) phase (10,000-8,000 B.P.) is represented by broad spectrum foragers who dispersed throughout most topographic zones and displayed a well-developed tool technology. The economic cycle centered on large mammals, molluscs, and plant resources. Apparently there were no permanent winter villages or groupings of people and settlements are associated with a riverine environment. The subsequent Cascade Phase (8,000-4,500 B.P.) represents a shift towards greater use of plant foods and aquatic resources including freshwater clams and salmon. The artifact assemblage is typified by the lanceolate Cascade projectile point and later by introduction of side-notched points. The Tucannon Phase (4,500-2,500 B.P.) reflects an aggregation of population into pit house villages and increased use of root crops and river clams. The Harder Phase (2,500-250 years B.P.) Represents expansion of pit house village sites, procurement of salmon and roots, and coincides with the transition from atlatl (spear thrower) use to bows and arrows (Sappington, 1995).

The area along the lower Snake River between Hells Canyon Dam and Lower Granite Dam contains an abundance of archaeological sites which, collectively, represent the major phases discussed in the previous paragraph. At Lower Granite Lake, 136 prehistoric and historic period sites range in age from the earliest period of human occupation to recent times. Large alluvial bars were major occupation surfaces prehistorically; 13 archaeological sites were recorded at river bars downstream of Clarkson before Lower Granite Lake was filled. Along this stretch of the lower Snake River, data recovery excavations have been made at the Wawawai site at Wawawai Canyon, the Wexpusmime site at Offield Canyon, the Granite Point site below Wawawai Canyon, and the Alpowa Locality below Clarkston. Findings include lanceolate and corner notched dart points, semisubterranean house pits, mortars and pestles, shell beads indicating trade from the Pacific coast, and remains of small mammals, fish, and shellfish.

Upstream of Lewiston, in the Asotin district, a “Snake River Archaeological District” and a “Nez Perce Snake River Archaeological District” have been nominated to the National Register of Historic Places. The districts include 97 seasonal campsites, 27 housepit sites, 44 burial sites, 23 storage shelters, and 17 additional sites which contained features such as pictographs, petroglyphs, fish walls, storage pits, and sweat lodges. About two thirds of the sites could be grouped into 11 separate site complexes or clusters on either side of the Snake River. Site density seems to fall off abruptly above the Grande Ronde on both sides of the river, possibly due to increasingly rugged topography.

A Native American cemetery is known to exist in the town of Asotin. The cemetery appears to represent the late prehistoric, protohistoric, and historic periods. Some of the burials contain varied grave goods and were interred in cedar cists marked by rock cairns.

Other significant sites include the Red Elk Rockshelter 10 km upstream of Lewiston; the Hasotino house pit village, now part of Hell’s Gate State Park and on the National Register; Buffalo Eddy rock art (including 885 glyphs) near River Mile 160 on the Washington side; and the Scorpion Knoll multicomponent site near Captain John’s Creek (Reid and Gallison, 1995).

7.6.4.1.2 Native Americans

This area is within the traditional territory of the Nez Perce Indians. The Nez Perce used lower canyons for winter settlement, fishing, and fall and winter hunting. Upland areas were used from late spring to fall for plant gathering, travel, and hunting The Nez Perce traditionally obtained about 50 percent of their diet from anadromous and other fish, most importantly the salmonids and steelhead trout. Game formed only 15-25 percent of their diet. At least 36 different edible plants were used, most important being roots such as camas or kouse. During late fall and winter months, the Nez Perce were located in fairly large villages along the Snake, Clearwater, and Salmon Rivers. Families generally returned to the same location each year. In spring, the bands and families dispersed to their favorite fishing stations along the rivers. Summer was a time of intense subsistence activities and intergroup contact, followed by fall fishing and hunting (deer were the most important food animal), although hunting continued year-round. The horse was adopted by the Nez Perce by the mid-1700's and provided ready access to the bison-hunting grounds on the Plains (Sappington, 1995).

7.6.4.1.3 History

Historic themes for the lower Snake River to Lower Granite Lake generally follow the thematic events common to the Columbia River Basin. The historic period began with the arrival of the Lewis and Clark expedition in 1805. This was followed by other expeditions, which further explored the region and established trading operations. Missionaries arrived in the 1830s, followed in the 1840s by settlers coming west. Gold was discovered in Idaho in the 1860s, leading to an influx of people into the area, and further settlement based on extensive dryland wheat farming. The 1880s brought construction of railroads and continued settlement. The 1900s has witnessed the damming of the Snake River, the development of major irrigation projects, and continued growth in the region (Corps and NMFS, 1994). Sites, structures, and facilities associated with these events can be expected to be found along this segment of the lower Snake River.

7.6.4.1.4 Traditional Cultural Properties/Sacred Sites

A diverse array of cultural resources exists within Nez Perce ceded areas. These resources include prehistoric Nez Perce resource procurement sites, hunting and gathering encampments, fishing stations, villages, open camp sites, battlefields, petroglyph and pictograph sites, historic mining sites, prehistoric trails and traveling routes. It is very likely that many of these sites are places of religious or cultural importance to the Nez Perce. In addition, the natural environment of the Nez Perce region provided a variety of resources, most of which were exploited to varying degrees (for example, 71 species of plants). It is probable that areas harboring such resources were used over a period of time by tribal members and would have served as traditional gathering areas.

7.6.4.2 Environmental Consequences

The effects of the Base Case and No Flow Augmentation scenarios would be indistinguishable. The results of both are to moderate flows in this reach of the Snake River. Implementation of the 1427i and 1427r scenarios would be identical in this river reach, increasing the annual flow volume and the average flow during the flow augmentation period. The significance of this flow increase would be difficult to determine or correlate with any possible adverse or beneficial effect on cultural resources or Traditional Cultural Properties.

7.6.5 Grande Ronde River Basin

7.6.5.1 Affected Environment

7.6.5.1.1 Prehistory

The Grande Ronde River basin has been occupied for millennia. By 7,000 B.P., technology reflected by stone tool manufacture was well-developed. Until the last 4,000 to 5,000 years, artifact technology was relatively stable, especially for projectile points. During the earlier period (approximately 8,000 to 4,000 B.P., the only major change in projectile points was from a bipointed lanceolate form to a triangular form. After 4,000 B.P., projectile point types and sizes became more variable (Hudson et al., 1978).

Professional archaeological investigations have been conducted in the Grande Ronde Valley since 1967. On Old Channel, an abandoned meander of the Grande Ronde, 27 prehistoric sites were located. Except for one rockshelter, all were "open sites" or "open campsites with burials." Fire cracked rock observed at some of the sites quite possibly mark prehistoric camas steaming pits (early settlers saw Nez Perce come to this valley to harvest camas). Three sites have been excavated in the Ladd Canyon area (Stockhoff Basalt Quarry, Marshmeadow, and Ladd Canyon). The Stockhoff Quarry, southeast of LaGrande, is a basalt resource site and lithic reduction station. The site contains lithic materials in various stages of manufacture, from raw material to finished artifacts. A variety of lanceolate and side notched points, various tools used in artifact production, and other artifacts were recovered, dating from 10,000 to 6,000 B.P. Unglazed pottery has also been reported along the Grande Ronde Basin (Hudson et al., 1978; Reid and Gallison, 1995).

Considerable variation is observed in the use of geographic locations for habitation and resource procurement areas. At higher elevations, open campsites, quarry sites, lithic reduction sites, and rockshelters are found. At lower elevations, complex village sites, open campsites, fishing stations, and numerous rockshelters have been located. Site density is lower at higher elevations and higher in the lower elevations (Hudson et al., 1978).

7.6.5.1.2 Native Americans

Aboriginal ethnographic boundaries in the Grande Ronde Basin area are not well-defined. The basin does, however, appear to fall within the area jointly exploited by the Cayuse, Umatilla, Nez Perce, Northern Paiute, Shoshone, and sometimes the Walla Walla Indians. The Cayuse, Umatilla, and Nez Perce settlements generally followed a linear pattern with winter villages located along banks of major rivers and their larger tributary streams. Associated dwellings were the long communal house, circular tipi lodge, semi-subterranean menstrual lodge, and sweat lodge. During spring, summer, and fall months, when portions of the village populations were involved in hunting, fishing, and gathering activities, similar dwellings were used. Among the Northern Paiute the settlement pattern was very similar. Principal food resources for the Cayuse, Nez Perce, Umatilla, and Northern Paiute were plant items and fish, supplemented with meat, berries, and roots. The annual seasonal round of food gathering activities for each ethnic group varied depending upon its geographic location. Trade relations among the Nez Perce, Walla Walla, Umatilla, Cayuse, and Northern Paiute were well established at the time of historic contact. The Grande Ronde Valley and Wallowa Lake were favorite areas for the annual social and trading event (Hudson et al., 1978).

7.6.5.1.3 History

Northeastern Oregon history includes themes which are similar to those in the Northwest in general, and includes exploration and the fur industry, military, overland migration, mining, ranching/farming, and transportation and communication. From the time of Lewis and Clark's expedition (1804-1806) until the discovery of gold (1860), this area usually was passed through or visited only briefly by explorers, traders, trappers, missionaries, and settlers. By the 1830s, the fur trapping/trading business had begun to wane. During the mid-1800s, forts were established as a response to Indian-White conflicts and as a means for protecting immigrants and settlers. By the 1840s, travel along the Oregon Trail (which passed through the Grande Ronde Valley) was increasing for immigrants destined for the Willamette Valley and Pacific coast. The earliest settlements developed at mining areas in the late 1850s and early 1860s, and the discovery of gold was the major stimulus for settlement in northeastern Oregon. The area grew rapidly and, as new finds were made, towns were created and markets were established for merchants and farmers. The Grande Ronde Valley and Powder River Valley became farming districts in the 1860s, and cattle and sheep raising grew throughout the 1860s, 1870s, and 1880s. The completion of the Northern Pacific Railroad in 1883 enabled timber to be shipped to other parts of the United States, and logging railroads began to develop in the area up to the 1930s. Major cutting operations continue to the present with new machinery and techniques (Hudson et al., 1978).

7.6.5.1.4 Traditional Cultural Properties/Sacred Sites

As with many Northwest tribes, religious practices were commonly related to natural phenomena (such as animals, plants, and geographic features), and it is likely that a variety of sacred places are associated with these natural phenomena. It is suspected that for tribes of the Grande Ronde and Powder River areas, many locations of cultural and religious importance are tied to the land and still retain sufficient integrity for traditional ceremonies to occur. The same would hold true for traditional plant and resource gathering areas. (Also see discussions under Snake River Upstream of Hells Canyon Dam and Salmon River Basin)

7.6.5.2 Environmental Consequences

Neither the Base Case nor the No Augmentation scenarios affect the Grande Ronde River basin. The effects of the 1427i and the 1427r scenarios in the Grande Ronde River basin are limited to elimination of irrigation on about 37,000 acres with retention of the water in the stream. Any effect that this would have on cultural resources, whether negative or positive would be minuscule.

7.7 Indian Trust Assets

The United States, with the Secretary of the Interior as the trustee, holds many assets in trust for Indian tribes and individuals and has a responsibility to protect and maintain rights reserved or granted by treaties, statutes, and executive orders. These rights are sometimes further interpreted through court decisions and regulations. This trust responsibility requires that all Federal agencies, including Reclamation, take all actions reasonably necessary to protect trust assets.

The Department of the Interior defines ITA's as legal interests in property held in trust by the United States for Indian tribes or individuals. Examples of trust assets are lands, minerals, hunting and fishing rights, and water rights. Reclamation has a responsibility for protecting archeological and historical properties and ITA's. Reclamation operations can affect ITA's in river corridors and reservoirs. Effects can extend beyond the river corridor to Federal lands where some tribes hold off-reservation treaty rights.

Reclamation has a responsibility to manage sensitive information with confidentiality. Much of the data is highly sensitive because of its religious or spiritual nature, and there is a concern that it could get into the hands of people whose motives are in direct conflict with the interests and beliefs of the tribes.

The Snake River basin upstream of Lower Granite Lake includes aboriginal areas of the following:

- Nez Perce Tribe (the Nez Perce Indian Reservation is in the Clearwater drainage which is not included in this analysis).

- Confederated Tribes of the Umatilla Reservation of Oregon (the Umatilla Indian Reservation is in the Umatilla River Drainage which is not included in this analysis).

- Shoshone-Bannock Tribes of the Fort Hall Indian Reservation in eastern Idaho.

- Northwestern Band of the Shoshone Indians of Utah (there is no reservation to be included).

- Shoshone-Paiute Tribes of the Duck Valley Indian Reservation in southern Idaho and northern Nevada.

- Burns-Paiute Tribes (the Burns-Paiute Indian Reservation near Burns, Oregon is not in the Snake River drainage and not included in this analysis)

ITAs with respect to salmon and steelhead fishing are not addressed in this section. Identifying these effects is within the domain of the overall Corps study and will be addressed by the Corps.

7.7.1 Snake River Basin Above Milner Dam

7.7.1.1 Affected Environment

Shoshone-Bannock Tribes located in southeastern Idaho have trust assets both on and off reservation. The northern boundary of the Fort Hall Indian Reservation is the Snake River, and a portion of the reservation is inundated by American Falls Reservoir. The Tribe's ceded lands in the Snake River basin include the area from the Henrys Fork and Jackson Lake to American Falls Reservoir. The Shoshone-Bannock Tribes through the 1868 Fort Bridger Treaty have the right to hunt and fish on any unoccupied Federal lands.

The Northwestern Band of the Shoshone Indians of Utah (Washakie) are a recognized tribal entity, but do not have a reservation. The Northwestern Band possess treaty-protected hunting and fishing which may be exercised on unoccupied Federal lands within the area pursuant to the 1868 Fort Bridger Treaty.

The alteration and decline of the historic aquatic resources has resulted in social, environmental, and economic losses to Native Americans. Native Americans traditionally relied heavily on the once abundant fish of the Snake River as a key component of their diet and way of life. Reservoir operations now impinge on archaeological sites, traditional cultural properties, and other Indian Trust Assets.

7.7.1.2 Environmental Consequences

It is not anticipated that any of the scenarios would have an effect on Indian owned lands or Indian water rights and that any effect on ITAs would be limited to ceded lands and related fishing, hunting, and related rights.

Riverflows and reservoir levels under the No Augmentation scenario are not sufficiently different from that of the Base Case to have an effect on ITAs.

Effects of the 1427i and 1427r scenarios on fish, wildlife, and vegetation, which may be considered part of the ITAs, are discussed in other sections. Effects on these, vary by location and season with some effects positive and others negative. Overall, the effects are expected to about balance, that is, there would be no net positive or negative effect specifically to ITAs in those classes. At this level of analysis, impacts to ITAs are difficult to measure. If flow augmentation in the magnitude of the 1427i or 1427r scenarios is carried forward, specific effects would need to be carefully and clearly identified.

7.7.2 Owyhee River Basin

7.7.2.1 Affected Environment

The Shoshone-Paiute Tribes of the Duck Valley Indian Reservation have trust assets that include reservation lands, water rights, and hunting rights. The reservation lies on the Idaho-Nevada border and was provided for by a treaty of October 1, 1863, established by Executive Order April 16, 1877. The reservation was later enlarged by the Executive Order of March 4, 1886, and the Executive Order of July 1, 1910.

7.7.2.2 Environmental Consequences

Indian land ownership and water rights would not be affected. It is anticipated that none of the scenarios would have an effect on ITAs in this area.

7.7.3 Payette River Basin

7.7.3.1 Affected Environment

The Nez Perce Tribe of the Nez Perce Reservation near Lewiston, Idaho has ceded lands that include the northern portion of Cascade Reservoir (1855 treaty). The tribe's off-reservation reserved rights include fishing, hunting, grazing, and gathering.

The Treaty of 1855 with the Nez Perce Tribe and the U.S. Government resulted in a reservation that included the entire Clearwater River basin as well as large areas in other basins. The treaty provides "The exclusive right of taking fish in all the streams where running through or bordering said reservation is further secured…as also the right of taking fish at all usual and accustomed places in common with citizens of the Territory…" In a subsequent 1863 treaty, the Nez Perce ceded the majority of these lands with the establishment of the present reservation, but reserved off-reservation fishing, hunting, grazing and gathering rights. Further court interpretations [United States vs. Oregon, Civ. 68-513 (D. Or); Washington vs. Washington State Commercial Passenger Fishing Vessel Association, 443 U. W. 687 (1979)] have clarified and defined the treaty rights concerning harvest habitat protection and fisheries management.

The tribe's treaty rights include an allocation to take up to 50 percent of the harvestable salmon and steelhead runs passing the tribe's usual and accustomed fishing places as well as a right to sufficient water quality and quantity to maintain these runs at harvestable levels.

The Nez Perce Tribe is the legal successor in interest to the Indian signatories of the treaty. The Nez Perce Tribal Executive Committee, under provision of the Nez Perce Code, enacts tribal laws applicable to members of the tribe. On- and off-reservation harvest regulations are recommended by the Nez Perce Fisheries Department, reviewed, and acted upon by the Fish and Wildlife Subcommittee, and passed by resolution of the Executive Committee.

7.7.3.2 Environmental Consequences

Indian owned land and water rights would not be affected by the flow augmentation scenarios. At this level of analysis, it is anticipated that none of the flow augmentation scenarios would have an effect on ITAs in the Payette River basin.

7.7.4 Salmon River Basin

7.7.4.1 Affected Environment

Several tribes have traditionally fished within the basin. By virtue of the treaty of 1855, the Nez Perce Tribe has the right to fish in usual and accustomed sites throughout the basin. The Shoshone-Bannock Tribes through the 1868 Fort Bridger Treaty have the right to hunt and fish on any unoccupied Federal lands. The extent of the Shoshone-Paiute Tribes fishing right remains unresolved pending anthropological and legal research and evaluation. Several court cases have established the scope and extent of the treaties and the subsequent rights possessed by tribal members.

7.7.4.2 Environmental Consequences

The No Augmentation scenario would have no effect on ITAs in the basin. Effects of the 1427i and 1427r scenario in the basin are to increase streamflows and water quality by reducing the amount of irrigated land. Any detectable effect on ITAs would be positive.

7.7.5 Grande Ronde River Basin

7.7.5.1 Affected Environment

The Confederated Tribes of the Umatilla Indian Reservation and the Nez Perce Tribe have utilized the fish resources of northeast Oregon for hundreds of years. The right to fish at usual and accustomed areas in the Grande Ronde River basin was secured by treaties signed with the United States in 1855 and upheld in subsequent court cases (ODFW, 1990).

Treaties with the tribes are similar in structure and form the basis for tribal involvement in fisheries management and planning in the basin. The treaty with the Umatilla Tribes is a legal document in which the confederated tribes gave up ownership of a vast territory of land extending from the lower Yakima River and along the mid-Columbia River to beyond the Blue Mountains into the Grande Ronde River drainage, south to the Powder River, west into the John Day River, and north into the Willow Creek drainage. Included within this territory are parts of the Snake, Imnaha, Tucannon, Burnt, and Malheur River drainages. In return, the Umatilla Tribes reserved the following, and other, rights: (1) the Umatilla Indian Reservation as a permanent homeland; (2) to maintain their own form of government and to make and enforce laws within their territorial jurisdiction; (3) the exclusive right to take fish in streams running through and bordering the reservation, as well as the right to fish at all other usual and accustomed sites in common with citizens of the United States (ODFW, 1990). Tribal members are entitled to fish both on and off the reservation throughout all parts of the main stem Columbia and Snake Rivers and in the

Umatilla, Grande Ronde, Walla Walla, Tucannon, Yakima, Imnaha, Powder, Burnt, Malheur, Willow Creek, and John Day drainages (ODFW, 1990). Note that the Umatilla Indian Reservation lies to the west and outside the Grande Ronde River.

7.7.5.2 Environmental Consequences

The No Augmentation scenario would have no effect on ITAs in this basin. Effects of the 1427i and 1427r scenario in the basin are to increase streamflows and water quality by reducing the amount of irrigated land. Any detectable effect on ITAs would be positive.

7.8 Recreation

The Snake River basin contains some of the most important and highly valued recreation resources in the Pacific Northwest; some of these resource have national prominence. Some river reaches and reservoirs are located within or near national parks, national forests, state parks, and local parks. Recreation resources afford a wide spectrum of recreation opportunities which have added to the quality of life and formed an important component of the regional economy. In addition, there are specially designated recreation areas, wildlife refuges, and trophy fisheries. Water resources are a recreation magnet in this arid region.

Time constraints of this analysis made it necessary to limit the analysis to Reclamation facilities and to focus on 11 representative reservoirs and river reaches. Other reservoirs and river reaches affected by flow augmentation operations could be expected to experience similar effects. C.J. Strike and Brownlee Reservoirs are important sites for recreation on the main stem Snake River but are not discussed because of a lack of readily available data. It can be assumed that recreation at these reservoirs would be affected by flow augmentation but neither a quantitative nor qualitative analysis is possible without additional data.

Reclamation acknowledges that other factors related to operations affect recreation activities, but those factors are not considered here due to the difficulty in accurately evaluating them. For this analysis, visitation in visitor-days is used as the marker of changes in recreation. Furthermore, this analysis assumes that most recreation occurs during the 5-month period of May through September and that most visits at reservoirs are water-dependent or water-related.

The recreation analysis is based on factors which can be accurately measured: streamflow, reservoir elevation, boat ramp access, boating feasibility, and fishing success. A range of target riverflows and specific reservoir elevations from May through September which permit access to recreation facilities were determined at representative recreation sites throughout the Snake River basin by inventorying existing information sources. A percentage of general distribution of use under current river/reservoir operations was developed for each of the recreation sites analyzed. Boat ramp access was the measurement criteria used to estimate the effect a change in operations would have on reservoir recreation visitation. Boat ramp access and the ability to boat and fish were the measurement criteria used to estimate the effects to river recreation visitation.

The hydrologic model of the No Augmentation scenario indicates minimal differences in storage at a few reservoirs in the basin from the Base Case scenario. Because of the minor differences in storage, recreation visitation at these reservoirs would not likely change from the Base Case scenario so an analysis of the No Augmentation scenario was not made.

7.8.1 Recreation Activities

7.8.1.1 Boating

Boating is one of the most popular water-dependent recreation activities. Lakes and reservoirs provide numerous flat-water recreation opportunities that include waterskiing, cruising, and fishing. Non-motorized boating, such as sailing and canoeing, represents a much smaller percentage of overall boating activity than motorized boating. Boating is supported by boat ramps, courtesy docks, and marinas. Most reservoirs have an operating marina.

During the summer months, waterskiing and personal water craft (jet ski) use are popular activities on most reservoirs and slack-water river reaches. These activities are normally enjoyed early in the recreation season when reservoirs are full. Reservoir drawdown and low river flows late in the recreation season often limit these activities. If drawdown and low river flows occur during the peak recreation season, these activities may be curtailed or eliminated.

Kayaking, canoeing, and scenic and whitewater rafting are the most popular boating activities on free-flowing streams; however, there is also motorized boating. Sections of the Snake, Payette, and Salmon Rivers are nationally renowned for whitewater opportunities. Reaches of the Henrys Fork, Payette, Boise, and Grande Ronde Rivers are known for scenic float trips. Hells Canyon National Recreation Area attracts both whitewater and jet boat enthusiasts from across the nation. The Henrys Fork has the only nationally designated water trail in the country reflecting the unique character and popularity of the scenic floating experience along this river (IWRB, 1996). Boating activities in the basin are dependent upon current Reclamation river/reservoir operations to maintain the quality and sustainability of resources and access to facilities. Whitewater rafting, scenic float trips, and fishing-related boating are the focus of a substantial outfitter and guide industry (USFS, 1996).

Whitewater boating requires a variety of flows to provide a broad range of recreational opportunities for operators of various skill levels. Generally, high spring flows provide challenges for advanced boaters. Moderate flows in the summer offer good river running for those wanting to improve their boating skills and those who enjoy a challenge. Low flows in the fall provide scenic floating experiences and fishing opportunities (Reclamation, 1996b). Changes in flow levels can change the recreation experience, the number of visitors served, and the whitewater skill level required.

7.8.1.2 Fishing

Fishing is one of the most popular recreation activities on the river system and provides an important boost to local economies. Fishing activities are also dependent upon current Reclamation river/reservoir operations to maintain the quality and sustainability of resources and access to facilities. River fishing tends to be widely dispersed in contrast to reservoir fishing. Fishing activity peaks in early summer after the spring runoff and remains significant through October. Some of the reservoirs at higher elevations (e.g., Cascade Reservoir and Jackson Lake) support ice fishing activities in the winter. The highest percentage of summer fishing on reservoirs is boat fishing, but there is also substantial shoreline fishing. Game fish species sought by anglers include anadromous fish as well as resident cold-water game fish such as trout and kokanee and warm-water game fish such as bass and perch. In the basin above Hells Canyon Dam, fishing for anadromous fish is confined to hatchery salmon and steelhead planted for a recreation fishery and sturgeon.

Many river reaches have high-quality fisheries. Reaches such as the South Fork Snake and Henrys Fork support high numbers of drift boats and other fishing-related boating. In past years, the Snake River below Palisades Dam and the South Fork Boise River have been included in Trout Unlimited's top 100 trout streams in the United States. The Snake River in Hells Canyon hosts renowned steelhead fisheries.

7.8.1.3 Camping, Viewing, and Day Use

Reservoirs and rivers are important destination recreation sites for a variety of water-related activities such as camping, viewing, and day use. Many campers choose their destination based on proximity to other recreation opportunities, particularly boating and fishing. Camping facilities have been developed at nearly all reservoirs and accessible river reaches to support overnight and day-use activities. Swimming is often associated with boating, camping, and picnicking. Almost all swimming occurs during the summer months when water and air temperatures are warmer.

The reservoirs and river corridors frame natural features to form majestic vistas. Numerous parks, roadside rest areas, and view points are located along highways so day-use visitors can take advantage of the visual resources. Viewing scenery and wildlife is a major component for many of the reservoir and river boating activities. Visitors are attracted to impressive natural features such as the Grand Teton Range, Shoshone Falls, Thousand Springs, Hells Canyon, and the Lower Salmon Gorge. Other points of interest include the dams and fish hatcheries. Many historic and prehistoric features are located along the shores of the Snake River and its tributaries. Evidence of the Oregon Trail, the Lewis and Clark Trail, and early pioneer settlements can be found along the river reaches.

Forests, riparian areas, and wetland communities are often the focus of recreational interest or activities, especially in the arid regions. Hunting and wildlife viewing are significant recreational activities in the basin.

7.8.2 Recreation Focus Reaches

Table 7-18 is an overview of the primary recreation resources at major reservoirs and along major river reaches prepared for SR^3 and adapted for use in this report. The table identifies the ratings (1-12) of those reaches that are considered to be most significant based on visitor use, uniqueness, and special designation (higher numbers equal higher ratings). The highlighted reservoirs and river reaches (M-number) were analyzed for this report.

Table 7-18 Selected Recreation Reaches (11 Focus Reaches Are Identified by Shading and Bolded M-#)

Major Reach	Subdivision		Recreation Diversity	Agency Designation	Public Concern	Unique Features	Score*
1. Snake River	1.1 **M-1**	Jackson Lake	Fishing, camping, viewing, picnicking, motorized boating, non-motorized boating, sailing, water skiing, winter use	Grand Teton National Park-NPS	International	Scenic and unparalleled views of the Teton mountain range, wildlife viewing, geologic features	12
	1.2 **M-2**	Jackson Lake Dam to Moose	Fishing, camping, viewing, non-motorized boating	Grand Teton National Park, Bald Eagle Management Area-NPS	National/ International	Scenic and wildlife viewing	10
	1.3 **M-2**	Moose to South Park	Fishing, camping, viewing, hunting, picnicking, non-motorized boating	Eligible Wild and Scenic River - USFS	Regional	Scenic and wildlife viewing	10
	1.4 **M-2**	South Park to East Table	Fishing, camping, viewing, hunting, picnicking, non-motorized boating	Eligible Wild and Scenic River - USFS	National	Scenic and wildlife viewing, white water character	10
	1.5	East Table to Palisades Reservoir	Viewing, non-motorized boating	Eligible Wild and Scenic River - USFS	National	White water character, canyon geology	9
	1.6 **M-3**	Palisades Reservoir	Fishing, camping, viewing, hunting, picnicking, non-motorized boating, motorized boating, swimming, water skiing, trails, sailing	Snake River Area of Critical Environmental Concern - BLM	Regional	Scenery - fall colors with aspens, cottonwood, and pines	9
	1.7 **M-4**	Palisades Dam to Irwin	Fishing, camping, viewing, hunting, picnicking, non-motorized boating, motorized boating, trails	Snake River Area of Critical Environmental Concern - BLM, Eligible Wild and Scenic River - USFS/BLM, Proposed as State Recreational. River - IWRB	National/ International	Quality of cutthroat trout fishing (considered one of the top 100 trout streams in USA), scenery, Fall Creek falls, cottonwood gallery, bald eagles	10
	1.8	Conant Valley to Black Canyon	Fishing, camping, viewing, hunting, picnicking, non-motorized boating, motorized boating, trails	Snake River Area of Critical Environmental Concern - BLM, Eligible Wild and Scenic River - USFS/BLM, Proposed as State Recreational River - IWRB	National	Unroaded canyon, bald eagles, quality cutthroat fishing (considered one of the top 100 trout stream in USA), scenic values, cottonwood gallery, geology	11
	1.9	Black Canyon to Henrys Fork	Fishing, camping, viewing, hunting, picnicking, non-motorized boating, motorized boating	Snake River Area of Critical Environmental Concern- BLM, Eligible Wild & Scenic River - USFS/BLM, Proposed as State Recreational River - IWRB	National	Quality cutthroat fishery (considered one of the top 100 trout streams in the USA), scenic values, bald eagles and other wildlife viewing opportunities	10
2. Henrys Fork	2.1	Henrys Lake	Fishing, camping, viewing, hunting, picnicking, non-motorized boating, motorized boating,	Quality trophy fishery and wild trout management - IDFG, Henrys Lake State Park-IDPR, Fremont County Park	National	Tremendous fishery, trophy fish and fish habitat	10
	2.2	Henrys Lake Dam to Island Park Reservoir	Fishing, camping, viewing, hunting, picnicking, non-motorized boating	National Recreation Water Trail - USFS, State Recreational River - IWRB, National Natural Landmark-NPS	National	Fishing opportunities, trophy fish and fish habitat, scenic values, wildlife viewing, geologic springs	11
	2.3	Island Park	Fishing, camping, viewing, hunting,		Local	Wildlife viewing	8

Table 7-18 Selected Recreation Reaches (11 Focus Reaches Are Identified by Shading and Bolded M-#)

Major Reach	Subdivision		Recreation Diversity	Agency Designation	Public Concern	Unique Features	Score*
		Reservoir	picnicking, non-motorized boating, motorized boating, sailing				
	2.4	Island Park Dam to Snake River main stem	Fishing, camping, viewing, hunting, picnicking, non-motorized boating	State Natural and Recreational River - IWRB, Harriman State Park -IDPR, Scenic Byway -USFS	National	Blue ribbon fishery, Sheep Falls, Upper and Lower Mesa Falls, Box Canyon, canyon geology, scenic viewing, wildlife viewing	11
3. Willow Creek/Ririe Lake – Not evaluated							
4. Snake River	4.1	Henrys Fork to Shelly	Fishing, viewing, hunting, picnicking, non-motorized boating, motorized boating, Idaho Falls green belt	City parks- Idaho Falls	Local	Idaho Falls, white water slalom course	4
	4.2	Shelly to American Falls Reservoir	Fishing, viewing, hunting	Fort Hall Indian Reservation	National	Fort Hall Bottoms, cottonwood gallery, geologic springs	8
	4.3 **M-5**	American Falls Reservoir	Fishing, camping, viewing, hunting, picnicking, non-motorized boating, motorized boating, sailing, swimming, water skiing, trails	National Migratory Bird Flyway - USFWS, Sportsman park - County	Regional	Wildlife viewing, paleontology	7
	4.4	American Falls Dam to Milner Reservoir	Fishing, camping, viewing, hunting, picnicking, non-motorized boating, motorized boating, sailing, swimming, trails	Minidoka National Wildlife Refuge - USFWS, Massacre Rocks State Park, Lake Walcott State Park -IDPR, City and County parks, National Historic Trail - NPS	Regional	Wildlife viewing, geologic and historic features	8
	4.5	Milner Reservoir	Fishing, camping, viewing, picnicking, non-motorized boating, motorized boating	Milner Historic Site - BLM, National Historic Trail - NPS	Local	Historic features - Oregon Trail, dams	5
55. Snake River	5.1	Milner Dam to Twin Falls	Fishing, camping, viewing, picnicking, non-motorized boating, trails	Eligible Wild and Scenic River - BLM, State Recreational River - IWRB, Proposed National Historic District - NPS, Snake River Rim Special Recreation Mgt. Area - BLM, Caldron Linn Nat. Reg - NPS,	Regional	Star Falls, geology and scenic values of river canyon, class V white water character at Milner by-pass	9
	5.3	Twin Falls Reservoir and Dam (includes Twin Falls)	Fishing, viewing, picnicking, non-motorized boating, motorized boating, water skiing	Snake River Rim Special Recreation Mgt Area - BLM	Local	Canyon geology and scenery, Twin Falls, historic features	7
	5.4	Shoshone Falls Reservoir and Dam (does not include Shoshone Falls)	Fishing, viewing, picnicking, non-motorized boating, motorized boating, water skiing	Snake River Rim Special Recreation Management Area - BLM	Local	Canyon geology and scenery	7
	5.5	Shoshone Falls to Crystal Springs (includes Shoshone Falls)	Fishing, viewing, hunting, picnicking, non-motorized boating, motorized boating, swimming, trails	State Recreational River - IWRB, Snake River Rim Special Recreation Management Area - BLM, National Register Site-NPS, National Natural Landmark- NPS, City and County	National	Pillar and Auger Falls, Shoshone Falls, "Niagara of the West," canyon geology and scenery, historic features	12

Table 7-18 Selected Recreation Reaches (11 Focus Reaches Are Identified by Shading and Bolded M-#)

Major Reach	Subdivision		Recreation Diversity	Agency Designation	Public Concern	Unique Features	Score*
				parks			
	5.6	Crystal Springs to Lower Salmon Falls Dam	Fishing, camping, viewing, hunting, picnicking, non-motorized boating, motorized boating, water skiing, trails, swimming, sailing	Box Canyon ACEC- BLM, Niagara Springs Natural Landmark, Hagerman Fossil Beds Natl. Monument - NPS, Hagerman Wildlife Mgt Area- IDFG, Thousand Springs Scenic Byway- IDT, State Recreational River - IWRB, Niagra Springs State Park -	Regional	Geologic springs, paleontology, wildlife viewing, rapids, historic features	11
	5.7	Lower Salmon Falls Dam to Bliss Dam	Fishing, hunting, picnicking, non-motorized boating, motorized boating	Eligible Wild and Scenic River - BLM, State Recreational River - IWRB	Local	Sturgeon fishing, one of few reaches in Idaho that can be boated year round. Frank Lloyd Wright House on Rim	8
	5.8	Bliss Dam to C.J. Strike Reservoir	Fishing, viewing, hunting, picnicking, non-motorized boating,	Snake River Birds of Prey Conservation Area - BLM, C.J. Strike Wildlife Mgt Area - IDFG, National Historic Trail - NPS, Three Island State Park - IDPR	Local	Sturgeon fishing, historic features, raptor viewing	7
	5.9	C.J. Strike Reservoir	Fishing, camping, viewing, hunting, picnicking, non-motorized boating, motorized boating, sailing	Snake River Birds of Prey National Conservation Area - BLM, C.J. Strike Wildlife Mgt Area - IDFG, National Historic Trail - NPS	Local	Geologic and historic features, waterfowl viewing	8
	5.10	C.J. Strike Dam to Noble Island	Fishing, camping, viewing, hunting, picnicking, non-motorized boating, motorized boating, swimming, trails	Snake River Birds of Prey National Conservation Area- BLM, Black Butte-Guffy Butte National Archaeological District- NPS, Ted Trueblood Wildlife Mgt Area - IDFG, National Register of Historic Places -NPS, Celebration Park -County	Regional	Largest concentration of nesting raptors in the world, geologic, pre-historic, and historic features	10
	5.11 Noble Island to Boise River– Not Evaluated						
	5.12 Boise River to Brownlee Reservoir– Not Evaluated						
	5.13 Brownlee Reservoir– Not Evaluated						
6. Little Wood Reservoir/ Little Wood River – Not Evaluated							
7. Boise River	7.1	Anderson Ranch Reservoir	Fishing, camping, picnicking, viewing, hunting, motorized boating, water skiing		Regional	Not Evaluated	
	7.2	Anderson Ranch Dam to Arrowrock Reservoir	Fishing, viewing, picnicking, non-motorized boating	State Recreational River-IWRB, Eligible Wild and Scenic River-USFS	National	High valued fishery, canyon, roadless, rated top 100 streams in U.S. by Trout Unlimited, geology	10
	7.3	Arrowrock Reservoir	Fishing, viewing, picnicking, non-motorized boating, motorized boating, water skiing		Local		4
	7.4 **M-6**	Lucky Peak Lake	Fishing, camping, picnicking, viewing, motorized boating, non-motorized	State Park - Spring Shores Marina-IDPR, Wildlife Management Area-IDFG	Regional	Proximity to city	9

Table 7-18 Selected Recreation Reaches (11 Focus Reaches Are Identified by Shading and Bolded M-#)

Major Reach	Subdivision		Recreation Diversity	Agency Designation	Public Concern	Unique Features	Score*
			boating, water skiing, sailing, swimming				
	7.5 **M-7**	Lucky Peak Dam to Glenwood Bridge	Fishing, picnicking, viewing, non-motorized boating, Boise greenbelt trail	Discovery Park-Corps, Eagle Island, County, Ann Morrison Park, Julia Davis Park -City, Barber Park-County	Local	Greenbelt, wildlife viewing, proximity to city	10
	7.6	Boise River-Glenwood Bridge to Snake River – Not Evaluated					
	7.7	Lake Lowell	Fishing, picnicking, viewing, hunting, motorized boating, water skiing, non-motorized boating, winter use	Deer Flat National Wildlife Refuge -USFWS	Local	National Wildlife Refuge	8
8. Payette River	8.1 **M-8**	Cascade Reservoir	Fishing, camping, viewing, hunting, picnicking, non-motorized boating, motorized boating, swimming, sailing, water skiing	Six proposed Wildlife Management Areas - USBR/USFWS, Cascade State Park-IDPR	Regional		10
	8.2 **M-9**	N.F. from Cascade Dam to Cabarton	Fishing, camping, viewing, picnicking, non-motorized boating, swimming	Payette River Special Recreation Management Area - BLM	Local	Canyon, roadless character	7
	8.3 **M-9**	N.F. from Cabarton to Smiths Ferry	Fishing, non-motorized boating	State Recreational River - IWRB, Payette River Special Recreation Management Area - BLM	National/ International	Wildlife	9
	8.4	N.F. from Smiths Ferry to Banks	Fishing, camping, viewing, picnicking, non-motorized boating	State Recreational River - IWRB, Eligible Wild and Scenic River - USFS, Payette River Special Recreation Management Area - BLM	National/ International	Whitewater skill level	9
	8.5 **M-10**	Banks to Horseshoe Bend	Fishing, camping, viewing, picnicking, non-motorized boating, motorized boating	State Recreational River - IWRB, Eligible Wild and Scenic River- USFS, Payette River Special Recreation Management Area - BLM	National		8
	8.6	Horseshoe Bend to Black Canyon Reservoir– Not Evaluated					
	8.7	Black Canyon Reservoir	Fishing, sailing, picnicking, viewing, hunting, motorized boating, water skiing	Montour Cooperative Wildlife Management Area - USBR/IDFG	Regional		5
	8.8	Black Canyon Dam to Snake River	Fishing, picnicking, viewing, hunting, motorized boating, non-motorized boating	Birding Island Wildlife Management Area - IDFG, Payette River Wildlife Management Area - IDFG	Local		6
	8.9	Deadwood Reservoir	Fishing, camping, viewing, picnicking, non-motorized boating, motorized boating		Regional		5
	8.10	Deadwood River from Deadwood Dam to S.F. Payette River	Fishing, non-motorized boating	Eligible Wild and Scenic River- USFS, Wild Trout Management - IDFG	Regional	Natural, roadless, whitewater, hot springs	9
	8.11	S.F. Payette River from Deadwood	Fishing, camping, viewing, picnicking, non-motorized boating	State Recreational River - IWRB, Eligible Wild and Scenic River - USFS, Payette River	National	Big Falls, Canyon, high outfitter use, hot springs	10

Table 7-18 Selected Recreation Reaches (11 Focus Reaches Are Identified by Shading and Bolded M-#)

Major Reach	Subdivision		Recreation Diversity	Agency Designation	Public Concern	Unique Features	Score*
		River to M.F. Payette River		Special Recreation Management Area - BLM			
	8.12	Middle Fork to North Fork (Banks)	Fishing, camping, viewing, picnicking, non-motorized boating	State Recreational River - IWRB, Payette Special Recreation Management Area - BLM	National	Whitewater character, Staircase rapids, hot springs	10
9. Owyhee River	9.1 **M-11**	Lake Owyhee	Fishing, camping, picnicking, viewing, hunting, motorized boating, water skiing, swimming, sailing, non-motorized boating	Owyhee State Park-ODPR, Honeycombs ACEC, Special Recreation Management Area-BLM	Regional	Dam and glory hole, scenery, geology, wildlife, fishing, historical cemetery, petroglyphs, hot springs	11
	9.2	Owyhee Dam to Snake River	Fishing, camping, picnicking, viewing, hunting	Wild and Scenic River designation, watchable wildlife area, Recreation Management Area-BLM	Local	Scenery, wildlife, hot springs, blue ribbon fishing for brown trout, cottonwood riparian area, geology	12
10. Malheur River	10.1	Warm Springs Reservoir	Fishing, camping, non-motorized boating	Eligible Wild and Scenic River - BLM	Local	Wildlife viewing, big horn sheep	4
	10.2	Warm Springs Dam to Juntura	Fishing, camping, hunting, non-motorized boating	Suitable Wild and Scenic River - BLM	Local	Wildlife viewing	6
	10.3	Juntura to Snake River	Fishing, viewing, hunting, non-motorized boating	Wilderness study area- BLM	Local	Scenic viewing, hot springs	7
	10.4	Beulah Reservoir	Fishing, hunting, motorized boating, water skiing		Local		4
	10.5	Beulah Reservoir to Juntura	Fishing, camping, picnicking,		Local		7
11. Burnt River	11.1	Unity Reservoir	Motorized boating, fishing, sailing, camping	Oregon State Recreation Area	Local		([1])
	11.2	Unity Dam to Snake River			Local		([1])
12. Powder River	12.1	Phillips Lake	Boating (motorized and non-motorized), fishing, camping, picnicking, swimming, water-skiing, sailing, hiking, scenic viewing		Local		([1])
	12.2	Mason Dam to Thief Valley Reservoir			Local		([1])
	12.3	Thief Valley Reservoir	Boating (motorized and non-motorized), fishing, camping, picnicking, scenic viewing, water-skiing		Local		([1])
	12.4	Thief Valley Dam to Brownlee	Fishing, scenic and wildlife viewing, camping	Wild and Scenic River	Local	Significant trout fishery	([1])

Table 7-18 Selected Recreation Reaches (11 Focus Reaches Are Identified by Shading and Bolded M-#)

Major Reach	Subdivision		Recreation Diversity	Agency Designation	Public Concern	Unique Features	Score*
		Reservoir					
13. Snake River	13.1	Brownlee Dam to Oxbow Reservoir	Fishing, camping, scenic viewing		Regional		([1])
	13.2	Oxbow Reservoir	Boating, fishing, camping				([1])
	13.3	Hells Canyon Reservoir	Boating, fishing, camping				([1])
	13.4	Hells Canyon Dam to Lower Granite Lake	Boating (motorized and non-motorized), fishing, camping, hiking, scenic and wildlife viewing, hunting, hiking	Hells Canyon National Recreation Area, Hells Canyon State Park, Wild and Scenic River	National	Deepest gorge in North America, cultural/ historic sites, scenic viewing	([1])
	13.5	Lower Granite Lake	Motorized boating, camping, hiking, swimming		Local		([1])
14.Salmon River			Boating (motorized and non-motorized), fishing, camping, swimming, hiking, scenic and wildlife viewing, hunting, hiking	Eligible Wild and Scenic River-BLM	National	Significant Steelhead fishery; popular whitewater runs; cultural/historic sites (e.g. Lewis and Clark Trail, Chinese settlements, native Indian sites)	([1])
15. Clearwater River			Boating (motorized and non-motorized), fishing, swimming, camping, hiking, scenic viewing	Dworshak State Park (off of main stem, on NF Clearwater)	National	International reputation for Steelhead fishery	([1])
16. Grande Ronde River			Boating (motorized and non-motorized), fishing, swimming, camping, picnicking, hiking, scenic and wildlife viewing	Hilgard Junction State Recreation Area; Red Bridge State Wayside	Local		([1])

[1]Not evaluated

7.8.3 Snake River Upstream of Milner Dam

7.8.3.1 Affected Environment

7.8.3.1.1 Jackson Lake

Jackson Lake in Teton National Park is located at a higher elevation than any other reservoir in the basin. At full pool, the surface area of the lake is 25,500 acres. Grand Teton National Park is part of the Greater Yellowstone Ecosystem, an area designated as one of 337 world-wide Biosphere Reserves established by the United Nations Education, Scientific, and Cultural Organization. In addition, Grand Teton and Yellowstone National Parks have long been recognized as "Crown Jewels" of the National Park system, receiving millions of visitors annually. Given the international, national, and regional importance of the area which surrounds Jackson Lake, it is recognized as an extremely important recreation resource.

Jackson Lake has numerous recreational facilities along its eastern shoreline, including two lodges, three marina complexes, three campground areas, and several canoe areas, hiking trails, scenic overlooks, and picnic areas. The western shore is undeveloped providing opportunities for wilderness camping, hiking, and boating (Reclamation, 1996b). Approximately 298,000 people visit Jackson Lake annually. The area receives visitors from all over the world .

Power boating, jet skiing, sailing, windsurfing, canoeing, row boating, and kayak touring are popular activities. Approximately 400 private boats owned by local residents are kept on the reservoir throughout the summer season. Reservoir concessions rented boats to approximately 13,000 visitors in 1996 and provide docking facilities for 64 boats at Colter Bay and 2,750 other boat mooring sites. The Grand Teton Lodge Company hosts 16,000 patrons annually on scenic boat cruises.

The primary concerns on the lake occur at lower water levels. The income potential for Grand Teton Lodge Company is severely impacted when lake levels drop below 6755 feet. At this level, the scenic tour boats cannot safely navigate the narrow entrance to Colter Bay and the floating docks located on Elk Island become unusable. Shallow water in the reservoir renders the docks unusable without boat damage and the gas pump becomes inaccessible. At elevation 6751 feet, the boat ramp becomes unusable. These lake levels were reached in 1994 and resulted in a 20 percent reduction in revenues for Colter Bay Marina. Leeks Marina would be impacted next and Signal Mountain would not be affected until levels drop below 6740 feet.

Aesthetics is another major concern in the northern and eastern segment of the lake during low water. Mud flats that appear at low water levels detract from the view of the Teton Range. The area to the east is adjacent to Jackson Lake Lodge, the primary resort on the lake. Over 100,000 visitors are housed during the summer season. Access to back country sites on the west shore is completely cut off at low water levels.

A 1991 Wyoming Game and Fish Department Creel Survey indicates an estimated 20,560 anglers fished 75,662 hours on the reservoir from May through September. An additional 6,548 anglers ice fished for 31,238 hours during the winter. The primary reservoir sport fishery is lake trout. Ice fishermen access the area by snow mobiles, cross country skis, and snow planes.

7.8.3.1.2 Snake River from Jackson Lake Dam to Palisades Reservoir

This reach of the Snake River extends approximately 69 miles. The river changes from a deep, slow-moving single channel to swifter, heavily-braided channels to a steep, single-channel whitewater canyon section. The Snake River runs through Grand Teton National Park and Bridger-Teton National Forest BLM lands, and private lands and receives visitors from all over the world. The Corps maintains a levee system between Moose and South Park (Reclamation, 1996b).

The heaviest recreational uses on the river are scenic raft floats and whitewater boating. Eight boat ramps provide access to the river between Moose and Sheep's Gulch. The whitewater section of the river in the Alpine Canyon area receives nearly 160,000 commercial boaters and nearly 40,000 private boaters annually. July and August are the two most popular boating months (Reclamation, 1996b). There are approximately 30 commercial guides operating on the river providing rafting, fishing, and instructional services.

Fishing is distributed throughout the system, but is most concentrated from Pacific Creek to Deadman's Bar and from Wilson to South Park. Fishing is done primarily from boats with bank fishermen making up only 25 percent of the anglers. Fifty-eight percent of all anglers used guide services in 1994, with 70 percent of all anglers using flies. The majority of anglers catch and release fish throughout this reach. The combined cutthroat trout catch rates for boat and bank anglers have decreased from 0.992 fish per hour in 1985 to 0.82 fish per hour in 1994. The number of anglers has steadily increased over the past 15 years with the highest concentration in September. Anglers are attracted to a 3-day "One-Fly" fishing contest held each year during the second weekend of September.

Periodic natural spring flushing of side channels and isolated ponds is considered of great benefit to the river system and recreational users. High flows clear debris from channels making them navigable. This increases the variety of fishing and wildlife viewing opportunities for scenic floaters. Higher flows provide more surface area and reduce conflicts among rafters and fishermen. Two boat ramps in Alpine Canyon become difficult to use when flows fall below 3,000 cfs, but rafters have been able to use the landings even at low water levels (Reclamation, 1996b).

7.8.3.1.3 Palisades Reservoir

Palisades Reservoir covers 16,150 surface acres at full pool, has 70 miles of shoreline, and is bordered by Targhee National Forest to the north and Caribou National Forest to the south. The reservoir receives 78 percent of its visitation from eastern Idaho residents and 10 percent from Wyoming residents. The most popular recreation activities in 1989 were pleasure boating (35 percent), boat fishing (34 percent), and waterskiing (30 percent) (USFS, 1989). More recent use of personal water craft (jet ski) has probably changed this combination.

Warm temperatures bring crowds that exceed the capacity of recreation facilities. Approximately 62,000 people visit Palisades Reservoir each year. The recreation carrying capacity of the reservoir declines throughout the recreation season as the reservoir level declines. Two developed boat ramp sites are heavily used as larger boats can be launched from these sites throughout the summer. Four other launch sites consist of old highway spurs or gravel pads which have limited parking and turn around areas, but are rendered unusable early in the season as the reservoir level drops. Winter recreation occurs on the reservoir even though the developed recreation sites close in the fall and are dormant throughout the winter. Ice fishing, cross-country skiing, and snowmobiling are popular winter activities promoted by area businesses (USFS, 1989). Hunting occurs throughout the region and is an important component of the economy of Grand and Swan Valleys.

Palisades Reservoir is considered one of the top flat-water fisheries in eastern Idaho. It supports cutthroat, lake trout, and brown trout populations. Angling hours have declined from 197,189 in 1980 to 22,506 in 1993 despite an increase in hourly catch rates from 0.30 fish per hour in 1980 to 0.35 fish per hour in 1993 (IDFG, 1993).

7.8.3.1.4 Snake River from Palisades Dam to Irwin

Flows of the main stem in this reach are regulated by releases from Palisades Dam. The river flows through one of the most extensive riparian cottonwood forests in the west (Idaho, 1975). National Forest lands border the south side of the river. There is some private home development. The north side of the river is mainly private; a few parcels of land are managed by BLM. Access to the river is maintained by BLM and the Forest Service (Reclamation, 1996b). Developed recreation facilities include campgrounds, boat access, and picnic facilities. Recreation use is concentrated around these facilities and day-use activities predominate. Approximately 225,000 recreation visits take place along this stream reach. The composition of recreation activities is: fishing (65 percent), camping (8 percent), picnicking (8 percent), boating (6 percent), sightseeing (5 percent), hunting (3 percent) and other (5 percent)(IWRB, 1996).

This river reach is world renowned for its native cutthroat fishery and is nationally recognized as one of the top 100 trout fishing streams in America (Pero and Yuskavitch, 1989). The fishing season begins late in June and extends into November. Estimated annual fishing has more than tripled from 53,676 hours in 1982 to 169,142 hours in 1996 (IWRB, 1996). The salmon fly hatch in early July brings anglers to this reach from across the country.

The fishing industry and supporting services provide the primary economic base (see chapter 6) for this rural region, and guided fishing trips have dominated the outfitting industry. Commercial guiding is managed by the BLM which allows only six companies to be permitted. No more than four boats are permitted on a particular section of the river per day. In 1994, 79 percent of the outfitted trips were for fishing, an increase of 24 percent from 1993 (Idaho Outfitters and Guides Licensing Board, 1995). In 1995, 5,877 individuals used the services of an outfitter in this area (IWRB, 1996). Anglers are primarily day users although the commercial outfitters do maintain base camps in the canyon for overnight trips.

Drift boats, rafts, canoes, and jet boats are commonly seen on the river. Use of personal water craft (jet ski) is also increasing. Motorized boating activity accounts for 20-40 percent of the boating use (IWRB, 1996). Four boat ramps provide access between Palisades Dam and Conant. Boat access at Conant received an estimated 36,267 visits in 1995 (IWRB, 1996). The area is primarily visited for fishing opportunities, but the number of scenic float trips is steadily increasing.

Flows affect the ability to conduct outfitted trips. An informal survey of outfitters indicated flows of 8,000-10,000 cfs are ideal for guided fishing trips. Maximum flow was identified as 15,000 cfs and the minimum flow was identified as 3,000 cfs. High or low flows limit angling success and the commercial marketability of guided trips. When flows are too high, angler pressure increases on other river reaches such as the Henrys Fork (IWRB, 1996).

Sustained high flows in 1995 severely impacted the fishing industry for the season. Large sections of the river eroded as much as 30 feet from the original shoreline. Log jams formed in the lower canyon from debris washed down by the high flows. The concern is not the high spring flush of the system but rather sustained levels of high flow (Reclamation, 1996b).

7.8.3.1.5 American Falls Reservoir

American Falls Reservoir, covering 57,669 surface acres with 100-miles of shoreline, is the largest Reclamation reservoir in the Snake River basin. The reservoir covers 57,669 surface acres and has 100 miles of shoreline. The climate is semi-arid with cold winters and hot, dry summers. American Falls Reservoir is relatively shallow (average depth of 50 feet); because of this, the water temperature tracks the ambient air temperature. Land ownership, other than Reclamation lands around the reservoir and the Fort Hall Indian Reservation at the upper end of the reservoir, is predominantly private. Reclamation manages 4,302 acres of land above the normal high waterline and 3,385 acres of land along the Snake River downstream of the reservoir.

There are approximately 185,000 visits annually to the reservoir. The reservoir is relatively shallow with an average depth of 50 feet; therefore, the water temperature tracks the ambient air temperature. The northeast end of the reservoir has a very shallow water depth. Mudflats are exposed during drawdown and form a wetland area referred to as the Fort Hall and Springfield Bottoms. The remaining shoreline is comprised of vertical cliffs up to 45 feet high, some of which are highly erodible and continuously retreating.

Maximum pool elevation is normally reached in late April or early May with irrigation deliveries beginning in April and continue into October. The reservoir water surface reaches an average low elevation of 4326 feet in September. There is no conservation pool requirement at American Falls Reservoir; therefore, the reservoir can be drawn down to the original river channel to meet irrigation demands. This occurred during drought conditions in 1977, in the late 1980s, and in the early 1990s.

Reclamation has recreation lease agreements with three entities around the reservoir: Bingham County, Seagull Bay Boat Club, and the city of American Falls. In addition there is Reclamation's American Falls Dam Visitors Center and day-use recreation area and Sportsman's Park, operated by Bingham County. Most visitors come from Bannock, Bingham, and Power Counties, but many visitors pass through the area on their way to Yellowstone National Park. The reservoir meets a large percentage of the local and regional recreation demand which has steadily increased at a slow rate over the past two decades. Recreation facilities include full-service campgrounds, picnic areas, boat docks and storage facilities, boat ramps, parking, sports fields, a restaurant, restrooms, showers, a dump station, and a laundry. Recreation activities include boating, fishing, swimming, camping, picnicking, windsurfing, sailing, water skiing (Reclamation, 1994b).

Visitation at the developed sites is dependent to a great extent on reservoir levels and the usability of boat launching facilities. Drought conditions limit boating accessibility early in the peak recreation season. When launching becomes difficult or impossible at the Seagull Bay boat ramp, recreationists switch to ramps at one of the other area. However, all ramps become unusable later in the season; the weather becomes hot and recreationists move to Palisades Reservoir and other higher-elevation reservoirs.

The heaviest use at Seagull Bay occurs from the beginning of April through July, or later if the water level permits and temperatures remain comfortable. The Seagull Bay boat ramp is the first facility to be affected by low reservoir levels and cannot be used when the reservoir is lower than elevation 4330 feet. Powerboats typically cannot use the ramp beginning in July, sailboats in mid-July, and small boats by the end of July. Peak use of the ramp occurs on weekends when up to 100 boats are launched. Weekday use of the ramp ranges from 5 to 10 boats.

Willow Bay receives the most use of the four recreation sites, but the boat launch usually closes in mid-July when the reservoir drops below elevation 4327 feet. Visitation to the marina drops drastically when the boat launch closes, but beach and day-use areas remain active until the water quality drops in the latter part of summer.

The Sportsman's Park recreation area is most heavily used from mid-June through mid-September. Over 200 people on weekend days commonly visit this area. As many as 25 boats are launched on weekdays and between 50 to 60 are launched per day on weekends. This boat ramp, at elevation 4322 feet, is typically the third to close due to low reservoir levels.

The boat launch near the dam (elevation 4312 feet) is heavily used as the ramp is accessible throughout normal to high-water supply years and it is accessible towards the end of the peak recreation season in low-water supply years. However, poor water quality discourages use of this launch area late in the season.

Fishing is an important recreation component at American Falls Reservoir. The main game fish species are rainbow trout, cutthroat trout, brown trout, yellow perch, and black crappie. Largemouth and smallmouth bass are also found. Most anglers fish the lower end of the reservoir from the dam to Seagull Bay and West Bay. A slightly larger percentage of anglers was found in a 1981 survey to fish the reservoir from boats (57 percent) than from the bank (43 percent) (Reclamation, 1994b). Between 20,000 and 30,000 anglers typically harvest an estimated 26,000 rainbow trout a year in approximately 125,000 angler hours (Reclamation, 1994b). Virtually all trout fishing is from boats and increases as fish populations become concentrated with declining reservoir levels. Creel census data indicate that most trout range in size from 1 to 2 pounds. Smaller trout are the product of the current years stocking program; the larger trout are carried over from the previous year. In low-water supply years, carryover of larger fish is generally poor.

7.8.3.2 Environmental Consequences

The single most important factor that affects recreation at reservoirs is the ability to launch boats because this directly affects boating, fishing, hunting, and waterskiing. Other activities that are indirectly affected by reservoir water levels are viewing, camping, and picnicking.

On rivers, the ability to launch boats, boatability, and fishability are the primary factors affecting recreation. Boatability refers to flow conditions that allow safe boating, and fishability refers to conditions that affect safe fishing and success in catching fish.

Water supply directly affects opportunity and the quality of recreational activities. More water in streams may produce benefits or adverse impacts for boating, fishing, camping, swimming and other day-use activities. Maintenance of riverflows during the high-use summer season, specifically July and August, would provide waves, hydraulics, and exciting rapids that satisfy some user groups such as kayakers and rafters. These same flows may also shorten boating trip times making it more economical for commercial outfitters (Reclamation, 1996b). However, other users such as novice boaters or those not wanting the higher risk may be excluded from reaches of the river.

Streamflows dramatically affect fish catch rates. Fishing could improve with higher flows, or rivers may become unfishable or access to the water could be impeded and boat launching become impossible. Those river reaches where fishing is the primary recreation activity would experience the greatest impacts with changes in flows. Increased flows, depending on the geomorphology of the river and other hydrologic conditions, may create dangerous flow conditions and wash out rapids and fishing holes.

Beaches may be inundated, eliminating dispersed camping or day-use opportunities, and higher flows could reduce water temperatures and the appeal for water contact activities such as swimming or wading.

Consistently high flows could improve general water quality. When water quality standards are not met, swimming and other full-body-contact activities and partial-contact activities (e.g., fishing) may be undesirable or even prohibited. Increased turbidity and algae can serve as a deterrent to recreation activity and reduce aesthetic values.

River flows lower than current operations could displace river enthusiasts of high-skill levels or those desiring a higher risk activity. The fishing activities could decrease due to increased water temperatures that exceed salmonid tolerances. Streamflows less than needed to operate boat ramps may result in water too shallow to safely boat, may reduce aesthetic appeal and fishing success, and generally reduce recreation opportunities.

Operational conditions that benefit or adversely affect wildlife resources and the sustainability of fish populations at reservoirs have a corresponding positive or negative effect on recreation activities. The ability to launch boats changes with reservoir level fluctuations and affects boating, fishing, hunting, waterskiing, and scenic viewing. Recreation, including activities restricted to the shoreline, is significantly reduced when reservoir levels fall below the boat launching facilities. However, reduced reservoir pools may concentrate fish populations and increase fishing success. Low reservoir levels for extended periods would be detrimental to the riparian habitat and the fishery.

For this analysis it was assumed that the recreation experience would be close to the same under the No Augmentation scenario as under the Base Case, so the No Augmentation scenario was not analyzed. This assumption was made because the magnitude of change between these scenarios appears to be slight and would be difficult to measure from a recreation perspective. Additional data and time would be required to better distinguish between these two scenarios.

7.8.3.2.1 Jackson Lake

Recreation visitation at Jackson Lake would remain unchanged except in September under the 1427i scenario as shown in table 7-19. Winter recreational use (ice fishing and snowmobiling) on Jackson Lake was not analyzed. Decreased boat ramp access under the 1427i scenario is the major cause for a projected decrease in visitation. Lower reservoir levels would minimally affect aesthetic quality if mud flats are exposed. However, exposure of mud flats could block access to back country sites on the western shore.

Table 7-19 Projected Visitation at Jackson Lake (Visitor-Days)

Month	Base Case and 1427r	1427i
May	14,900	14,900
June	59,600	59,600
July	104,300	104,300
August	89,400	89,400
September	29,800	28,310
Total	298,000	296,510

7.8.3.2.2 Snake River Near Moran

The 1427i and 1427r scenarios would have adverse impacts to recreation on this river reach. Under the 1427i scenario there would be a loss of boating access and losses to the commercial guide industry which makes up 58 percent of all angling in this reach. The small percentage of bank anglers that use this reach would not be able to offset the economic loss incurred by the commercial guide industry. Visitation under the 1427i is projected to decline 10 percent in May, 15 percent in August, and 20 percent in September. Under the 1427r scenario, visitation is projected to decline 5 percent in May and 15 percent in August and September. Projected visitation is summarized in table 7-20.

Table 7-20 Projected Visitation on Snake River Downstream of Jackson Lake Dam (Visitor-Days)

Month	Base Case	1427r	1427i
May	14,350	13,633	12,915
June	71,750	71,750	71,750
July	100,450	100,450	100,450
August	86,100	73,185	73,185
September	14,350	12,198	11,480
Total	287,000	271,215	269,780

7.8.3.2.3 Palisades Reservoir

The analysis of recreation at Palisades Reservoir is based on data for boat access at two of six boat ramps.

The only scenario to have an impact is the 1427i scenario. Reservoir drawdown would begin earlier in the year during the heaviest recreation use, reducing visitation as boat ramp access becomes increasingly difficult and facilities are overcrowded. A reduction in visitation would be expected beginning in July (10 percent) and increasing in August (15 percent) and September (20 percent). Table 7-21 summarizes projected visitation.

Table 7-21 Projected Visitation at Palisades Reservoir (Visitor-Days)

Month	Base Case and 1427r	1427i
May	3,100	3,100
June	9,300	9,300
July	21,700	19,530
August	21,700	18,445
September	6,200	4,960
Total	62,000	55,335

Although the 1427r scenario would result in somewhat higher reservoir levels in August and September (compared to the Base Case), the levels would not likely result in increased visitor use.

7.8.3.2.4 Snake River Downstream of Palisades Reservoir

Recreation in this reach would be adversely affected in July and August under the 1427i scenario. July and August flows would be higher and would limit access for boating and exceed safe flows for fishing. Visitation is projected to be reduced by 15 percent in July and by 5 percent in August. Projected visitation is summarized in table 7-22.

Table 7-22 Projected Visitation on the Snake River Downstream of Palisades Dam (Visitor-Days)		
Month	Base Case and 1427r	1427i
May	14,075	14,075
June	56,300	56,300
July	84,450	71,783
August	70,375	66,856
September	56,300	56,300
Total	281,500	265,314

7.8.3.2.5 American Falls Reservoir

The 1427i scenario would have a significant adverse affect on recreation at American Falls Reservoir as reservoir drawdown from June through September would likely limit access early in the recreation season to the one boat ramp closest to the dam. Water quality and fisheries would also decline sharply. The quality of the recreation experience may decline to unacceptable levels for the majority of recreationists who may choose to relocate to other reservoirs. American Falls Reservoir would experience a 23 percent seasonal reduction in visitation. The reduction in visitation would be 10 percent in May, 20 in June and July, and 30 percent in August and September.

Reservoir levels under the 1427r scenario would generally exceed existing Base Case scenario water elevations. The drawdown would generally follow a similar schedule as current operations, and more water would be available for recreation later in the season. Recreation use would likely continue to decline moderately as the recreation season progresses as it does under current operations.

The effects on recreation are summarized in table 7-23.

Table 7-23 Projected Visitation at American Falls Reservoir (Visitor-Days)			
Month	Base Case	1427i	1427r
May	18,500	16,650	17,575
June	27,750	22,200	24,975
July	64,750	51,800	61,513
August	64,750	45,325	58,275
September	9,250	6,475	7,863
Total	185,000	142,450	170,201

7.8.4 Boise River Basin

7.8.4.1 Affected Environment

7.8.4.1.1 Lucky Peak Lake

Lucky Peak Lake, a Corps facility, is the most popular recreation site within the Boise River system due to its close proximity to the city of Boise. It receives about 787,300 visits per year and 95 percent of the visits originate from Ada County. The reservoir is 12 miles long, has 45 miles of shoreline, and covers 3,019 acres at full pool. The primary recreation activities are: boating (29 percent), picnicking (26 percent), swimming (19 percent), fishing (15 percent), and waterskiing (11 percent). Lucky Peak Lake State Park, located just downstream from the dam, is the most heavily used State park in Idaho (Beck & Baird, 1993).

Lucky Peak Lake has produced excellent fall trout fishing during normal to high water supply years. Anglers spent an estimated 162,505 hours fishing at Lucky Peak Lake in the 1990-1991 fishing season. According to information provided by IDFG, the catch rate averages .31 fish per hour (Beck and Baird, 1993). The majority of hours expended (60 percent) are in the winter to spring period. Bank anglers comprise 57 percent of the total anglers; boaters, 39 percent; and ice anglers, 3 percent.

The optimum reservoir level for recreation purposes is the full pool elevation of 3055 feet. Boat launching access sites are particularly sensitive to drawdowns as many sites become inaccessible when the reservoir drops only 5 feet.

The Corps identified 10 major and 10 minor recreation areas along the shoreline. All of the sites are day use only. Six of the major sites are accessed by automobile and the remainder are accessible only by boat. The most heavily used recreation sites on the reservoir are Spring Shores Marina, Barclay Bay boat ramp, and Turner Gulch boat ramp. The reservoir is maintained at full pool during normal water supply years from Memorial Day through Labor Day. Barclay Bay and Robie Creek ramps typically are not operational until around the first of June, which is when the reservoir starts to recede due to irrigation releases. These two ramps, along with Macks Creek ramp, are inaccessible by mid-June. The shorter ramp at Spring Shores is dry by the first of July while the longer ramp continues to function until around the first of August. The reservoir surface acreage, visual resource, and user experience can be badly diminished by this time in dryer water years. The Turner Gulch ramp operates at the minimum reservoir pool and is, therefore, never dry. During low water supply years, most boat ramps can operate only until mid-July.

In a wet water year, the lake is full for about 2 months, from July 1 to September 1, actually less time near full pool than in a normal water year due to flood control operations and because high water is about 1 month later than a normal water year. With the exception of early June, the pool elevations are very good for boating until early September (Shalkey Walker Associates, Inc., 1995).

During drought years, the early drawdown substantially affects boating use. Barclay Bay, Robie, and Macks Creek ramps become inoperable early in a dry year. As the Barclay Bay ramp becomes inoperable and the Spring Shores ramp approaches this situation, use pressure increases on the Turner Gulch ramp. Boat-in access sites are particularly sensitive to drawdowns. Many of these sites become inaccessible when the lake drops only 5 feet.

7.8.4.1.2 Boise River Downstream of Boise Diversion Dam

Boise Diversion Dam is located about 3.5 miles downstream from Lucky Peak Dam. About 2 miles further downstream is Barber Park which is the starting point for a locally-renowned summer pastime of floating the Boise River. Here, river floaters launch inner tubes and rafts for the 5-mile float into the center of the city of Boise. The river flows through a protected riparian corridor along which Boise has developed five large urban parks, which are connected by the Greenbelt, an extremely popular pedestrian/bikepath which parallels the river from Lucky Peak Dam to Eagle Island.

Barber Park is a 22-acre fee-use park owned and maintained by Ada County. Facilities include a boat launch, concession stand where rafts and inner tubes are rented, a day-use park with facilities for group use, and parking for about 800 vehicles. The park accommodates over 10,000 river floaters per day in the summer months (Beck and Baird, 1993). Ann Morrison Park is the bottom end of the floatable section. After public schools start in the fall, floating drops to about 100 people per day. During the winter, watching bald eagles along the river near the park is popular.

Kayakers and canoeists float the river between April and June when flows are 1,500-3,000 cfs. This volume of flow forms a Class III rapid at a weir in downtown Boise which is appropriate for intermediate and advanced kayakers.

The river is a tremendous asset within Ada County and, along with the parks and Greenbelt, is a continuing source of community pride. Not only does the river offer a diverse range of recreational opportunities, it provides great aesthetic benefits. The Boise River Festival, which originally centered around the river in downtown Boise, is a multi-day celebration of the connection between the river and the community. The festival draws over 1 million people annually and provides a sizable economic contribution to the community. This annual festival takes place the last week of June.

The main stem Boise River is open to fishing year around and provides a popular put-and-take fishery. River management goals are to enhance the habitat, stock the river seasonally with fingerling brown trout and adult steelhead, stock catchable rainbow trout year around, screen diversions to prevent loss of large fish, and manage the river for a high density of anglers. A 1989 survey indicated 488 anglers spent 867 fishing hours and caught 302 fish at a rate of 0.35 fish per hour (IDFG, 1989; Beck & Baird, 1993).

7.8.4.2 Environmental Consequences

7.8.4.2.1 Lucky Peak Lake

Recreation at Lucky Peak Lake would be adversely affected in July, August, and September by the 1427i scenario. The quality of the recreation experience would decline to unacceptable levels for the majority of recreationists, and water quality and fisheries would decline sharply. Projected visitation (compared with the base case) would be 10 percent less in July, 40 percent less in August, and 50 percent less in September. The smaller surface area would constrict use, increase the possibility of user conflict, and severely impact user safety.

The 1427r scenario would result in boat ramp access similar to the Base Case.
The effects on reservoir visitation are summarized in table 7-24.

Table 7-24 Projected Visitation at Lucky Peak Lake (Visitor-Days)

Month	Base Case and 1427r	1427i
May	78,726	78,726
June	118,089	118,089
July	275,541	247,987
August	275,541	165,325
September	39,363	19,682
Total	787,260	629,809

7.8.4.2.2 Boise River Downstream of Boise River Diversion Dam

The 1427i and 1427r scenarios would adversely impact recreation, especially in August, the month receiving heaviest recreation use. Flows higher than the Base Case in May and June would have less impact mainly due to colder water temperatures and historically less use on the river. July flows under both the 1427i and 1427r scenarios would exceed 1,500 cfs (as measured at Glenwood Bridge) about 40 percent of the time, which represents a 25 percent increase over the Base Case scenario. The loss of safe recreational flows through Boise during the peak summer recreation season would represent significant impact and far-reaching effects to residents of the area as well as city and county recreation programs.

Overall adverse impact on recreation throughout this reach stems from the fact that flows under the Base Case are already at maximum levels for safe tubing. Higher flows in August for the 1427i and 1427r scenarios would appear to preclude safe recreation flows in nearly 60 percent of years of the 62-year period of analysis compared to the Base Case under which riverflows never exceed 1500 cfs in August. A 40 percent drop in use levels is estimated . Projected visitation is summarized in table 7-25.

Table 7-25 Projected Visitation on Boise River Downstream of Boise River Diversion Dam

Month	Base Case	1427i	1427r

May	17,500	8,750	9,975
June	17,500	8,750	8,750
July	87,500	64,750	64,750
August	175,000	75,250	70,000
September	52,500	52,500	52,500
Total	350,000	210,000	205,957

7.8.5 Payette River Basin

7.8.5.1 Affected Environment

7.8.5.1.1 Cascade Reservoir

Cascade Reservoir is located in the west-central mountains of Idaho, on the North Fork of the Payette River in Valley County. The economy of Valley County, Idaho is particularly dependent upon recreational resources. Two major reservoirs–Cascade and Deadwood Reservoirs–and Payette Lake provide boating, fishing, waterskiing, and other water-based recreational activities. The towns of Cascade (population 2,629) and McCall (population 1,181) are growing at the rate of 6 percent/year and are major destination resorts for regional residents and out-of-state visitors. Total employment within the county is 4,750 workers, with tourism supporting over 2,000 workers (42 percent of workers). The government sector employs an additional 1,000 workers, and agriculture supports 240 workers. Over 90 percent of the county is public lands. The region supports water-based sports, wildlife, and wilderness, and winter sports, making it a year-round recreation center.

The city of Cascade is near the south end of the reservoir; the city of Donnelly, near the north end. Reclamation administers a narrow strip of land of irregular width around most of the reservoir. Generally, the lands west of the reservoir away from the immediate shoreline are administered by the Boise National Forest. The remaining surrounding land is privately owned, except for isolated parcels of State and Federal lands. Cascade Reservoir has a surface of 28,300 acres at normal full pool which is 4828 feet. The reservoir is shallow; the average depth being only 26.5 feet. Since 1983, a 300,000-acre-foot minimum pool has been maintained. This results in a mean annual drawdown of 12 feet. Lowest water levels are typically reached in October; highest in June. At full pool, the reservoir is 21 miles long and has 86 miles of shoreline. The southern portion of the reservoir is wide and unsheltered from wind; the widest point being 4.5 miles.

The reservoir is situated in Long Valley, a broad valley with large areas of open grasslands and sagebrush which afford expansive views of the surrounding mountains. The reservoir receives most use from areas within a 2-2½ hour drive; this includes the city of Boise and Ada, Adams, Boise, Canyon, Gem, Payette, Valley and Washington Counties. Access is via U.S. Highway 55.

Recreation facilities are managed by IDPR/Reclamation, and USFS. Several private organizations lease land from Reclamation or the Forest Service. Reclamation and IDPR are in the process of transferring 11 Reclamation managed recreation sites to the Idaho State Park system. Camping is a secondary use to fishing, the primary recreation activity, but is the most significant use on Reclamation lands. Peak use begins in mid-May and ends when cold, wet weather arrives in September. The developed recreation sites are located around the reservoir and include picnicking facilities with tables and grills, boat ramps, campgrounds with drinking water, vault and flush toilets, and camping spurs with tables and grills. There are about 233 designated single and double campsites in campgrounds ranging from 12 to 42 individual party campsites (Reclamation, 1991). There are 10 sites with public boat ramps around the reservoir which provide a total of 17 lanes. When the reservoir falls below 4812 feet, eight of the boat lanes are unusable. Elevation, slope, and water current limit the extension potential of the boat launches at Donnelly City Park, French Creek, Southwest Idaho Senior Citizens Recreation Association, and Morning Dawn (Reclamation, 1991).

Fishing is the primary recreation activity at Cascade Reservoir. It is estimated that the reservoir receives approximately 130,000 angler days of use per year. Fishing occurs throughout the reservoir and preferred fishing spots change with the seasons. Yellow perch is the most popular fish, followed by trout and salmon (Reclamation, 1991). Since 1995, however, the yellow perch population in Cascade Reservoir has been in significant decline and angling pressure is the lowest recorded in the 1980s and 1990s (IDFG, 1998). The poor fishing has caused a large drop in angler use of the reservoir and serious loss of economic value of the fishery.

There are 10 developed recreation sites around the reservoir with public boat ramps which provide a total of 17 boat launching lanes. Eight of the boat lanes are unusable when the water level falls below elevation 4812 feet.

7.8.5.1.2 North Fork Payette River Downstream of Cascade Dam

The Payette River is a major tributary of the Snake River draining about 3,240 square miles in west-central Idaho. Over 64 percent of the basin is public land. The Payette River is located about 45 minutes driving time from the Boise metropolitan area via State Highway 55. Flows on the North Fork Payette are controlled by releases from Cascade Reservoir. The flow gauge is located 0.2 miles downstream from Cascade Dam and about 6 miles upstream of Cabarton Bridge (IWRB, 1991).

Lands adjacent to the river are managed by the Boise National Forest, BLM, or privately owned. State Highway 55 parallels the river along much of its length. There are two distinct white water reaches and one flat water reach. Recreation activities on and along the river corridor include sightseeing, boating, fishing, swimming, camping, picnicking, berry picking and hunting.

The North Fork Payette River has one flat-water reach and the remainder can be split into two distinct whitewater reaches. Recreation activities on and along the river corridor include boating, fishing, sightseeing, swimming, camping, picnicking, berry picking, and hunting. Irrigation releases from Cascade Dam enhance mid- to late-summer boating on the North Fork.

The flat-water reach begins below Cascade Dam and extends down river to Cabarton Bridge. The river meanders through Long Valley, a broad, flat valley with interspersed summer home developments and agricultural lands. This section of river is valued for scenic floating by recreationists that use kayaks, rafts, drift boats, and canoes. Use has been fairly light, but interest in scenic river trips by canoe has been growing and will probably translate into greater use levels in the near future.

The North Fork is a whitewater boating attraction of regional, national, and international interest and has been designated as a Recreational River by the State of Idaho. The North Fork, in conjunction with the South Fork Payette River (not included in this analysis), forms a whitewater recreational complex with conditions ranging from relatively easy novice-class water to highly challenging water demanding expert boating skills (IWRB, 1991). The upper reach extends from Cabarton Bridge to Smiths Ferry. The reach from Smiths Ferry to Banks may be the most continuous stretch of whitewater in the world and is used primarily by kayaks and smaller catarafts. The Idaho Whitewater Association holds annual whitewater rodeos on the Payette River between Deer Creek and Banks which draws national and international boaters. The Idaho Department of Parks and Recreation (IDPR) found that participants in the 1990 rodeo came from Idaho (29 percent), other states (68 percent), and from other countries (3 percent) (IWRB, 1991).

Outfitters use portions of the Payette River for commercial float trips. Eight outfitters are licensed by the Idaho Outfitters and Guides Licensing Board to operate on the North Fork, South Fork, and main stem of the Payette River. Five permits are granted by the USFS for four reaches including the North Fork from Cabarton Bridge to Smiths Ferry.

The North Fork fishery below Cascade Dam is supported by wild trout reproduction. Fishing accounts for about 8 percent of the use of the North Fork (IWRB, 1991). Recreationists spent an estimated total of 45,926 hours of use in 1980 along the North Fork. The fishery from Cabarton to Smiths Ferry is unique in west-central Idaho in that it provides an isolated wading stream fishery for wild rainbow trout. The catch rate is generally in excess of one fish per hour, and the population contains a significant portion of trophy size fish (Scully, 1987). Most fishing occurs at campgrounds and highway turn outs between Rainbow Bridge and Banks.

7.8.5.1.3 Payette River Downstream of Banks

The main stem of the Payette River from Banks to Horseshoe Bend is heavily used by private boaters and commercial outfitters. The primary recreation activity is whitewater rafting. The reach can be divided into a whitewater segment from Banks to Beehive Bend and a calmer water segment from Beehive Bend to Horseshoe Bend. The Banks to Beehive Bend reach has been designated as a Recreational River by the State of Idaho.

Jet boats use the main stem Payette River during spring flows; over 80 percent of the jet boaters are Idaho residents. The Western Whitewater Association, Inc. estimates use at more than 500 user-days per year. The Association sponsors club runs between Banks and Black Canyon Reservoir during periods of high runoff.

7.8.5.2 Environmental Consequences

7.8.5.2.1 Cascade Reservoir

The 1427i scenario would adversely impact recreation at Cascade Reservoir. Cascade Reservoir would experience heavy draw down for most of August and September. This would leave boat launch facilities unusable during the peak recreation season and would adversely impact the sport fishery. The recreation experience would likely drop to unacceptable levels for the majority of recreationists. Visitation would be reduced 10 percent in June, 15 percent in July, and 40 percent in August and September. Water quality, aesthetics, and reservoir fishing, all of which contribute significantly to the recreation experience at Cascade Reservoir, would be severely impacted. The local economy would suffer significant impacts as visitors would look to other lakes or reservoirs for recreation.

The 1427r scenario would impact recreation, but not as much as the 1427i scenario. The 300,000-acre-foot conservation pool would be maintained in September, but pool levels would be lower than with the Base Case. Visitors would experience more crowding around developed recreation facilities, and aesthetic appeal would likely be lost due to development of large mudflat areas. Water quality, an important factor at Cascade Reservoir, may also decline. Visitation would be reduced 10 percent in June and July and 5 percent in August. The projected effects on reservoir visitation are summarized in table 7-26.

Table 7-26 Projected Visitation at Cascade Reservoir (Visitor-Days)

Month	Base Case	1427i	1427r
May	22,500	22,500	22,500
June	67,500	60,750	60,750
July	157,500	133,875	141,750
August	157,500	94,500	149,625
September	45,000	27,000	45,000
Total	450,000	338,625	419,625

7.8.5.2.2 North Fork Payette River Below Cascade Dam

The North Fork Payette River whitewater reaches would be minimally affected under all scenarios. However, the 1427i or 1427r scenario would adversely affect more casual recreation such as fishing, floating, and canoeing. Under the 1427i scenario, visitation is likely to be decreased by 25 percent in September. Under the 1427r scenario, visitation in September would be down only 5 percent. Projected visitation is summarized in table 7-27.

Table 7-27 Projected Visitation on the North Fork Payette River (Visitor-Days)

Month	Base Case	1427i	1427r
May	410	410	410
June	1,640	1,640	1,640
July	2,460	2,460	2,460
August	2,460	2,460	2,460
September	1,230	923	1,169
Total	8,200	7,893	8,139

7.8.5.2.3 Payette River Downstream of Banks

None of the scenarios would have a measurable effect on recreation visitation along this river reach. However, a general change in the seasonal flow regime could result in displacement of various user groups or users with different boating skill levels. Generally, higher flows appeal to the highly skilled boater, but the general boating population out numbers the highly skilled boaters. Lower flows accommodate boaters of all skills, but appeal most to boaters with intermediate skills. The mix of users and magnitude of use may change. However, a more detailed analysis would be required to better quantify impacts.

7.8.6 Owyhee River Basin

7.8.6.1 Affected Environment

Lake Owyhee is located in eastern Oregon on the Owyhee River. The reservoir is long and narrow and trends north-south. At full pool, water covers 13,900 acres and the shoreline is about 150 miles long. At full pool the average depth is 81 feet. The Vale District, BLM, developed a Wild and Scenic River Management Plan for the Main, West Little, and North Fork Owyhee Rivers (BLM, 1993) which are upstream of Lake Owyhee. Within the main Owyhee River corridor, the BLM administers the 110 river miles upstream of Birch Creek and Reclamation manages the 10 river miles from Birch Creek downstream to the backwater of Lake Owyhee.

The area is isolated but the reservoir provides recreational opportunities on a regional basis. Recreational activities include camping, swimming, fishing, waterskiing, boating, and hunting. Visitors come from both Idaho and Oregon.

Public recreation sites with developed facilities are concentrated at the north end of the reservoir near Owyhee Dam. Developed sites include the Owyhee Dam/Glory Hole, Malheur County boat ramp, and Lake Owyhee State Park. The only developed public recreation facility located south of this area is Leslie Gulch.

The Owyhee Dam/Glory Hole site is a day-use area. Recreation facilities include interpretive signs, observation deck, and parking turnout space.

Malheur County maintains a one-lane boat ramp about ½-mile southeast of the dam. Associated facilities include parking on the opposite side of the road and portable vault toilets.

Lake Owyhee State Park is operated by the Oregon Department of Parks and Recreation. Recreation sites include Gordon Gulch and McCormack campground. Gordon Gulch is a day-use area with 14 picnic sites, restrooms, a four-lane boat ramp, and a parking area with 57 vehicle parking spaces and 24 boat trailer parking spaces. On occasion when campsites at the McCormack campground are full, campers are allowed to stay at Gordon Gulch.

McCormack campground is a fully developed day and overnight use area. Facilities include 43 camping spurs (33 tent sites and 10 RV sites with electrical hookups), picnic tables, restrooms, shower facilities, a boat ramp, and fish cleaning facilities. Fishing is the primary weekday activity and waterskiing is the primary weekend activity for park users.

Leslie Gulch is located approximately 35 miles south of the dam and managed by the BLM. The area is popular for vehicle-supported day and overnight recreational activities. Developed facilities include: two single-unit vault toilets, a two-lane concrete boat ramp, a gravel surfaced parking area for motor vehicles and boat trailers, and a large parking area for overnight use. The site is the final take-out for whitewater boaters on the Owyhee River.

The shoreline provides outstanding opportunities for primitive and unconfined recreation activities such as camping and hiking. There are a number of dispersed undeveloped sites which are popular among boat-in campers and day-use recreationists.

There are two cabin lease sites on the reservoir. The Dry Creek Arm subdivision has 17 cabin lease sites and is accessible by motorized vehicle or by boat, and the Fisherman's Cove Subdivision has 43 cabin lease sites and is accessible only by boat. There are 4 cabin leases on State lands.

Use tends to be evenly distributed throughout the summer months but has been steadily declining since 1971. The decline may in part be attributed to a decline in fish size and catch rates, and the conversion of Bully Creek Reservoir in 1973 to warmwater fish production which became the area's top crappie producer in 1980 (Reclamation, 1994a).

Another factor contributing to the decline in recreational use is the fluctuation in reservoir water surface elevation. The prolonged drought in the late 1980s-1990s resulted in a reservoir elevation in June 1992, of 2596-feet, 50-feet below the average elevation over the previous 12 years. Substantial drops in reservoir elevation have significant adverse effects on the quality of the recreation experience. As boat ramps become increasingly distance from the reservoir water surface, boat launch and retrieval operations become increasingly difficult. Additionally, the barren shoreline is unattractive, reducing the aesthetic quality of the area for picnicking, bank fishing, swimming, and other day-use activities (Reclamation, 1994a).

Use figures at the park typically coincide with fishing conditions at the reservoir. When angling success is good, visitation increases. According to recreation data collected by the Oregon State Parks Department, visitors primarily come from (in descending order); southwest Idaho (Ada County), Portland, and Ontario (Reclamation, 1994a). Water-based activities include fishing, motorized and whitewater boating, windsurfing, and swimming.

7.8.6.2 Environmental Consequences

The 1427i and 1427r scenarios would adversely affect recreation at Lake Owyhee. The 1427i scenario would draft the reservoir more quickly and deeper than under the Base Case. Loss of the Leslie Gulch boat ramp, the uppermost ramp on the reservoir, would preclude use of the upper end of the reservoir and have a highly negative impact on recreationists floating the river and accessing the Leslie Gulch area for take out of boats. Aesthetics, recreation facilities, water quality, and the quality of the fishery would all suffer. Oregon State Parks facilities would likely experience a decline in recreation use. Visitation to the reservoir is projected to decline 10 percent in May and June, 15 percent in July and August, and 5 percent in September.

Under the 1427r scenario, Lake Owyhee would be drawn down slightly faster than under the base case. An 8 percent seasonal reduction in visitation would occur. Visitation is projected to decline 10 percent in May through July and 5 percent in August.

Table 7-28 summarizes projected visitation at Lake Owyhee.

Table 7-28 Projected Visitation at Lake Owyhee (Visitor-Days)

Month	Base Case	1427i	1427r
May	19,600	17,640	17,640
June	24,500	22,050	22,050
July	19,600	16,660	17,640
August	19,600	16,660	18,620
September	14,700	13,965	14,700
Total	98,000	86,975	90,650

7.8.7 Summary of Recreation Effects

Table 7-29 summarizes the recreation analysis for all the flow augmentation scenarios with the Base Case considered to be 100 percent. The percent of seasonal change from the base case scenario is shown.

Table 7-29 Summary of Potential Summer Recreation Visitation (Percent Compared to Base Case)

Area	Base Case and No Augmentation	1427i	1427r
Jackson Lake	100	99	100
Palisades Reservoir	100	89	100
American Falls Reservoir	100	77	92
Lucky Peak Lake	100	80	100
Cascade Reservoir	100	75	93
Lake Owyhee	100	89	92
Snake River downstream of Jackson Lake Dam	100	86	94
Snake River downstream of Palisades Dam	100	94	100
Boise River downstream of Boise River Diversion Dam	100	25	18
NF Payette River downstream of Cascade Dam	100	96	99
Payette River downstream of Banks	100	100	100

Table 7-29 shows that the 1427i and 1427r scenario would result in the loss of some recreation and the loss would be far more widespread and greater in depth with the 1427i scenario than with the 1427r scenario. Recreation losses would be greater for the Boise River reach below Boise River Diversion Dam than for any other site. Other sites with loss greater than 20 percent include American Falls Reservoir, Cascade Reservoir, and Lucky Peak Lake. Overall, recreation losses would be greater under the 1427i scenario than the 1427r scenario at all but two sites.

The 11 recreation areas featured in this analysis were selected based on geographic and recreational diversity to show the general effects and can be used as an example of what could happen at other reservoirs and stream reaches. Some of the losses would likely be mitigated by recreationist moving to other sites for recreation. However, this could come at a price. Displaced use absorbed by other areas may result in overcrowding, increased user conflicts, damage to facilities, and deterioration of the site. Ultimately, the net effect would be loss of recreation experience and decline in the quality of the recreation experience. This analysis acknowledges that there is a link among recreation sites and uses, but that a quantitative analysis of this aspect is not feasible at this level of study.

7.9 Wild and Scenic Rivers

The Wild and Scenic Rivers Act of 1968 requires Federal agencies to consult with the appropriate managing agencies whenever proposed actions may affect a river designated, or identified as eligible or suitable for wild and scenic river designation.

> "(d)(1) In all planning for the use and development of water and related land resources, consideration shall be given by all Federal agencies involved to potential national wild, scenic and recreational river areas, and all river basin and project plan reports submitted to the Congress shall consider and discuss any such potentials. The Secretary of the Interior . . . ."

The listing and descriptions in this section are limited to those rivers reaches that could be affected by operation of Reclamation facilities or by private irrigation in those areas identified for potential purchase of water rights. The descriptions of the river reaches were taken from the 1992 River Information Digest published by American River Management Society, Western Region; the Wild and Scenic River Act of 1968; and appended materials from the Federal Government's Wild and Scenic Rivers Act Internet site. Some of the geographic terms used to describe the river reaches are incorrect or inconsistent with accepted standards so it is difficult to clearly identify the reach. These cases are noted with a comment printed in italics.

The various states have also applied state designations to specific river reaches including some of the reaches that are included in the National Wild and Scenic Rivers system. River reaches with state designations were not identified for this analysis.

7.9.1 Affected Environment

Rivers included in the National Wild and Scenic Rivers system are classified as a wild, scenic, or recreational river based upon the unique attributes and the amount of human encroachment and development that affects these rivers. Several river reaches in the Snake River basin are included in the National Wild and Scenic Rivers System and several other reaches are proposed for inclusion in the system. The description of some of these reaches is unclear and comments have been included where that is true. River reaches and their designation within the general area of analysis that are now part of the national system include:

- Snake River, main stem
  - The reach from Hells Canyon Dam downstream to Pittsburgh Landing (wild river)
  - The reach from Pittsburgh Landing downstream to the Willamette meridian (scenic river)

- Owyhee River
  - The South Fork from the Idaho-Oregon State line downstream to Three Forks (wild river) *(Comment: meaning is unclear as the South Fork confluence with the main stem (East Fork) is in Idaho and about 30 miles upstream from Three Forks)*
  - The North Fork from the Idaho-Oregon State line to the main stem (8 miles) (wild river)
  - The main stem from Three Forks downstream to China Gulch (wild river)
  - The main stem from Crooked Creek downstream to the Lake Owyhee (wild river)

- Salmon River, Middle Fork
  - Origin to the confluence with the main stem Salmon River.

- Salmon River, main stem
  - The reach from the North Fork to Corn Creek (46 miles) (recreational river)
  - The reach from Corn Creek to Long Tom Bar (79 miles) (wild river)

- Grande Ronde, main stem
  - From the Wallowa River to the Oregon-Washington State line (48 miles) (Some segments designated as wild, others as recreational)

The following river reaches have been identified for potential addition to the National Wild and Scenic Rivers system. Studies will be conducted by the appropriate managing agency to determine river reach eligibility and suitability for inclusion in the National Wild and Scenic Rivers system. Again, some of the river descriptions are not decipherable and comments have been included. These river reaches include:

- Snake River
  - Main stem, from the southern boundaries of Teton National Park to the entrance to Palisades Reservoir.
  - Main stem from an eastward extension of the north boundary of section 1, township 5 north, range 47 east, downstream to the town of Asotin, Washington.
  - South Fork *(Comment: the main stem is sometimes referred to as the South Fork),* Palisades Dam to Heise and Heise to Menan
  - Main stem from Blackfoot to American Falls Reservoir
  - Main stem , Milner section
  - Main stem, Murtaugh to Twin Falls Dam
  - Main stem, Lower Salmon Falls Dam to Bliss and Bliss to King Hill

- Bruneau River
  - The entire main stem
  - West Fork from Rowland Nevada to Indian Hot Springs

- Owyhee River
  - South Fork, Oregon from the Oregon-Idaho border downstream to Owyhee Reservoir. *(Comment: description is incorrect, see comment above)*
  - East Fork from Garat Crossing to confluence of East and South Forks
  - Main Stem from South Fork/East Fork confluence to Oregon border (*Comment: East Fork Owyhee River in Idaho and Nevada is considered to be the main stem*)

7.9.2 Environmental Consequences

The flow augmentation scenarios would increase flows during the summer months and decrease flows during the winter months. This would more closely mimic the natural river system without any development. The No Augmentation scenario would have the opposite effect but would generally not be measurable. In most reaches now in the National Wild and Scenic Rivers system, these flow changes would be minor, but generally beneficial. Although a definitive analysis was not made, it is clear that the flow augmentation scenarios would have little or no effect on the status of river segments currently included in the National Wild and Scenic Rivers system.

8 Social Analysis

This chapter presents findings related to social well being. Discussions includes political divisions, communities, employment, income, social well being, and other categories of social effects. The focus of the social analysis is potential irrigation and recreation related impacts on (1) those who live in irrigation service areas and (2) those who use reservoirs and rivers for recreation purposes.

In the Snake River basin, there are residents who may have a direct or indirect interest in the enhancement of salmon and steelhead. As indicated in chapter 1, Reclamation did not analyze the potential effects of flow augmentation on salmon and steelhead as that analysis is the responsibility of the Corps. As a result, Reclamation had no basis for, and did not conduct, social analysis relative to potential changes in salmon and steelhead populations.

Given the magnitude of the Snake River basin and the difficulty of identifying social impacts, case studies were made of two irrigation service areas and two recreation areas. Under this approach, hydrology, economic, and other data were collected on the 1427i and 1427r scenarios and used in discussions with a limited number of knowledgeable persons in the case study areas. These discussions helped identify potential impacts to communities, families, and individuals. Discussions were also held with a few individuals in each irrigation service area to help identify unique conditions and impacts that might be potentially more significant to specific irrigation service areas.

8.1 Population and Communities

8.1.1 Idaho, Oregon, Nevada, and Wyoming

Forty-two counties drain into the Snake River system from Idaho, Oregon, Nevada, and Wyoming. There are 167 communities within the basin with 1.1 million residents, ranging from major metropolitan areas to remote cross-road communities. A list of all named communities within the affected areas and up to 10 miles adjacent to the irrigation service areas was developed. The list includes unincorporated communities of as few as 8 residents, as well as incorporated townships. This selection is based upon the presumption that all identifiable communities have a role and use in local culture and thus warrant being included in the analysis. Where available, population growth trend and rate of change is reported and an estimate of the extent of economic diversity of employment within the communities is provided. This information is included in attachment I at the end of this report.

8.1.2 Indian Reservations and Other Indian Tribes

Another political division of the area is Indian reservations. Two Indian reservations are located in the area–the Fort Hall Indian Reservation in Idaho and the Duck Valley Indian Reservation that spans the Idaho/Nevada border.

8.1.2.1 Fort Hall Indian Reservation

The Shoshone and Bannock Tribes (population 3,593) occupy the Fort Hall Indian Reservation, which spans 544,000 acres near Blackfoot, American Falls, and Pocatello, Idaho. The Snake River, the Blackfoot River, and American Falls Reservoir form the northern and northwest boundaries of the reservation. Agriculture comprises one of the most significant sources of revenue on the reservation. About one-third of the reservation includes prime agricultural lands, of which nearly 73,000 acres are irrigated. Most of the irrigated lands are leased to outside farming interests, but the tribes operate about

2,000 acres of their own. Multiple livestock operations are located within or near the reservation, including a buffalo herd (350 cows) that is used for food services and retail sale. The tribes currently receive lease payments of about $130 per acre of irrigated farmland and somewhat less for grazing land. Although there are several natural springs and slackwater areas on the reservation which support native fisheries, no commercial development of fishery or timber resources has occurred.

In recent years, the tribes have been expanding the local economy through commercial enterprise, developing and leasing phosphate mining, agricultural products manufacturing, tourism, and recreation. The labor force on the reservation is above 1,000, but unemployment remains high at about 26.5 percent (1996). Per capita income for residents of the reservation is $4,610.

8.1.2.2 Duck Valley Indian Reservation

The Shoshone and Paiute Tribes (908 persons) reside on the Duck Valley Indian Reservation which consists of approximately 290,000 acres located in southern Idaho and northern Nevada, approximately 100 miles north of Elko, Nevada.

The topography is characterized by rolling rangeland, traversed by the Owyhee and South Fork Owyhee Rivers. Over 260,000 acres of the uplands are used for grazing, and 14,000 acres are irrigated. An additional 3,000 acres are potentially irrigable. The BIA holds the land in trust for the tribes, and the tribes lease farmland through a bidding system to local farming contractors.

The predominant employment sectors in the region are government and agriculture. The predominant sources of commerce within the reservation are from recreational fishing at two reservoirs on the reservation, marina services, land leases, and grazing permits. Commercial development is very limited, although there is potential for agricultural and mineral development. The labor force consists of some 450 persons, and unemployment is typically very high (over 25 percent).

8.1.2.3 Other Indian Tribes

The Burns-Paiute, Umatilla, Nez Perce and the Northwestern Band of the Shoshoni Indians have reservations or colonies which are outside the analysis area for this flow augmentation report. However, their traditional use areas extend within this area.

8.2 Values

8.2.1 Rural Values

Rural people in Idaho, Nevada, eastern Oregon, western Wyoming hold strong agrarian values, which are slowly changing as a result of in-migration of people from distant urban areas and economic change. Western rural people often extol the virtues of hard work, independence, conservative political views, utilitarian views of the land and natural resources, and the opportunity and right to access and use public lands for pleasure and livelihood. Most value land ownership, private property rights, and prudent fiscal management. They are prone to feel that their management of the land is a proper form of stewardship that enhances, not consumes the land. They often hold a strong sense of intimacy and attachment to their land, often building toward and bequeathing their heritage to future generations. Ranchers often treasure the sense of peace, quiet, and privacy their remoteness may provide, and dislike the intrusion of outsiders into their community.

Local communities are being affected by forces which they cannot control, forces they perceive to be dictated by state or Federal government or other outside interests including , market forces and in-migration. Their sense of place (local identity) is being affected by immigration, growth, and development.

Still, rural residents realize they cannot exist in isolation, and they need the services that urban areas provide. This trend results in a double-bind in which rural communities appear to be increasingly linked to urban centers for economic survival, yet the residents feel left out of the process of forming decisions for the future of their community. These ongoing changes are powerful, dynamic, unpredictable, and generally uncontrollable at the local level, and communities are left with the challenge of adapting as they can.

Increased immigration to rural regions is indirectly fostering increased restrictions on use of the land area, increasing regulation, and changing the character and quality of the rural landscape. Ecologically oriented newcomers may volunteer to serve on governmental agency task forces to bring their version of 'improvement' to an area.

8.2.2 Urban Values

Urban residents in Idaho tend to be more liberal and perceive themselves as more "environmentally-oriented" than their rural cousins, but they are comparatively conservative. Proposal for major environmental change in the region are likely to become very contentious.

8.2.3 Indian Values

The Indian people hold concepts that are quite different from those of most non-Indians. To the Indian people, the land is sacred in its own behalf, and the natural resources provide for the lifestyle and economy of the people. Indian tribes in the inland northwestern states used to migrate in a 'great circle' across the landscape, moving to river valleys in the winter and to mountains in the summer to follow the natural food cycle produced by the seasons (Clark, 1953). Indian people harvested the earth's abundance in each area produced by the seasons, the root crops and nuts in winter and spring, the berries in summer, the salmon, deer and elk in the fall, and stored food to survive through the cycle.

Each ecosystem held a valued and unique role in supporting the people at different stages of time. Thus, tribes now dedicate much of their treaty rights, including reserved water rights, to the protect and preserve natural resources and wildlife. These include instream flows to support the native fishery; rangelands to support deer, elk and buffalo; and preserves for wild food crops.

The Winters Doctrine, established in 1908, declared that Indian reservation lands set aside by treaty include a reservation of sufficient water to fulfill the purposes of reserving the lands. In recent years, Tribal reserved water rights have been quantified through negotiations that must be approved by Congress to become effective.

For many tribes, water is essential to economic and cultural survival. In water rights negotiations, tribes may seek to dedicate some of their reserved water rights to in-stream use in support of the native fishery. Water rights so defined would, when approved, enjoy state recognized and protected priority dates.

8.2.4 Tourism

The magnet that drew the original settlers a century ago now draws tourists who often import the urban conveniences and lifestyle to the rural countryside. Tourists often hold very different values from local people.

8.2.5 Recreationists

People who enjoy and use the abundant recreational resources are a key public of the Pacific Northwest. Four different types of meaning which recreationists attach to the recreational landscape have been identified:

- Scenic/Aesthetic - the value of the visual character of the land, the scenic purity and integrity, and the multiple themes within the landscape (mountains, valleys, deserts, rivers, forests, seasons, wildlife, wilderness experience, etc.).

- Use of the resources - the value of protecting and maintaining the privilege of access and use of the recreational resource.

- Cultural/Symbolic - the human, emotional, spiritual and symbolic identification with place that people attach to recreational resources, which may include a shared sense of impersonal ownership and possession (favorite mountains, rivers, campgrounds, ski resorts, etc.).

- Individual/Expressive - the highly individualized and personal meanings people attach to a place or activity, and that is part of their “sense of self” (the identity of being an outdoor type of person, a hiker, a skier, etc.). Recreationists can be very pro-active in protecting the privilege and their personal use of recreational resources.

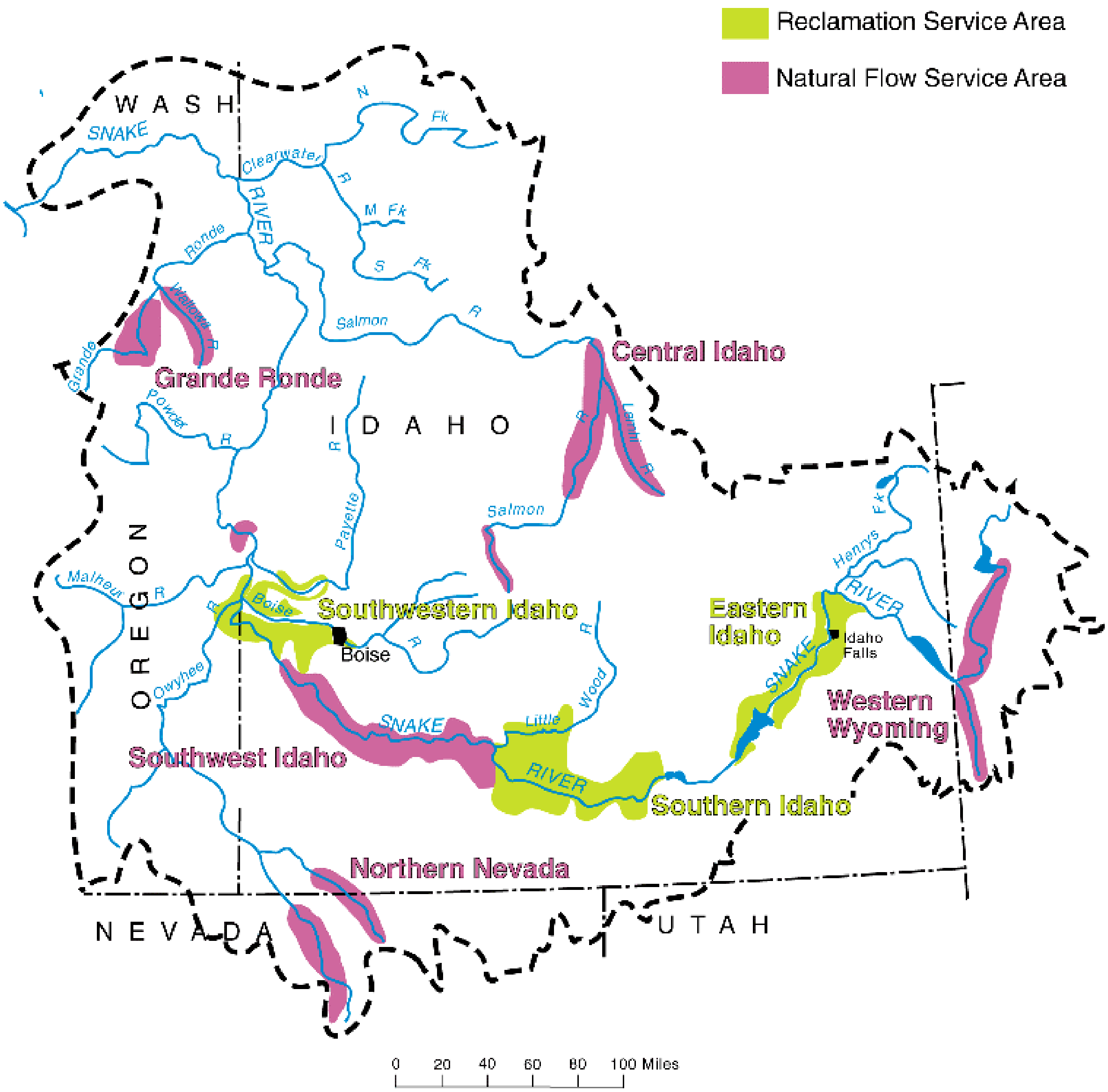
The meanings people attach to their recreational experience determine the quality of life for residents and visitors to the region. Recreationists tend to feel their land is something special to be treasured and protected, and are pro-active in supporting access and use of recreational opportunities.

8.3 Irrigation Service Areas

8.3.1 Affected Environment

Eight irrigation service areas were identified based on water supplies that could be impacted by one or more of the flow augmentation scenarios (see Snake River Basin Irrigation - Potential Impact Areas map). These irrigation service areas are not equivalent to the five irrigated agriculture economic regions (see figure 6-1) or the four functional economic regions (see figure 6-2) identified in chapter 6. Therefore, figures related to employment and economics identified in this chapter vary from that presented in chapter 6. The eight irrigation service areas are based on the water supplies used for flow augmentation in this analysis and defined primarily by irrigation service areas. All of the economic data presented in this chapter is based on that presented in chapter 6 but adapted and extracted to the eight irrigation service areas presented in this chapter.

Three of the irrigation service areas are Reclamation service areas, i.e., the lands receive at least a portion of their water from storage space in Reclamation reservoirs and that water supply would be reduced by the flow augmentation scenarios. Most of the lands in the Reclamation service areas also have natural flow water



SNAKE RIVER BASIN
IRRIGATION - POTENTIAL IMPACT AREAS

rights, which would not be affected by the flow augmentation scenarios. Five of the irrigation service areas are identified as natural flow right service areas indicating that all of the water rights used for irrigation are for diversion of natural flows. In these areas, a specific acreage of irrigated agriculture would be curtailed, and flows normally diverted to irrigate those lands would remain instream to provide a flow augmentation supply.

The reader is directed to the frontispiece map for geographic detail and to figures 6-1 for county designations used in the following descriptions.

Attachment I at the end of this report lists all of the communities in each of the eight irrigation service areas and provides information on the 1996 population, population growth, and economic diversity index. The definition of economic diversity and the general meaning to small communities is discussed. The economic diversity index is a summative index based on the diversity of industries within a community. Communities with only one industry (such as agriculture or timber resources) are inordinately affected by swings in the economic/market cycle, in that residents have few opportunities for alternative employment. Communities with several industries can tolerate economic swings with fewer adverse effects. Economic diversity scores in the range of -10 to +10 have been developed for Snake River basin communities. Higher positive scores represent greater economic diversity; -10 indicates a community that is totally dependent on agriculture.

8.3.1.1 Western Wyoming Irrigation Service Area

This natural flow irrigation service area consists of 90,000 acres along the upper Snake River in Lincoln and Teton Counties, Wyoming, extending from Moose Valley, Hoback Junction, Wyoming, on the Snake River (33,700 acres irrigated), and Freedom, Thayne, Grover, and Smoot in the Salt River Valley on the Idaho-Wyoming border (56,300 acres irrigated) (see figure 6-13). This natural flow service area constitutes about 15 percent of the farmland and 85 percent of the irrigated land in the two counties. The area is primarily a ranching based economy.

The two-county population is 27,500, and growing about 2 percent per year during this decade. The largest employment sector is Federal, State, county, and city government; USFS and National Park Service (Teton National Park and Yellowstone National Park) facilities are located in the area. Commerce within the region revolves around tourism, recreation, forest products, and agriculture (predominantly ranching), creating moderate levels of employment diversity. Economic diversity scores were developed only for Afton (-0.41) and Alpine (2.57)

A total of 613 farms exist within the two counties, farming 621,000 acres, and producing about $34 million for the regional economy. Approximately 470 farms with 106,000 acres total are irrigated in the counties; some acreage is irrigated from groundwater. Most of the farms are long established family operations, with 60 percent of the operators having farmed for 10 years or more. Over 37 percent of the farmers are over 60 years of age, with only 11 percent under age 35. Approximately 8 percent of farms are operated by tenant farmers. About 245 Lincoln and Teton County farmers hire about 945 farm workers/year (not including family members), with a payroll of $2 million.

8.3.1.2 Eastern Idaho Irrigation Service Area

This Reclamation irrigation service area consists of 396,000 acres (computed from Minidoka Project acreage) serviced by 49 water districts, extending along the Snake River from Rigby to American Falls, Idaho. Currently, about 4,830,000 acre-feet are diverted for irrigation in an average year. The service area is located predominantly within Bingham, Bonneville, and Power Counties, with small portions extending into Bannock and Jefferson Counties (see figure 6-13). The service area constitutes about 17 percent of the three-county area but about 70 percent of the irrigated acreage in the three-county area.

The population of the major three-county area is about 128,700 and has been growing at 2 percent per year during the 1990s. Twenty-six communities are located within the greater irrigation service area; 14 are under 1,000 in population, 4 are 1001-2500, and 8 communities are greater than 2,500 ranging up to 51,000 in size; the populations of 5 communities were not determined. Approximately 85 percent of the population lives in the four largest cities in the service area which are Idaho Falls, Blackfoot, Pocatello, and American Falls, Idaho. Seven small communities that are unincorporated serve primarily as residential areas for farm laborers.

Total employment in the five-county area is approximately 66,200 workers, and fairly diversified in employment when compared to other economic regions in the Pacific Northwest (economic diversification score is -0.67). The largest employment sectors in the region are Federal, State, county, and city government and education (about 14 percent). Idaho State University, the Idaho National Engineering and Environmental Laboratory (which employs some 10,000 workers), and food processing firms are located within the service area. Farm employment is about 3,400 workers (5 percent of total). Commerce within the region revolves around intensive agriculture, predominantly row crops (potatoes), grains, forage, and livestock. Food processing firms import about 20 percent of their production from neighboring regions, supporting additional workers.

There are approximately 2,349 farms within the three-county region, farming 2,260,000 acres. About 1,871 farms irrigate 564,000 acres within the counties. The average size irrigated farm is 305 acres. Irrigated agriculture adds about $409 million to the regional economy.

Over two-thirds of farmers in the region have farmed for 10 years or more, with 32 percent being more than 60 years of age. Only 12 percent of farmers are under age 35. Approximately 11 percent of farmers are tenant farmers. Over 1,195 farm operators hire over 9,800 employees (other than family members) in the three-county area, adding some $35 million to the local economy.

8.3.1.3 Southern Idaho Irrigation Service Area “The Magic Valley”

This Reclamation irrigation service area consists of 681,000 acres serviced by eight water districts, extending along the Snake River from Minidoka to Bliss, Idaho. In an average year, about 3,500,000 acre-feet are diverted for irrigation. The service area is located predominantly within Cassia, Gooding, Jerome, Lincoln, Minidoka, and Twin Falls Counties (see figure 6-13). The irrigation service area constitutes about 69 percent of irrigated acreage in the six-county area. The counties are aggregated to provide a profile of general characteristics.

Over 135,400 people live in the six-county area, which has been growing at the rate of 2 percent per year this decade. There are 42 communities located within the greater irrigation service area. Twenty-four of the communities are under 1,000 population, 4 between 1,001 and 2,500, and 9 cities over 2,500 (ranging up to 32,000 in population). Approximately 45 percent of the population live in the six largest cities in the service area, including Burley, Gooding, Heyburn, Rupert, Twin Falls, and, Shoshone, Idaho. Five communities within the service area are unincorporated, primarily serving as residential areas for farm laborers.

Total employment of the six-county areas is about 53,000 workers, with over 12,100 persons employed in agriculture (23 percent). The area is fairly diversified in employment when compared to other economic regions in the Pacific Northwest (economic diversification score is -0.05). This region employs a comparatively large number of Hispanics in the food processing industry, which dominates commerce in the region. Government and public education workers constitute about 18 percent of the workforce. Twin Falls Community College, USFS, and BLM facilities are located in the area. Commerce within the region revolves around intensive agriculture, (potatoes, sugar beets, legumes, grains, forage) and dairy and livestock operations. Food processing firms import about 20 percent of their production from neighboring regions, supporting additional workers in the area. The natural springs in the area support a significant trout aquaculture industry, which is expanding.

There are over 4,800 farms within the six-county area, farming 1,930,000 acres. About 4,113 farms irrigate 986,500 acres within the counties, some from groundwater pumping or natural flow diversion. The average size irrigated farm is 240 acres. Agriculture adds about $1 billion to the regional economy.

Over 57 percent of farmers in the region have farmed for 10 years or more, with 27 percent being more than 60 years of age. Only 13 percent of farmers are under age 35. Approximately 15 percent of farmers are tenant farmers. Over 2,300 farm operators hire over 16,000 employees (other than family members) in the six-county area, adding some $80 million to the local economy.

8.3.1.4 Southwest Idaho Irrigation Service Area

This natural flow irrigation service area consists of a 200-mile reach of the Snake River, and two tributaries, between Twin Falls and Weiser, Idaho, constituting about 150,000 acres. Most of this irrigation service area is located in Twin Falls (16 percent), Elmore (30 percent), Owyhee (30 percent), and Canyon Counties (16 percent) in Idaho. Small portions of the service area extend into Ada and Washington Counties in Idaho and into Malheur County in Oregon. About 24 percent of the irrigated lands in the four main counties is within this natural flow service area. Most of the land in the service area is irrigated by high-lift pumping (a lift greater than 300 feet). The cost of water delivery for this service area is relatively high (due to high pumping costs per acre) compared to other service areas, thus farmers are particularly vulnerable to market conditions.

Elmore and Owyhee Counties, where 60 percent of the natural flow area is located, are characterized by sparsely populated rangeland and public lands, with irrigated farms concentrated along the Snake and Boise Rivers. Seven communities are located within the service area. About 32,700 people live in the two-county area, which has been growing at the rate of 2 percent per year this decade. Approximately 44 percent of the population lives in the five towns of Glenns Ferry, Grandview, Homedale, Marsing, and Mountain Home, Idaho. The communities of the region are so widely dispersed that an economic diversity rating for the region was not developed.

Total employment of the two counties is 14,844 workers, with over 2,375 persons employed in agriculture. The largest employment sector in the south central Idaho region is Federal, State, county, and city government and education (42 percent). Mountain Home Air Force Base is the major employer for the region. Other commerce within the region revolves around intensive agriculture, (potatoes, sugar beets, legumes, grains, forage) and livestock operations. Agriculture adds about $362 million to the regional economy.

There are 846 farms within the two-county area, farming 1,105,560 acres. About 670 farms irrigate 175,500 acres within the counties, with an average size of 260 acres. The predominant crops are grains, potatoes, legumes, sugar beets, forage crops, and livestock.

Over 55 percent of farmers in the region have farmed for 10 years or more, with 31 percent being 60 years or older in age. Only 9 percent of farmers are under age 35. Approximately 15 percent of farmers are tenant farmers. About 375 farm operators hire over 5,000 employees (other than family members) in the two counties, adding some $20 million to the local economy.

8.3.1.5 Southwestern Idaho Irrigation Service Area "The Treasure Valley"

This Southwestern Idaho irrigation service area (which includes some lands in eastern Oregon) consists of 515,000 acres serviced by 28 water districts, extending from Melba, Boise, Weiser, and Homedale, Idaho, and Adrian, Vale, and Ontario, Oregon. In an average year, about 3,100,000 acre-feet are diverted for irrigation. The service area is located predominantly within Ada, Canyon, Gem, Payette, and Owyhee Counties in Idaho, and a portion of Malheur County, Oregon. This service area comprises about 85 percent of the 663,000 irrigated acres in the six-county area. The water districts of the Owyhee Project (Owyhee, Gem, and Ridgeview Irrigation Districts and Owyhee Ditch Company) have contracts for the largest amount of storage space in the area -- 715,000 acre-feet. The next largest amount of reservoir space, 615,000 acre-feet, is controlled by the Boise Project Board of Control which is composed of five irrigation districts. Black Canyon and Emmet Irrigation Districts control 303,000 acre-feet of space.

Forty-two communities and cities are located within the greater irrigation service area; most populated is the Boise urban area. Fifteen communities are under 1,000 population, 6 are 1,001-2,500, and 13 cities are over 2,500 ranging up to 152,000 residents. Eight communities are unincorporated, mostly in rural Owyhee County. The six-county population is about 432,000, is urban in character and has been growing 18 percent per year this decade. Approximately 53 percent of the population live in the six largest cities in the service area, including Boise, Nampa, Caldwell, Payette, and Weiser, Idaho and Ontario, Oregon.

Total employment within the region is 239,000 workers. The area is well diversified in employment when compared to other economic regions in the Pacific Northwest (economic diversification score is 0.84), primarily a product of manufacturing and processing industries in the area. Federal, State, county, and city government and education constitutes about 13 percent of the workforce, while agriculture employment is about 5 percent. Caldwell is a center for Hispanic employment in the State, supporting the major food processing industry. The State Capital of Idaho, Boise State University and several major nationwide corporations are located in the region. The latter include Albertsons, Boise Cascade, Hewlett-Packard, Micron Electronics, Zilog Technology, Morrison Knudson, and others. Other major industries include major regional food processing firms and manufacturing, such as Amalgamated Sugar, Ore-Ida, and J.R. Simplot.

There are about 5,887 farms on 3,040,360 acres within the six-county region, producing some $730 million for the regional economy. About 5,098 farms are irrigated, covering 633,560 acres. Commerce within the region revolves around intensive agriculture (orchards, potatoes, vegetable crops, sugar beets, legumes, grains, forage) and livestock operations. The average size of irrigated farms is 124 acres, which reflects the smaller more intensive orchard and vegetable crop operations in the area. Over 56 percent of the farms are operated by farmers who have farmed over 10 years; while 32 percent of farmers are over age 60, only 10 percent are under age 35. About 12 percent of farms are operated by tenant farmers.

Approximately 2,407 farms employ 28,000 workers, with a payroll of $69 million. The local agriculture supports considerable secondary food processing manufacturing and the regional economy.

8.3.1.6 Northern Nevada Irrigation Service Area (Owyhee River Basin)

This natural flow irrigation service area consists of 43,000 acres that receive natural flow diversions from the South Fork and the main stem (East Fork) Owyhee River on and adjacent to the Duck Valley Indian Reservation; 14,000 acres are located on the reservation. The service area is located within Elko County, Nevada, and extends northward into Owyhee County, Idaho and comprises about 48 percent of the irrigated land in Elko County.

Five small communities are located within the greater irrigation service area–Owyhee, Mountain City, Patsville, Wild Horse, and Riddle. The rural communities are stable in size, and primarily support local agriculture and the reservation. Alternative employment in the area is limited primarily to government and tourism sectors (fishing and hunting). The economic diversity of individual communities or the region as a whole was not estimated.

Approximately 360 farms exist within Elko County, providing some $51 million to the regional economy and reservation. About 235 farms on 126,700 acres are irrigated from stream diversions and groundwater pumping, producing forage for cattle and sheep operations on the adjacent rangeland. The forage produced on these farms is critical to support livestock operations in the surrounding uplands, which would also be affected by a reduction in water supply to the service area.

8.3.1.7 Central Idaho Irrigation Service Area (Salmon River Basin)

This natural flow irrigation service area consists of 127,000 acres in the Challis and Salmon, Idaho area. About 100,000 of those acres are along the main stem Salmon River and the remainder is along the Lemhi and Pahsimeroi Rivers. The area produces forage for support of cattle operations and is isolated geographically, with few cropping alternatives. The service area comprises all but a few thousand acres of the irrigated land in Custer and Lemhi Counties, Idaho, and also includes a few acres in Blaine County. This service area constitutes about 85 percent of the total irrigated acreage in the two counties.

Four communities are located within the greater irrigation service area–Baker, Carmen, Challis, and Salmon. The two-county population is 12,289 and growing about 3 percent per year this decade. The largest city in the area is Salmon with 3,270 residents.

The local economy is based upon agriculture and forestry (1,088 workers) and Federal, State, and county government (1,300 employees), and tourism. The economic diversity score for the region is 1.77, which reflects the alternative employment of the timber products sector. USFS and BLM facilities are located here; 93 percent of the land is forest and rangeland. Total employment for the two-county region is approximately 6,000 workers.

Approximately 600 farms operate on 334,600 acres within the two counties, producing over $33 million for the regional economy. Only 4 percent of the land area is usable for farming, producing grain, forage, and some potatoes. Some 508 of the 600 farms in the counties are irrigated, watering 129,000 acres. The average size of irrigated farms is 254 acres. The forage produced supports the livestock operations in the surrounding rangeland.

Over 60 percent of the farm operators have farmed for 10 years or more. About 36 percent of the farm operator are over 60 years age, and only 6 percent are under age 35. Approximately 10 percent of the operators are tenant farmers. Some 225 farm operators hire about 720 workers, adding a payroll of $2,760,000 to the local economy.

8.3.1.8 Grande Ronde Irrigation Service Area

This natural flow irrigation service area consists of 102,000 acres irrigated from natural flow diversions, extending from La Grande and Union, Oregon on the Grande Ronde River and Joseph to Minan, Oregon on the Wallowa River. The service area is located within Union and Wallowa, Counties, Oregon.

Fourteen communities are located within the greater irrigation service area. The two-county population is 31,750 but the population has fluctuated sharply in recent years, primarily affected by market trends in the forest products industry. Within the past 5 years, annual population growth has been about 2 percent per year. The largest city is LaGrande, with about 13,000 residents.

Total employment within Union and Wallowa counties is 13,900 workers. The largest employment sector is in Federal, State, county, and city government and education (about 47 percent). The agriculture sector constitutes 15 percent of total county employment (2,070 workers). Eastern Oregon University and the Umatilla and Wallowa Whitman National Forests are located in the area. Boise Cascade Company and several small manufacturers and agricultural processing firms service the area.

About 1,210 farms on 1,167,620 acres operate within the two counties, producing over $75 million for the regional economy. Commerce within the region revolves around intensive agriculture (legumes, grains, mint, and forage) in the LaGrande area and livestock operations in the Wallowa area. The economic diversity score for the region is +1.35, which reflects the presence of the timber products sector.

There are 619 farms irrigating 94,257 acres in the counties, with an average size of 152 acres. About 10 percent of the farms are operated by tenant farmers. About 34 percent of farmers are over age 60, and only 7 percent are under age 35. Some 420 farms employ over 2,000 workers in the counties, with a payroll of over $5 million.

8.3.2 Environmental Consequences

The impacts of the No Augmentation Scenario were not evaluated as the potential impacts are considered to be not measurably different from the Base Case.

The effects of the 1427i and 1427r scenarios on communities and individuals would be complex, varying according to the particular characteristics of individual farmers and communities. In many ways this action would be an experiment in itself, as there are no examples of this geographic scale or magnitude of water transfer ever having occurred in the United States. There have been some examples of smaller scale water transfers and programs. The 1427i and 1427r scenarios would have distinct impacts on the vitality and stability of rural communities and these impacts would result as much from the individual characteristics of the communities themselves as the specific changes in water use and recreation. Communities vary in their resilience to economic and social change, depending upon the nature and qualities of the employment base, the human capital and organizational capacity to make necessary changes in their communities, and the process through which the scenarios are implemented (timing, economic reallocation, mitigation, and institutional facilitation).

Communities whose economic livelihood is based on a single employment sector are sometimes known as ‘high risk’ communities (see attachment I). One standard defined in the literature specifies high risk communities with more than 20 percent of the population employed in a single economic employment sector, such as agriculture, forest products, or a single manufacturing firm. Communities with few employment sectors have limited occupational alternatives to which people can shift when economic conditions dictate change. Communities that are small, isolated, lack economic diversity, are dependent upon natural resources, and that have low leadership capacity are more likely to be “most at risk.”

The two kinds of irrigation service areas, Reclamation and natural flow, would likely be affected quite differently by the flow augmentation scenarios. To more efficiently collect information on potential effects on the large number of irrigation service areas, a case study was developed for one Reclamation irrigation service area (Southern Idaho) and one natural flow service area (Grande Ronde). This information was then used as the basis for effects common to other irrigation service areas of the same kind. Additional information was then developed to identify effects that would be unique to specific irrigation service areas.

To collect information, a limited number of knowledgeable people in the two case study areas were contacted to identify and assess the impacts of the sale of water rights and the corresponding changes that would occur in rural communities. In addition, a few knowledgeable people in all other service areas were contacted to help identify conditions unique to specific areas. Irrigation district managers and board members, County Extension agents, Natural Resources Conservation Service staff, and others were selected and contacted by telephone during November, 1998.

Reclamation irrigation service areas would be affected to different degrees by the 1427i and 1427r because of the amount of water acquired and the operation of the reservoirs would be different for the two scenarios (see chapters 4 and 6). In contrast, the effects on the natural flow areas would be the same under either the 1427i or 1427r scenario because irrigation would be curtailed on the same amount of acreage under each scenario. As a result, the discussion of effects on irrigation service areas compares or contrasts the two scenarios in discussions of the Reclamation irrigation service areas but does not do so for the natural flow irrigation service areas.

A key factor in how farmers, ranchers, and other water users would respond to a flow augmentation program is the purchase of water rights. Potential implementation issues and water purchase plans remain at a conceptual level (see chapter 9). Assuming that a water purchase plan were implemented, many water users would like to see a program that would still allow the seller to irrigate some lands. These ideas include selling water rights that are not used, selling floodwater rights (available only during the highflow period in the spring), and selling natural flow or storage water rights and then developing wells to continue irrigating. Others would like to sell their water rights and then subdivide their land for residential and business use.

None of the above actions would be acceptable for purchase of water rights for flow augmentation, particularly for dry years. Rights not being used, with rare exception, would not be eligible for sale because the question of forfeiture for non-use would likely arise during any transfer proceeding. Flood rights are not reliable and would not be good candidates for flow augmentation purchase. Replacement of surface water rights with pumping goundwater for irrigation would not be viable candidates for flow augmentation purchase because of interactions between surface water and groundwater. In some areas the additional groundwater pumping would unacceptably impact other domestic wells and irrigation water supplies. Subdivided land would likely use municipal water supplies, most often groundwater, and require as much water as cropped land. In any purchase for flow augmentation, the net effect of groundwater and surface water outflow at Lower Granite Lake would be a key analysis parameter.

A viable program for water acquisition of natural flow rights must require that the lands from which the water is acquired remain dry (not irrigated) for the duration of the water acquisition. Irrigation of the lands with alternative water sources would not reduce total consumptive use, defeating the purpose of water accusation. In contrast, acquisitions of storage space would not necessitate that lands be left dry, but would require that the total the water supply available to irrigation be reduced by the amount of water acquisition. This could be accomplished by decreasing the total irrigated acreage (some lands left dry), switching to less water intensive crops, or taking the risk of an inadequate water during drought years.

This discussion of effects on irrigation service areas is separated into two parts (1) Reclamation irrigation service areas and (2) natural flow irrigation service areas. Each part provides (1) an overview of effects likely to be felt by all irrigation service areas within the category (Reclamation or natural flow), and (2) a discussion of effect specific to each irrigation service area within the category. A final part of the irrigation service area effects is a compilation of perceived attitudes and opinions toward the flow augmentation scenarios.

8.3.2.1 Reclamation Irrigation Service Areas

There are three Reclamation irrigation service areas: Eastern Idaho, Southern Idaho, and Southwestern Idaho. Of these, Eastern Idaho would experience only minor impacts under the 1427i and 1427r scenarios. The other two service areas would experience impacts primarily associated with loss of insurance water (water needed during drought years) under the 1427i scenario. The 1427r scenario would lead to significant impacts in the Southern Idaho and Southwestern Idaho service areas, with the Southern Idaho area experiencing the greatest impacts.

8.3.2.1.1 Impacts Across Reclamation Irrigation Service Areas

Findings regarding the Reclamation Service areas, based on the hydrologic studies, economic studies, and discussions with key individuals, include the following:

- Boards of directors, not individuals, make decisions regarding water sales, and they are not inclined to provide any more water for instream flows.

- Program implementation may be difficult due to the following attitudes and beliefs held by irrigators:
  - Water should not be permanently separated from the land.
  - Additional flows would not help the salmon.
  - The Federal Government, Indian tribes, and environmentalists are unlikely to be satisfied with any specific flow augmentation.

- Many of the farms in well established irrigation areas are owned and operated by multi-generation farming families. These families tend to have strong ties to the land and the community and would likely be unwilling to take any action, such as selling water supplies, that would endanger their present lifestyle.

- Social costs of the program would likely exceed current estimates, especially if a flow augmentation program is implemented over a short time period.

- The total amount of the purchased water would not likely show up in the Snake River (due to theft, evaporation, miscalculations, errors in diversions, etc.).

- The majority of employment impacts would be felt by farm laborers and local agri-businesses. In southern Idaho, a typical 500-acre farm in southern Idaho employs two hired men. Agriculture-related businesses such as suppliers, processors, and others in a specific region would employ about as many laborers as the region farmers. The people most likely to be affected would be low-income, temporary workers, with few alternative employment opportunities. Impacts would likely be greatest in isolated communities.

- The 1427r scenario would have much more negative impacts than the 1427i scenario.

- Impacts of the 1427i and 1427r scenarios could be severe during an extended period of drought.

- The Southern Idaho irrigation service area would be the most heavily impacted Reclamation irrigation service area under both scenarios, followed by the Southwestern Idaho irrigation service area.

- Under the 1427i scenario:

    - Much of the acquired water might come from irrigators who have "insurance water" that protects them against shortages during dry years. These dry years occur infrequently, on an average of 1 in 7 years, but they can be costly when they occur in successive years. In average years, around 1 percent or less of lands would be taken out of production, but in dry years, about 5 percent would be taken out of production.
    - Depending on the water acquisition program and how districts and irrigators would choose to spread risks and costs, all of the irrigation water supply for some individuals might be removed and the irrigation curtailed on those lands
    - Lands in production and average year cropping patterns would remain about the same.
    - During extended drought periods, more jobs, businesses, and farms would be lost.
    - During periods of drought, farmers would shift to less water-intensive crops and more lands would be taken out of production.
    - Demographic effects would not be significant unless there was an extended period of drought.
    - Tax impacts on rural communities would be relatively minor.
    - Quality of life would remain mostly unchanged unless an extended period of drought were experienced.

- Under the 1427r scenario:

    - The insurance water now relied on for protection against drought years would be acquired for flow augmentation, and water delivery to more lands would be permanently curtailed. In some areas with good natural flow rights farmers might continue farming by converting to crops that do not need late season water, e.g., grains and grass for pasture, and cutting hay only once in good years. In some areas natural precipitation and natural flow rights are insufficient to support grain crops.
    - A significant amount of lands would permanently be taken out of production. As much as 13 percent of irrigation service area lands would be taken out of production in average years, and as much as 24 percent of lands would be taken out in dry years in local areas.
    - Some lands would be abandoned and some farmers would likely leave the area.
    - Agricultural businesses would decline, and some would go out of business. The decline in agriculture would spread to the rest of the rural economy.
    - There would be a significant effect on demographics. In some areas, much of the farm labor population would move away. Opportunities for younger members of farm families would be

reduced, and many of them would migrate from the area. Many mid-sized farmers, perceived by some to be the heart of the agricultural community, may sell out and leave. Young farmers would leave the area for other employment, taking their young families with them. Older farmers would tend to retire earlier and more would tend to retire out of the area.

- Impacts on taxes and service would be significant and costs of services, e.g., Aid to Families with Dependent Children, unemployment compensation, and health and police departments would go up.
- Many rural communities would become less viable with reductions in population, tax base, services, and infrastructure, but most small communities would survive with a reduced economic base and population.
- The character of many communities and rural areas would be changed.
- Quality of life would significantly degrade in many areas.
- Social conflict among farmers would increase, especially during the transition period while the program was being implemented.
- Lifestyles for some would change, some would no longer be farmers, some would be forced to abandon a rural life style.

8.3.2.1.2 Eastern Idaho Irrigation Service Area

Under the 1427i scenario, the Eastern Idaho irrigation service area, in average years, would receive about 20,000 acre-feet less than under the Base Case. About 2,000 acres would be taken out of production in an average year and 9,000 acres would be taken out of production in a dry year.

Under the 1427r scenario, the Eastern Idaho irrigation service area in average years would receive somewhat less water than the Base Case. About 1,000 acres would be taken out of production in an average year and 11,000 acres would be out of production in a dry year.

The overall effect of the 1427i and 1427r scenarios would be negligible on income with most of the effect in the livestock and crop production sectors. Income from crop production for the region would decrease 2-4 percent.

Individuals may be interested in participating in a water purchase program. Some individuals would sell part of their acreage to developers and use the proceeds to restore the viability of their farming operations. Some individuals who are at risk of forced liquidation because they can’t service their debt may get out of the farming business while they can still protect their equity. Small ditch companies serving a few farms might consider selling. All of these individuals might consider selling water rights for the same reasons that they sell land.

Many irrigators in the Eastern Idaho service area have more senior natural flow rights than irrigators downstream. Therefore many could sell all or part of their storage supplies and continue to irrigate with privately held water rights and grow less water-intensive crops. Some of the lands in the foothills could be satisfactorily dry farmed without any irrigation–mostly wheat with summer fallow. Some lands could be placed into the CRP program. Many individuals today can make as much putting land into the CRP program, given today’s depressed prices, as they can make by continuing to farm it.

Most young people who have left farming in recent years have remained in the area and work in agri-business such as grain companies, potato processing plants, etc. Those who leave farming through retirement also tend to stay in the area. Some farmers whose water right was acquired would retain part of the farmstead to live on, while others would move to town. Some older people would lease their land and live off the equity.

Downturns in agriculture are buffered somewhat in eastern Idaho by a diversification in the economy that includes large food products processing firms, the Idaho National Engineering and Environmental Laboratory west of Idaho Falls, and a large mining industry. However, many of the communities such as Aberdeen and Springfield are highly dependent on agriculture and would experience greater proportional impacts from water sales in that area.

Unlike the other Reclamation service areas, the Eastern Idaho area is made up of a few large water districts and many small ones. Although the impacts of the scenarios on the service area as a whole are fairly small, impacts might tend to be concentrated if the water acquisition program were focused on a few small areas. This could have a significant negative effect selected farmers.

There are a number of small ditch companies in the Eastern Idaho service area. Unlike irrigation districts, an individual selling out of a ditch company is usually not responsible for continuing to pay operation and maintenance costs. This would often put a burden on the remaining members of the organization.

8.3.2.1.3 Southern Idaho Irrigation Service Area

In an average year, the Southern Idaho irrigation service area would receive, compared to the Base Case, about 50,000 acre-feet less under the 1427i scenario and about 440,000 acre-feet less under the 1427r scenario.

Under the 1427i scenario, 8,000 acres would be taken out of production in an average year and 74,000 acres would be taken out of production in an extremely dry year. Under the 1427r scenario, a significantly greater acreage would be taken out of production, 88,000 acres in an average year and 290,000 acres in a dry year. Most of this land would be used for dryland grazing, but some would be abandoned.

The economy of the Southern Idaho service area is about 65 percent dependent on agricultural production, the highest proportion in the state. Water users are concerned that under the 1427i scenario some agricultural processors might withdraw from the area due to loss of irrigated land to sustain a reliable crop rotation and increased uncertainty. They believe that fewer potatoes would be produced in the area. Potato growers have talked about buying a processing plant, and they might do so to avoid some adverse impacts. Losses in processing and potato production would impact equipment and other agricultural services.

The 1427i scenario would have major negative effects on the economy. Impacts would pervade the entire area, but might be most concentrated near small agricultural communities with tight budgets. Counties and communities could handle 10 percent impacts given enough time to absorb impacts on schools, fire departments, etc. However, the 1427r scenario would produce much more severe impacts during average years and impacts would be even worse during periods of extended drought.

Of the districts in the area, only the Minidoka Irrigation District and the Burley Irrigation District (BID) have large supplies of insurance water. In an average year, they could give up 200,000 acre-feet and still have an adequate supply. Minidoka Irrigation District might willingly sell some water. BID put some water into the rental pool in 1991 and ran out of water in 1992. Due largely to significant frustrations of BID patrons as a result of that experience, BID has not rented water since 1991 and would not likely be willing to sell water.

A few districts, or parts of districts, in the Southern Idaho irrigation service area have fairly good natural flow rights; most do not. With acquisition of storage water for flow augmentation, some individuals with better natural flow rights would continue to farm, using their water on less intensive crops such as grains. Many individuals with junior rights might be able to grow nothing more than grass pasture. Some would try winter wheat, but it's unlikely that it would be profitable with so little moisture.

Communities like Gooding, Hazelton, Kimberly, and Jerome that have been built around service to agriculture and have little diversification would be more heavily impacted under the 1427r scenario. Smaller, less diversified communities such as Acequia and Declo could receive even greater impacts.

8.3.2.1.4 Southwestern Idaho

In an average year, this service area would receive about 50,000 acre-feet less under the 1427i scenario and about 260,000 acre-feet less under the 1427r scenario compared to the Base Case.

Under the 1427i scenario, 9,000 acres would be taken out of production in an average year, and 52,000 acres would be taken out of production in an extremely dry year. Under the 1427r scenario, 49,000 acres would be lost in an average year and 111,000 acres would be taken out of production in a dry year.

Most of the land taken out of production under the 1427i and 1427r scenarios would be planted to grass and pastured where possible, but some land would be abandoned. Rural property away from urban growth areas would have little remaining value without water. A few acres on the fringe of the irrigation service area, e.g., north of Middleton and Notus, have been abandoned in recent years and reverted back to desert. Other fringe lands could be abandoned under the 1427r scenario as some areas are too sandy and too dry to grow even mountain grasses if storage water were removed.

Because of agriculture's much smaller contribution to the economy of the Southwestern Idaho, compared to the rest of the state, the overall impacts of even the 1427r scenario would not be great. However, the more rural areas and counties would be impacted under the 1427r scenario.

Southwestern Idaho is a rapidly growing, rapidly urbanizing area. Individuals living close to city limits are likely candidates to sell their water, especially those living on smaller parcels and those nearing retirement.

Farmers with marginal land would be candidates for water sales. For example, there are as many as 25,000 acres of marginal lands across the Owyhee, Ridgeview, and Gem Irrigation Districts. Some of this land is farmed by people who make their primary living in town and work their land as a hobby.

One district official reported that his district would permit individuals to sell their water rights so long as the district operation and maintenance fees on their lands and any additional district costs resulting from the sale were covered. Some districts, such as the Nampa-Meridian which runs through the heart of the Boise Valley urban area, allow people to buy out of the district if there is no way to get water to their property. The districts are now supplying closed-pipe system water to subdivisions to avoid buy-outs.

Some semi-retired people might leave the area. In many areas people are working in town and living in the country, and they would continue to do so with or without their water.

Many rural communities that are near rapidly urbanizing areas might change in character as a result of the 1427r scenario, but would likely stay viable. Some of the less diversified communities such as Greenleaf, Notus, and Parma might have significant problems if water shortages were concentrated in their area.

Farmers in several areas would likely experience a variety of water problems under the 1427r scenario. For example, removing irrigation water from lands would reduce aquifer recharge and reduce return flows in some areas. In recent drought years, individuals in some areas have had to drill new domestic wells. Reduced irrigation would lead to similar effects. Downstream users tend to have more water than upstream users during drought years due to irrigation returnflows. That would happen less frequently with greatly reduced water applications under the 1427r scenario.

Rural/urban conflicts would be greater, especially under the 1427r scenario with farmland likely being subdivided at a greater pace unless provisions in water acquisitions stipulated that the use of M&I water on those lands would not be allowed.

8.3.2.2 Natural Flow Irrigation Service Areas

There are five natural flow service areas: Western Wyoming, Southwest Idaho, Northern Nevada, Central Idaho, and Grande Ronde. Natural flow irrigation water users gravity divert and/or pump their own water supply from the natural flows of the river. Western Wyoming, Northern Nevada, and Central Idaho areas are relatively isolated ranching areas. The Grande Ronde area contains one valley that is primarily ranching and one valley is row cropped. The Southwest Idaho natural flow area is predominantly a high-lift pump area that has high-value crops. These natural flow irrigation service areas contain a large number of individual farm operators that operate independently. The operators hold their own water rights, which are attached to the land. Some farms may be owned by corporations, but the majority are family farming units. All of these areas would be heavily impacted by the scenarios with land taken out of production ranging from 25-56 percent of the irrigated acreage.

There would be no difference between of the 1427i and 1427r scenarios in the natural flow areas. Water rights would be purchased on a voluntary basis and the water would be committed to flow augmentation in support of salmon migration in the lower Snake River system. All the water would be removed from 221,500 acres within the Snake River basin. This would require a major reorganization of agriculture in twelve counties. Program implementation would require changes in state law in Idaho and Nevada which do not currently allow the transfer of water from irrigation to instream flows.

8.3.2.2.1 Impacts Across Natural Flow Irrigation Service Areas

Many of the conclusions with regard to the Reclamation irrigation service areas also apply to the natural flow irrigation service areas but are repeated here for clarity. The conclusion for natural flow irrigation service areas, based on the hydrologic studies, economic studies, and discussions with key individuals, include:

- Program implementation would be difficult due to the following attitudes and beliefs held by irrigators:
  - Water should not be permanently separated from the land.
  - Additional flows would not help the salmon.
  - The Federal Government, Indian tribes, and environmentalists are unlikely to be satisfied with any specific flow augmentation.

- Many of the farms in well established irrigation areas are owned and operated by multi-generation farming families. These families tend to have strong ties to the land and the community and would likely be unwilling to take any action, such as selling water supplies, that would endanger their present lifestyle.

- The total amount of purchased water would not show up in the Snake River, unless there is aggressive water rights enforcement.

- All the identified natural flow irrigation service areas would be significantly impacted.

- Reduced irrigation production on 25-50 percent of the lands of the service areas would adversely affect the economic base of those areas.

- Lands with curtailed irrigation would likely result in the following:

  - Cattle ranching lands in fairly wet areas would likely be leased or purchased by neighbors who would continue cattle operations on those lands which would support lower numbers of cattle.
  - Crop lands in fairly wet areas would likely be dry farmed, while crop lands in dry areas would likely revert to native vegetation which would support limited grazing.

- Some sellers of water rights might take town jobs or leave the community, while some of the long-term residents would likely stay on the land or in the community.

- Social costs (all of the negative effects to communities, families, and individuals) of the program would likely exceed current estimates, especially if a flow augmentation program is implemented over a short time period.

- A significant share of funds from the sale of water rights would probably not stay in the area. Farmers and ranchers would probably use funds to first service debts. Those sellers that left the community would take the funds with them.

- Suppliers, processors, and virtually all agricultural businesses would be negatively impacted with some agri-businesses closing. The downturn in the agricultural sector would flow to other economic sectors. Hardest hit would be small businesses in remote areas.
- A significant number of jobs (3-6 percent) in local areas, as opposed to larger regions, would be lost. The majority of employment impacts would be felt by farm laborers and local agri-

businesses. The hardest hit would be farm and ranch workers, including many seasonal employees, and teenagers who would normally help out in farming and ranching operations. Job losses could range from 20-50 percent of the farm work force in isolated areas. Cutbacks in agriculture would impact local retailers and other non-agricultural businesses. The most impacted people are likely to be low-income, temporary workers, with few alternative employment opportunities.

- Demographic impacts would vary, but most areas would lose some population. Opportunities for younger members of farm families would be reduced and many of these young people would move out of the area. Older farmers would tend to retire earlier and more would tend to retire out of the area. Much of the farm labor population would move from the area.

- Many rural communities would become less viable due to reductions in the population base, the tax base, services, and the infrastructure.

- Tax impacts of large scale reduction of irrigated agriculture would be significant. Services such as schools, hospitals, nursing homes, police and fire protection would be reduced, but the demands and costs for some services such as Aid to Families with Dependent Children, unemployment compensation, health services, and police protection would increase.

- Conflict among water users would increase, especially during the transition period while the program was being implemented.

- The quality and character of rural life in all service areas would be irreversibly changed. Lesser educated and older residents would be most affected.

- Family stability, security, and functionality would change with extended families dispersing and younger members unable to farm or remain in the area due reduced employment opportunities.

- Lifestyle would change for many individuals.

8.3.2.2.2 Western Wyoming Irrigation Service Area

Under the flow augmentation scenarios, water rights would be removed from 30,000 acres, about one third of the service area.

It's unlikely that much water would be sold in Teton County. Much of the land is held by prosperous families who intend to either keep their land as working ranches or protect the land as unsubdivided open space. The aesthetics of the Jackson area would be negatively impacted if water were taken off these lands and they no longer operated as working ranches. The most likely purchasable water rights would be the few working ranches near Alpine and the owners of the dairy and cattle operations along the Salt River (Star Valley). Much of this area is comprised of third and fourth generation families (Heritage Farms) who tend to have very strong feelings about keeping land and water together and would be very unlikely to sell to the Federal government.

Most of the curtailed irrigation acreage would be located in Lincoln County in Star Valley and most of that valley has been converted to sprinklers in recent years, increasing infrastructure investment and debt loads. There is considerable subdivision pressure in the area because of the attraction of the city of Jackson and the national parks. The prospects for subdividing the land would significantly raise the cost of the appurtenant water rights. Some of the dairy operations in that valley might continue and survive by importing feed. Other lands would be bought or leased by neighbors to provide feed for cattle.

Because of strong family ties, some sellers would retire and stay in the area. Younger people who didn't try to stay on dairy farms would likely move due to lack of opportunities. A few individuals would stay and help work lands that were acquired or leased by neighboring operations.

The local economic impacts associated with removing production on up to 50 percent of the irrigated lands in Lincoln County would be significant. Suppliers, processors, and other agricultural businesses in neighboring counties would be negatively impacted.

Out of a base of 12,000 jobs, 200-300 jobs would be lost. The hardest hit would be farm workers (presently about 900 workers), including many seasonal employees, and teenagers who would normally help out in farming and ranching operations. Much of the job loss would be concentrated in the sparsely-populated Star Valley area.

Removing the water rights from the land and taking that land out of irrigated agricultural production would greatly reduce Lincoln County's tax base. The few acres losing water in Teton County would have little impact on that county's economic base.

Star Valley would likely lose population, unless some of the agricultural loss could be made up through gains in recreation subdivisions and by other means. There would be fewer opportunities for young people (especially in family agricultural enterprises), and more young people would leave. Some older residents would likely leave the area earlier than they might otherwise have done.

8.3.2.2.3 Southwest Idaho Irrigation Service Area

Water rights would be removed from 68,000 acres, about 45 percent of the Southwest Idaho natural flow service area.

The majority of the area is in family farms, but there are significant corporate interests as well. Development of these lands started in the 1950's when both power and land were cheap, and farmers started developing desert lands in the area. Most of this development involved high lifts of around 300 feet out of the Snake River. Power rates have become more expensive and commodity prices are currently quite low. When the land was first opened up, the virgin soil was an outstanding medium for growing potatoes and tremendous yields were realized in the early years. Now, production and crop values have declined, and increasingly, other less-profitable crops must be planted in a crop rotation pattern. Some of the smaller farmers with operations averaging 300-400 acres are having the most difficulty and might be among the first to sell.

The farms in this area are among the best candidates for a water purchase program. Much of the land would likely go back to desert, some of it sustaining limited spring and fall cattle and sheep grazing. Weeds would almost certainly be a problem on much of the dry land, exacerbating an already major problem with weed infestation in the area.

Most of the present owners would likely move off the land, some choosing to leave farming while others (including corporations) would set up farming operations elsewhere.
This irrigation service area is the largest potato growing area in southwest Idaho and is also a major producer of sugar beets. Reducing the irrigated acreage by one-half with an accompanying reduction in crop production would be felt throughout the irrigation service area. Suppliers, processors, and virtually all agricultural businesses would be negatively impacted.

The economies of Owyhee and Elmore counties would be significantly impacted. These are sparsely populated rural counties with agriculture making up a large amount of the economic base. More than 70 percent of Elmore County's agricultural production comes from the farms in this service area.

Job losses would range from 600 to 1,200 jobs; farm workers would suffer the greatest losses. Many of these would be permanent workers living on farms and in nearby communities and many are Hispanic. Much of the job loss would hit the small rural communities the hardest, making it hard for many businesses to survive.

Dramatically reducing the value of 68,000 acres of irrigated agricultural land by removing the water would create a considerable decrease in assessed valuations. The majority of that loss in revenues would be felt in Elmore and Owyhee counties, the two most rural and sparsely populated counties in the service area. This would likely result in a noticeable increase in taxes and fees to county residents as well as a reduction in services.

Population numbers would decline dramatically in some areas. Once the water was taken off much of the land, there would be little to keep people in the area. Much of the economic and social cost would be born by the Hispanic community. The communities of Bruneau and Grandview, among the poorest in the state, and Glenns Ferry would be hard hit because irrigated agriculture along the Snake River forms a large part of their economic base. These communities have been declining in population in recent years. Many of the farm laborers who would lose their jobs live in these communities. Recent efforts to restore these communities would be set back. The loss of jobs, and population would put pressure on schools, churches, and other community institutions. Most of the other communities in the service area are close enough to land irrigated from other sources that they might not be as greatly impacted.

8.3.2.2.4 Northern Nevada Irrigation Service Area

It is assumed that most, if not all, of the water rights purchased (from 14,000 acres) would be from lands in the South Fork of the Owyhee River.

There is some non-tribal land on the East Fork above Wildhorse Reservoir, but most of the non-Indian land is on the South Fork which is a very isolated area. Most of the land in the Independence Valley headwaters is held by about a half-dozen families who have been in the area since the turn of the century. Below Independence Valley, most of the land is in large holdings operated by a few corporations. Recently, mining companies have bought several ranches in Elko County and use part of the water rights for milling operations while continuing to irrigate most of the land and continuing ranching operations. Larger landowners might consider selling water from a wetland portion or areas that are sub-irrigated. If the assumptions of the flow augmentation scenarios are to be realized, virtually everyone in the area would have to sell their water rights.

After curtailment of irrigation, lands above the floodplain would transition back to native conditions with shrub overstory and bunch grass understory within 3-4 years. These lands would provide some limited grazing potential. Some lower lands would produce one cutting of hay and some fall pasture. Production would be uneven since this area is subject to long periods of drought that can extend for periods of 6-8 years. Forage production would be expected to drop by as much as 90 percent on lands from which irrigation water was removed. Most of the lands from which water was removed would likely be used for dry land grazing.

Individuals or corporations who sell only a portion of their water right would likely stay in the area. If families sold their entire water right, they would likely move out of the area. Corporations selling their entire water rights would likely develop similar operations elsewhere. Their lands would most likely be leased or sold to the remaining large ranches or corporations.

Many of the sellers would probably leave the area, taking most of their proceeds from the water sales with them. Only a portion of the proceeds received by those who stayed would remain in the local economy. Between 100 and 300 jobs would be lost. The hardest hit would be agricultural workers, including many seasonal employees.

Virtually all of the trade in the area is centered in Elko, and that's where most of the local impacts to agricultural and other businesses would occur. However, Elko is large enough and sufficiently diversified that it would not be greatly impacted. There would be some impact on Elko County's tax base as a result of removing about 16 percent of the county's irrigated acres, but the effects would not be of a great enough magnitude to significantly impact services.

Some agri-business impacts would be experienced in the Twin Falls and Boise areas in Idaho.

With the loss of 40 percent or more of the production from the lands, many of the South Fork residents would likely leave. Most of those remaining would be tied to the few large cattle operations left behind. There would most likely be a shift from family ranches to larger entities.

The largest town in the natural flow irrigation service area is Tuscarora which is not much more than a post office.

Several of the multi-generation ranching families in the service area would move, breaking ties. Lifestyles would change for some individuals. Some would no longer be farmers, and others would be forced to move to urban areas to find employment, abandoning at least some elements of a rural lifestyle.

8.3.2.2.5 Central Idaho Irrigation Service Area

Under the 1427i and 1427r scenarios, water rights would be removed from 71,500 acres, about 56 percent of the irrigation service area. The most likely sellers would be older people who are retiring and widows or others who inherit ranches and have no family members interested in taking over. Owners whose ranches aren't making enough money (usually the smaller ones) could also be candidates. Many of these ranches might be in the higher valleys of the Pahsimeroi and Lemhi Rivers.

Most of the land would revert to high desert and might be leased or purchased by neighboring ranchers and grazed, producing about 1 animal unit month per 7 acres. It's unlikely that much additional feed would be imported to support current livestock numbers. Livestock numbers would likely be reduced in proportion to the reduction in feed supply. Some parcels might be subdivided.

Younger ranchers who sold would likely leave the area and ranch somewhere else. Some older ranchers would leave, but others would retire and stay in the area. A few sellers may try to maintain their present operations by importing feed.

Beef cow/calf agriculture accounts for over 90 percent of gross agricultural income in the area. Of the available feed in the area, 71 percent is produced on private lands with over 90 percent on irrigated lands. Removing most of the production from these irrigated lands would lead to a reduction in beef cattle revenue of about $13 million annually. Household earnings would drop about $8 million annually, and employment would be reduced by 400 jobs out of a base of 6000. Much of this job loss would be to the present base of 720 agricultural workers. Most of the job loss would occur in Salmon (220 jobs). About 70 jobs would be lost in the Challis area, 40 in the Pahsimeroi, and 60 in the Tendoy-Leadore area. Two of the three farm supply businesses would likely go out of business, resulting in less competitive prices.

The next nearest trade centers, Missoula and Idaho Falls, are about 150 miles away. Salmon, the largest trade center in the area would see an earnings loss of 6 percent, a job loss of 10 percent, and a loss of 48 percent of the jobs in the farming sector.

If flow augmentation is realized, 70 percent or more of the water rights might be sold out of the less productive upper Lemhi and Pahsimeroi valleys. Taking that much production out of those areas could greatly impact the local communities. Much of the social life of the Pahsimeroi Valley is built around the little school at Patterson. That school would likely close. The one-room school at Tendoy would also likely close. All the businesses in Leadore would suffer major losses of clientele and a number of them would likely close. The entire landscape and character of these upper valley communities would change as ranches closed down, families left, and schools and businesses closed. The Salmon and Challis communities would suffer less impact because much of Challis' economic base is built around mining. Salmon is sufficiently large and diversified that even though it would suffer the greatest loss in employment and income, it would not be as greatly impacted as the smaller communities in the area.

The tax bases of Lemhi and Custer County would be decreased considerably with up to a 90 percent devaluation of over half of the irrigated land. This would put a greater burden on the remaining tax base and lead to the reduction of some services.

Many individuals would have a reduction in income or change in employment. Some would need to leave the area to find work. Many of those who stayed in the upper valleys would find themselves living in a different kind of community with fewer people, fewer services and weakened institutions.

8.3.2.2.6 Grande Ronde Irrigation Service Area

Water rights would be removed from 37,000 acres of the 102,000 acres in this natural flow irrigation service area.

There is an especially great deal of resistance to separating water from the land in this area. The first water rights to come on the market would likely be the ones that are not being used, followed by floodwater rights that are only good during the first part of the summer. Some individuals in the Grande Ronde Valley are interested in converting to wells and would consider selling their surface right if a conversion to groundwater were possible. None of these water rights would be acceptable for flow augmentation as discussed earlier in this section. Rights not being used, with rare exception, would not be eligible for sale because avoid the question of forfeiture for non-use would be difficult during a transfer proceeding. Floodwater rights might be subject to purchase but are not reliable in dry years and would not be good candidates for flow augmentation purchase. Surface water rights replaced with goundwater supplies would ultimately result in no net gain to the lower river and would not be viable candidates for flow augmentation purchase.

Some older people who are retiring, especially those with no family interested in continuing the operation, would consider selling. Some who have very marginal land might be willing sellers. Other candidates would be individuals whose entire land holdings are marginal financially, and not providing a sufficient return to cover the debt load. Individuals who might be interested in converting from full-time farming to hobby-farming by getting an off-farm job might also be candidates. In the Wallowa Valley wealthy individuals from outside the valley are the most likely to be new purchasers of land, because most locals can not afford the high land values. Frequently these new immigrants do not stay long. Their lack of strong local ties, and turnover make them candidates for potential water right sales.

Although there is almost no interest in permanently removing water from the land, area ranchers (especially in the Wallowa Valley) have been innovative in exploring lease options, and have leased water to support instream flows.

The primary rural land use in the Wallowa area is cattle ranching. Without water the land would go from yielding two cuttings of hay and fall aftermath to one cutting of hay. Some individuals would try for a while to buy lost hay production either locally or by importing. Others would simply cut back on the number of cattle run on the land. Many would like to subdivide and there is a big market for rural lots, but current Oregon land use laws limit opportunities for subdivision of farmland.

The Grande Ronde Valley is primarily row-cropped with many specialty crops and high value seed crops. If possible most water sellers would sink wells and continue to irrigate. This could probably be done in about 20 percent of the basin that sets over a very deep basalt aquifer. Several wells in this area have artesian pressure, bringing the deep water almost to the surface. A conversion from surface to groundwater irrigation in these areas would likely have no adverse impacts on local streamflows; and in some areas the irrigation return flows may increase river streamflows. The effects of converting to groundwater by tapping the 200-foot deep alluvial aquifer are much less certain since that aquifer is likely connected to the river. It is unlikely that the sale of natural flow water rights by converting to groundwater, even in a deep aquifer, would be acceptable for flow augmentation purchase. Those individuals who were prohibited from converting to irrigation with groundwater or chose not to could dry farm the land themselves or lease it to a neighbor.

In the Grande Ronde Valley most sellers would stay on the land dryfarming or irrigating with wells, unless they were of retirement age. If they had a large debt load they would likely sell the land. The question is more uncertain in the Wallowa Valley, in that some individuals might take town jobs if they were available. A large purchase program would likely have a depressing effect on the regional economy, making the prospect of alternative enterprises less likely. Many sellers in the Wallowa Valley might leave the valley, leasing or selling the dryland to their former neighbors or for ‘hobby farm’ development.

The impacts associated with greatly reducing production would be considerable. Suppliers, processors, and virtually all agricultural businesses would be negatively impacted. Reductions in agricultural businesses would lead to reductions in other businesses throughout the economy. Locals feel that the majority of the proceeds from water sales would be lost to the local economy.

Out of a total of 14,000 jobs, employment is estimated to decrease by 500-700 jobs, but most locals feel losses would be greater. The hardest hit would be farm workers, including many seasonal employees, and teenagers who normally help out in farming and ranching operations.

With the reduction in economic activity in the area, it would be more difficult to attract new investment, and more difficult to finance present operations. With more of the area depending upon dryland farming, incomes would fluctuate more depending upon weather cycles.

Taxes paid on those lands taken out of production would be reduced by about 75 percent. The reduced tax base would result in reduced services at schools, hospitals, police and fire protection, less road maintenance, etc. Fees would be created or increased to cover many services putting a greater burden on the non-agricultural community. Oregon has tax and land use laws that would prevent more traditional sources of revenue such as subdividing farm ground and raising property taxes beyond specified limits.

Population growth in the Grande Ronde valley would continue to fluctuate, dependent upon other natural resource and commercial employment which tend to change in accordance with regional economic cycles. The area may continue to experience some in-migration as industrial development slowly expands in the area, but the loss of a considerable amount of agricultural production and related job and income loss would hamper growth. Some of the Hispanic laborers who commute from the Ontario area would likely be displaced, and some non-resident aliens would have to find seasonal work elsewhere. Some older residents would likely leave the area earlier than they might have otherwise done. The greatest risk of population loss would be in the Wallowa Valley since its economic base is so greatly tied to agriculture. There would be fewer opportunities for young people and more of them would migrate out of the area. Residents are concerned that neighbors would move away and some "quality" people important to the health of the community would leave while others would be discouraged from coming to the area.

A water purchase program is certain to generate conflict. A recent proposal to federally fund a conservation project in the Wallowa subbasin that would have benefitted local irrigators and improved local fish habitat was seen by many as a federal intrusion and "water grab" and was bitterly opposed. Any federal government effort to remove water from agriculture and take it outside the basin would be very contentious and would almost certainly create a strong and cohesive local opposition. Locals who supported the program would be ostracized. After irrigation rights were converted to instream rights, there would be additional conflict. Irrigation patterns, especially those built around rotation and sharing of neighbors' water would be impacted. Keeping part of the rotation in the stream for instream flows would frustrate the seller's neighbors and would likely increase the difficulty of obtaining a full water supply that may depend on irrigation returnflows of the seller. Another threat to the supplies of other irrigators is the likelihood of decreased late-season flows resulting from reduced recharge of aquifers when irrigation water is removed. If these aquifers are not recharged with irrigation water, late-season streamflows are likely to be reduced.

Residents tend to feel that a water purchase program would negatively impact quality of life in their community due to conflicts over water sales, layoffs of agricultural workers, potentially reduce opportunity to rent or lease farmland, decrease local commerce, and decrease the counties' ability to provide social services to the rural population. Residents feel that family relationships would be affected with both older members and younger members less likely to remain in the community. They feel they would lose quality people from the basin, and be less likely to attract new ones. They feel that they need to add more diversity and stability to their community to remain viable, but perceive that a purchase program would lead to less diversity and more instability. County revenues would decrease, decreasing services and putting pressure on other delivery systems, including their schools and hospitals. In general residents see a large water purchase program impacting virtually every aspect of their lives, and perceive that most of those impacts would be negative.

Grande Ronde and Wallowa irrigators have been proactive in supporting the Grande Ronde Watershed Program, which seeks to restore salmon habitat in the Grande Ronde basin. Even though streamflows are critical for both salmon habitat and agriculture, irrigators are seeking to accommodate the needs of the fish. Some landowners have agreed to lease water for instream flows, and others are willing to adjust irrigation withdrawals to minimize adverse fishery impacts. It is unclear how a water purchase program would affect the salmon in the Grand Ronde system as compared to Snake River migration, but it is conceivable that such a program could set back one of the strongest salmon recovery programs in the region. Conflicts over water purchases have recently set back efforts in the Wallowa subbasin to simulate freshets in the Lostine River. Conflicts over a much greater purchase program and its impacts on irrigation (perceived or otherwise) could have considerable dampening effects on local salmon restoration efforts. Some residents who have been working hard to restore salmon runs feel that many people would resent a program imposed from the outside and would see that as a signal that local efforts had been of little utility.

The Confederated Tribes of the Umatilla Indian Reservation and the Nez Perce Tribe have made formal commitments to protecting and enhancing the salmon fisheries of the Grande Ronde River basin, in support of their treaty rights. They have been active in restoring anadromous fishery habitat throughout the region. It is not clear what impacts a water purchase program would have on salmon habitat in the Grande Ronde subbasin (ceded territory of the Umatilla Tribes) and the Wallowa subbasin (ceded territory of the Nez Perce Tribe). Late summer flows might increase in some areas and decrease in others. It is likely that some salmon habitat would be degraded by higher stream temperatures resulting from reduced groundwater flows.

8.3.2.3 Summary of Issues Expressed by Water Users and Others

The issues and views expressed by those contacted on potential effects the 1427i and 1427r scenarios are summarized below. Many of the same or similar issues views expressed were by both those associated with Reclamation irrigation service areas and those associated with natural flow irrigation service areas. These issues and views are listed first. The following notation is printed at the end of each item and is used to indicate the source of the issue or view:

(R)	Reclamation irrigation service area
(N)	Natural flow irrigation service area

- *Irreversibility.* Few people are willing to permanently separate water from the land.**(R)(N)**

- *Viability.* It is difficult to conceive that the identified water supplies could be made available for flow augmentation on a voluntary basis, even with compensation based on full market value.**(R)(N)**

- *Impact on Natural Flows.* There are major concerns over the impacts on aquifers, springs, and return flows from reducing irrigation.**(R)**

- *Economic Impacts.* There is a fear that economic impacts would be greater than estimated,**(R)(N)** especially given a series of dry years.**(N)**

- *Tax Base.* County tax bases would be reduced greatly as a result of devaluing lands from which water had been removed.**(R)(N)**

- *Community Viability.* There is a concern over impacts on rural communities, many of which are already stressed.**(R)(N)**

- *Equity.*

  - There are concerns that communities and individuals least able to cope with impacts would be hit the worst.**(R)(N)**

- There is the perception that a few Snake River subbasins would receive crippling impacts, while other subbasins would remain untouched.**(N)**
- There is the view that much more water would be taken from natural flow areas than from Reclamation project areas.**(N)**

- *Timing.* Rapid implementation of flow augmentation would be a shock to communities, if implemented more slowly, communities would have time to adjust.**(R)(N)**

- *Institutional Constraints.*

  - Individuals can't sell water out of irrigation districts or canal companies. Irrigation water can't be transferred to instream use in Idaho.**(R)**
  - Water law in some states may not permit purchased water to be protected for instream flows or transferred to instream use across state boundaries.**(N)**

- *Future Guarantees.* Water users are afraid to lease or sell part of their water rights until they're certain that their remaining supplies would be protected.**(R)**

- *Effectiveness of flow augmentation.* Flow augmentation won't work. The 427,000 acre-feet currently dedicated to flow augmentation hasn't benefitted the salmon, and there's no evidence that additional water would help.**(R)**

- *Enforceability.* Some question whether current water purchase agreements are being enforced and suggest that the problem of enforceability would be much greater with a large purchase program.**(R)**

- *Abandoned Lands.* Crops could not be grown on many of the lands in the Snake River basin with natural flows. There is a concern that lands would be abandoned and become a source of dust, weeds, pests, and disease threatening neighboring lands.**(R)**

- *Impacts on other water users.***(N)**

  - Would the old water right be left in the stream? If the full right were protected in the stream, other users couldn't get their water. Only the consumptive use of the old water right should be protected.
  - Return flows are a critical source of water for many water users. If these flows are reduced or eliminated other water users would be affected (likely without compensation).

- *Impact magnitude.* The size and concentration of the program in a few areas would change the whole character of rural communities.**(N)**

- *Program constraints/limiting impacts.* There is a need to limit the amount of water that could be taken out of basins, and the amount of water that could be taken out of any given area within a basin.**(N)**

- *Flow increases.* Some or much of the purchased water may not show up in the river**.(N)**

8.4 Recreation

Reclamation identified reservoirs and river reaches for recreation in its SR^3 process. For this analysis 11 reservoirs and river reaches were selected for analysis of potential effects of the flow augmentation scenarios on recreation. Table 7-17 in chapter 7 summarizes the river reaches including recreation activities, agency designations and unique features. Chapter 7 also provides a short description for each reservoir and river reach. Additional information on these selected reservoirs and river reaches is provided in this section.

Millions of people use the Snake River system for recreational purposes in one form or another, and feel an intimate and personal sense of ownership for their favorite lake, river reach, or camping site. Idaho and Wyoming have achieved an international reputation for exceptional scenery, whitewater rafting, trout and salmon fishery, and pristine camping sites, and any change in their quality would affect both local and visiting recreational users.

Use of recreational resources in the Snake River basin has been increasing steadily each year, with many facilities becoming destination sites for out-of-state visitors. Both visitors and residents expend about 3 million visitor-days per year enjoying Idaho water resources; this total does not reflect the use of winter sports, commercial facilities, and sporting events. Water-based recreation in the Snake River basin contributes an amount in excess of $180 million/year to state economies.

Reservoirs provide significant recreational opportunities, including boating, fishing, water skiing, sailing, camping, picnicking, viewing, and other activities. Reservoirs that are located near urban areas receive significantly greater use than remotely located reservoirs and river reaches near urban areas. River reaches are used for fishing, boating, float boating, camping, and wildlife uses.

8.4.1 Affected Environment

See chapter 7 for a discussion of recreation.

8.4.2 Environmental Consequences

Analysis of the effects of flow augmentation on recreation focused on two high impact areas: (1) the Snake River from Jackson Lake, Wyoming to Idaho Falls, Idaho and (2) Cascade Reservoir and the Payette River downstream to Banks, Idaho. These two areas would experience the most significant change in lake levels and river flows under the flow augmentation scenarios.

In November 1998, agency management and staff (NPS, USFS, BLM, IDPR, IDFG, etc.), representatives of the local Chamber of Commerce, and local outfitters and guides familiar with the recreational areas were contacted. The No Augmentation scenario was considered to be indistinguishable from the Base Case, so discussions were limited to the 1427i and 1427r scenarios. Information on riverflows and reservoir elevations under the Base Case, 1427i, and 1427r scenarios was provided in telephone contacts.

Based on the interviews, four general perceptions and reactions to possible change in reservoir and river flow levels became apparent:

- Implementation of the 1427i or the 1427r would degrade the overall quality of recreational opportunity on a long term basis in the Snake River basin. Effects of either scenario would not be equally distributed geographically or among user groups. The 1427i scenario would have much greater adverse impacts on recreational opportunities than the 1427r scenario.

- Relatively small changes in flow augmentation within a region could have profound effects at the community level and on personal livelihood. The greatest effects would be found on selected sub-populations and user sub-groups.

- There is considerable variability among persons and groups in perception of potential effects of the flow augmentation scenarios. These perceptions depend on the particular circumstances, experiences, recreational activities, and preferences of each person. For example, river kayakers may be relatively unconcerned with possible changes in reservoir levels or reservoir fisheries.

- Recreational activities are often antithetical, in that river flow conditions that might be good for whitewater rafters can be devastating to trout fly fishermen. Thus, change in lake levels and river flows can be expected to be variously perceived as good or detrimental, with no absolute standard.

8.4.2.1 Snake River From Jackson Lake to Idaho Falls

Although respondents gave different evaluations of the effects, depending to some degree on their particular focus on recreational use, there was general concurrence on the following:

- This section of the Snake River system is subject to considerable fluctuation in flow during a single water year and throughout the years. Although the 1427r and 1427i scenarios would have significant effects on local recreational use of the reservoirs and rivers, the induced impact of implementing either scenario would be less than the variation in natural flow and water levels in most months of the year and within most years. Impacts on streamflows would be most adverse in the months of September and October.

- The predominant river recreational use of this section of the Snake River is floating, fishing, and camping. Reduction of riverflows below Jackson Lake during February and increases in riverflows during March would not significantly affect recreational use of the river at that time since primary use of the river does not begin until early May.

- The peak period of river use is May through October, declining sharply after Labor Day. High riverflows under the 1427i scenario would potentially reduce opportunities for floatboating on some reaches in June and July. Some kayaking is done on selected reaches below Jackson Lake; this activity might be enhanced by high streamflows.

- There is concern that in-stream habitat for the native trout might be adversely affected by high riverflows in the spring and lower than normal flows in late fall. Low streamflows may significantly degrade fly fishing quality in September and October.

- Change in riverflows would probably cause commercial outfitters and guides to rebuild their marketing and operations pattern for the summer months, possibly affecting income.

- There is a steady (about 5-10 percent per year) increase in the development of both year-round and summer homes along the section of the Snake River and in the Jackson Lake and the Palisades Reservoir areas. Residents are primarily attracted to the area by the quality of recreational opportunities. A change in quality would affect property values and growth rate along riverbank areas.

- The predominant recreational use of Palisades Reservoir is motorized boating. Motorized boat users appear to be adaptable and would adjust to changes in water levels that would affect dates of use. The impact of reservoir levels upon boating is expected to be minimal unless there is an adverse impact on fish populations.

- Water sports at Jackson Lake is directly dependent on water levels. Under the 1427i scenario, early and extended drawdown might beach the marina, limit use of the reservoir for water sports, and degrade the outstanding scenic quality for which this area is known. Beaching the marina would significantly affect the local economy during July through September

- Commercial recreational use of this section of the Snake River and reservoirs has developed a national and international clientele, which supports the regional economy. Any reduction in recreational use would have immediate negative effects on income to local businesses.

8.4.2.2 Cascade Reservoir and Payette River to Banks, Idaho

Based on based on the hydrologic studies, economic studies, and discussions with key individuals, the flow augmentation scenarios would be expected to have the following impacts:

- Commercial recreational use of Cascade Reservoir and the Payette River downstream of Cascade Reservoir serves a major urban population and has become a national and international attraction. Most recreational commerce is conducted in the four months between June - October. Any change in recreational opportunity would have immediate negative effects on local income.

- The local recreational economy in the Cascade Reservoir area is growing rapidly and is a primary source of revenue to the area. Summer home development is increasing at more than 10 percent per year and upgrading in value. Recreational use visits usually span several days but some visits may last the entire summer. A reduction in water levels under the 1427i scenario could cause a 30-50 percent reduction in the pace of local development and a downturn in the local economy.

- The main attraction of the reservoir is boating and fishing. Reservoir use is directly linked to water levels, with low levels beaching boat docks and creating mud flats. A marina is planned for the year 2000. The 1427i scenario could threaten recreation income.

- Fishing quality in Cascade Reservoir is directly affected by water level and quality. Low water levels during winter can result in fish kills. Low water levels in the summer tend to foster high water temperatures during mid-summer, negatively affecting fish propagation. There is a major effort by local governments to control algae growth and contamination by phosphates. Early drawdown of the reservoir under the 1427i scenario would likely adversely affect water quality and fish productivity and reduce recreation use and associated income.

- The predominant river recreational uses of the Payette River are floating, kayaking of international renown, fishing, and camping. Some reaches have Class 4 & 5 rapids during spring flows. The peak period of use is May through September, declining sharply after Labor Day. Changes in streamflow would directly affect floatboating operations and could limit use to the highly experienced and reduce commercial floatboating income.

- Low lake levels may increase stream temperatures downstream of Cascade Reservoir and degrade stream habit quality used by native trout. Reduction in fish population could reduce general recreation quality and use and negatively affect incomes dependent on recreation.

- Lower riverflows in September and October may significantly degrade fishing quality on the Payette River.

8.4.3 Issues Expressed by Community Members

The issues and views expressed by those contacted about the potential effects of the 1427i and 1427r scenarios are summarized below. Many of the issues and views were expressed by both those associated with the Wyoming area and those associated with the Cascade Reservoir area. Issues and views expressed by both groups are placed at the beginning of the list below. The following notation is printed at the end of each item and is used to indicate the source of the issue or view:

(S) Snake River reach from Jackson Lake to Idaho Falls, Idaho.
(C) Cascade Reservoir and the Payette River downstream.

- *Regionalism*. Residents and recreational users should not have to endure the costs and inconveniences of flow augmentation for the benefit of interest groups in other states.**(S)(C)**

- *Cost/Benefit.* There is a belief that the flow augmentation action is not justified by the costs, local or regional.**(S)(C)**

- *Loss of value/income*. There is a general belief that compensation would be appropriate for recreational homeowners loss of property value, employment losses, or income losses to commercial outfitters that would be caused by flow augmentation scenarios.**(S)(C)**

- *Research.* There may not be sufficient research and information to justify the flow augmentation action.**(S)(C)**

- *Role of Government*. The Federal Government should not impose new requirements on state and local governments in this action.**(S)(C)**

- *Species Protection*. Native trout habitat in Wyoming should not be degraded to protect salmon in Idaho.**(S)**

- *Degradation of Environmental Quality.*

  - Snake River native and cold-water fish species, fishing quality, and water quality (reservoir and river) should be protected from the potential adverse flow augmentation actions.**(S)**
  - Flow augmentation would cause additional pollution problems that could negatively affect native and cold-water fish species, fishing quality, and water quality (reservoir and river).**(C)**

8.5 Environmental Justice

Consideration of environmental justice in water resource planning documents is required by the 1994 Executive Order 12989. Environmental justice refers to the potential for disproportionate impacts to minority and/or low income populations. The executive order defines environmental justice as follows:

> "The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences from industrial, municipal and commercial operations or the execution of federal, state, local and tribal programs, and policies."

8.5.1 Affected Environment

Minority and low-income populations in the Snake River basin are primarily Hispanic and Native American populations and others who may be involved in farm labor pools including migrant workers. Most farm laborers are in comparatively stable families, with most workers residing in the area. About one-third of the farm labor workforce is migrant, working mostly during the peak summer months of April through October.
The majority of farm laborers are Hispanics. Although minority farm workers are found in all regions, the largest numbers are employed in the Magic Valley (Twin Falls area) and the Treasure Valley (Boise, Idaho to Ontario, Oregon and Weiser, Idaho area). Minority population in Idaho are Hispanic (7 percent), Native American (1.3 percent), Asian (1 percent) and African-American (0.5 percent). The minority work force in Idaho ranges from 7,500 workers in the winter months to 17,500 workers in the peak harvest season. Most work at irrigating and harvesting food crops and orchards or in the agricultural processing firms located within the region.

The greatest concentrations of Native Americans in the area of analysis reside on the Fort Hall Indian Reservation located along the main stem Snake River and the Duck Valley Indian Reservation located along the Owyhee River. The Nez Perce Tribe, with a reservation in northern Idaho, and the Confederated Tribes of the Umatilla Indian Reservation in northeast Oregon are outside the geographic area of this analysis but have treaty rights and some ceded lands lie within analysis area (Grande Ronde River basin, Salmon River basin, and Payette River basin).

Native American and Hispanic communities in the basin rely heavily on the agricultural economies of their communities for their livelihoods. Both groups contribute to the local economies through purchases, providing services, and by conducting and supporting cultural events.

8.5.2 Environmental Consequences

The impact of the flow augmentation scenarios is primarily on the irrigated agriculture and recreation sectors of the economy and secondary industries related to these sectors. Economic effects of any magnitude tend to filter down and affect those at the lowest economic levels the first and perhaps to the greatest extent. Part-time and minority farm workers tend to be the most vulnerable to economic adversity, as they are the last to be hired and the first to be laid off when market conditions change. Workers in small remote communities with limited employment diversity are the most vulnerable, as there are few employment alternatives. These groups are also most likely to suffer declines in the quality of life from shifts in economic adversity and are least likely to benefit from subsidy or mitigation actions. Job retraining programs are often not productive for residents in remote communities as there is often no alternative job careers even if there is retraining.

The 1427i and the 1427r scenarios would have negative economic impacts that would filter down to part-time and minorities farm workers and workers in associated industries. Minority workers in industries not associated with crops, crop production, and agricultural support industries would not generally be affected by the flow augmentation scenarios. None of the scenarios target minority or low-income populations, nor can flow augmentation goals be achieved without economic effects filtering down to these groups.

9 Implementation Issues and Concerns

Acquisition of water from the upper Snake River basin for use in the lower Snake River to augment flows for salmon migration poses a number of problems for the residents of the area, the states, tribes, and the Federal government. Chapters 5-8 discuss major resource, economic, and other effects that could occur if the 1427i and 1427r scenarios identified in this analysis were implemented. This chapter focuses mainly on the socio-economic and state water law based concerns and issues. There are separate ESA, National Environmental Policy Act (NEPA), CWA, and Wild and Scenic River Act related concerns that are largely matters of federal purview that would also need to be addressed. Since this document is prepared under the auspices of Federal law, and will serve to implement a Federal decision (albeit with strong input from states, tribes, and the general public), the Federal law based conflicts are assumed to be resolvable in the Federal government's implementation actions. Consequently, this chapter does not address in any detail the Federal law based issues.

It is recognized at the outset that there is a range of legal theories and opinions, each supported by legal analysis, as to the interplay among the Reclamation Act as amended, the ESA, tribal treaties, and state water law. The summary discussion in this chapter does not fully identify all of the nuances of the various legal theories involved. This chapter is an attempt to address the relatively narrow issues associated with local implementation of a program to provide a total of 1,427,000 acre-feet for flow augmentation. It is not intended to portray the legal position of any party.

The current flow augmentation program, which provides 427,000 acre-feet, has been implemented for the most part without the enthusiasm of state officials or Idaho water users. Acquisition of water for the current program follows the principle of acquiring water only from willing sellers and, after 4 years, has managed to permanently acquire approximately 78,000 acre-feet of storage space and natural flow rights. Rental pools and other sources provide the remaining volume. More importantly, this acquisition and delivery program is based upon the cooperative interplay of Federal statutes mandating salmon recovery and state laws establishing state control of water within their borders. The State of Oregon has granted a formal transfer for the use of 17,650 acre-feet of natural flow rights acquired by Reclamation. In addition, Reclamation has obtained interim permission, through an Idaho statute, to acquire and release water allowing the use of the water for downstream flow augmentation. That statute, however, expires on January 1, 2000.

Basin reservoirs have been operated in a manner that has sought to balance competing interests. Such operations naturally create controversy among local interests because of the competing needs for a limited resource. Irrigators, hydropower producers and consumers, reservoir boaters, river floaters, reservoir and river anglers, campers, and others all value the same water resources for their specific objectives and advocate reservoir operation changes to benefit their particular interests. Each of these competing interests are critical of current operations, and resist changes that they perceive diminish the resources they value.

Major questions that need to be addressed in evaluating the acceptability of flow augmentation include the following:

- Would flow augmentation improve salmon and steelhead populations?
- If flow augmentation would improve populations, would flow augmentation be the most cost effective and efficient means?
- What would be the total cost to acquire the volume of water?
- Who would provide the funds, how much, and how soon?
- What would be involved in acquiring the water, and how soon could it be provided?
- Would the states agree to a plan?
- What would the Federal government do if the states or local interests do not agree?

As a contrast to the scenarios analyzed in this document, it is important to note that the current Columbia River flow augmentation is provided from storage space under the exclusive control of Reclamation and the Corps in reservoirs of the FCRPS. Impacts to reservoir fisheries, recreation, and other resources occur, but normal Columbia River flows are of such magnitude that existing water rights holders are not impacted by the Columbia River flow augmentation program.

There is insufficient storage space in the Snake River basin under Reclamation's and the Corps' exclusive control to provide a large amount of water for flow augmentation without significant impacts to natural resources, recreation, and economic sectors. The current 427,000 acre-feet can be provided only through strong reliance on rental pools. Providing larger amounts of water would require the reallocation of existing water rights and/or contract entitlements held by irrigation entities in Idaho and Oregon and, perhaps, in Wyoming and Nevada.

9.1 State Water Law

The Western States obtained ownership of streams and control of the water within each state upon admission to the United States. Section 8 of the Reclamation Act of 1902 recognizes this principle by requiring that the acquisition and use of water for Reclamation projects be governed by state law, unless preempted by Federal law. Section 8 (32 Stat. 390; 43 U.S.C. §§ 372, 383) states:

> "Nothing in this act shall be construed as affecting or intended to affect or to in any way interfere with the laws of any State or Territory relating to the control, appropriation, use, or distribution of water used in irrigation, or any vested right acquired thereunder, and the Secretary of the Interior, in carrying out the provisions of this act, shall proceed in conformity with such laws, and nothing herein shall in any way affect any right of any State or of the Federal government or any landowner, appropriator, or user of water in, to, or from any interstate stream or the waters thereof: *Provided*, That the right to the use of water acquired under the provisions of this act shall be appurtenant to the land irrigated and beneficial use shall be the basis, the measure, and the limit of the right."

Reclamation storage and release of water for project purposes has complied with state water law.

State laws regulate the acquisition and the use of water and limit the use of water to beneficial purposes as determined by the state. Water rights are secured in accordance with state water law, and water rights granted by the state are defined in terms of the type of water use, the period of use, the source of water, the location of the point of diversion and place of use, and the rate and total volume that may be diverted, if applicable (some rights do not involve a diversion). Any changes in water use from those described in the water right definition must generally be authorized by the state through an approval of a transfer of water right. Reclamation has secured changes in purpose of use of Oregon natural flow rights and secured interim Idaho legislation approving the use of stored water for flow augmentation.

Watermasters in Idaho and Oregon oversee the local diversion and use of water to assure compliance with water rights of record. These activities tend to be more intense for those stream segments or basins where there is insufficient water to meet all valid water rights. In these cases, the watermasters regulate the diversion of water to assure that the available water supply is distributed to valid rights of record in accord with the prior appropriation doctrine.

Having worked very hard together during the last several years to meet flow augmentation requirements in accordance with state water laws, Reclamation and the states have charted a course away from the contentious issue of potential preemption of state law. Rather than devote precious resources to legal wrangling over the interplay of explicit congressional directives regarding salmon recovery and the 1902 Reclamation Act's Section 8 waiver of sovereign immunity, the states and Reclamation have developed mechanisms to meet flow augmentation needs through state law. Rather than spending energy and staff time responding to water user claims of 5th Amendment takings of private property, Reclamation has worked with water users to develop and consummate sales and rentals of water rights and storage contract entitlements for flow augmentation on a willing seller basis. In return, a state law based scheme to provide flow augmentation has meant that local watermasters are available to assist Reclamation in determining release rates, to account for water released for flow augmentation, and to track flows downstream to assure that the flow augmentation releases are protected from hostile diversion. It remains to be seen whether state cooperation would be forthcoming to meet future flow augmentation needs.

9.2 State Opposition to Flow Augmentation

Flow augmentation to date has been highly contentious. Many State officials, legislators, and water interests begrudgingly cooperated with Reclamation efforts to secure Idaho legislation to approve and protect the release of 427,000 acre-feet for flow augmentation.

Transfers in purpose of use of a water right would first be addressed by the IDWR, to determine the beneficial nature of the new use and assure that other water right holders, junior or senior, are not harmed by the transfer. Idaho law also requires that transfers involving more than 50 cfs or 5,000 acre-feet must be expressly approved by the State Legislature. Discussions with a variety of Idaho governmental and water user interests indicate that a call for 1,427,000 acre-feet for flow augmentation would be considered unacceptable to Idaho and would be strenuously opposed at all levels. It is reasonable to assume, as far as Idaho is concerned, that a flow augmentation commitment of 1,427,000 acre-feet could not be willingly accomplished under the umbrella of State water law.

Idaho opposition to flow augmentation would come not just from irrigation water users. Boise, Twin Falls, Idaho Falls, and other Idaho communities are experiencing significant growth. The Boise valley, for example, is experiencing unprecedented groundwater shortages. United Water Company, which serves the city of Boise, is undertaking an innovative program to acquire irrigation water supplies in order to meet near-term demands for municipal water from additional surface supplies. Potato processors in southern Idaho pump from the declining SRPA which would be negatively impacted by both the 1427i and 1427r scenarios. In addition, minimum reservoir elevations sustain highly valued recreation areas.

Riverflows downstream of key Reclamation reservoirs have served to sustain premier fisheries. The reductions in established reservoir pools and streamflows would impact significant portions of the nonagricultural public. The "local public interest" must be taken into account by the Director of the IDWR in deciding on changes of use, and the local public is likely to strongly oppose potentially detrimental changes in current streamflows and reservoir elevations.

Maintenance of target reservoir elevations and streamflows downstream of key Reclamation dams are integral components to protect water quality. In most cases, the cost of meeting water quality standards with reduced reservoir elevations or streamflows would be very high. For example, one estimate of additional annual water treatment costs that might be incurred to remove increased metal contaminants was between $20-$40 million for the city of Boise alone (Sommers, 1998). The present value of the added cost would be between $60-$120 million.

Oregon involvement in flow augmentation has been in the form of the approval of a change of use associated with natural flow rights along the Malheur and Snake Rivers. This action was accomplished without serious challenge from local water right holders. However, a call for 1,427,000 acre-feet of flow augmentation would require change of use for considerable volumes of Oregon water held in Reclamation reservoirs. Local water right holders could be expected to strenuously oppose such action and the State would be expected to protect other water right holders, junior and senior, from harm as a result of water right changes.

Wyoming has participated in flow augmentation efforts to date only to the extent that storage releases from Jackson Lake have been used to help provide the current 427,000 acre-feet of flow augmentation. In briefings on this analysis of additional flow augmentation, Wyoming officials expressed grave concerns over any efforts to acquire water supplies from Wyoming water users. The Idaho-Wyoming Snake River compact provides that Wyoming may use 4 percent of the flows of the upper Snake River; the remaining 96 percent is allocated to Idaho. A significant use of the Snake River in Wyoming is for recreation at Jackson Lake and on the Snake River downstream. The difficulties in securing changes of use and protection of water in Wyoming would probably be no more imposing than similar efforts would be in Idaho or Oregon. However, the relatively small area of the Snake River basin that lies within Wyoming argues against attempting to acquire any amount of the limited supply of water from Wyoming.

Nevada has not participated in flow augmentation efforts to date. When being briefed on this additional flow analysis, Nevada officials expressed serious concerns about the use of any Nevada water for flow augmentation. Nevada has critical water supply problems. Its allocation of the Colorado River is small in comparison with that of other Colorado River Basin states, and rapidly expanding municipalities, such as Las Vegas and Reno, are in short supply. Snake River basin water has not been considered for use outside the local basin, however, because of local conditions, including the ongoing negotiations to settle the water rights of the Duck Valley Indian Reservation. Securing changes of use and protecting water in Nevada would probably be no more imposing than for similar actions in Idaho or Oregon. However, like Wyoming, the small area of the Snake River basin in the state argues against attempting to acquire any Nevada water.

9.3 Methods of Acquiring Water

The two obvious ways to implement a flow augmentation program are by administrative action and through specific Federal legislation.

9.3.1 Administrative Action

Reclamation has provided 427,000 acre-feet of flow augmentation as an administrative action. The extent of Reclamation's authority was considered in 1995 during development of the BIOP and Reclamation's ensuing ROD. Reclamation concluded that 427,000 acre-feet could be provided as a reasonable and prudent alternative. However, providing 427,000 acre-feet would eliminate most, if not, all of the system flexibility. If not for current system flexibility and careful management, resource and recreation uses would suffer unacceptable impacts under the 427,000 acre-feet operation. Larger volumes were specifically considered, but were not selected.

This analysis reveals that Reclamation can provide 427,000 acre-feet about 82 percent of the time with the resources currently available, including reacquired storage space and acquired natural flow rights. Limited additional water supplies can be acquired under Reclamation's existing authorities to provide increased reliability of providing the 427,000 acre-feet.

This analysis reveals that providing an additional 1 MAF can only be accomplished by imposing never before experienced impacts on project purposes. The potential budgetary impacts are also significant.

An argument can be made that the urgent need to undertake significant salmon protection measures calls for administrative action to reallocate water supplies for ESA purposes under one of the legislative approaches discussed below. While the need for salmon protection is compelling, the passionate and united local opposition to additional flow augmentation volumes and the potential costs would assure court and Congressional oversight of any action to reallocate water. This analysis reveals that Reclamation would not be able to meet its historic obligations and commitments to project beneficiaries or to fully meet all congressionally authorized project purposes while also providing 1,427,000 acre-feet for flow augmentation. Although arguments exist to support an administrative decision to meet flow augmentation requirements at the expense of specific project purposes, legislation appears to be necessary, from a pragmatic if not legal basis, to clarify Reclamation's responsibility in this regard and provide the necessary funding to carry out the reallocation of water.

9.3.2 Legislative Action

As discussed above, legislation could clarify Reclamation's responsibilities under original Reclamation Project authorizing statutes in light of new demands for flow augmentation. Congress could authorize Reclamation to provide an additional 1 MAF for flow augmentation. That authorization would effectively amend the original Reclamation project authorizations by including flow augmentation as a project purpose. Congress would also identify how the water should be provided and authorize and appropriate the required funds.
There appears to be three potential legislative approaches for the acquisition and delivery of water for flow augmentation:

- Invoke the "prior or superior claims" provisions of Reclamation repayment contracts and reallocate stored water for flow augmentation with no reimbursement to project beneficiaries for their loss of stored water.

- Release stored water on the basis that it constitutes a taking, for which compensation (lost income) must be paid.

- Institute a willing buyer/willing seller program.

9.3.2.1 Prior or Superior Claims

Most if not all repayment contracts with water user entities in the basin contain a clause that exempts the United States from liability in the event of shortage of water. One of the causes of shortage is listed as "prior or superior claims." If the prior or superior claims clause were invoked, water would be released from Reclamation project reservoirs on the basis that the ESA need constituted a superior claim. Under this approach, the United States would not be liable for monetary damages associated with the water released.

This approach could be implemented relatively quickly, but the actual release of water could be delayed for an indefinite period due to court actions. Affected water users would undoubtedly fight the release of water by every means possible, including court actions.

One serious downside to this approach is that it would only apply to project water supplies. Thus, it would impose a disproportionate burden on Reclamation project beneficiaries, since the approach does not involve natural flow rights. The controversy associated with this approach would certainly erode support for any changes in Idaho law that would permit the use of privately held natural flow rights.

The extreme degree of contention that would result from this approach is difficult to overstate. Reclamation seeks to fulfill its responsibilities in a manner that engenders cooperation from all affected parties, although agreement of all parties in managing finite water supplies is sometimes not possible. Adoption of a prior or superior claims approach is unlikely to lead to a consensus or even begrudging acceptance. A divisive debate over state and local rights could easily infect efforts to implement this approach.

If water rights in the Snake River basin were reallocated as proposed, it would require Congressional legislation similar to that adopted by Congress for California's Central Valley Project; CVPIA, Public Law 102-575, 106 Stat. 4706 et seq. It is worthwhile to quickly review CVPIA history, since the circumstances involved in the CVPIA enactment have some applicability to the Pacific Northwest. In California, conflicts existed for many years over the operations of Reclamation's Central Valley Project, including estuary water quality problems and ESA listed fish. The reallocation of project water supplies to additional uses was ardently sought by various parties and passionately opposed by project water users. Under the CVPIA, Congress directed the Secretary, through Reclamation, to:

> ". . . dedicate and manage annually 800,000 acre-feet of Central Valley Project water for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized by this title; to assist the State of California in its efforts to protect the waters of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; and to help meet such obligations as may be legally imposed upon the Central Valley Project under State or Federal law following the date of enactment of this title, including but not limited to additional obligations under the Federal Endangered Species Act."

Under CVPIA Section 3406(b), Reclamation is to reduce irrigation water supplies to a part of its irrigation contractors by 50 percent in order to meet the purposes of the legislation. However, since these contractors were injured by the reduction in irrigation supplies, they sued the United States to determine among other things whether an article in the parties' water service contract was valid and whether it would excuse the government from liability for water shortages due to "any other causes" (i.e., reductions due to enactment of the CVPIA).

On appeal, the Ninth Circuit Court of Appeals found that the provision was valid and that it did absolve the United States from liability for reduced irrigation deliveries especially when the provision was read together with the contractors' option to renegotiate its contract when Congress amends the provisions of Reclamation laws. *O'Neil v. United States*, 50 F.3d 677, 688 cert. denied, 516 U.S. 1028 (1995). The court stated: "We conclude that the contract's liability limitation is unambiguous and that an unavailability of water resulting from the mandates of valid legislation constitutes a shortage by reason of 'any other causes.'" *O'Neil*, 50 F.3d at 684.

It should be noted that the Central Valley contracts differ from those used in the Snake River basin in Idaho and Oregon. In particular, almost all contracts used in the Snake River basin are permanent repayment contracts that are not subject to renegotiation, whereas CVPIA contracts are water service contracts which have a set term for contract duration. Whether the contract differences would result in a different decision by the court is open to debate.

Implementation of this approach would likely involve the following steps:

- Congress would authorize the reallocation of project water supplies similar to the CVPIA.
- The Bureau of Reclamation would prepare rules and regulations outlining the criteria for selecting flows to be used for flow augmentation.
- Reclamation would complete an EIS on the rules and regulations.

9.3.2.2 Taking

As an alternative to exercising the prior or superior claims provision of contracts, Congress might direct Reclamation to release contracted water for flow augmentation, subject to claims for damages. This approach could be implemented relatively quickly but would also likely become involved in the courts. The water users might seek to enjoin Reclamation from releasing water until the matter was resolved.

The political implications of a taking would be severe, but possibly not as dramatic as the prior or superior claims approach, and there could be opportunities for voluntary release of water by natural flow or storage right holders.

Funding could come from direct Congressional appropriations or the BPA. However, the $435 million per year BPA cost cap for fish and wildlife already is fully allocated to various projects.

A taking would likely be implemented through passage of legislation similar to the CVPIA with the proviso that the Federal government would be liable for damages for water supplies it would make available for flow augmentation, and the appropriation of funds to cover anticipated costs. The costs of acquisition under this approach would likely be in the low range of possible acquisition costs identified in chapter 6 (from $10 million to $31 million per year for the 1427i scenario and $31 million to $87 million per year for the 1427r scenario). Further detail on potential acquisition costs is provided in chapter 6.

This approach could be implemented through the following steps:

- Congress would authorize the reallocation of project water supplies similar to the CVPIA, with general criteria on when the use of water for flow augmentation would constitute a taking.

- The Bureau of Reclamation would prepare rules and regulations outlining the criteria for selecting storage supplies to be used for flow augmentation, and other matters.

- Reclamation would complete an EIS on the rules and regulations.

9.3.2.3 Willing Buyer/Willing Seller

The current flow augmentation program acquires water through a willing buyer/willing seller approach. This approach would be the most benign from a social/political perspective, although experience indicates that local opposition could occur. Other advantages include the possibility of targeting certain water supplies (i.e., natural flows, non-Federal storage, diversions in the salmon migration corridor, etc.).

A major downside to this approach is the length of time to implement. It would take several years to obtain a large volume of water. For example, purchase of 1 MAF, about one-sixth of the consumptive use in the Snake River basin, would arguably require purchase of water rights for about one-sixth of the irrigated farmland. This amount of farmland would not likely be placed on the market for several years unless the willing purchase price is greatly inflated over historic price offerings.

The cost of this approach would be greater than that under the taking approach. Funding needs can be determined only through real-world water acquisitions, but common sense and experience argue that water right prices would increase dramatically and rapidly. Colorado has an active water market with water costs of thousands of dollars per acre-foot. The demand for water by Colorado cities has raised bid prices far above those for irrigation water. The minimum market value might be $57 million per year for the 1427i scenario and $82 million per year for the 1427r scenario. Market values could approach or even exceed $71 million per year for the 1427i scenario and $190 million per year for the 1427r scenario (see chapter 6 for additional detail)

Another factor that warrants consideration is significant volumes of water would need to be acquired from irrigation entities, rather than individual water users. Reclamation Law for many decades has favored the contracting of project water supplies to irrigation entities. The hydrology analysis reveals that providing 1,427,000 acre-feet for flow augmentation requires reallocation of very large volumes of water stored in Reclamation reservoirs. Essentially all of that water is held by irrigation entities, as opposed to individual contractors. Water supplies in Reclamation reservoirs in Oregon are held by irrigation districts organized under Oregon Law. In Idaho, canal companies, irrigation districts, other water-user organizations, and a few individuals hold contract entitlements to water supplies. However, the majority of the storage space is held by large irrigation entities consisting of hundreds or thousands of patrons.

There is certainly reason to argue that individuals will make sound economic decisions–many water users would be willing to sell their water supply if it can be sold for a value that equals or exceeds the income that would have been realized by using the water for agriculture. Water rights and contract entitlements held by water user entities, however, must be sold by the entity. The directors of such organization tend to consider the needs of the entire entity and not the needs of any one individual. This institutionalizing of decision making concerning water potentially available for sale would, thus, appear to reduce the ease and increase the cost of water to be acquired.

Another area of concern is Idaho's current reticence to enact legislation that would permit the transfer of natural flow or storage rights to instream purposes. Without the ability to rely on water supplies from Idaho, Reclamation could not provide 1,427,000 acre-feet. It appears that any decision to provide 1,427,000 acre-feet would need to be made over Idaho's objection. This would require a deviation from the 1995 BIOP and ROD which require that flow augmentation be accomplished in accordance with state water law.

A fast-track approach, which may keep total costs lower and provide more water at an early date would likely involve most or all of the following steps:

- Congress would authorize a one-time buyout of water rights and appropriate sufficient funding to acquire the water. The legislation would also require that state water administrators cooperate in the use of water for flow augmentation. However, it is recognized that Congressional action to require state cooperation in water reallocation would not be guaranteed. There is considerable tension over whether the Federal government or the states should have the final say in allocating water. Many Senators of Western States could be expected to defend state sovereignty over water.

- Federal agencies would prepare rules and regulations outlining the criteria for participation and the process to be followed.

- Federal agencies would complete an EIS on the rules and regulations.

- Water users would submit bids, describing how much water they would be willing to sell and the price (the actual bid process could require all bids at one time or in phases).

No long-term, willing-seller water acquisition has occurred in the Western States at a scale comparable to what is being assessed in this analysis. The logistics and cost of negotiating acquisition contracts at this scale would have to be addressed prior to implementation. Verification and enforcement of agreements to change diversion and use of irrigation water could present problems. Third-party impacts on farm workers and suppliers as well as financial impacts of lost revenue and increased social services costs to local governments are discussed elsewhere in this analysis. These indirect impacts could generate significant opposition that would tend to erode the user-friendly nature of a willing seller program. Details of operational changes required to manage reduced irrigation water delivery also would have to be examined.

9.4 Protection and Delivery of Flow Augmentation Water

Water acquired in upstream states would need protection from hostile diversion in all states through which the water must pass. With no comprehensive interstate allocation of the Columbia and Snake Rivers, Federal water managers are challenged to secure such state-to-state protection. Whether each state can be compelled to protect contributions from upstream states is a question that has been avoided to date (due in part to moratoria on new diversions in Washington and Oregon). One question which has not been answered is whether any state in the Columbia River Basin would, in a water-short year, curtail diversions of existing state water rights holders, so that flow augmentation water from an upstream state could be protected instream. Without such voluntary state protection of augmentation flows, one must consider whether some Federal legal mechanism might be available to accomplish the same end.

10 Consultation and Coordination

Federal water resource agencies are required under various mandates, including the NEPA, to conduct public involvement efforts and to consult and coordinate activities with other Federal agencies as part of the process of conducting a feasibility study and preparing environmental documents. Reclamation is conducting this flow augmentation analysis for the Corps, which has the ultimate responsibility for public involvement and agency coordination activities. Apart from the Corps' actions, Reclamation wanted key stakeholders in the Snake River basin to be aware of this flow augmentation analysis and the findings. This chapter describes the voluntary and discretionary public outreach activities in which Reclamation engaged.

Reclamation identified state and Federal agencies, local governments, and interest groups early in 1998 to help complete the analysis and define the scope and methodology. Preliminary information was disseminated on a request/response basis. In the early stages, distribution of information was ad hoc, in response to requests.

The scope and methodology of analysis were solidified by the summer of 1998, potential participants were identified, and time lines were established. The flow augmentation analysis team designed an outreach strategy to provide for the systematic and consistent dissemination of information. This strategy organized key stakeholders into (1) basin water users, and (2) State agencies in Wyoming, Nevada, Oregon, and Idaho; the tribes; media; water users; and others.

Reclamation outreach activities were centered on three purposes: (1) to provide a general orientation; (2) to describe the methodology of the analyses and seek feedback from technical experts; and (3) to present initial findings. Reclamation provided written materials, made presentations, and met with focus groups to accomplish these goals. Reclamation personnel spoke with the appropriate state officials in each state in the basin and responded to all invitations. All meetings to date are summarized in table 10-1.

Reclamation is continuing its commitment to ensure that key stakeholders in the Snake River basin are aware of Reclamation's role in the Corps feasibility study/EIS, the process used in the flow augmentation analysis, and the results of the analysis.

Table 10-1 Flow Augmentation Analysis Outreach Activities

Date	Organization	Purpose	Attendees
December 17, 1997	Decision System Configuration Team	General Orientation	20
March 20, 1998	SR^3 Workshop	General Orientation	22
March 31, 1998	USFWS	General Orientation	2
May 8, 1998	Payette Watershed Council	General Orientation	6
May 21, 1998	Committee of Nine, Idaho	General Orientation	30
June 4, 1998	Economics Focus Group	Technical Feedback	26
June 11, 1998	SR^3 Tribal Forum Meeting	General Orientation	9
June 12, 1998	Hydrology Peer Review Focus Group	Technical Feedback	21
July 15, 1998	Corps Roundtable	General Orientation	100
July 16, 1998	Fort Hall Tribal Council	General Orientation	10
July 27, 1998	Idaho State Officials and Congressional Delegations	General Orientation	25
July 31, 1998	Hydrology and Economics Focus Group	Technical Feedback	47
August 5, 1998	Directors of Oregon State Agencies	General Orientation	25
August 13, 1998	Portland Area Federal and State Agencies	General Orientation/ Initial Findings	20
August 25, 1998	NPPC, Fish Four Committee	General Orientation/ Initial Findings	15
August 26, 1998	Corps Drawdown Regional Economic Workgroup	General Orientation/ Initial Findings	25
August 27, 1998	USFWS	Initial Findings	2
September 10, 1998	Multiagency Implementation Team established by NMFS	Initial Findings	15
September 15, 1998	Henrys Fork Watershed Council	General Orientation	50
September 16, 1998	Wyoming State Agencies	General Orientation	10
September 25, 1998	Nevada State Agencies	General Orientation	2
September 29, 1998	Idaho Water Users Association	General Orientation	40

11 List of Preparers

A list of persons who participated to a significant degree in the preparation of this document is provided below.

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George Cawthon	Ph.D. Botany; Technical Writer /Editor; Bureau of Reclamation - 20 years	Report Preparation
Robert C. Christensen	M.S. Zoology; Supervisory Environmental Specialist; Bureau of Reclamation - 25 years	Wetlands
David Duncan	Ph.D. Sociology; Senior Associate 22 years in Water Resource Planning	Social Analysis
Earl Ekstrand	Ph.D. Resource Economics; Natural Resource Economist Federal Government - 5 years	Recreation Economics
Paula Engel	M.S. Agricultural Economics; Resource Economist; Bureau of Reclamation - 6 years?	Regional Economics
Dave Harpman	B.S. Fisheries & Wildlife Management, M.S. & Ph.D. Natural Resource Economics; Natural Resource Economist; Bureau of Reclamation - 10 years	Hydropower Economics
Stephen Hatchett	Ph.D. Agricultural Economics; Economist; 16 years experience	Agricultural Economics & Land Use
Robert Horton	Ph.D. Sociology; Natural Resources Planning 20 years experience	Social Analysis
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Name	Qualifications	Participation
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Roger Larson	B.S. Civil Engineering; Hydraulic Engineer; Bureau of Reclamation - 23 years	Hydrology
Jill Lawrence	B.S. Home Economics; Native American Affairs Coordinator; Bureau of Reclamation - 21 years	Indian Trust Assets
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	Bureau of Reclamation - 6 years	
Jo Snyder	Technical Writer/Editor; Bureau of Reclamation - 18 years	Report Writer
Joe Spinazola	B.S. Forest Management; Regional Groundwater Specialist; Bureau of Reclamation - 18 years U.S. Geological Survey - 2 years	Groundwater
Leslie Stillwater	B.S. & M.S. Civil Engineering; Hydraulic Engineer; Bureau of Reclamation - ? years	Hydropower Analysis
LeAnn Towne	B.S. Civil Engineering; Supervisory Civil Engineer; Bureau of Reclamation - 8 years	Hydrology
Lisa Wuttke	B.S. Civil Engineering; Hydraulic Engineer; Bureau of Reclamation - 17 years	Hydrology

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Attachment A Reclamation/IPC/USFWS Agreement on Flow Augmentation

PN-6400

Mr. Joe Marshall
Idaho Power Company
PO Box 70
Boise ID 83707

Subject: Release of Reclamation-provided Water for Flow Augmentation, 1996-99

Dear Mr. Marshall

On January 17, 1996 the Bureau of Reclamation (Reclamation) met with representatives of your company and the U.S. Fish and Wildlife Service (FWS) to discuss an agreement regarding the schedule and magnitude of flows provided for salmon in compliance with the March 1995 Biological Opinion (BO) issued by the National Marine Fisheries Service (NMFS) on the operation of the Federal Columbia River Power System. The BO calls upon Reclamation to provide 427,000 acre-feet (427 KAF) from the Snake River above Brownlee Reservoir to assist in meeting salmon target flows at Lower Granite Dam. Another BO was issued by the FWS and includes terms and conditions for protection of snails in the Middle Snake River.

Reclamation and Idaho Power Company understand that the FWS is uncertain at this time of what flow regimes are necessary to conserve and recover the listed snail populations and that FWS may in the future require variable flows for research purposes. Reclamation, Idaho Power Company, and the FWS understand that new information regarding the status or life history requirements of the listed snails may require re-consultation under Section 7 of the Endangered Species Act which could result in modifying or voiding this agreement. Reclamation and Idaho Power Company recognize that salmon flow augmentation releases in the Payette River must be managed to reflect the needs of listed species at Cascade Reservoir, reservoir water quality and fish and wildlife, and the environmental needs of the lower Payette River. Idaho Power Company, Reclamation and FWS also recognize that water rights for the Deer Flat National Wildlife Refuge are being adjudicated in the SRBA. This agreement is not intended to affect and does not affect the water rights of the FWS or other valid water rights.

This letter agreement addresses how flows will be provided in terms of schedules and rate of flow for salmon and snails from the upper Snake and the Payette rivers for 1996-1999:

SNAKE RIVER OPERATING PRINCIPLES

- Reclamation will coordinate and plan its release of salmon flow augmentation to be no greater than 1500 cfs below Milner Dam exclusive of flood control releases.

- If needed for research purposes, Reclamation will work with the FWS to provide variable flows exceeding 1500 cfs below Milner Dam during flood control release periods.

- Reclamation will facilitate a down-ramping rate for flows at Milner near the end of the salmon water release for the purpose of protecting listed snail populations. Reclamation, FWS, and Idaho Power Company will jointly negotiate a ramp rate acceptable to all parties

- If for research purposes the FWS desires flows below Milner Dam that exceed 1500 cfs during the non-flood release periods, Reclamation, FWS, and Idaho Power Company will jointly negotiate flow schedules acceptable to all parties.

PAYETTE RIVER OPERATING PRINCIPLES

- Annually, in March or April, Reclamation, FWS, and Idaho Power Company will meet with interested Cascade and Payette River user groups to develop and operating plan for the coming year.

Reclamation's ability to limit below-Milner flows to 1500 cfs, and still meet its salmon related flow augmentation requirements, depends in part upon Idaho Power's ability to shape the releases of those flows from Brownlee Reservoir in a manner consistent with Technical Management Team recommendations. Idaho Power has made arrangements (independent of any involvement by Reclamation or FWS) pertaining to shaping of flows from Brownlee Reservoir, and will continue to shape flows in accordance with those arrangements for the life of the Agreement. Either party, however, may terminate this agreement at any time by providing 30 days written notice to other parties.

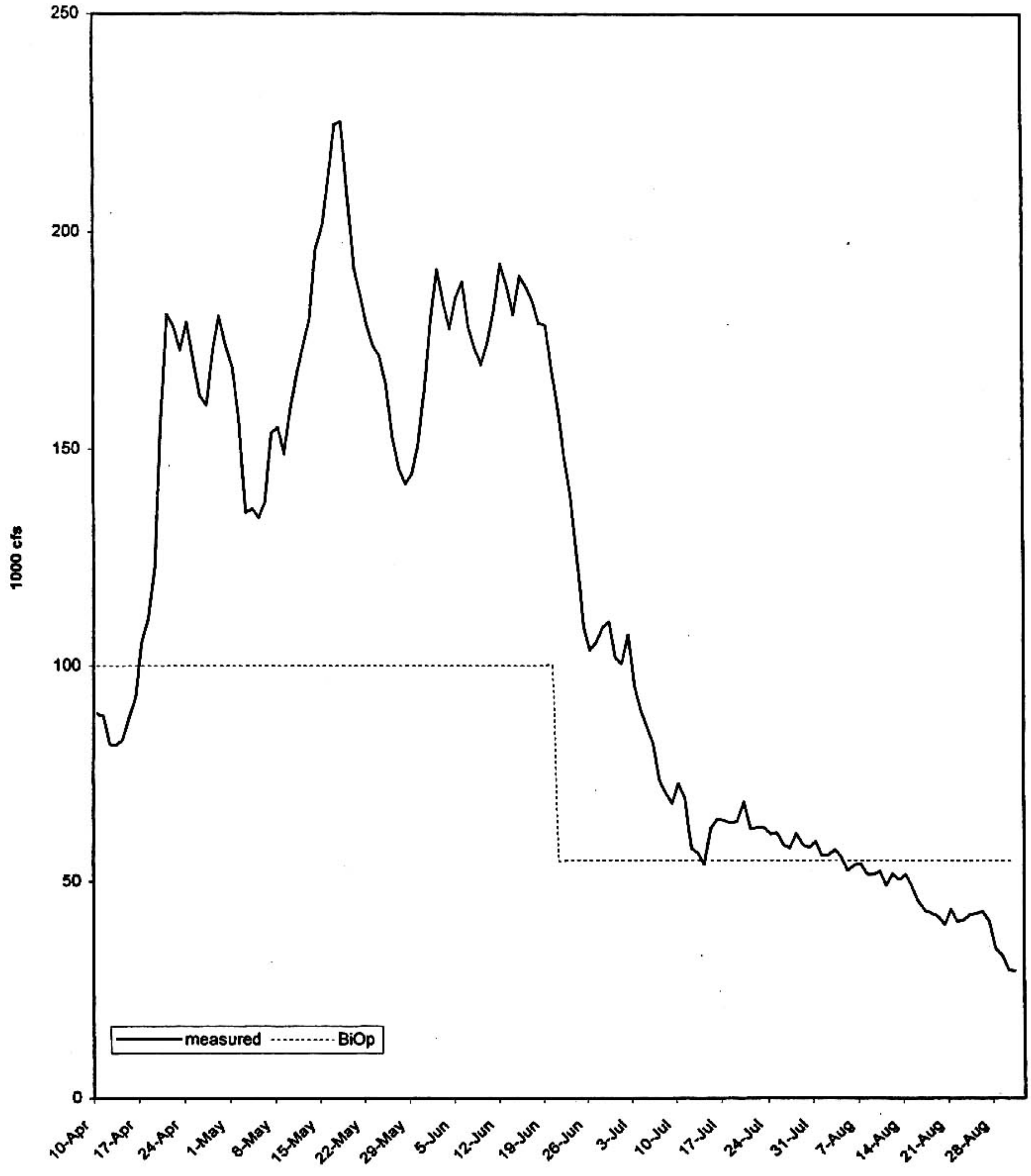
We appreciate Idaho Power Company's cooperation in providing shaping or pass-through at Brownlee Reservoir, in keeping with the NMFS 1995 BO, and FWS for working with us to try to accommodate the needs of Idaho Power Company while conserving the listed snail species. To confirm your understanding of the release principles addressed above, please sign the triplicate copies, retain one for Idaho Power Company, and return the other two to us.

Sincerely,

John W. Keys, III
Regional Director

Attachment B Flows Past Lower Granite Dam During the 1997 Flow Augmentation Season

1997 Flows: Snake R. blw Lower Granite Dam



Attachment C Operating Considerations

Reservoir	Rule used in the Model	Operational Requirements and/or Considerations
Jackson	Yes	**Flood Control Rules**.
	Yes	Maximum 20,000 cfs Limit at Flat Creek Gauge - **Informal Flood Control Target**. Exceeded if needed to maintain flood control space. Channel capacity in this area subject to change
	Yes	Minimum winter release 280 cfs or inflow whichever is less - **Administrative decision** based on Wyoming Game and Fish recommendation, nothing formal
	No	Maximum winter release 600 cfs October thru March - **Informal** for fish.
	No	Ramp up limit 50 cfs/day October 1 to early spring - **Informal rule of thumb.**
	No	Ramp down limit 30 cfs/day October 1 to early spring - **Informal rule of thumb**.
	No	Minimum 2,000 cfs through September - **Informal** desired by boaters.
	No	Minimum 5,000 cfs for Alpine Canyon Reach - **Informal** desired by whitewater outfitters (guide books recommend 1,000 - 10,000 cfs).
Palisades	Yes	**Flood Control Rules**.
	Yes	Maximum Limit of 20,000 cfs at Heise - **Flood Control Target**
	No	Start of irrigation minimum 500-1000 cfs at Lorenzo - **Informal** to avoid dewatering river reaches.
	Yes	Minimum Winter 550 cfs October thru March - **Resolution of the Committee of Nine** in consideration of aquatic resources .
	No	Minimum Winter 1500 cfs - **Informal** at suggestion of Idaho Game & Fish for juvenile trout protection.
	No	Ramp down limit 0.5 foot of stage per 2 hours near Irwin gauge - **Informal**.
Grassy Lake	Yes	No winter releases.
Island Park	No	Initial Maximum 7,800 cfs at Rexburg - Although **official flood stage**, flooding is limited to lowland pastures and small amounts of crops.
	No	Maximum 12,000 cfs at Rexburg -**Informal Channel Capacity** at which level infrastructure damage begins.
	No	Normal Operation Maximum 2,000 cfs - **Informal** to avoid flooding in last chance area while not under flood control operations.
	Yes	Normal Flood Control Maximum 3,260 cfs when below spillway - **System constraint** maximum due to outlet gates. If higher releases

Reservoir	Rule used in the Model	Operational Requirements and/or Considerations
		needed for flood control, spillway will provide.
	Yes	Minimum Summer 1,200 cfs at St. Anthony gauge - **Informal** to meet demands when water supply is adequate. Not expected to exceed 1,500 cfs to meet demand.
	No	Minimum Summer 1,000 cfs near Rexburg - **Informal rule of thumb** to meet demands in poor runoff years.
	No-- almost always met	Minimum Winter Target 300 cfs - **Informal** if water year and space holders allow.
Ririe	Yes	**Flood Control Rules**.
	No - exceeded as need to meet Flood Control Rules	Limit of 1,200 cfs - **Flood Control Target**.
	No	Maximum 400 cfs - **Informal** to maintain the reservoir high for recreation and avoid excessive erosion of the stream channel and pump stations.
American Falls	Yes Yes	Minimum 30 cfs or reservoir inflow up to the water right, whichever is greater - To meet **downstream natural flow rights**. Maximum 20,000 cfs at Minidoka -**Informal Reclamation Limit**. No formal flood control rules. Sandbagging needed beginning at flows around 25,000 cfs.
	No	Minimum pool 100,000 acre-feet - **Informal**. No official minimum or conservation pool, but water quality becomes a concern below this level.
	No	Minimum 300 cfs - **Informal** target at recommendation of the Governor of Idaho in consideration of aquatic resources.
		Minimum 2,000 cfs in October - **Informal** for fish.
	No	Ramp at flows of 2,000 cfs or less is 200 cfs per hour - **Informal.**
	No	Ramp at flows of 2,000 cfs or greater is 500 cfs per hour - **Informal**.
		Minimum Elevation 4345 November thru February - **Informal** to prevent ice damage to structure.
Minidoka/ Walcott	Yes	Irrigation Season Maintenance of 4245 elevation at Lake Walcott - **Informal** to meet demands.
	Yes	Winter Season Maintenance of 4240 elevation or lower November thru February - **Informal** to prevent ice damage to spillway boards and dam piers.
	No	Minimum at Spillway 1,300 cfs April 15 to September 15, 1,900 cfs July and August- **Commitment related to new powerplant**.
	No	April 1 to October 31, but outside the above dates, first 5,035 cfs through powerplant, next 1,300 cfs through spillway - **Commitment**

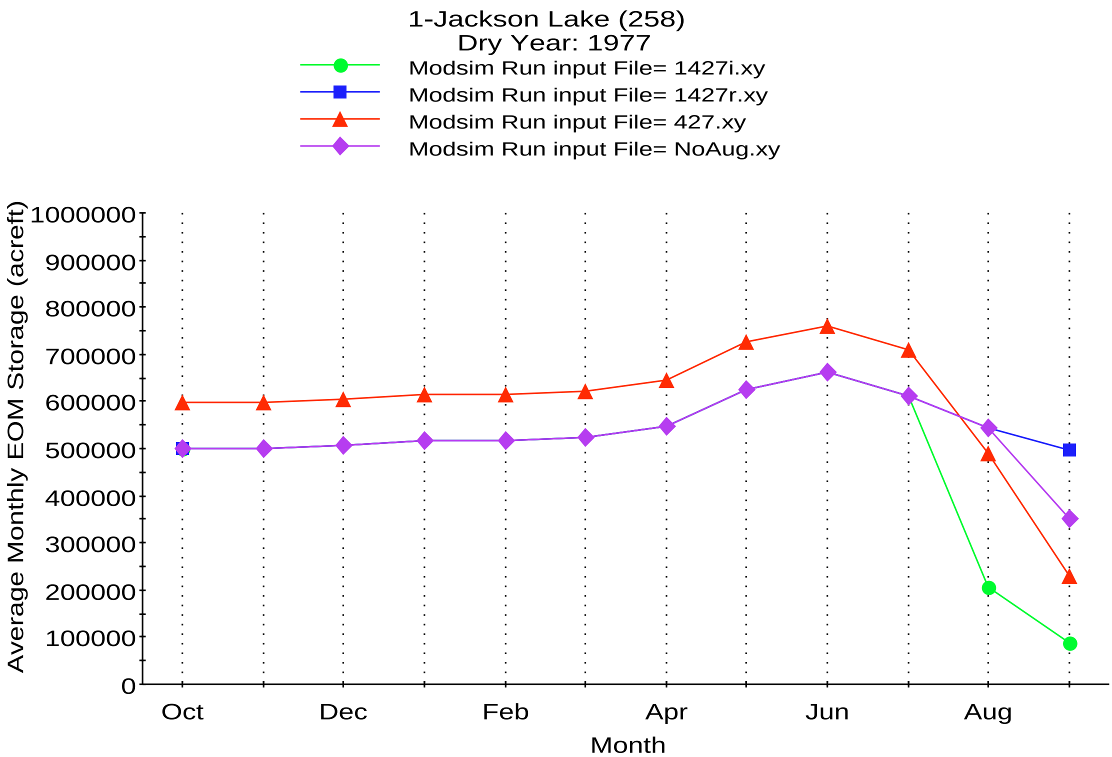
Reservoir	Rule used in the Model	Operational Requirements and/or Considerations
		related to new powerplant.
Milner	No	Minimum 200 cfs - **FERC License Requirement**.
Little Wood	Not Modeled	**Flood Control Rules**.
	Not Modeled	Maximum 1,200 cfs at Carey, Idaho - **Flood Control Target**.
	Not Modeled	Maximum 1,100 cfs - **Physical Restriction** due to poor outlet tunnel conditions except under extreme conditions i.e. spill condition.
Anderson Ranch	Yes	**Flood Control Rules**.
		Minimum 600 cfs April 1 to September 15 - **Administrative decision** outlined in Water Control Manual. Not always met.
	Yes	Minimum 1,000 cfs - **Informal** consideration for rafting.
	No	Avoid weekend flow changes - **Informal** consideration for recreation.
		Minimum 300 cfs September 16 to March 31 - **Administrative decision** outlined in Water Control Manual. Not always met.
Arrowrock	Yes	**Flood Control Rules**.
	No	Minimum 80 - 100 cfs when Lucky Peak is low - **Informal**, released to keep the channel watered.
Lucky Peak	Yes	**Flood Control Rules**.
	Yes	Maximum 6,500 cfs at Glenwood Bridge - **Flood Control Target**.
	Yes	Maximum 7,000 cfs at Parma, Idaho - **Flood Control Target**.
	No	Ramp up and down 500 cfs per day - **Informal rule of thumb**.
	No	Minimum 150 cfs - **Informal** for water quality and stream maintenance for aquatic resources. Reclamation provides 80 cfs minimum dilution for water quality. IDFG provides an additional 70 cfs for aquatic resources, which may not be available in low supply years.
	No	Minimum 240 cfs preferred - **Informal** for water quality and in stream flow maintenance for fish and wildlife. Recommended by IDFG high & average years.
	No	Target March 1 to 14, 4,500 cfs - **Informal** target per IDFG recommendation.
	No	Target March 16 to June 30 1,100 cfs - **Informal** target. Consistent with IDFG recommendation.
	No	Target Summer 1,100 cfs - **Informal** target meets irrigation flows and consistent with Ada County Parks and Waterways recommendation of 1,500 cfs or less for tubing the Boise.
Cascade	Yes	**Flood Control Rules.**
	Yes	Maximum 12,000 cfs at Horseshoe Bend - **Flood Control Target**.
		Maximum Normal 2,300 cfs - **Informal** when possible through IPC's

Reservoir	Rule used in the Model	Operational Requirements and/or Considerations
	Yes	Powerplant.
	No	Maximum 5,000 cfs - **Flood Control Target**
	No	Minimum 2,300 cfs at Horseshoe Bend June, July, and August reduced to 2,000 cfs mid September - **Informal to meet demand**.
	No	Minimum Summer 1,300 cfs - **Informal** in consideration of whitewater recreation.
	No	Minimum Summer 1,000 cfs Cabarton to Smiths Ferry - **Informal** in consideration of most recreation uses.
	No	Minimum Summer 1,200 cfs Smiths Ferry to Banks- **Informal** in consideration of most recreation uses.
	Yes	Minimum 100 cfs Cascade to Cabarton Bridge reach, 200 cfs Cabarton Bridge to Smiths Ferry, and 300 cfs Smiths Ferry to Banks Reach - **Informal** to accommodate fishery interests.
	Yes	Minimum 200 cfs or inflow, whichever is less - **IPC water right**.
	No	Minimum 400 cfs Banks Reach to Black Canyon - **Informal** to accommodate fishery interests.
	Yes	Minimum Conservation pool 300,000 acre-feet - **Environmental Assessment** for the management of uncontracted space in Cascade and Deadwood.
Deadwood	Yes	**Flood Control Rules**.
	Yes	Maximum 12,000 cfs at Horseshoe Bend - **Flood Control Target**.
	No	Minimum 50 cfs below Deadwood - **Administrative decision** in consideration of water quality and aquatic resources.
	No	Minimum 400 cfs Banks Reach to Black Canyon - **Informal** to accommodate fishery interests.
	No	Minimum 650 cfs - **Informal** consideration of whitewater recreation on Deadwood River.
	No	Minimum 2,300 cfs at Horseshoe Bend June, July, and August reduced to 2,000 cfs mid September - **Informal to meet demand**.
	No	Target 800 cfs - **Informal** consideration as desired flow for whitewater recreation on Deadwood River.
	No	Target 1,000 cfs - **Informal** consideration as desired flow for whitewater recreation on South Fork Payette River (Deadwood River to North Fork).
	No	Ramp up 100 cfs first day, 200 cfs day 2 and 3, 250 cfs days 4 and 5 for flows 0-1000 cfs - **Informal** to accommodate recreation use on the river.
	No	Ramp up 250 cfs per 3 hours - **Informal** to accommodate recreation use on the river.
		Minimum Conservation pool 50,000 acre-feet - **Environmental**

Reservoir	Rule used in the Model	Operational Requirements and/or Considerations
		Assessment for the management of uncontracted space in Cascade and Deadwood.
Black Canyon	No	Maximum 16,000 cfs at Emmett - **Flood Stage.**
	No	Minimum 1,000 cfs during irrigation - **Informal** to assist diversions.
	No	Minimum 1,100 cfs at all times and 2,500 cfs February to May - **Informal** to enhance waterfowl nesting downstream of Black Canyon Dam.
	Yes	Minimum 500 cfs - **Informal** for fish habitat and water quality.
Owyhee	Yes	**Informal Reclamation Flood Control Rules**.
	No	Minimum 10 cfs October thru March - **Informal** at the discretion of the Joint Board of Control.
	No	Minimum 100 cfs April thru September - **Informal** Oregon Department of Fish and Wildlife recommendation in the lower Owyhee River for stream resource maintenance.
	No	Average 200 cfs during irrigation season - **Informal** to meet downstream demand.
Warm Springs	Not Modeled	**Flood Control Rules**.
	Not Modeled	Maximum 8,000 cfs of Malheur River at Vale - **Flood Control Target**.
	Not Modeled	Ramp up at 1,000 cfs or less 250 cfs per 2 hours - **Informal**.
	Not Modeled	Ramp up at 1,000 to 2,000 cfs 500 cfs per 2 hours - **Informal**.
	Not Modeled	No winter releases - 2-3 cfs due to seepage.
Beulah	Not modeled	**Flood Control Rules**.
	Not modeled	Maximum 8,000 cfs of Malheur River at Vale - **Flood Control Target**.
	Not modeled	Maximum 1,000 cfs below dam - **Flood Control Target**.
Bully Creek	Not Modeled	**Flood Control Rules**.
	Not Modeled	Maximum 8,000 cfs of Malheur River at Vale - **Flood Control Target**.
	Not Modeled	Maximum 3,000 cfs below dam - **Flood Control Target**.
Phillips Lake		**Flood Control Rules**.
		Maximum 500 cfs at Baker City - **Flood Control Target**.
Thief Valley	Not Modeled	Minimum Drawdown 3104.5 elevation - **Informal** due to water quality concerns downstream.
		Maximum 75 cfs as pool nears 3104.5 elevation - **Informal** due to

Reservoir	Rule used in the Model	Operational Requirements and/or Considerations
	Not Modeled	water quality concerns downstream.
Unity	Not Modeled	Maximum 300-400 cfs - **Discharge Channel Capacity**.
Mann Creek		**No Considerations Identified**.

Attachment D Wet and Dry Year Graphs of Reservoir Content and Releases



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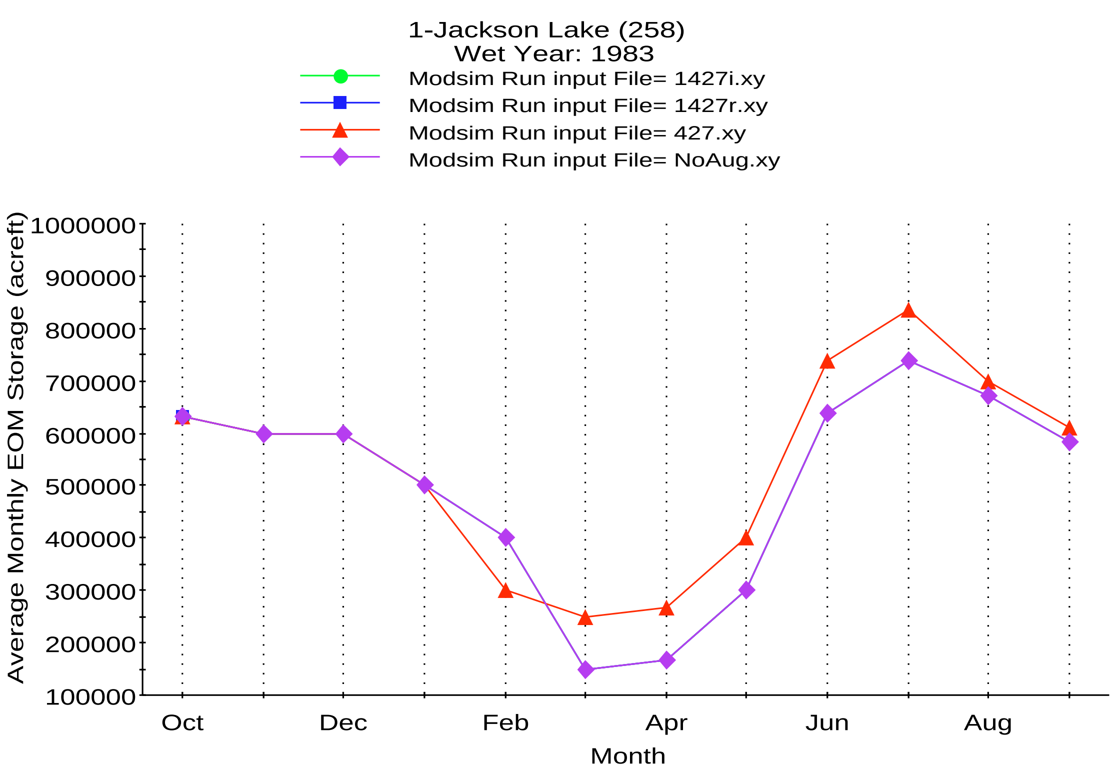

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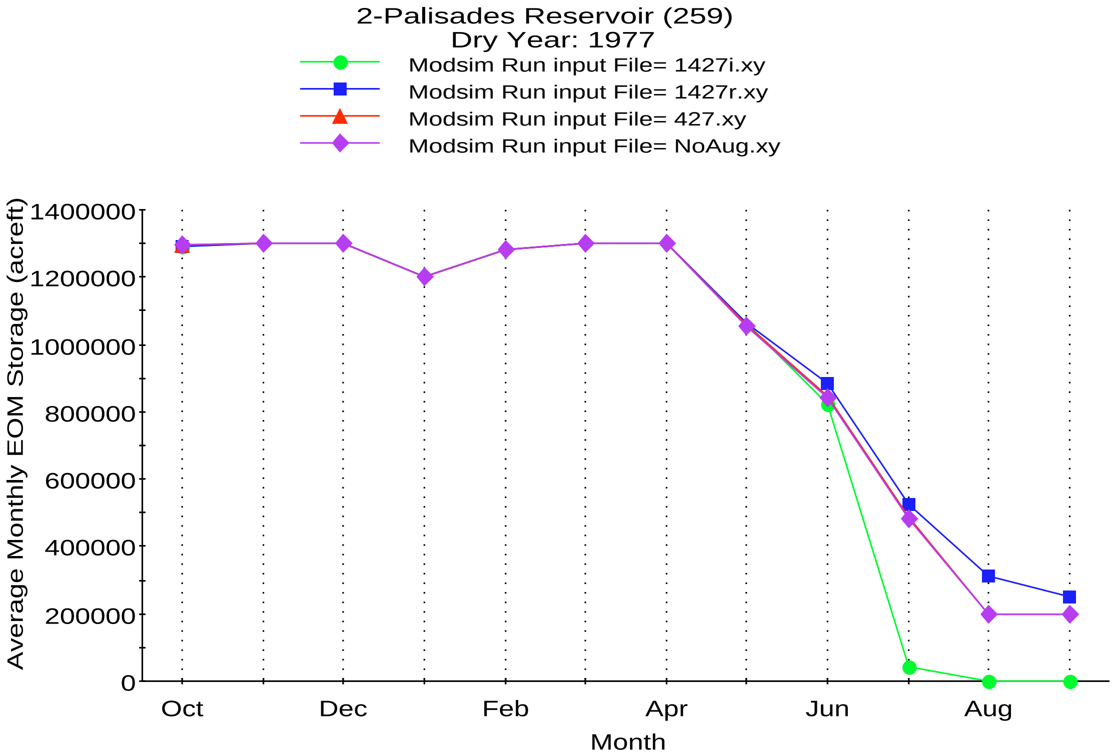

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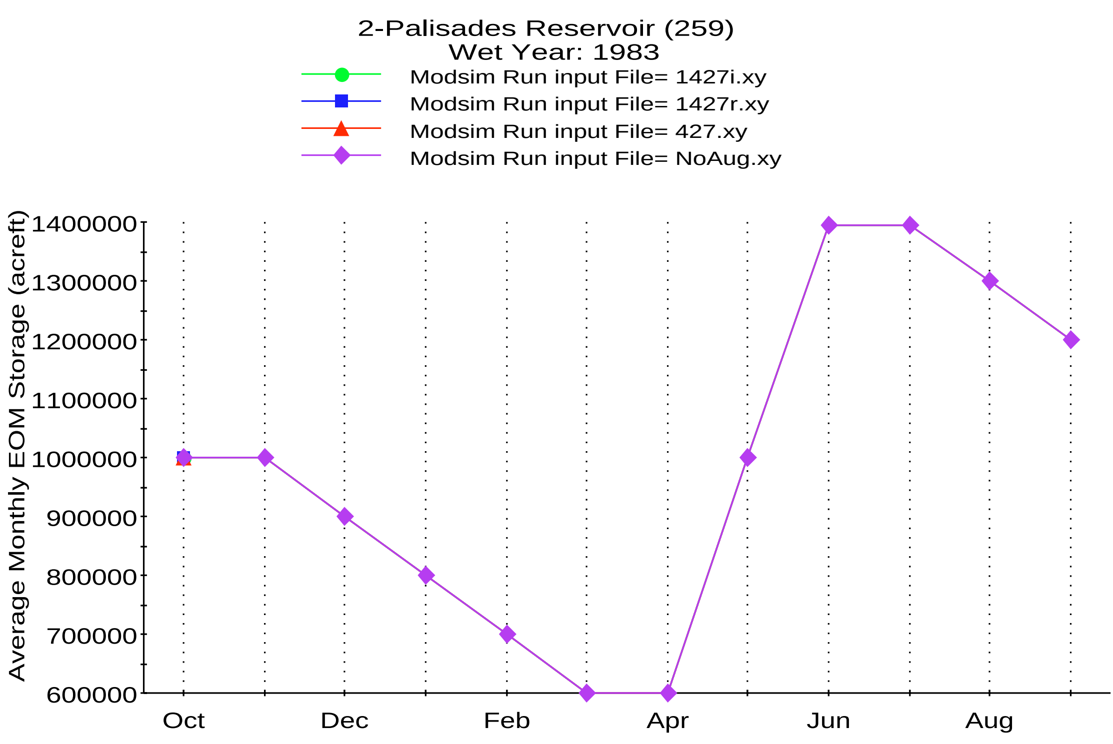

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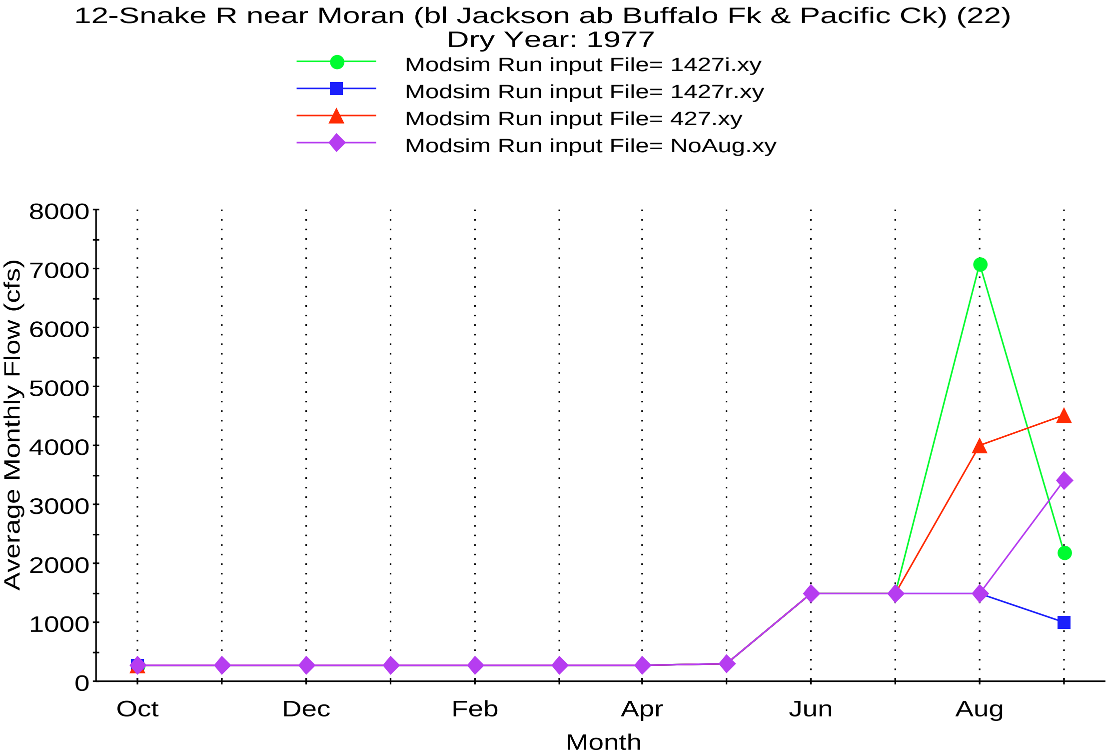

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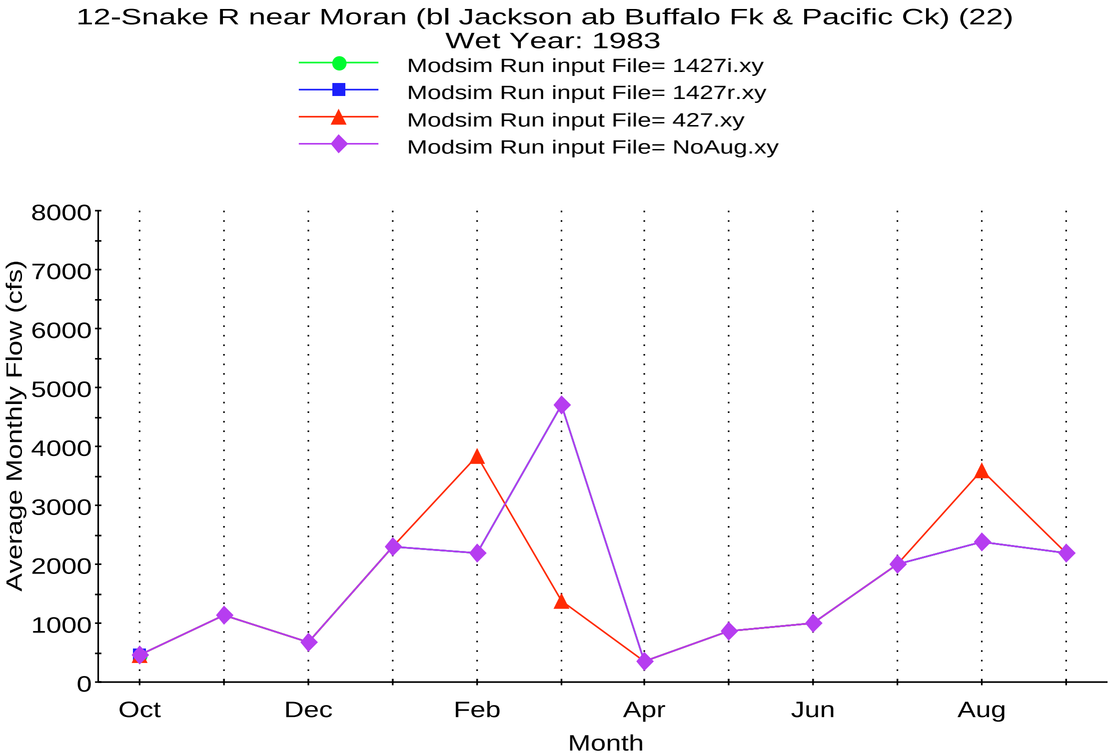

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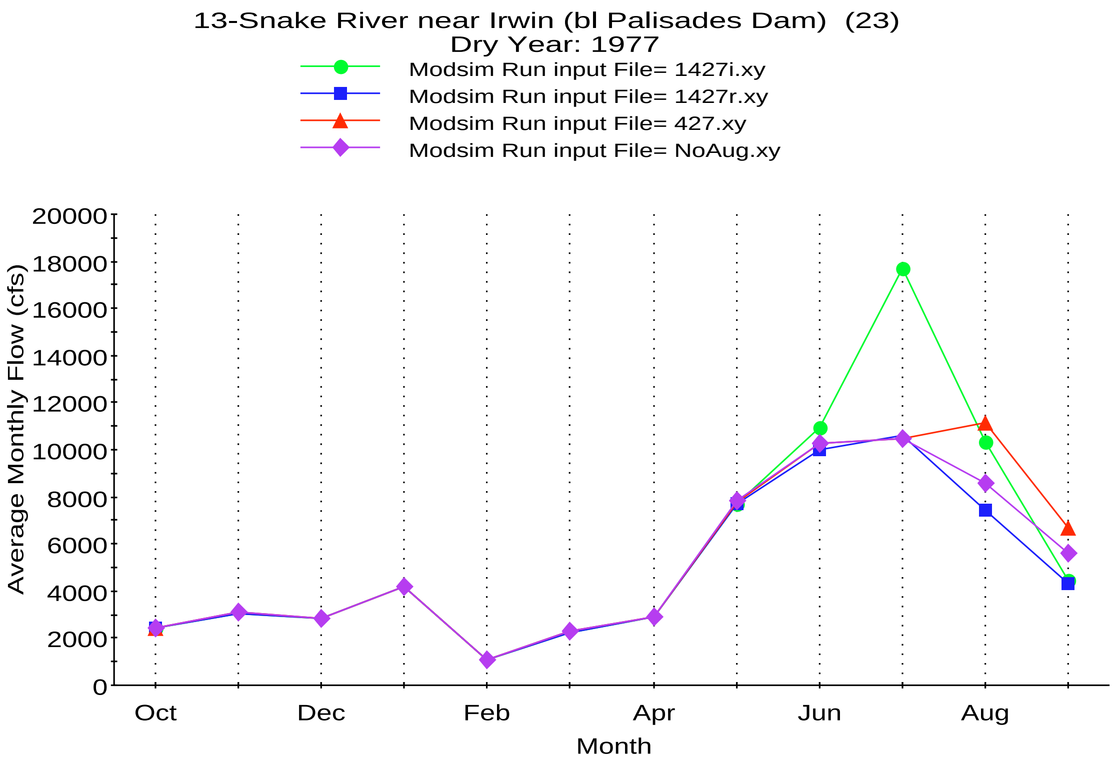

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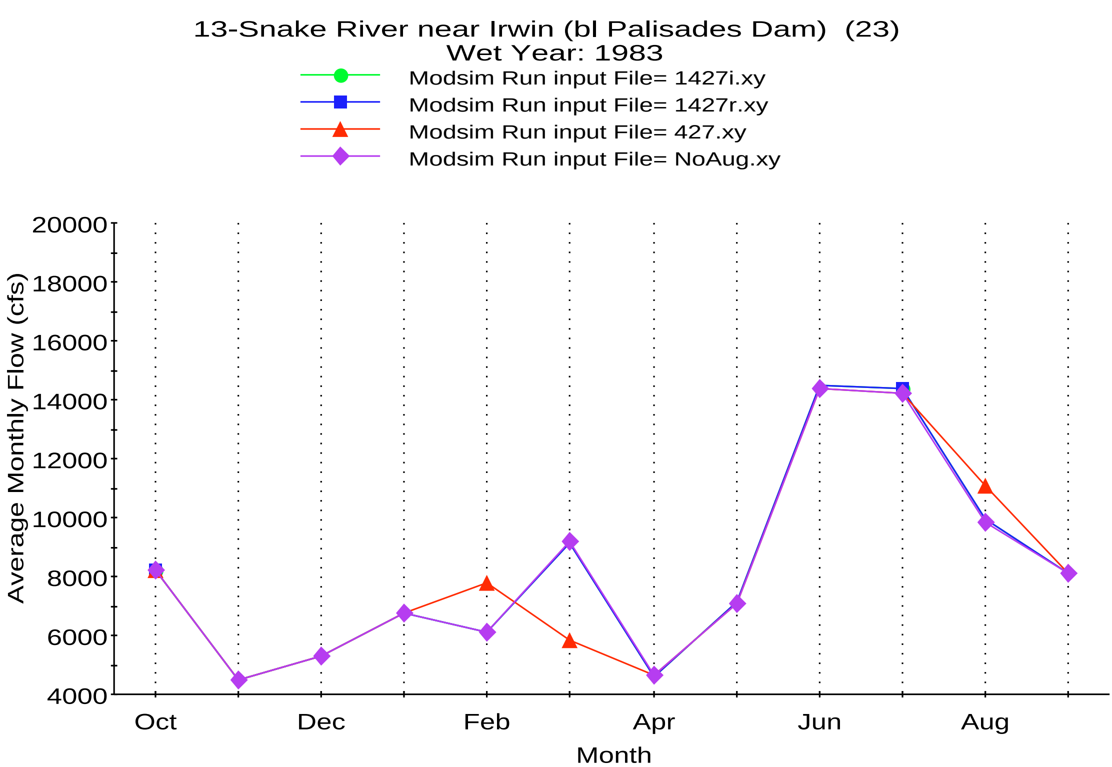

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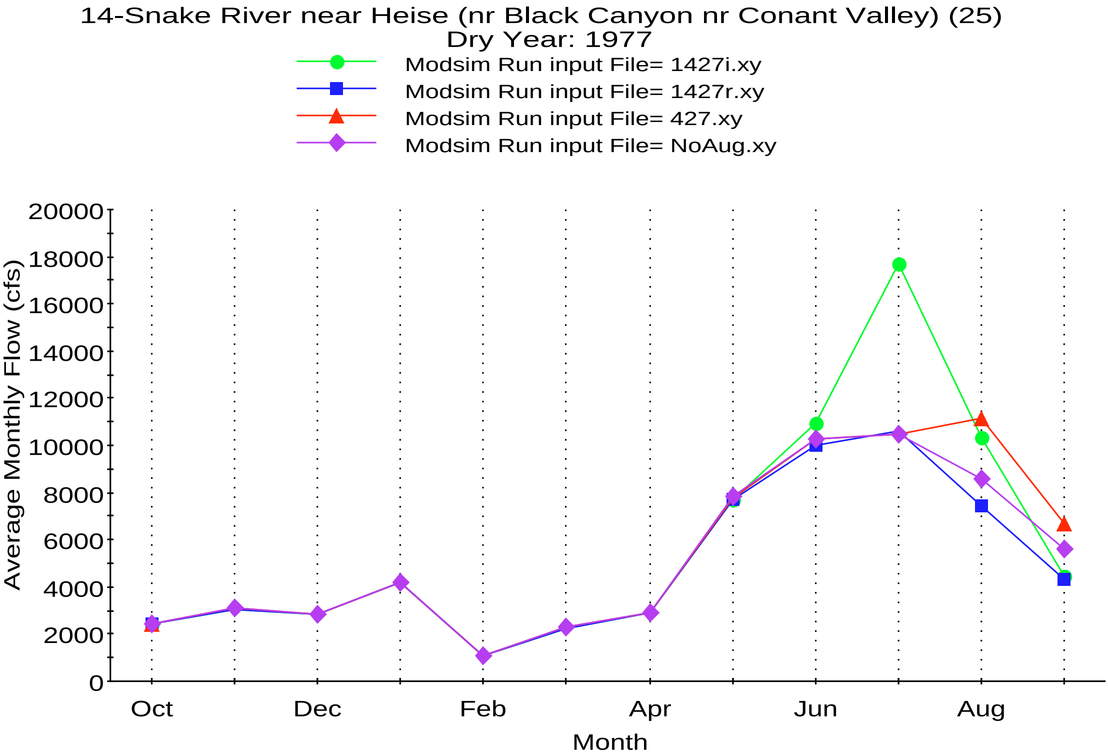

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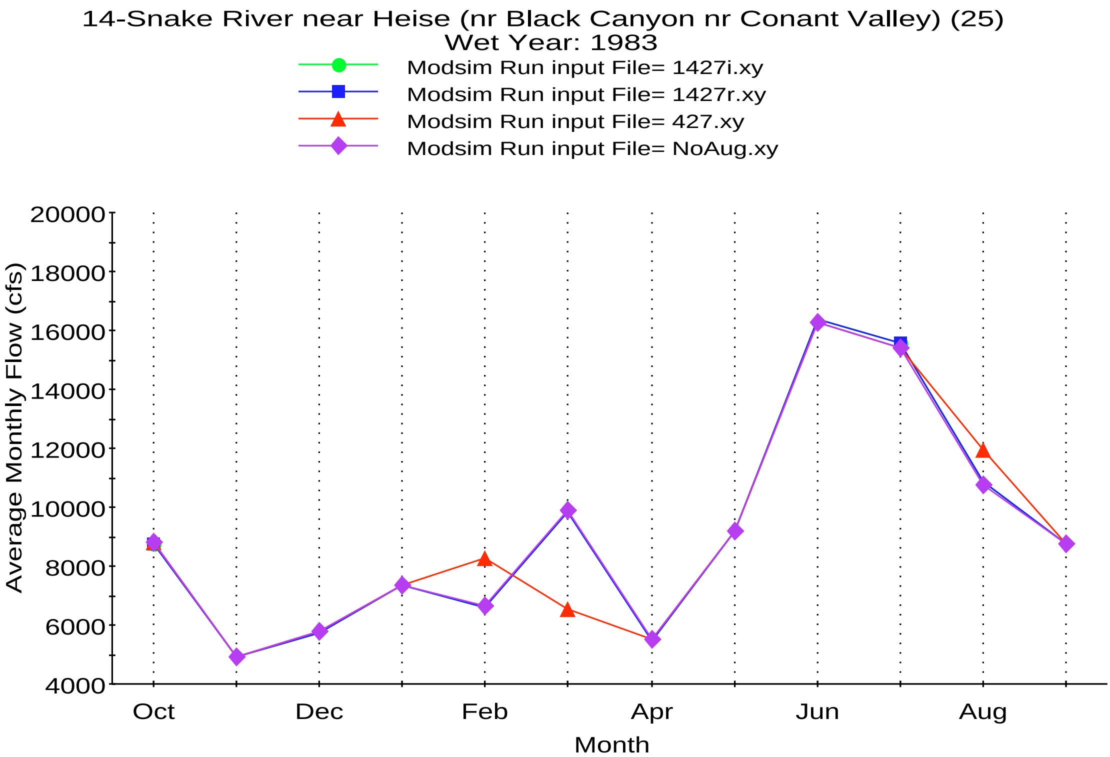

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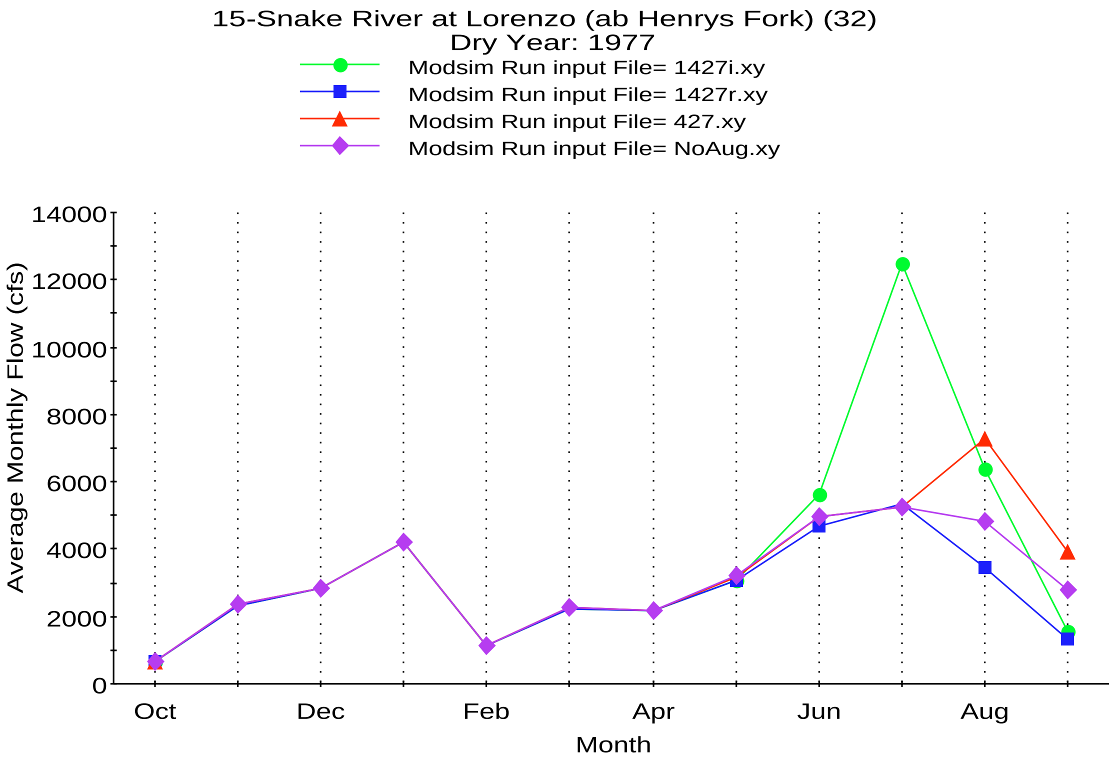

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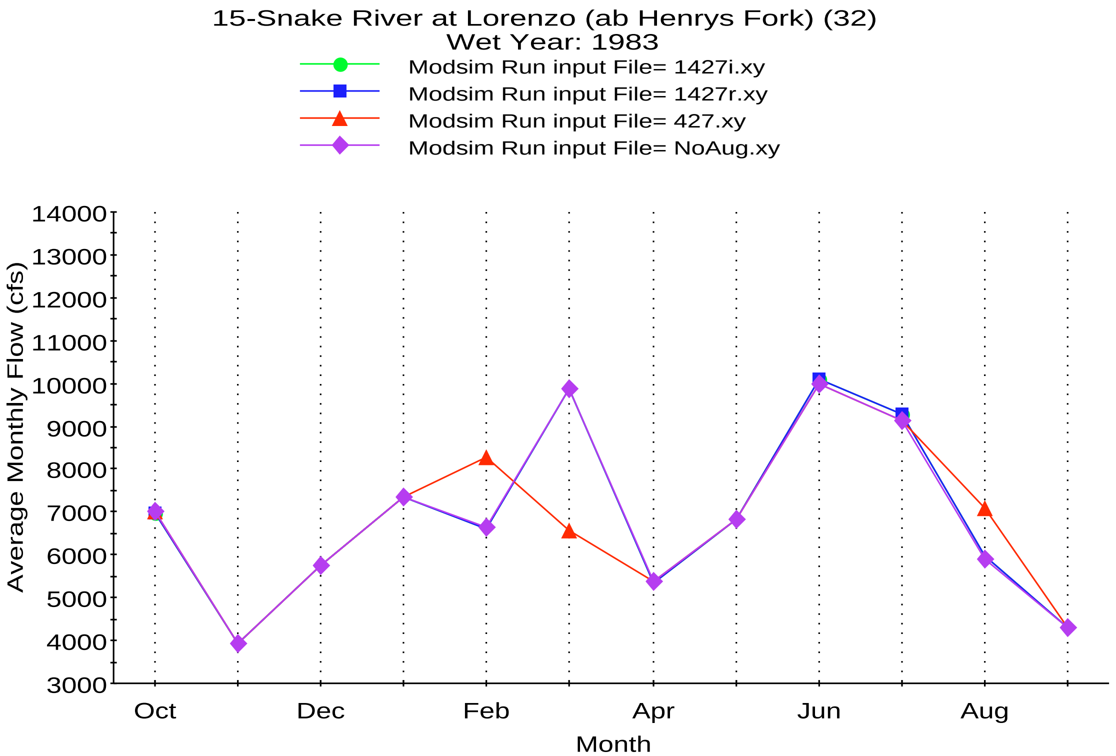

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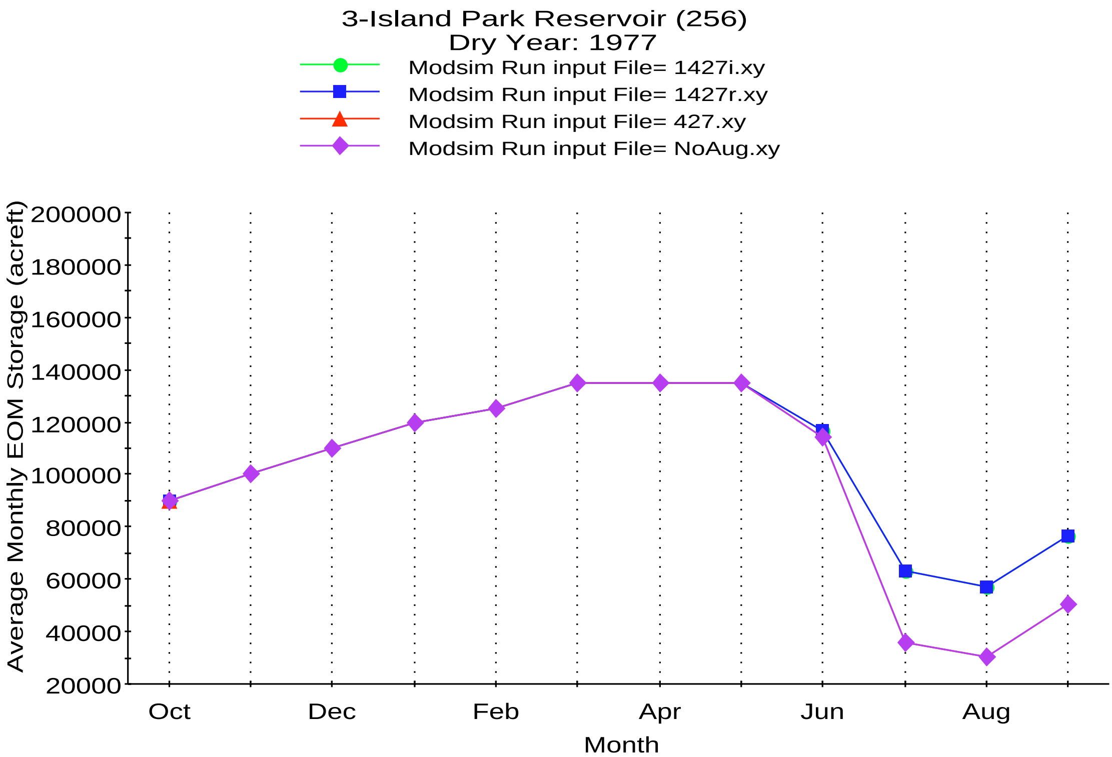

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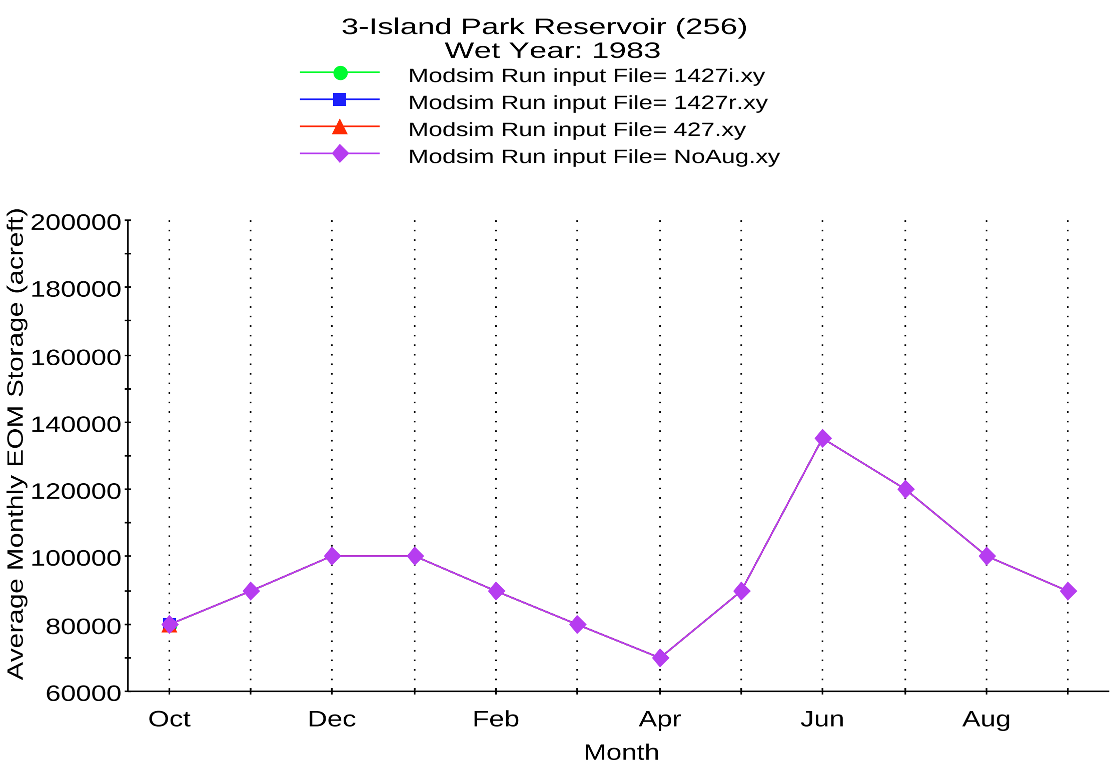

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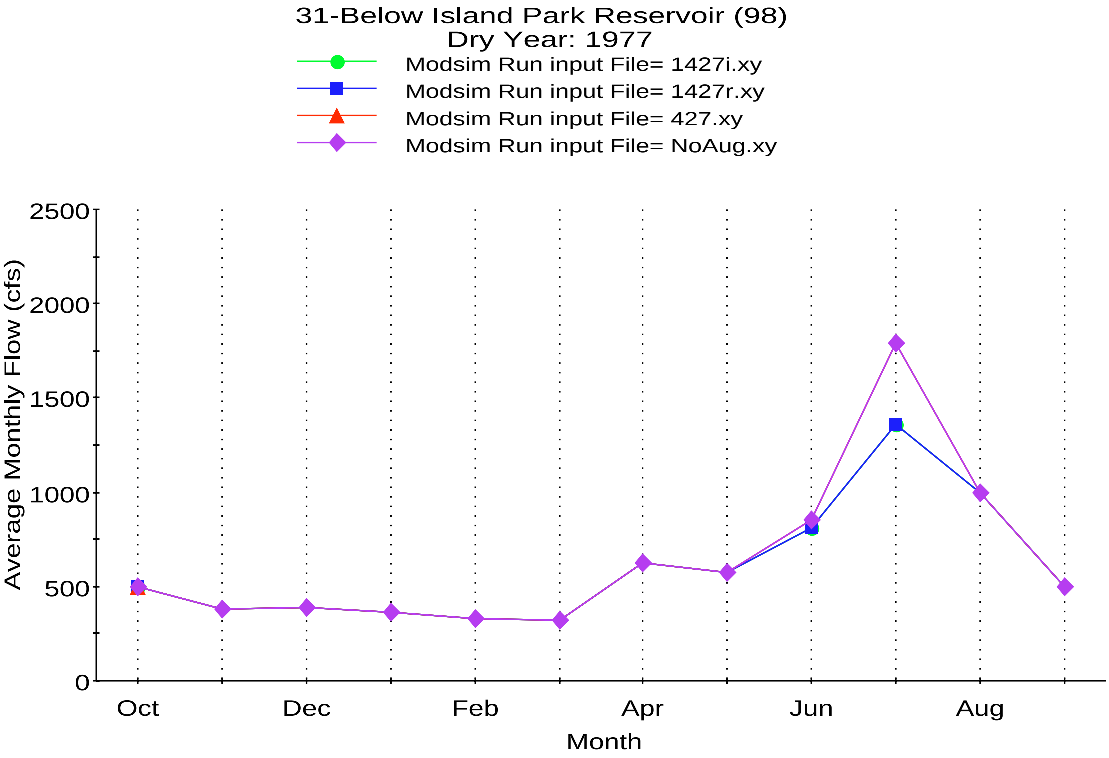

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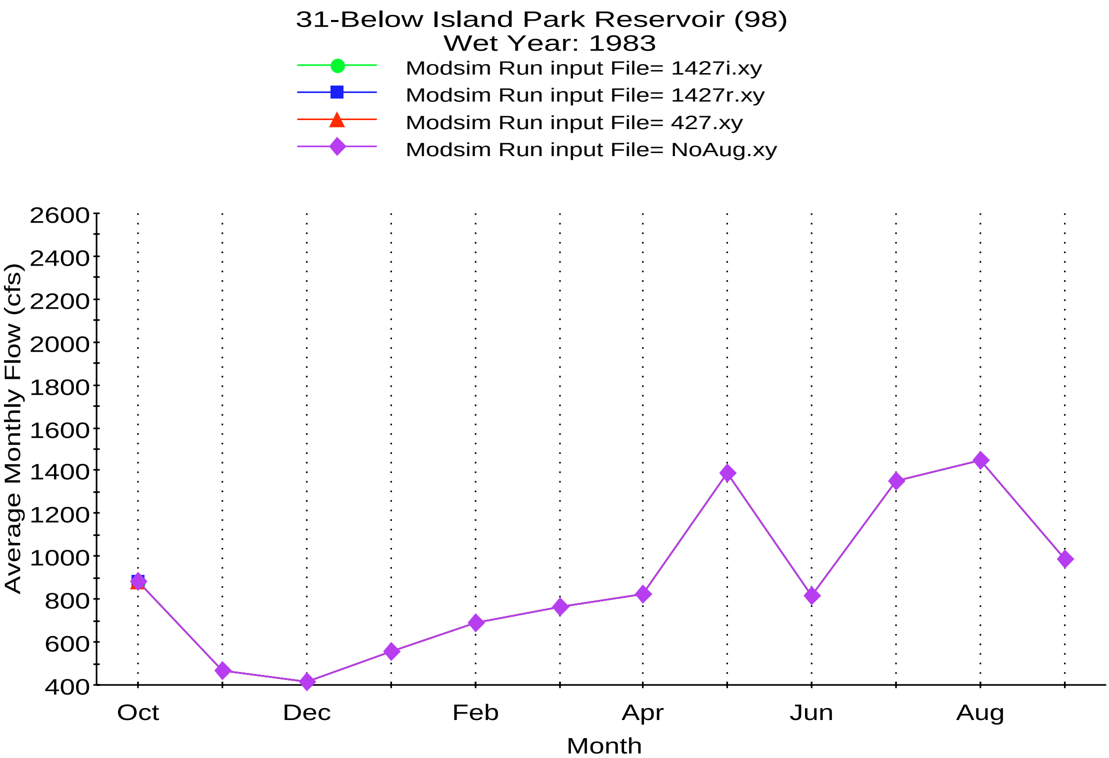

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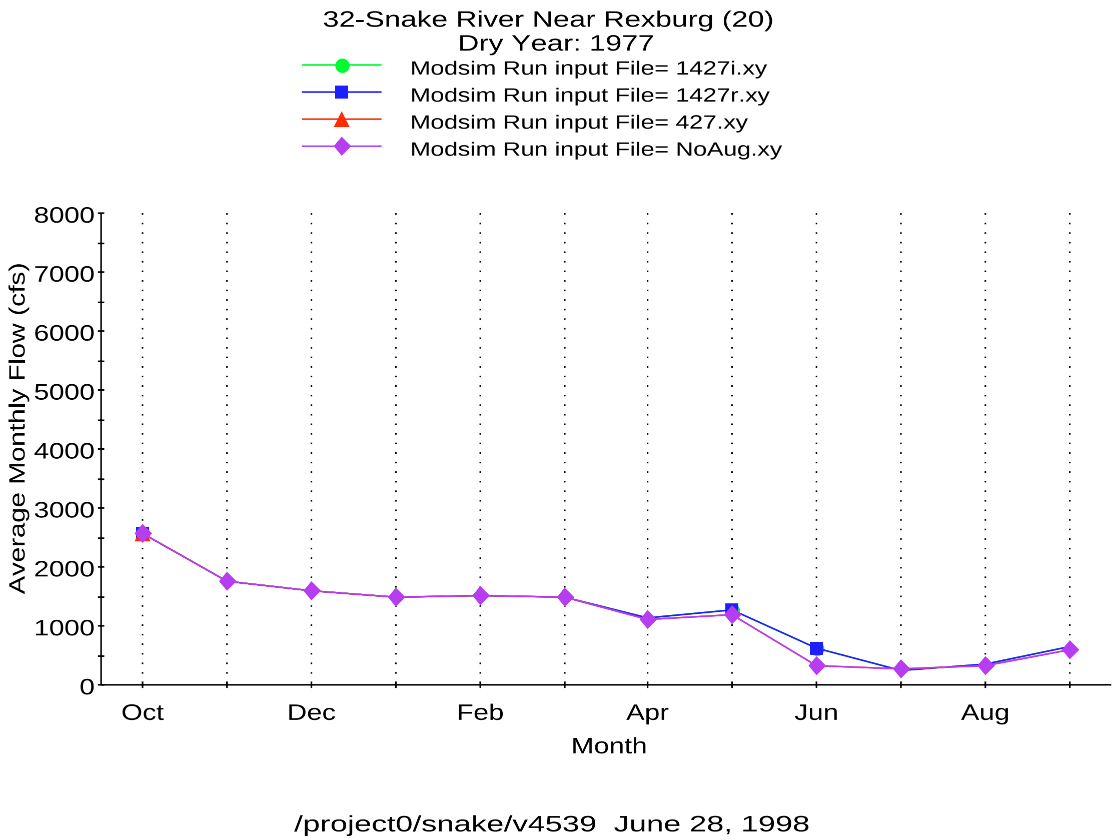
32-Snake River Near Rexburg (20)
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Modsim Run input File= 1427r.xy
Modsim Run input File= 427.xy
Modsim Run input File= NoAug.xy
Average Monthly Flow (cfs)
8000
7000
6000
5000
4000
3000
2000
1000
0
Oct
Dec
Feb
Apr
Jun
Aug
Month
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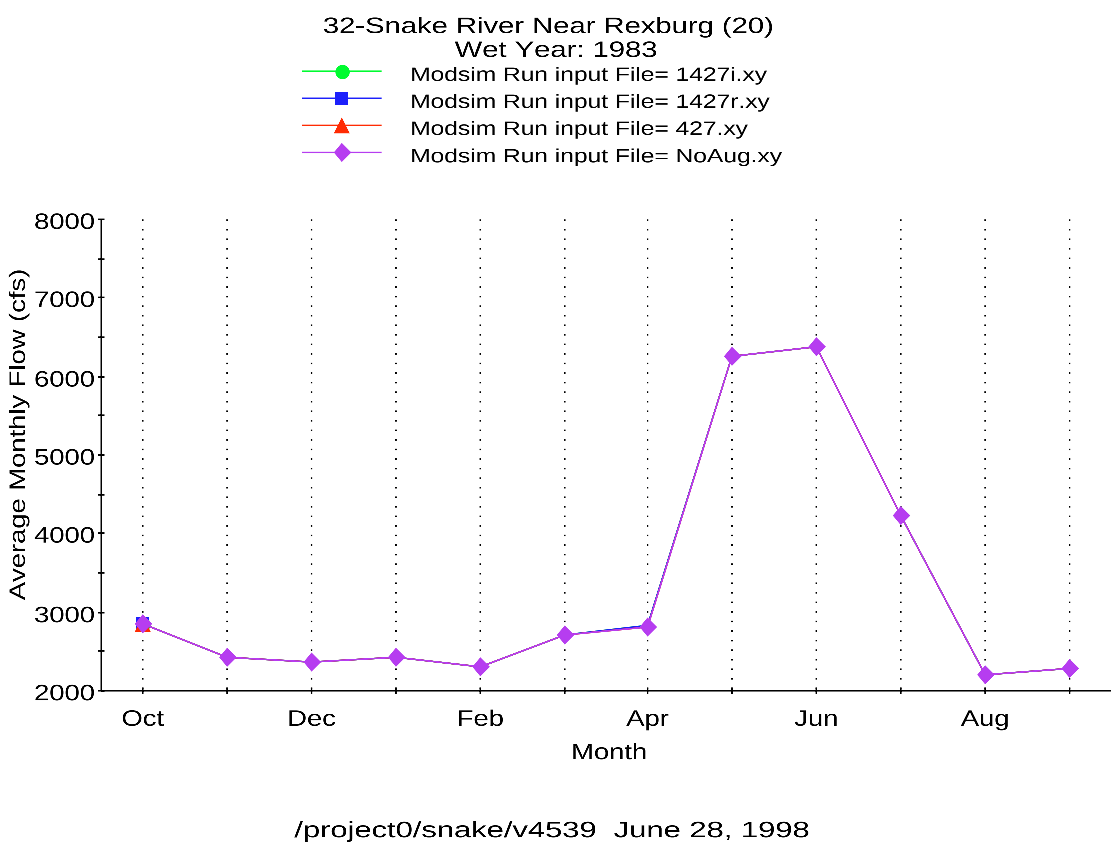
32-Snake River Near Rexburg (20)
Wet Year: 1983
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Modsim Run input File= 1427r.xy
Modsim Run input File= 427.xy
Modsim Run input File= NoAug.xy
Average Monthly Flow (cfs)
8000
7000
6000
5000
4000
3000
2000
Oct
Dec
Feb
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Jun
Aug
Month
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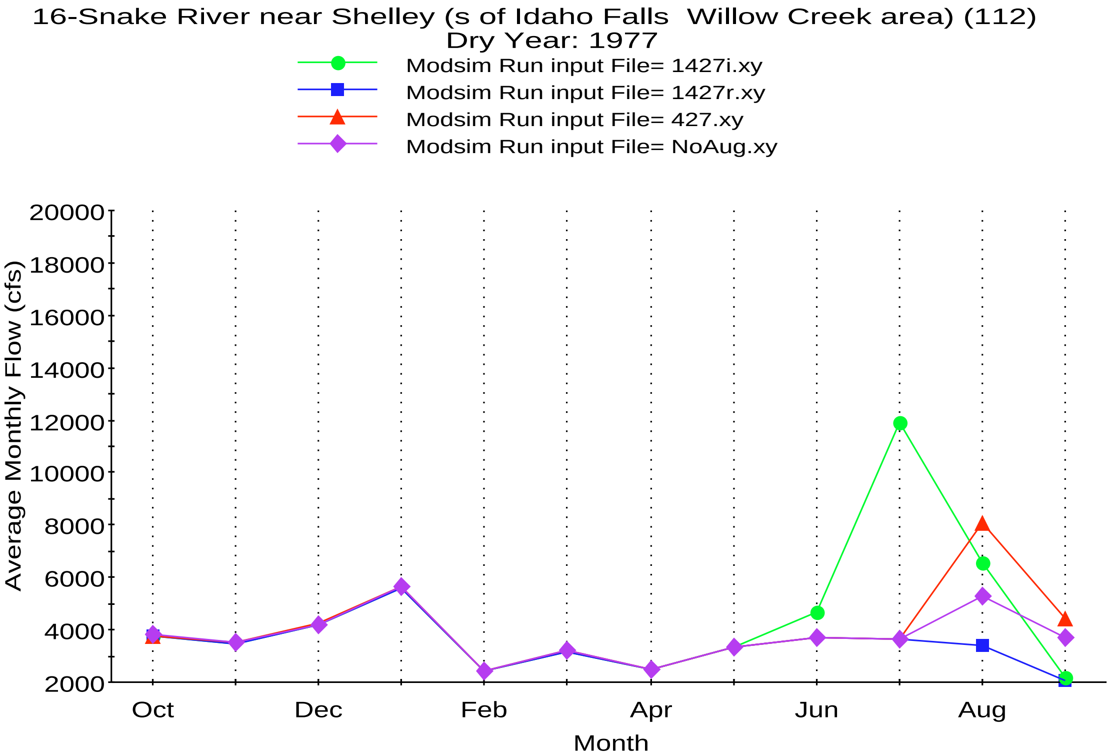

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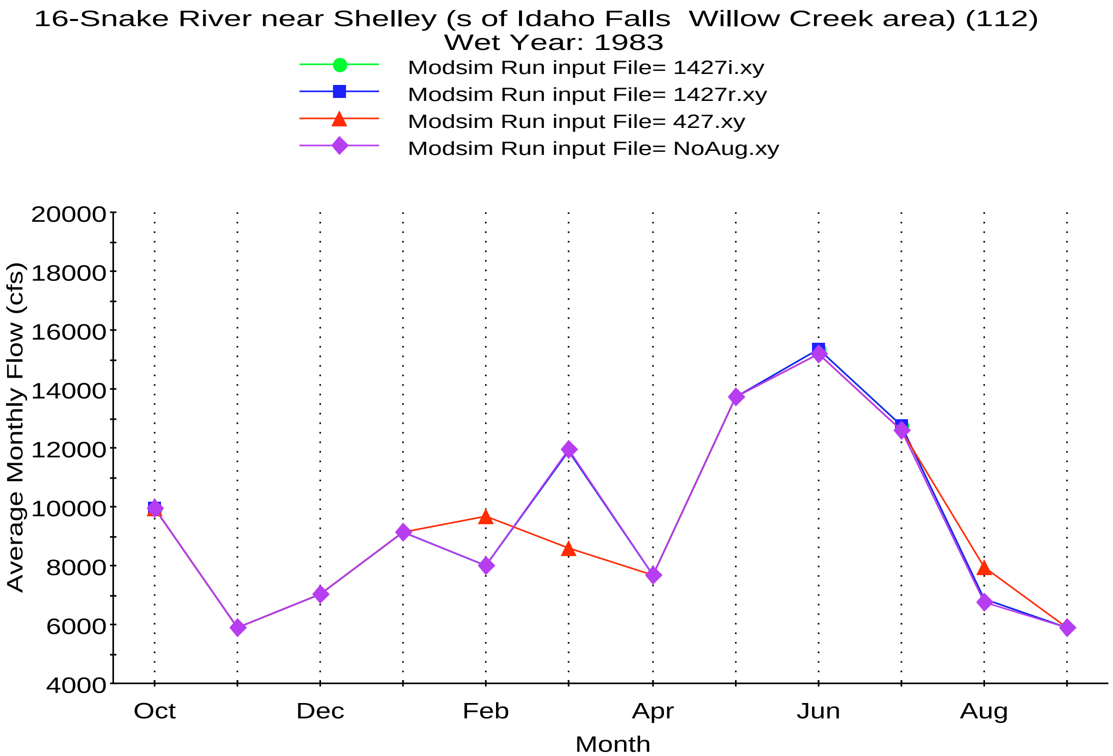

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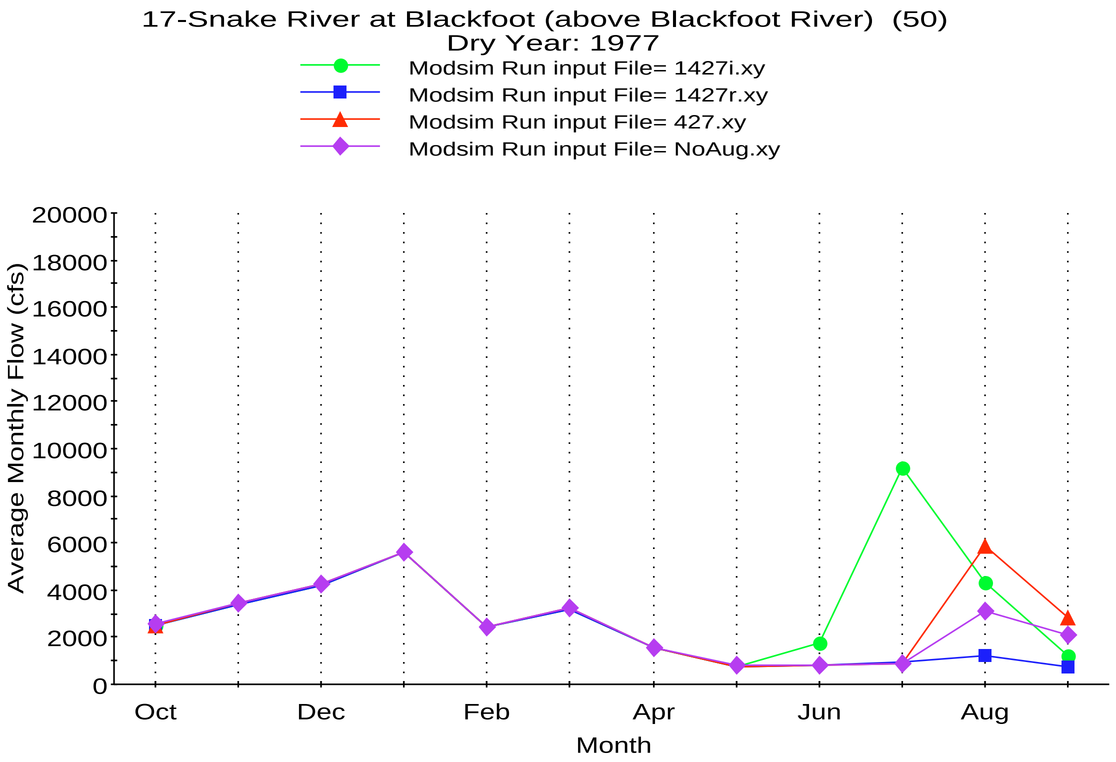

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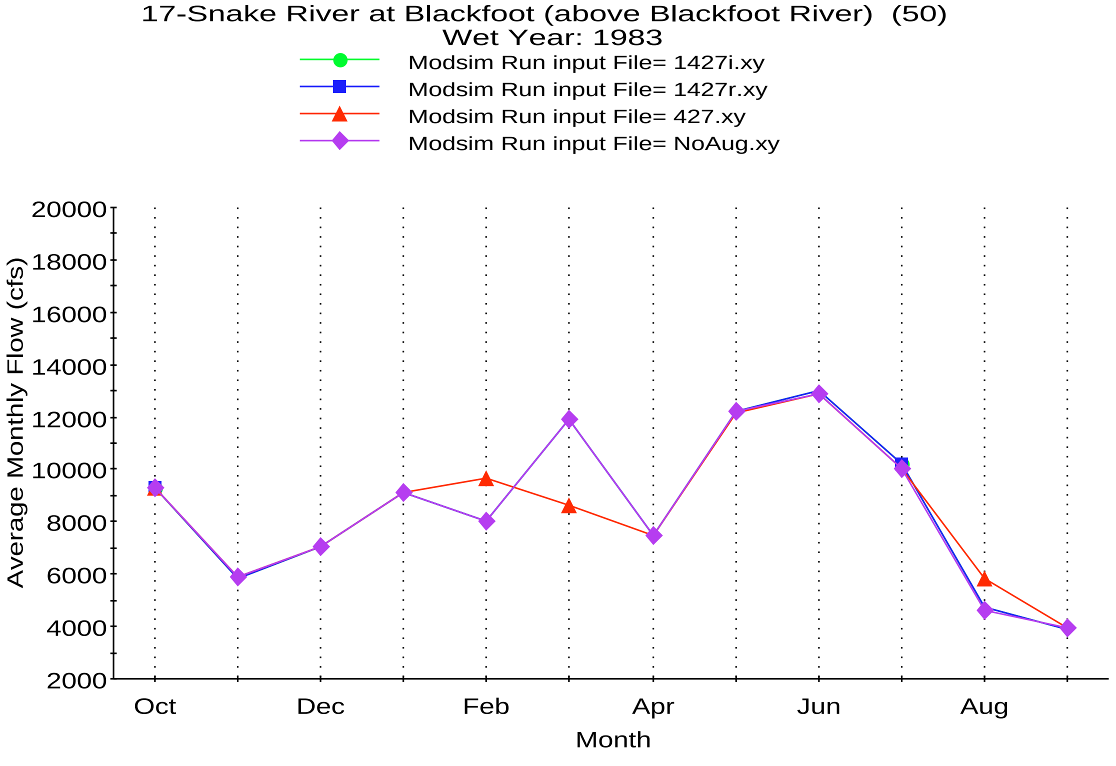

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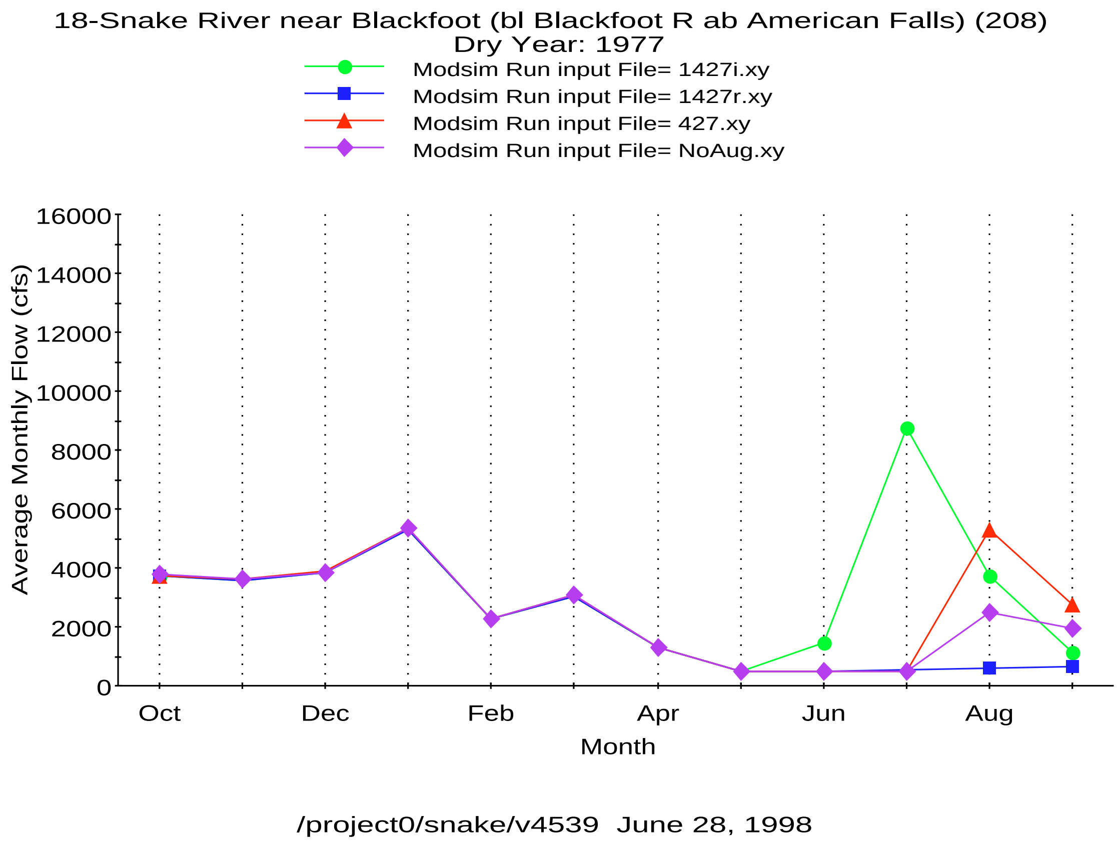
18-Snake River near Blackfoot (bl Blackfoot R ab American Falls) (208)
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Modsim Run input File= 1427r.xy
Modsim Run input File= 427.xy
Modsim Run input File= NoAug.xy
Average Monthly Flow (cfs)
16000
14000
12000
10000
8000
6000
4000
2000
0
Oct
Dec
Feb
Apr
Jun
Aug
Month
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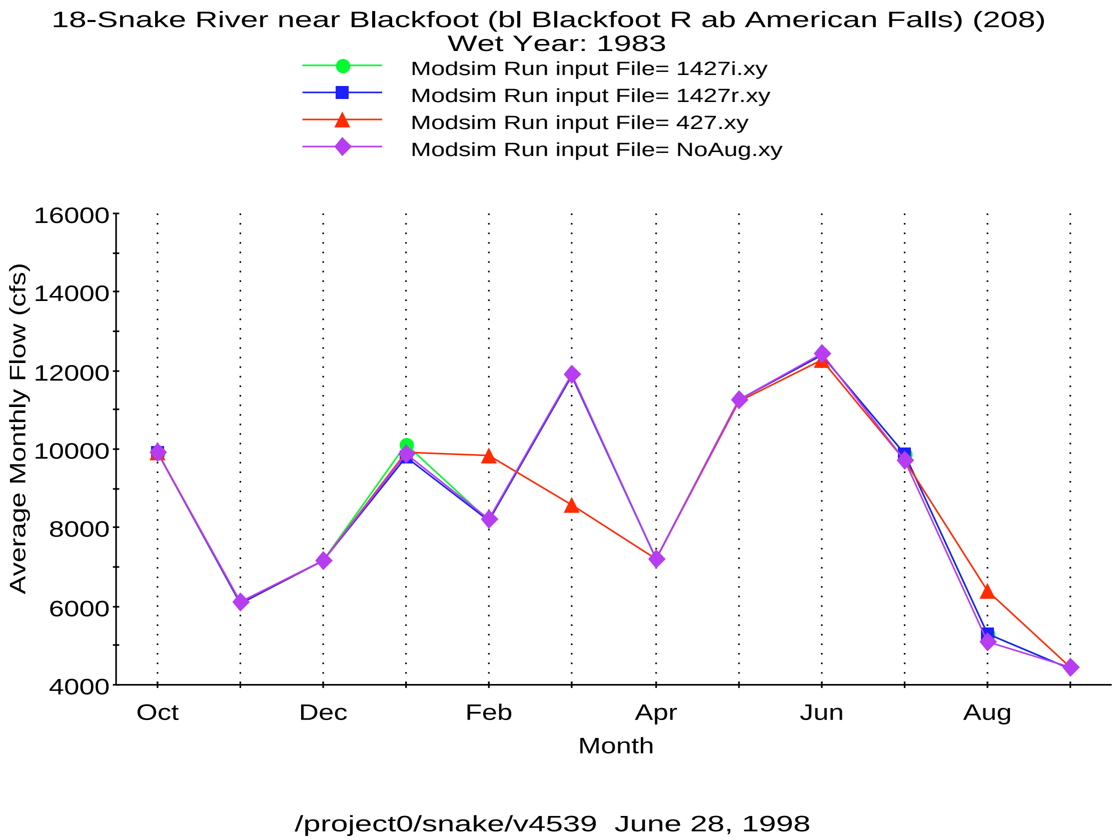
18-Snake River near Blackfoot (bl Blackfoot R ab American Falls) (208)
Wet Year: 1983
Modsim Run input File= 1427i.xy
Modsim Run input File= 1427r.xy
Modsim Run input File= 427.xy
Modsim Run input File= NoAug.xy
Average Monthly Flow (cfs)
16000
14000
12000
10000
8000
6000
4000
Oct
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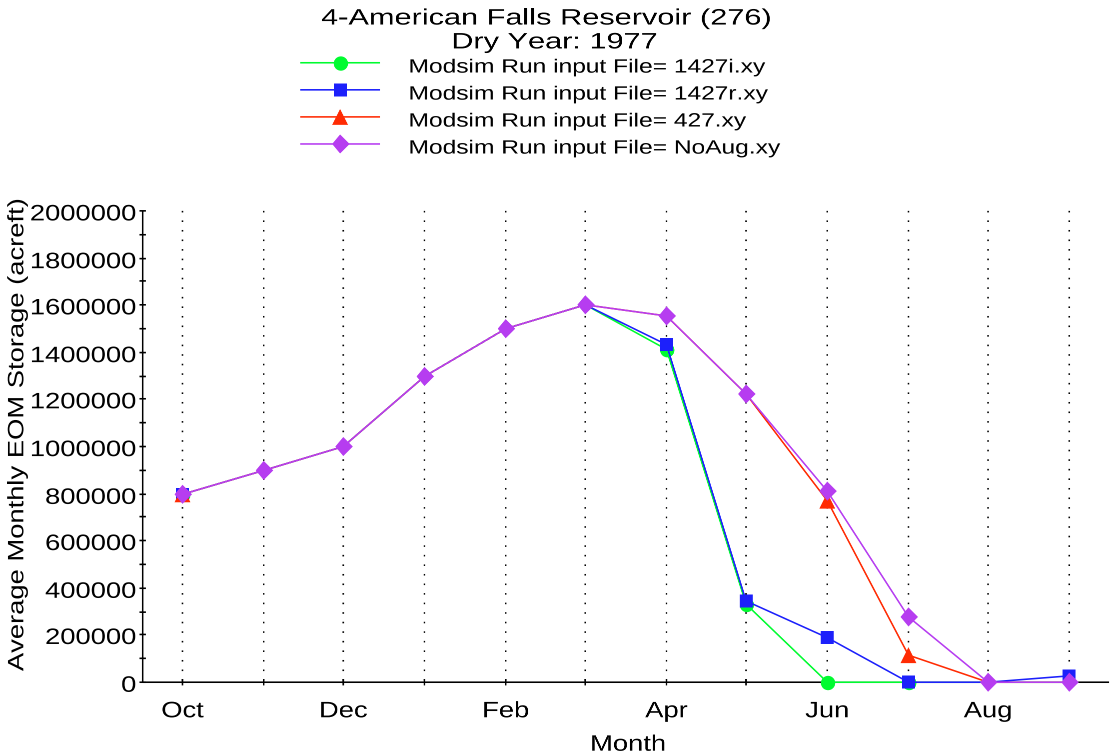

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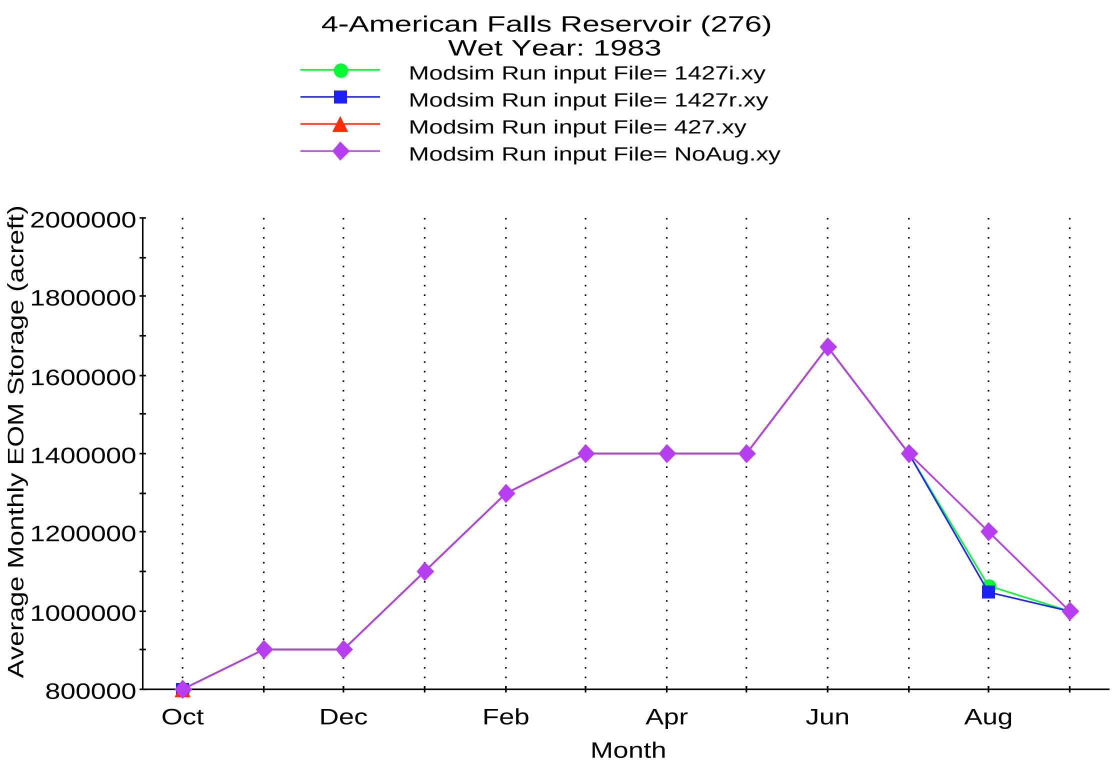

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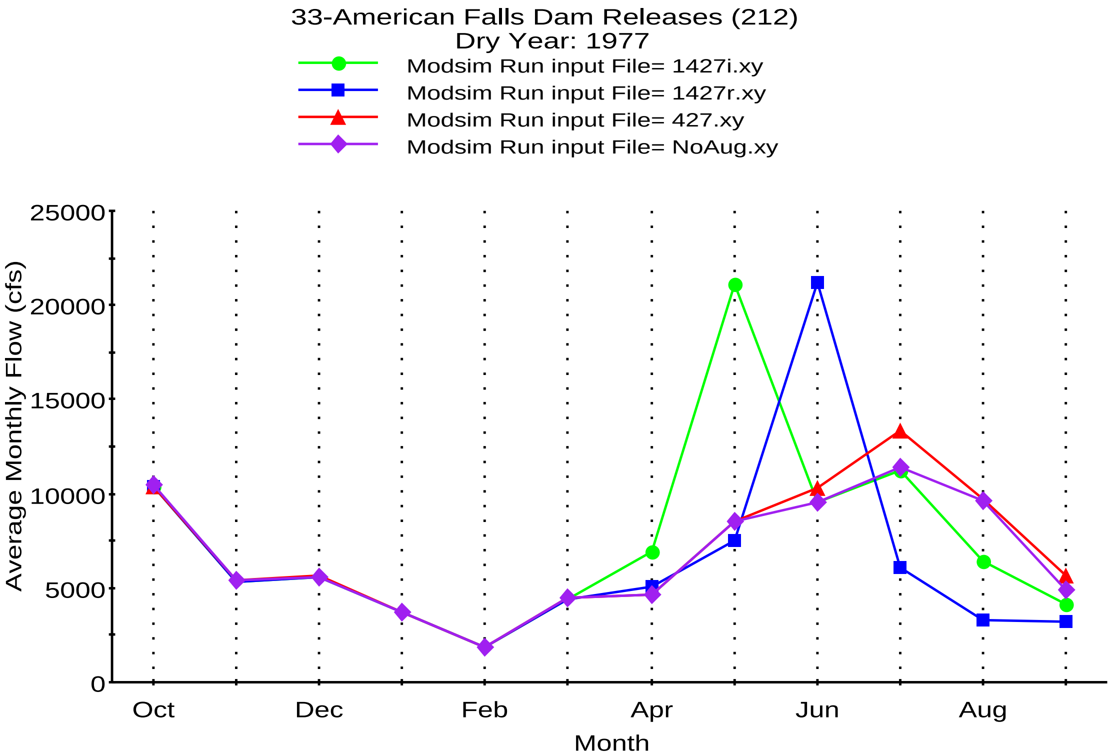

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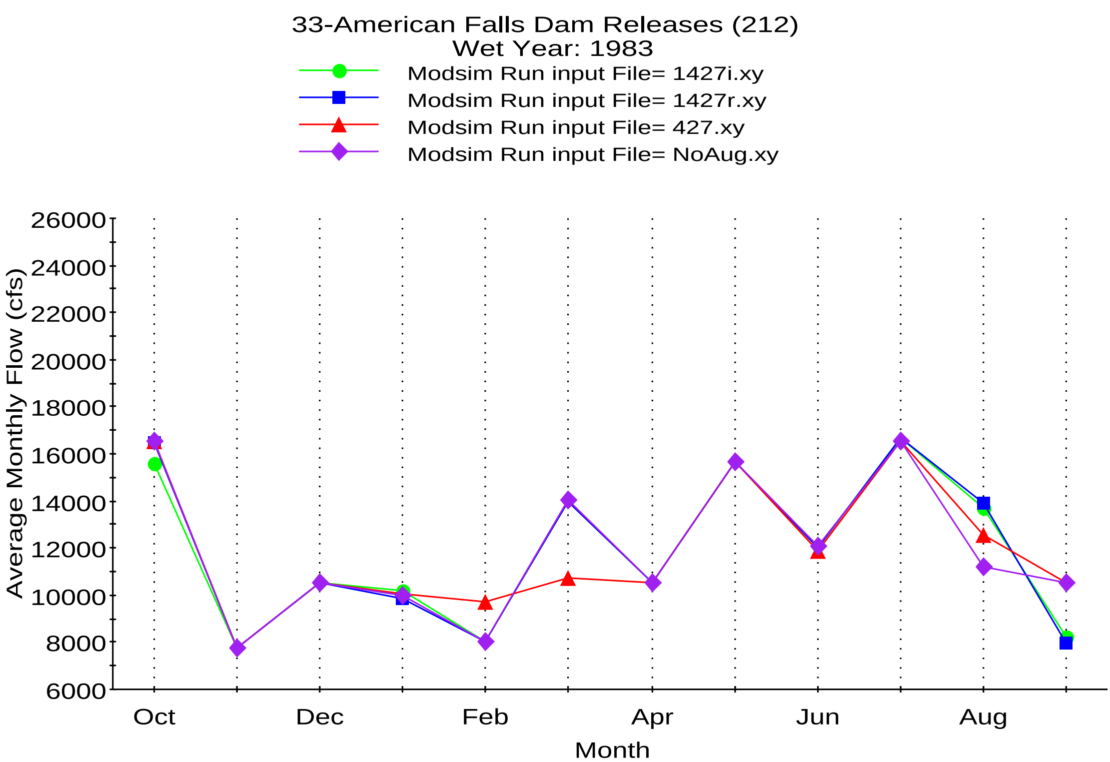

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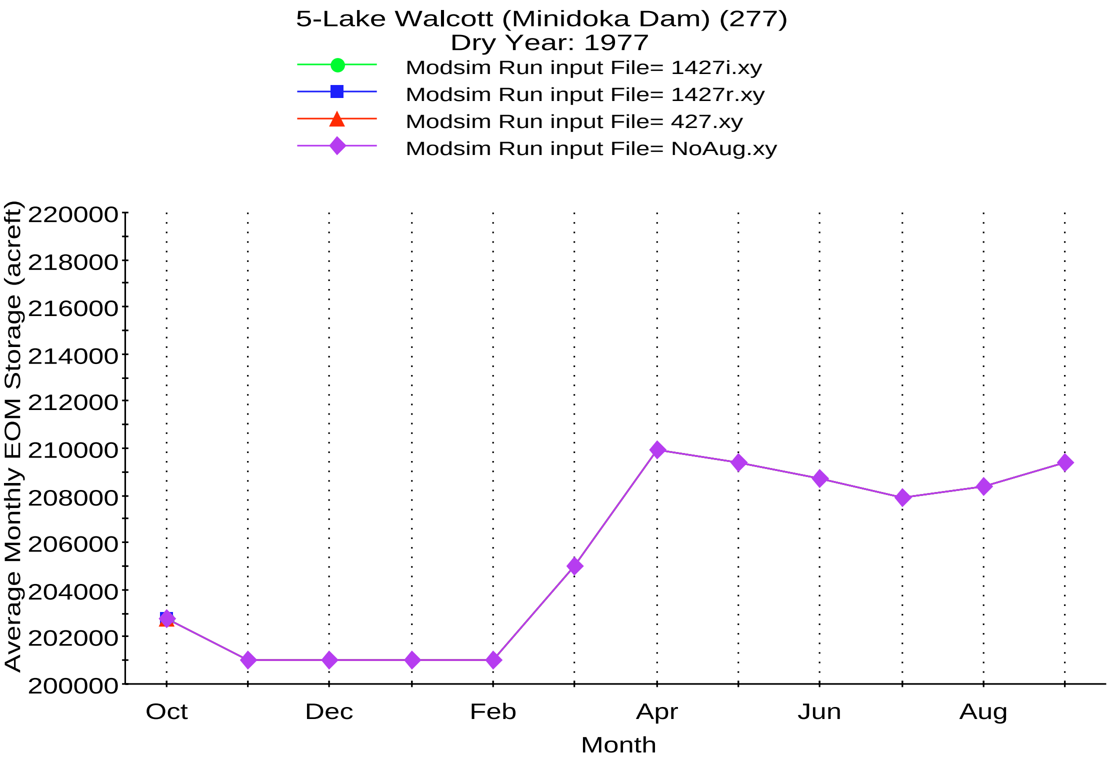

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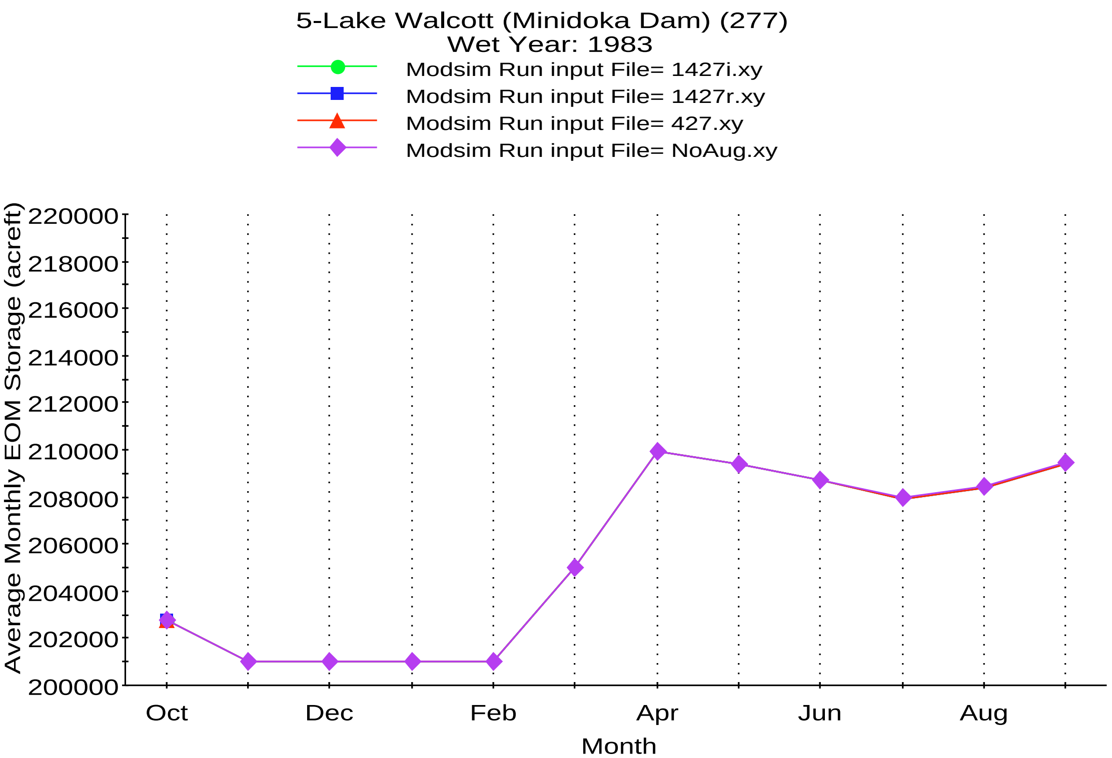

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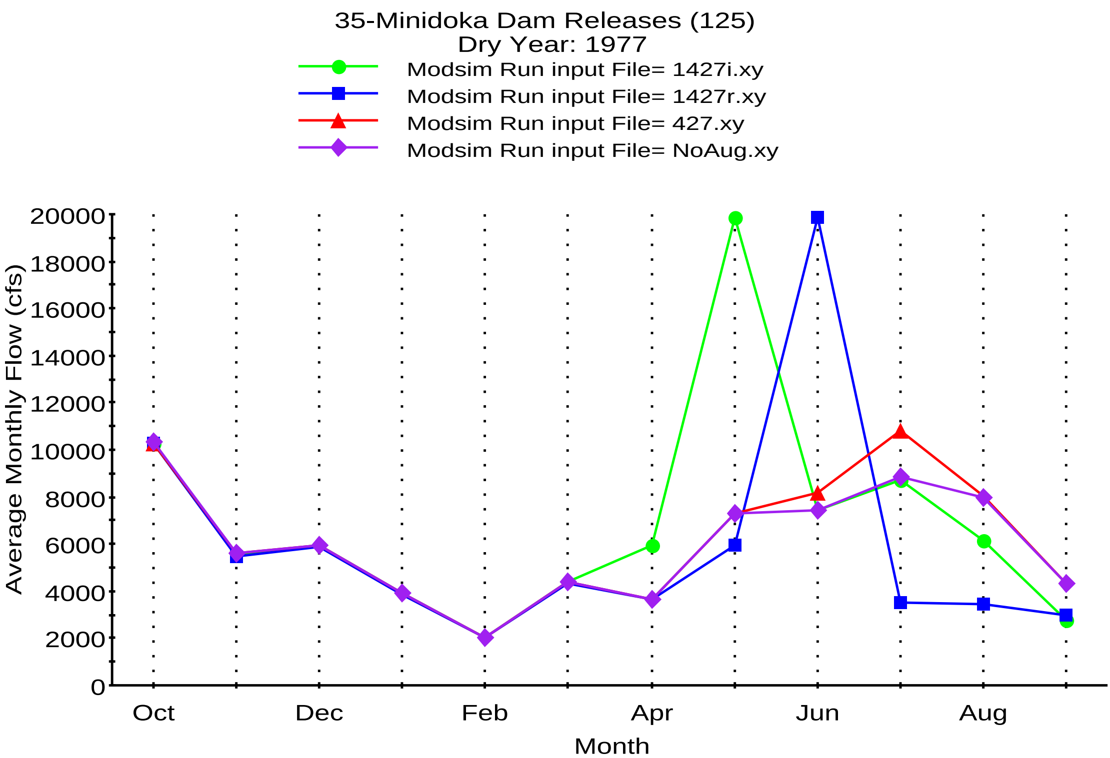

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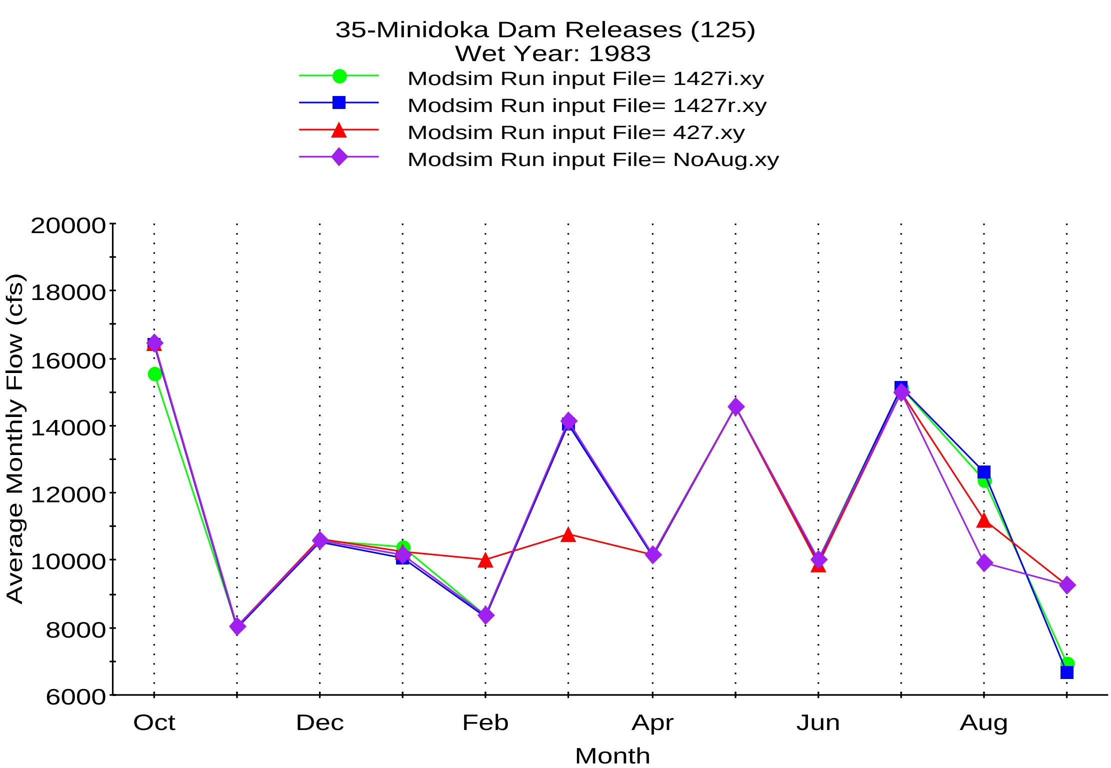

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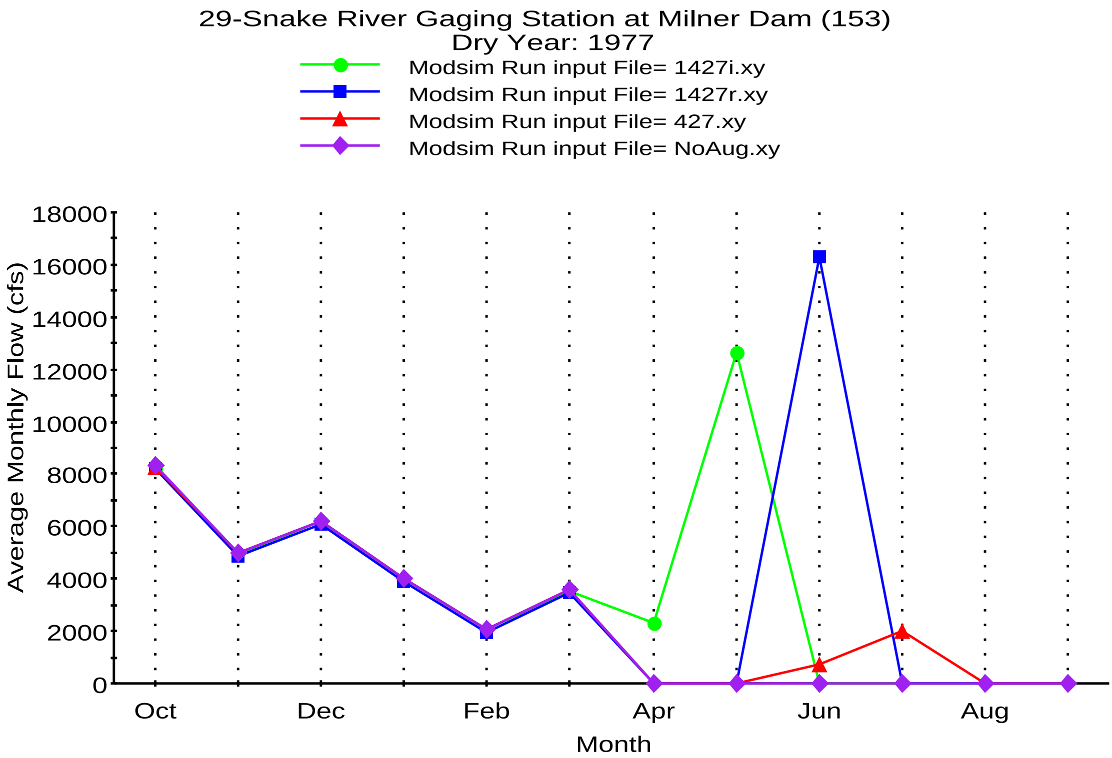

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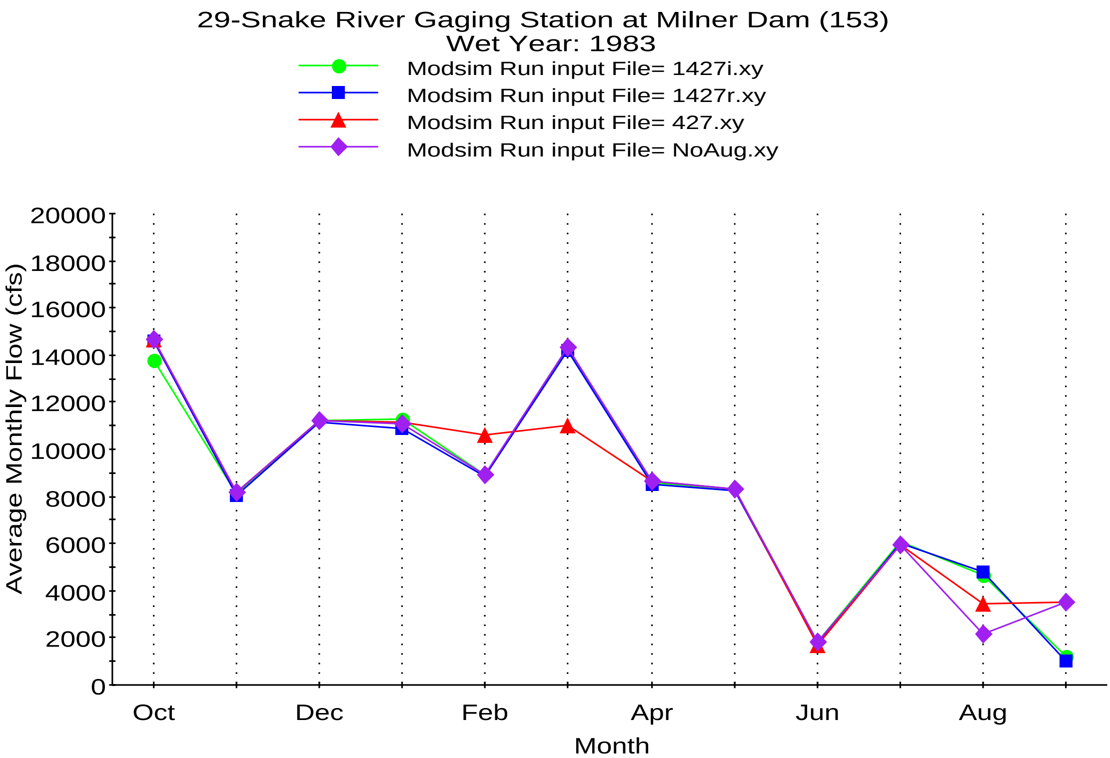

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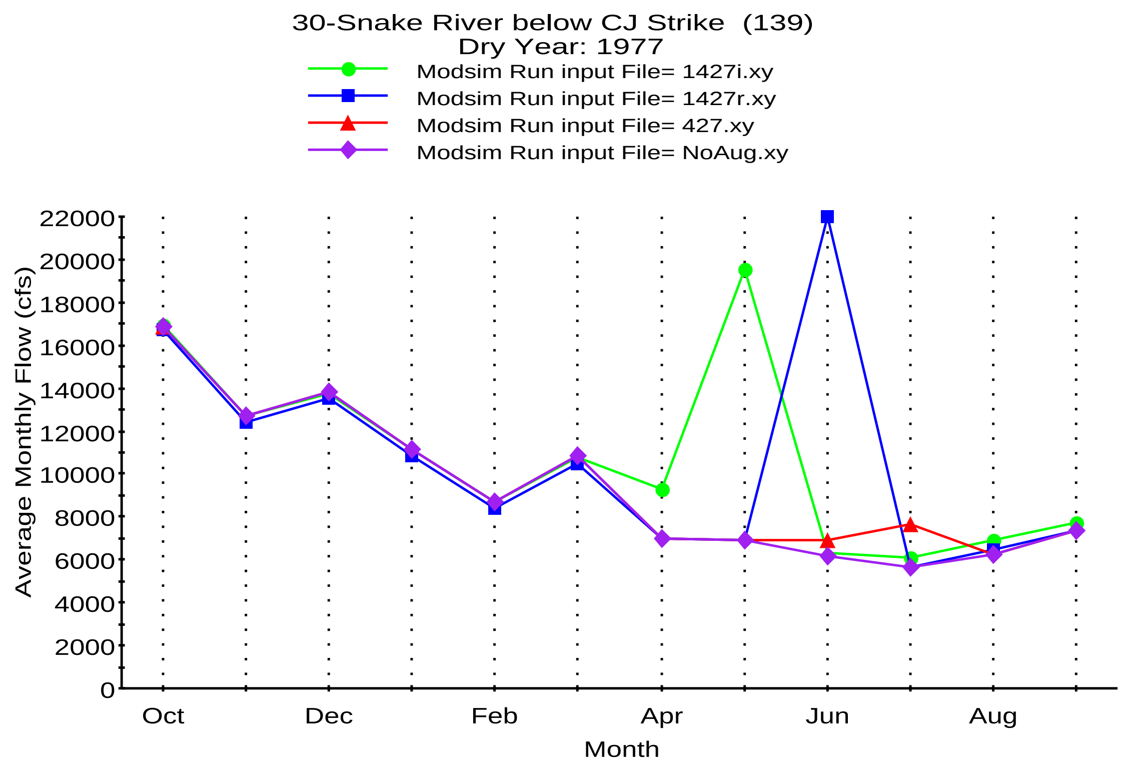

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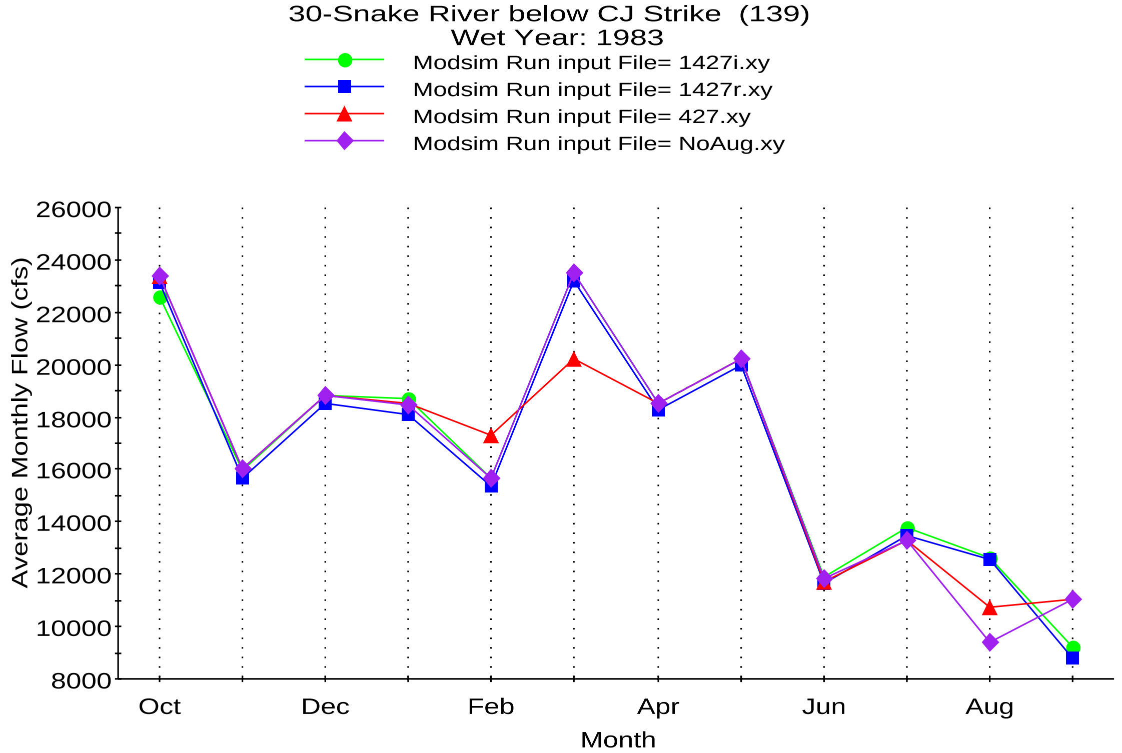

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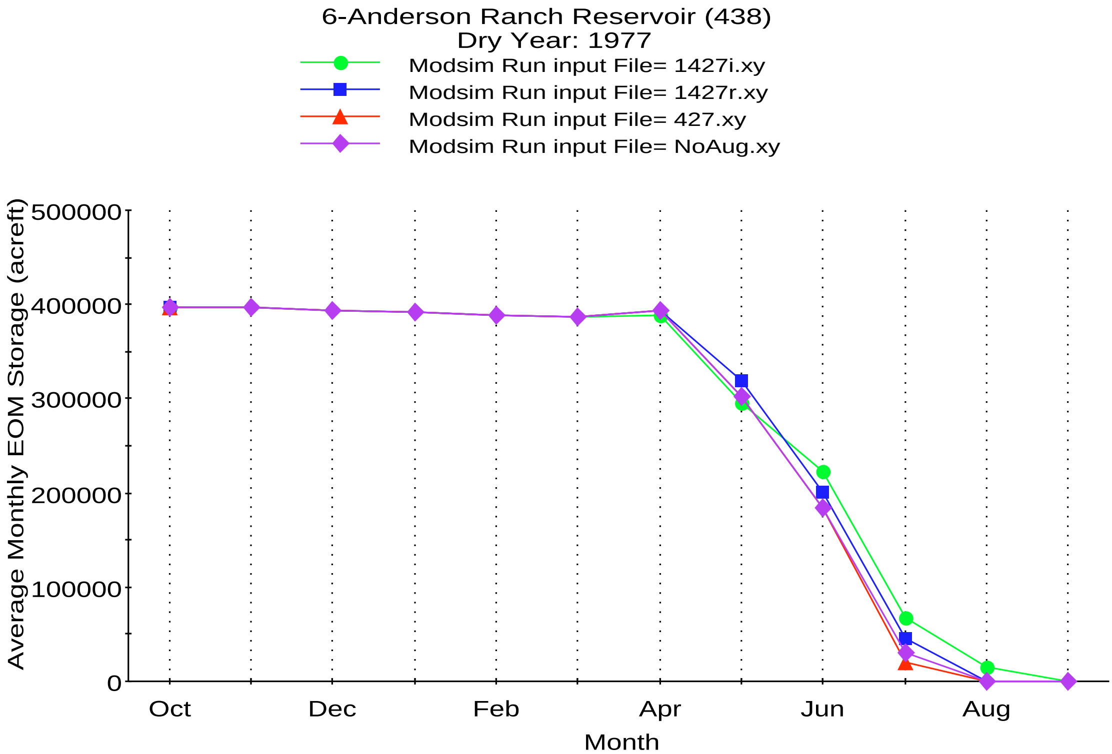

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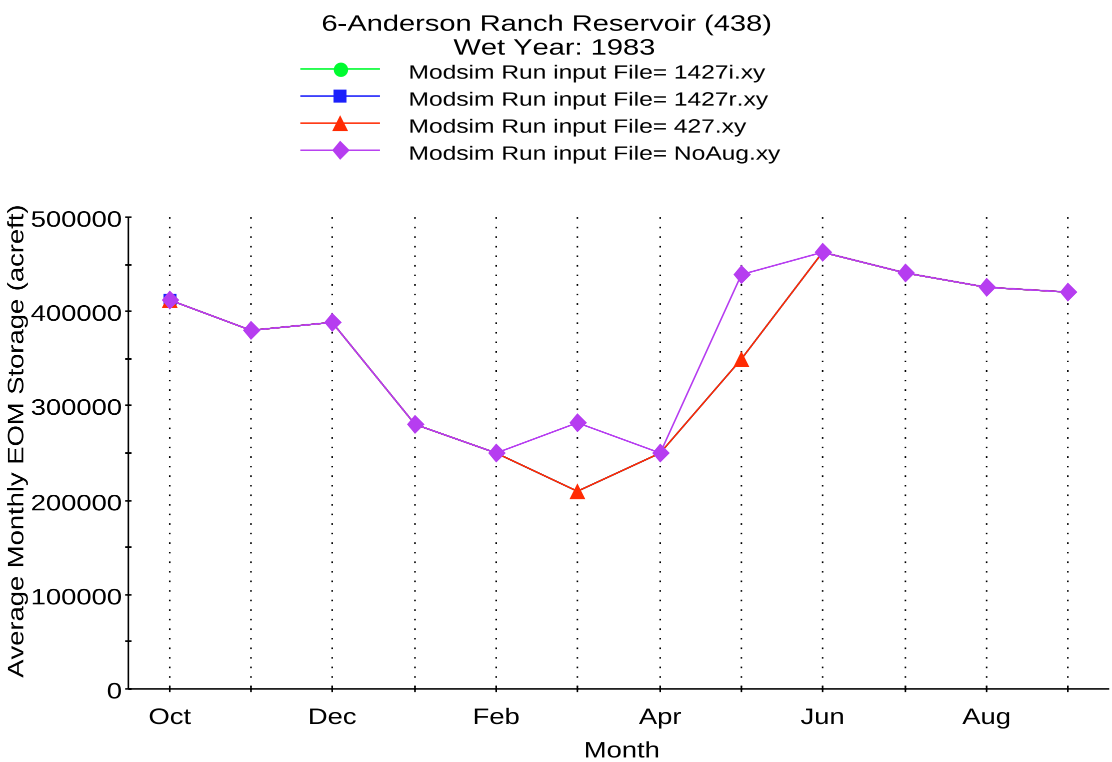

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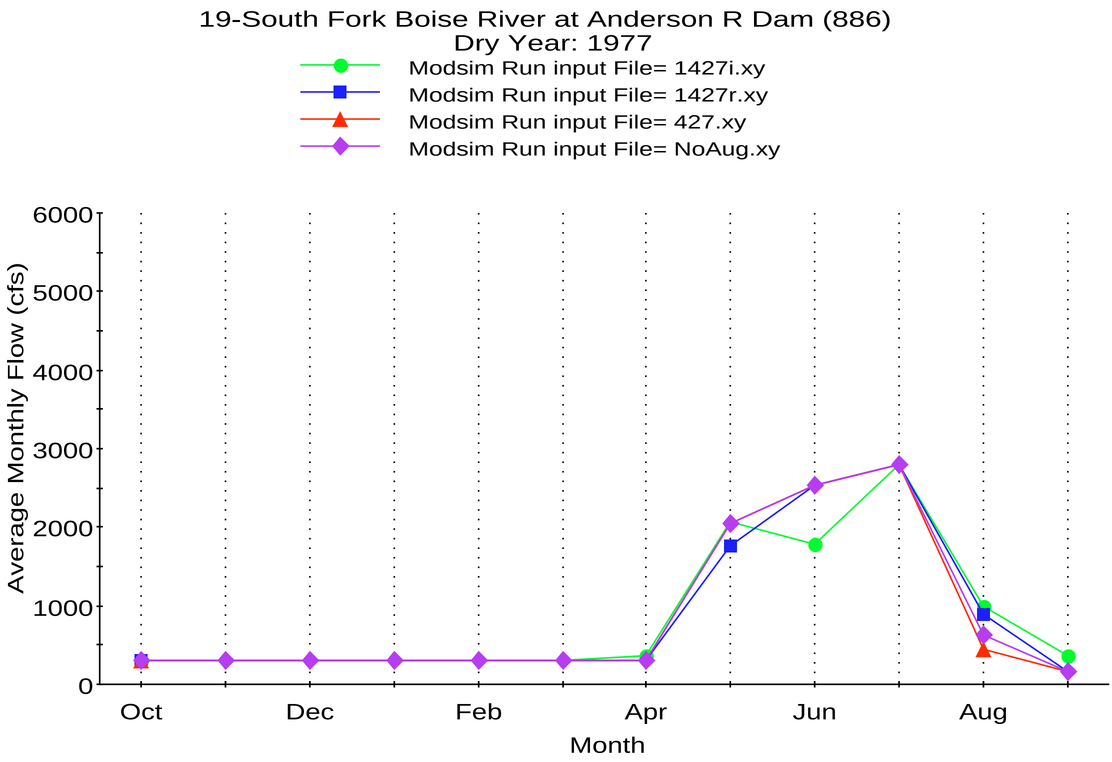

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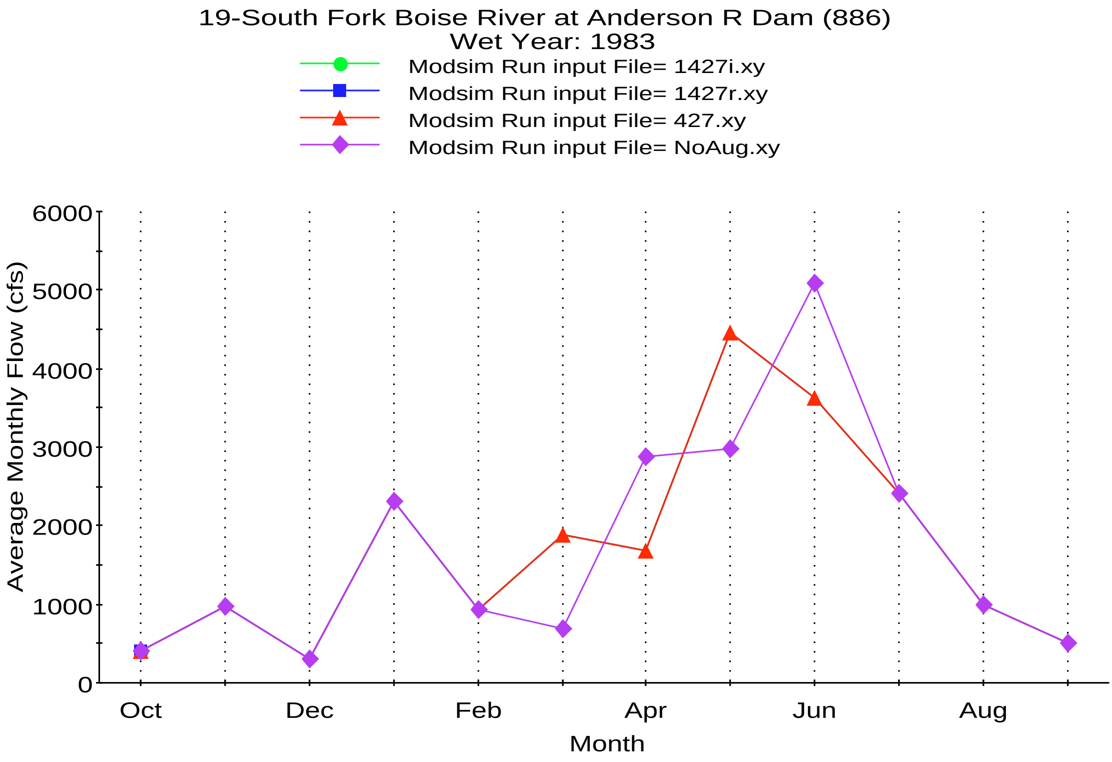

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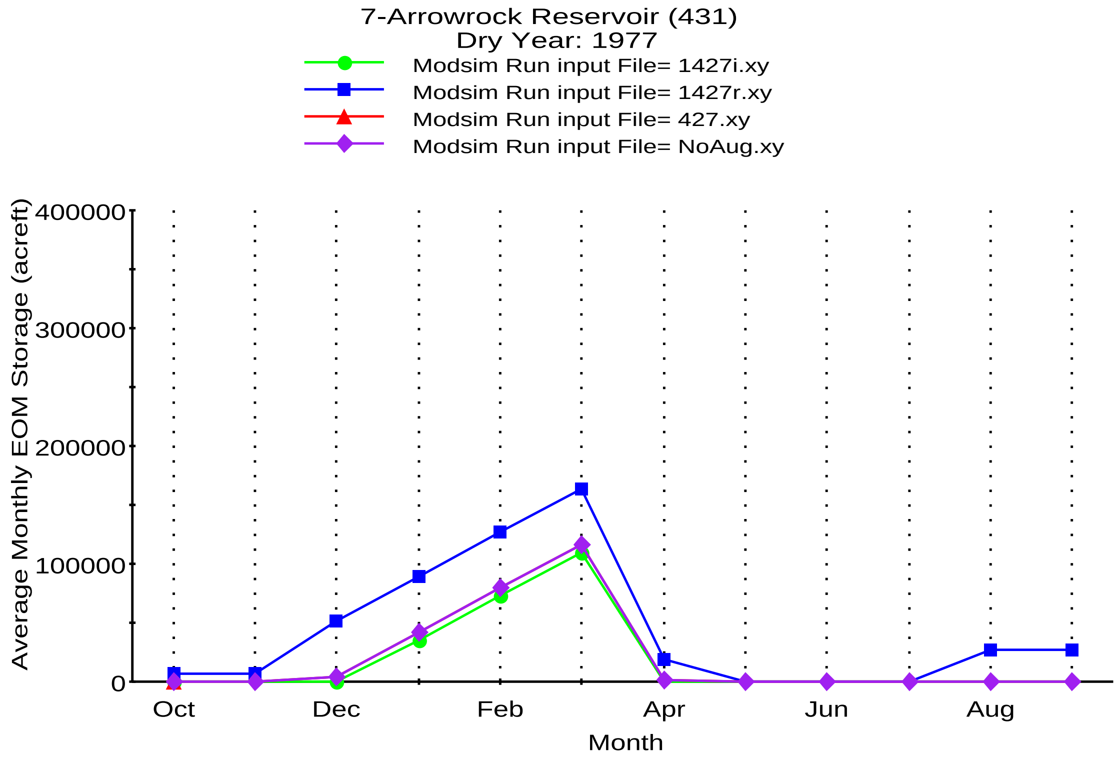

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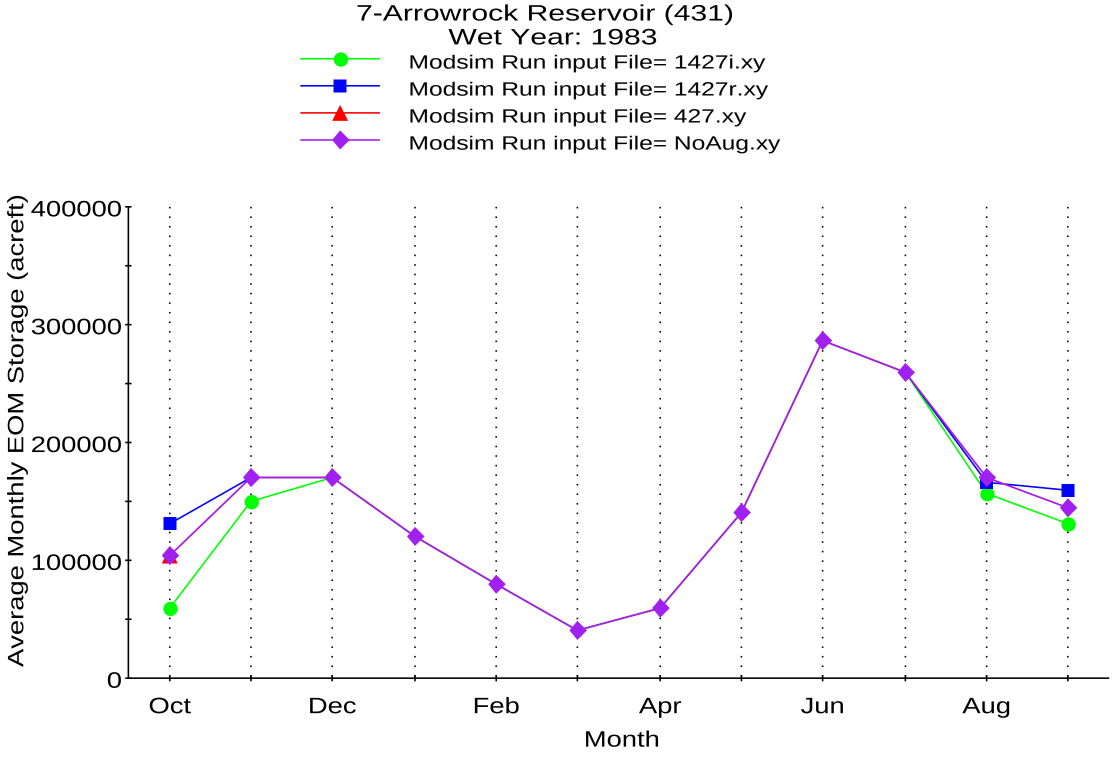

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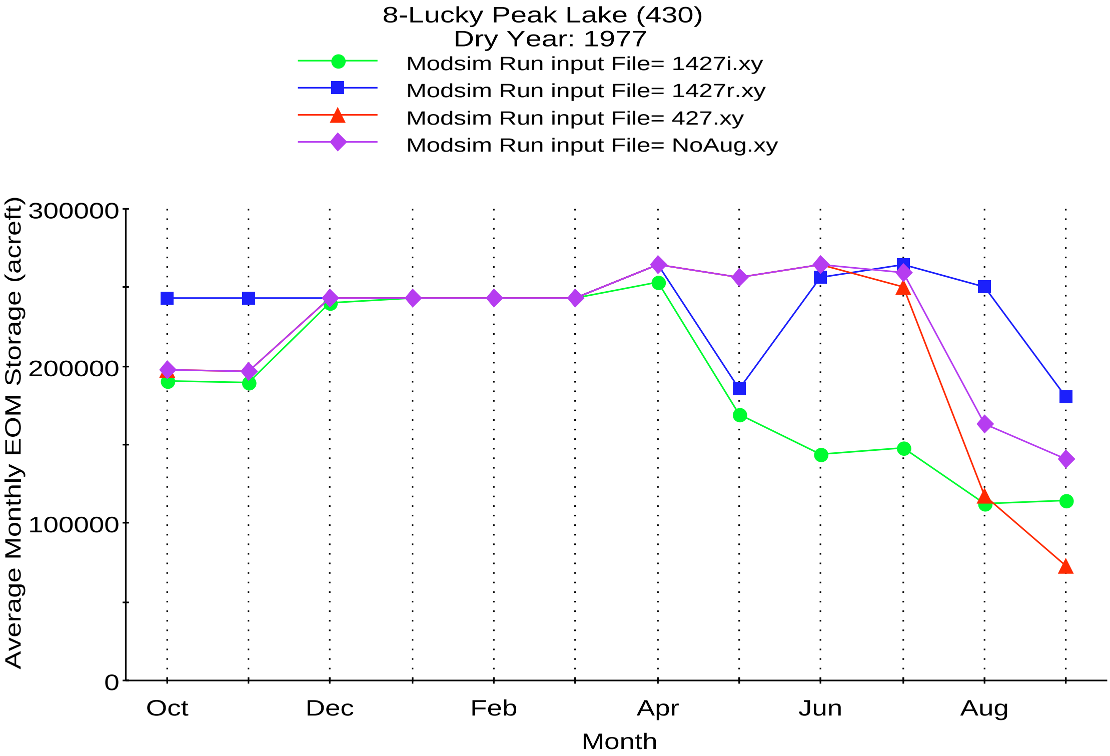

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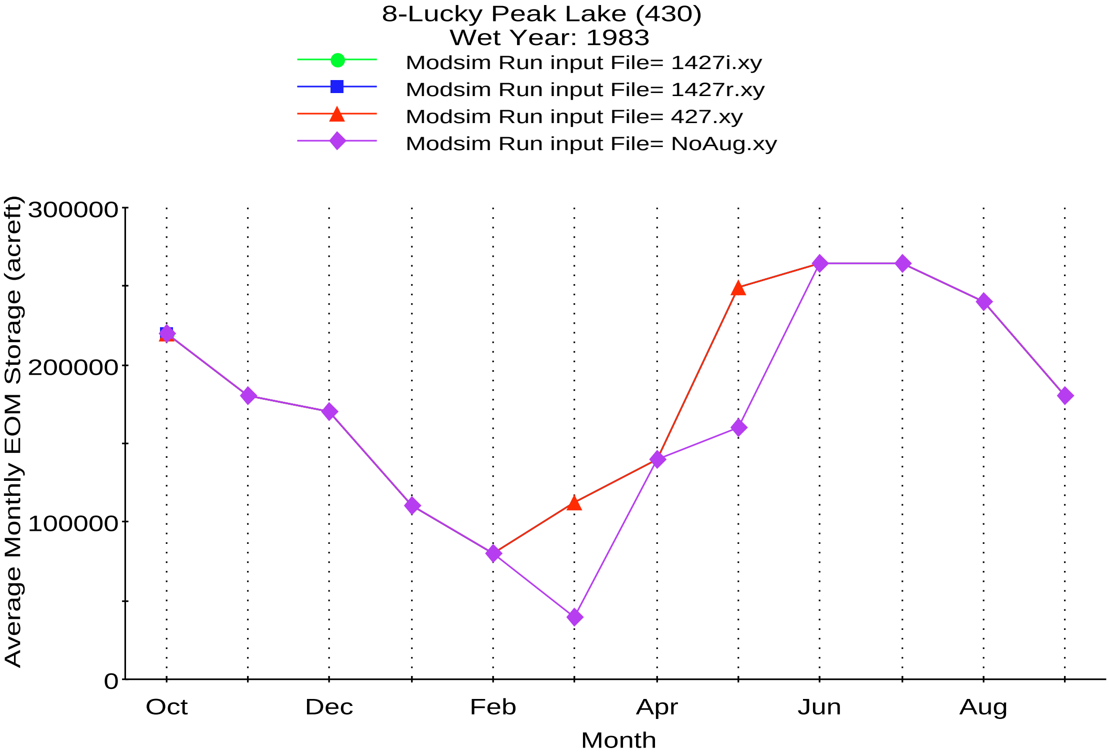

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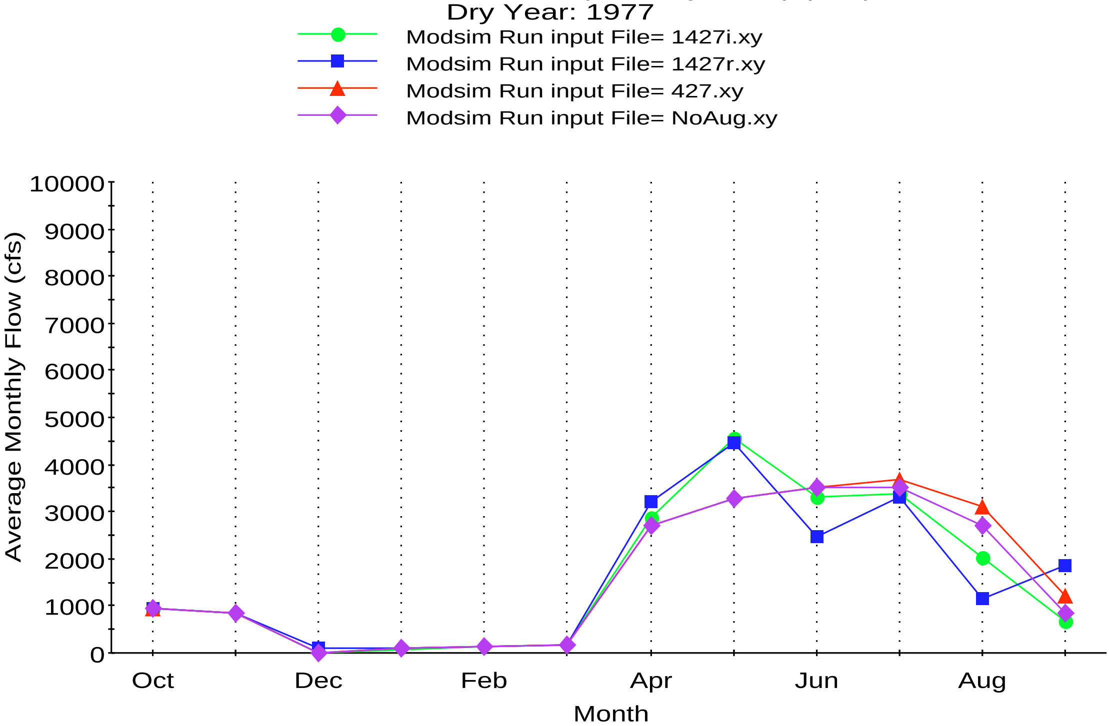
20-Boise River near Boise (bl Lucky Peak) (861)
Dry Year: 1977



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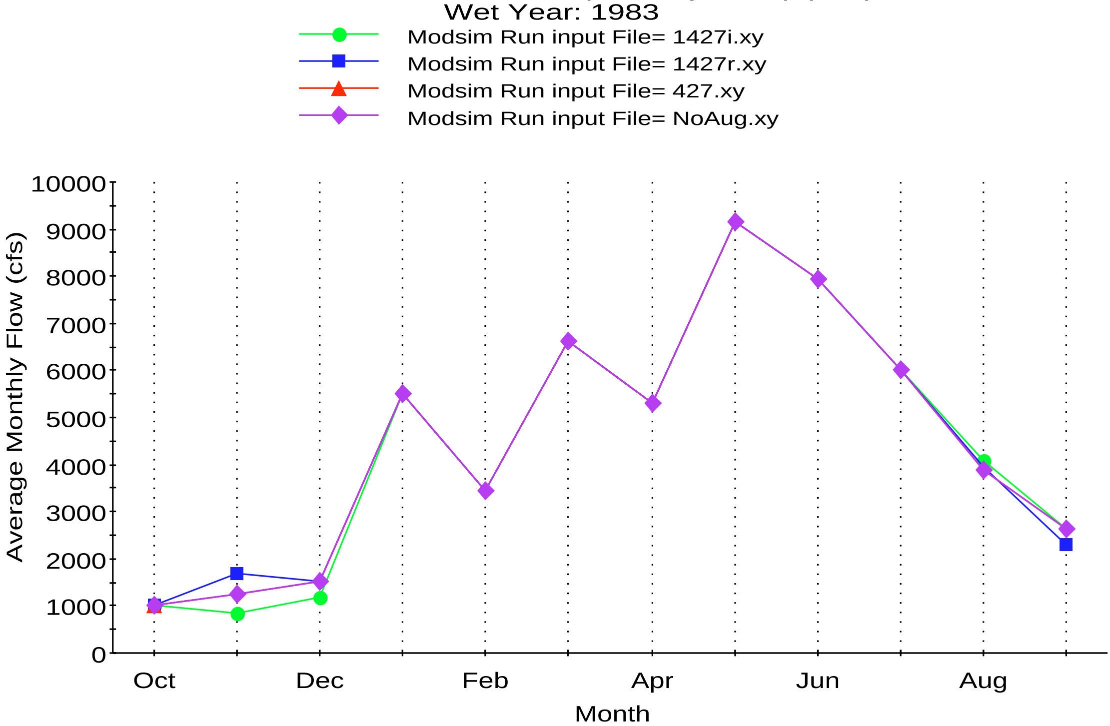
20-Boise River near Boise (bl Lucky Peak) (861)
Wet Year: 1983



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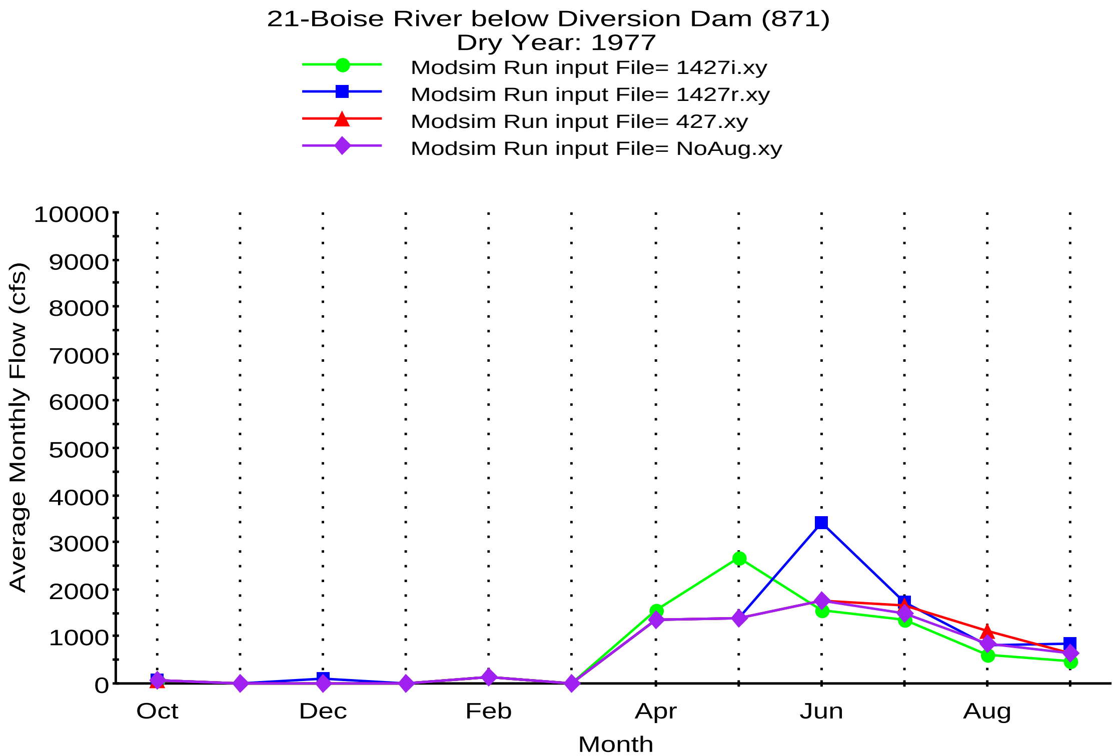

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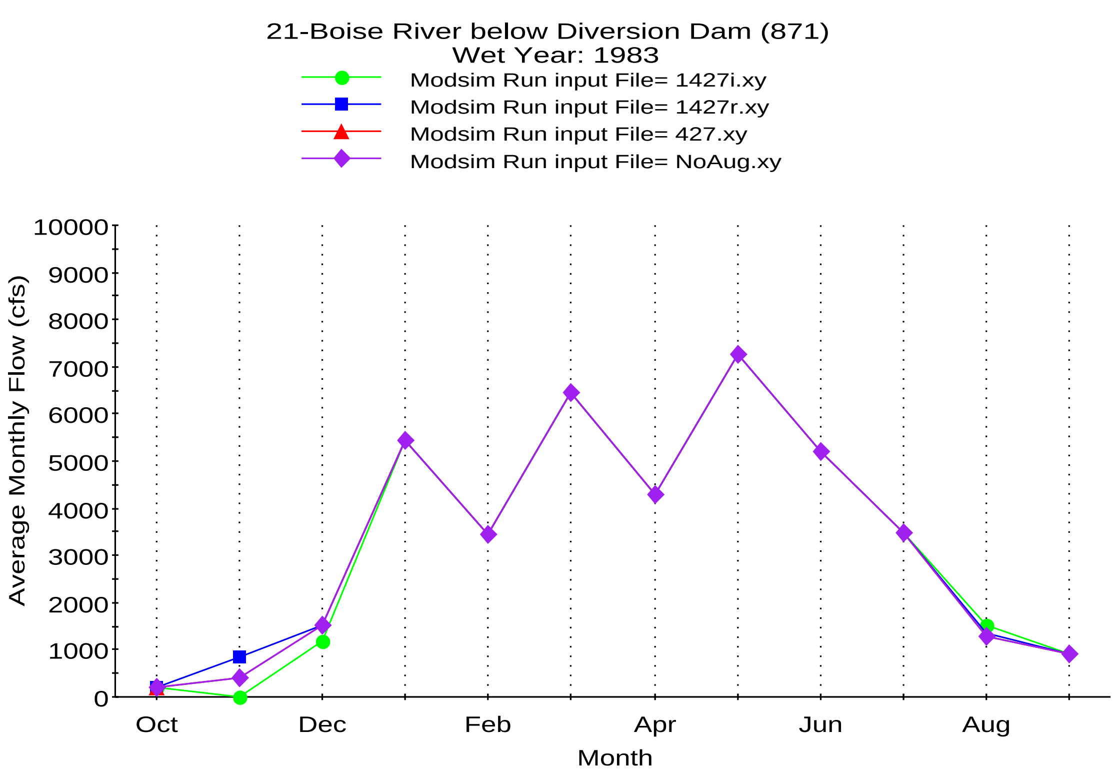

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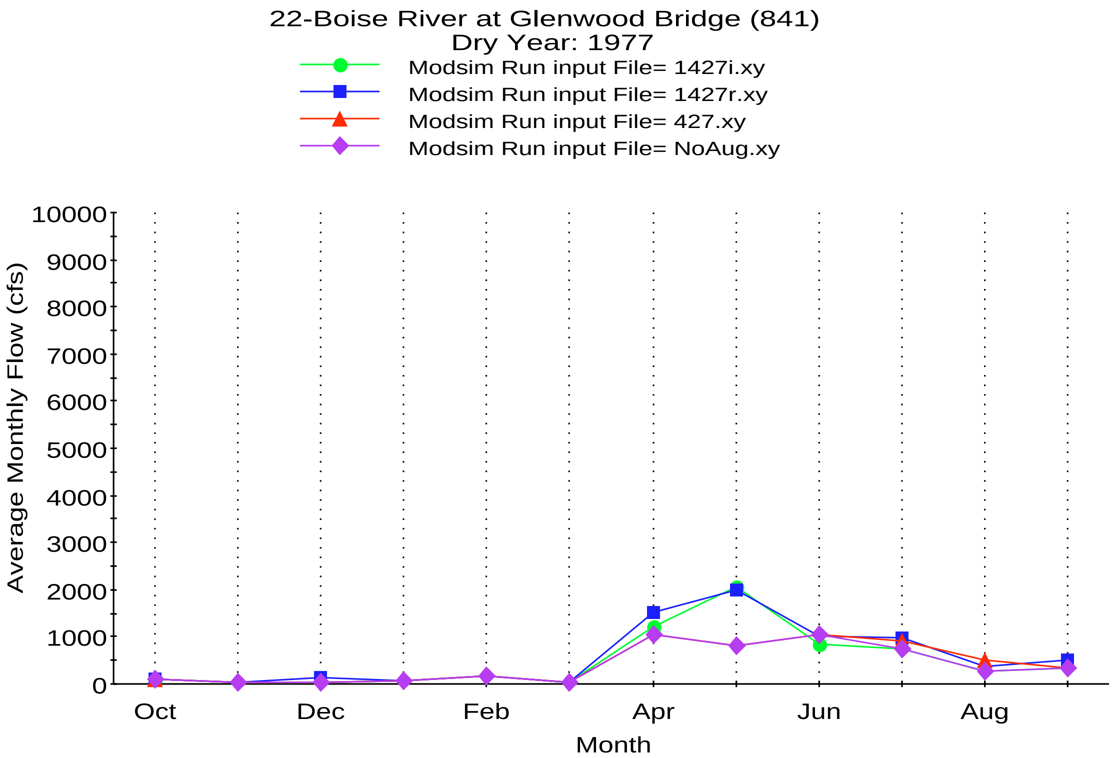

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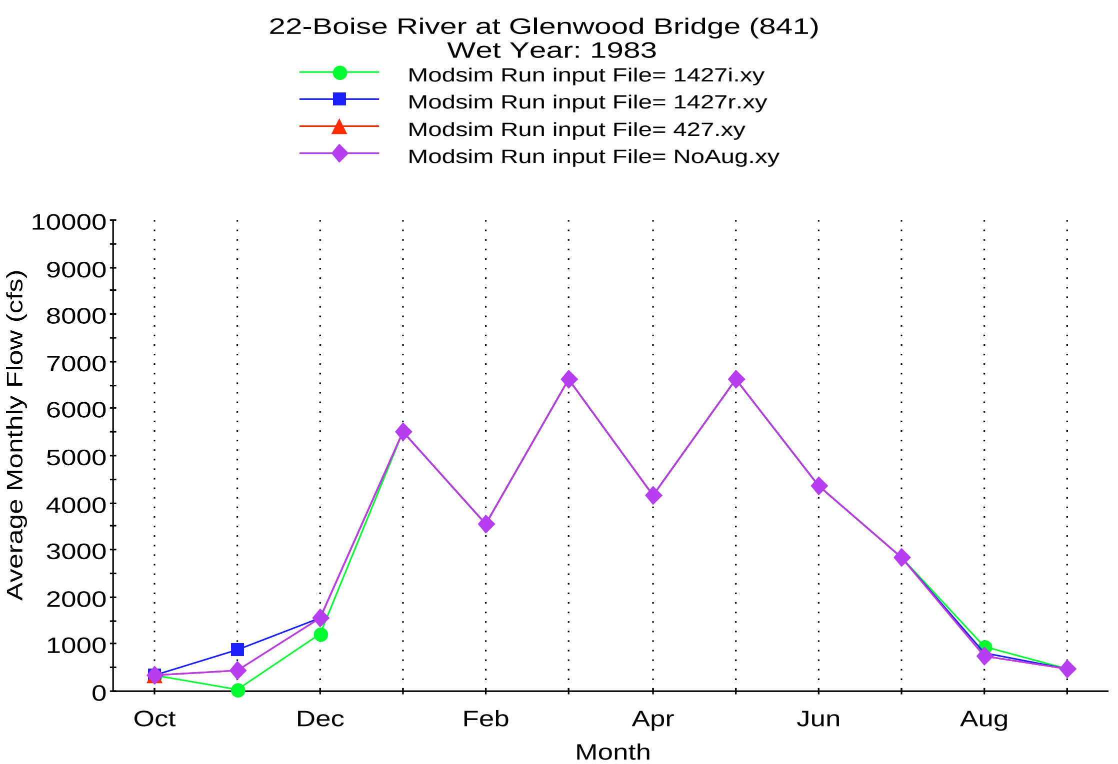

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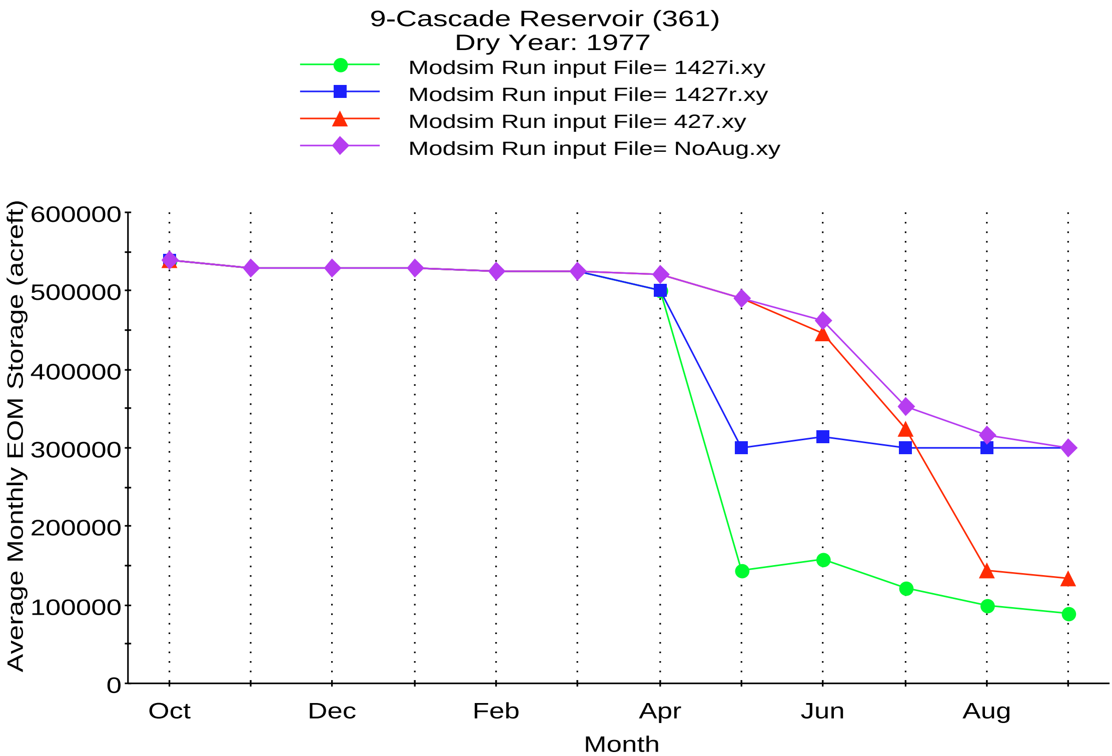

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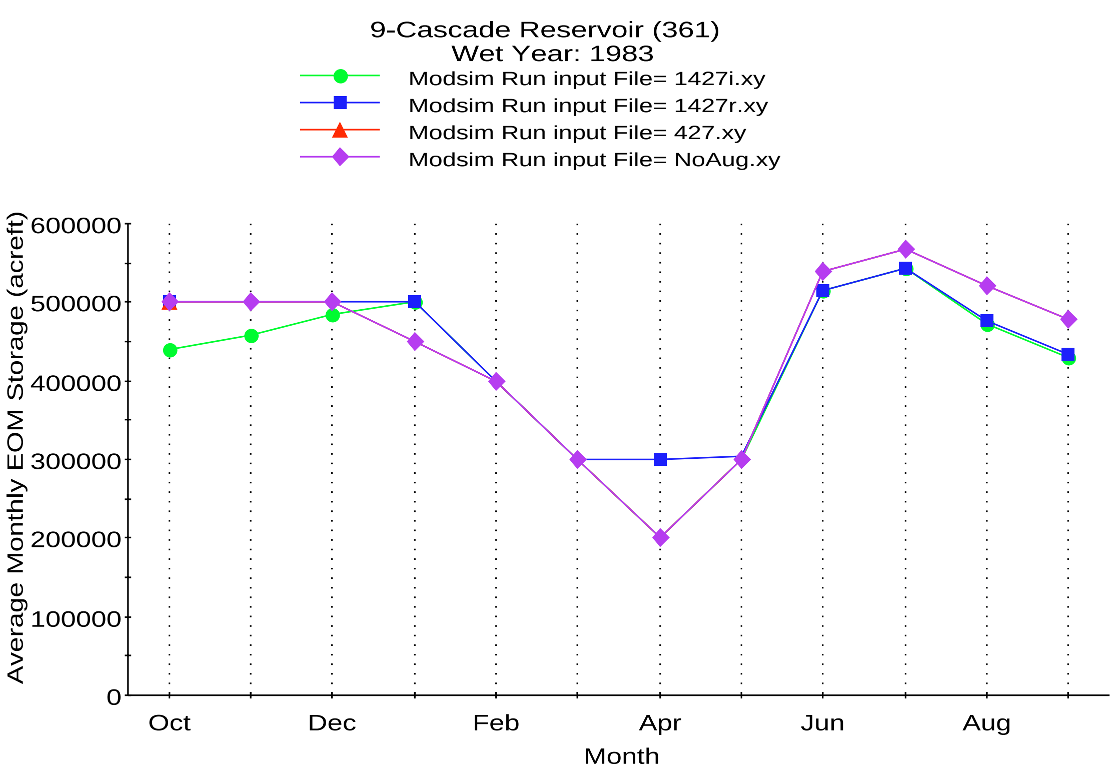

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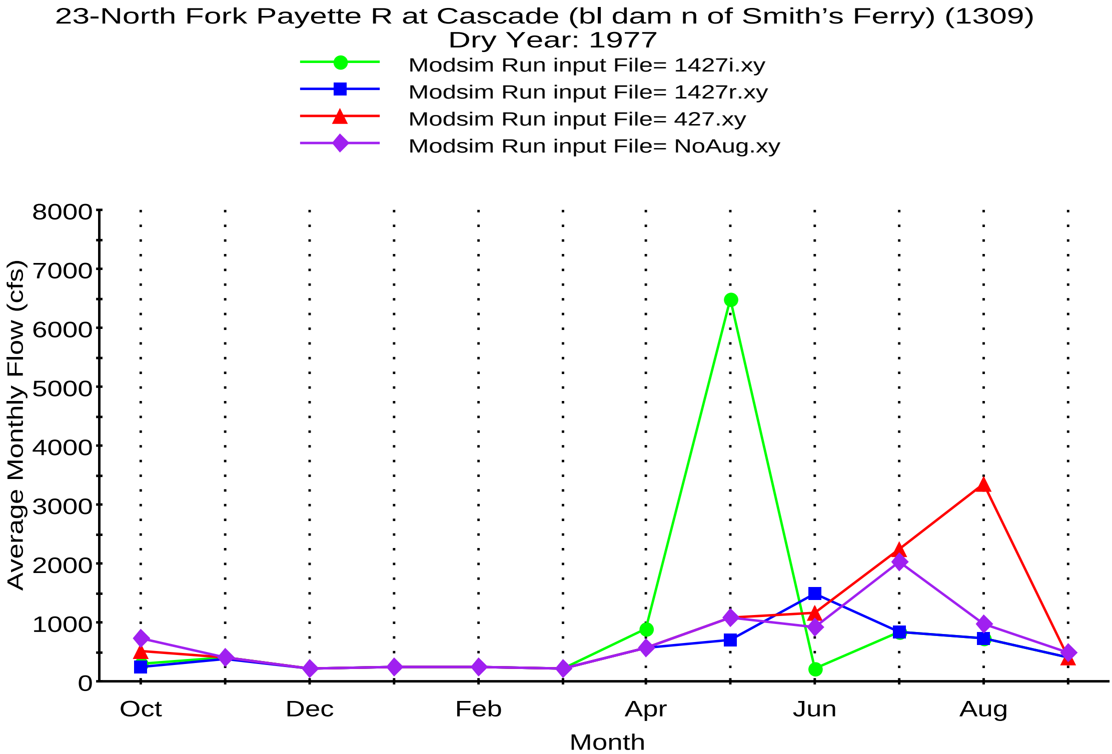

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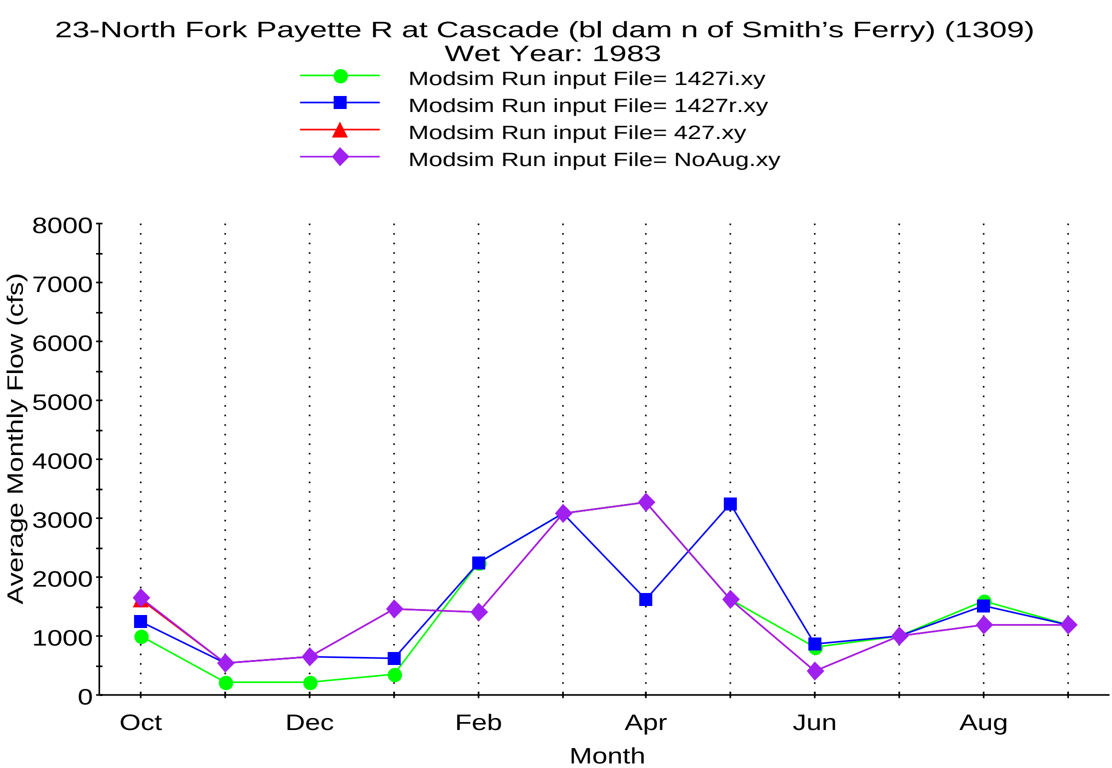

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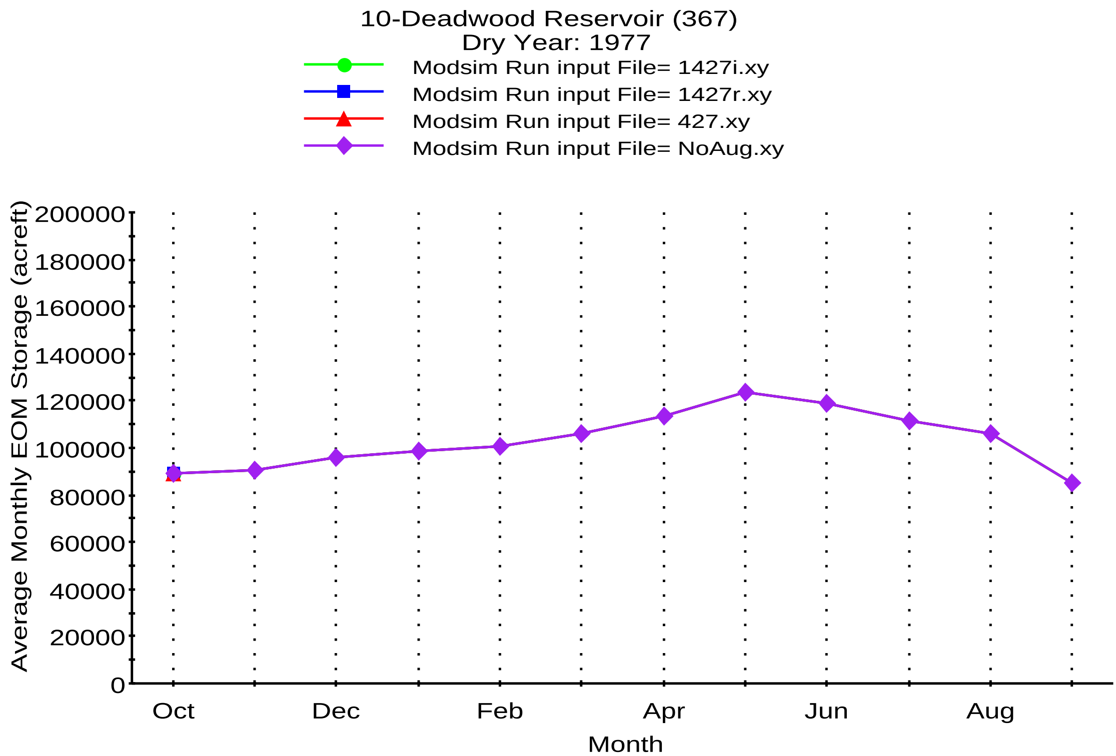

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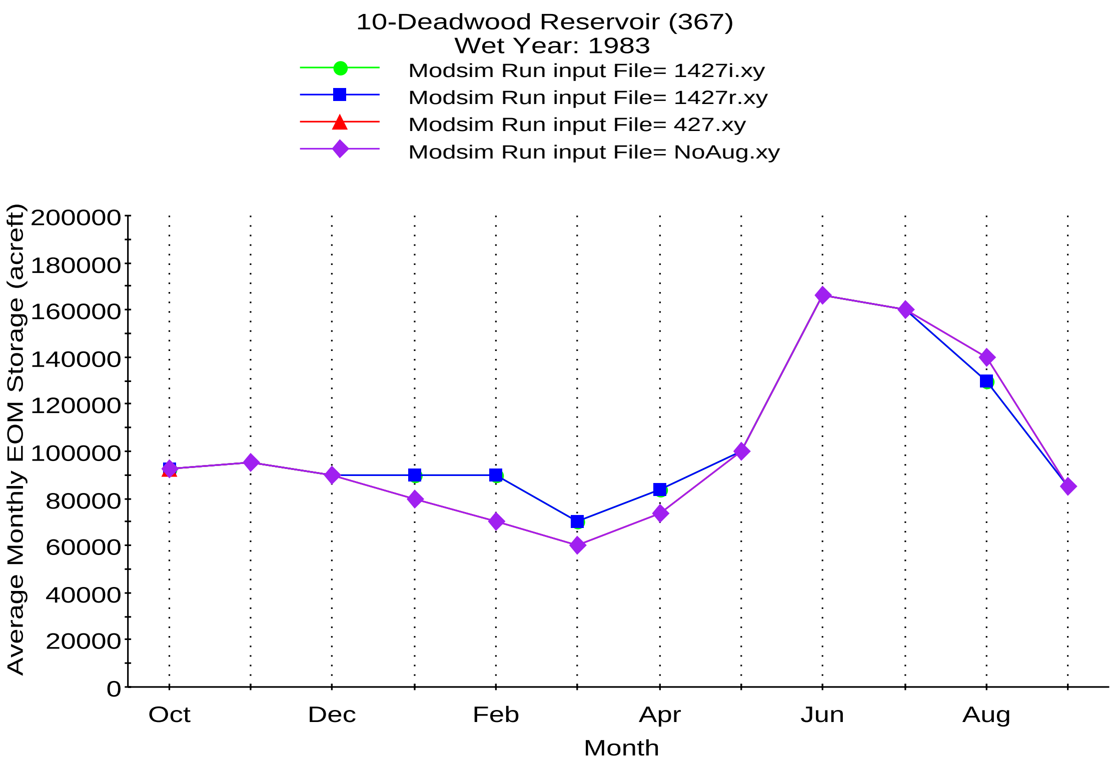

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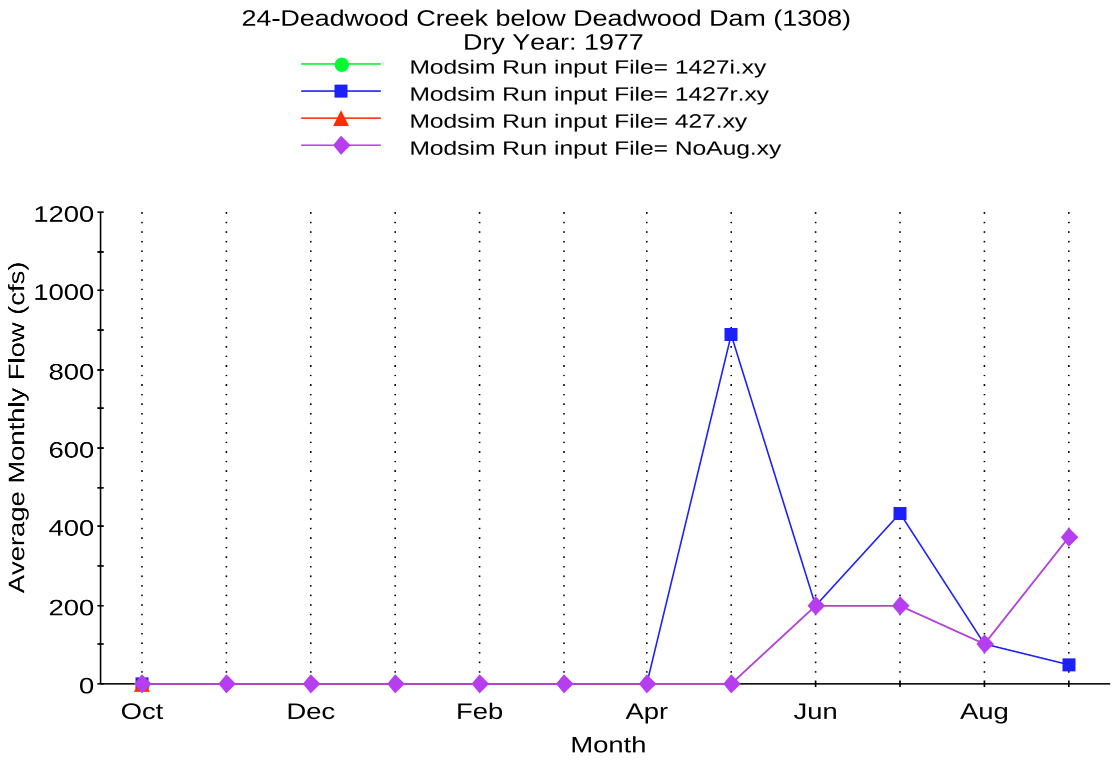

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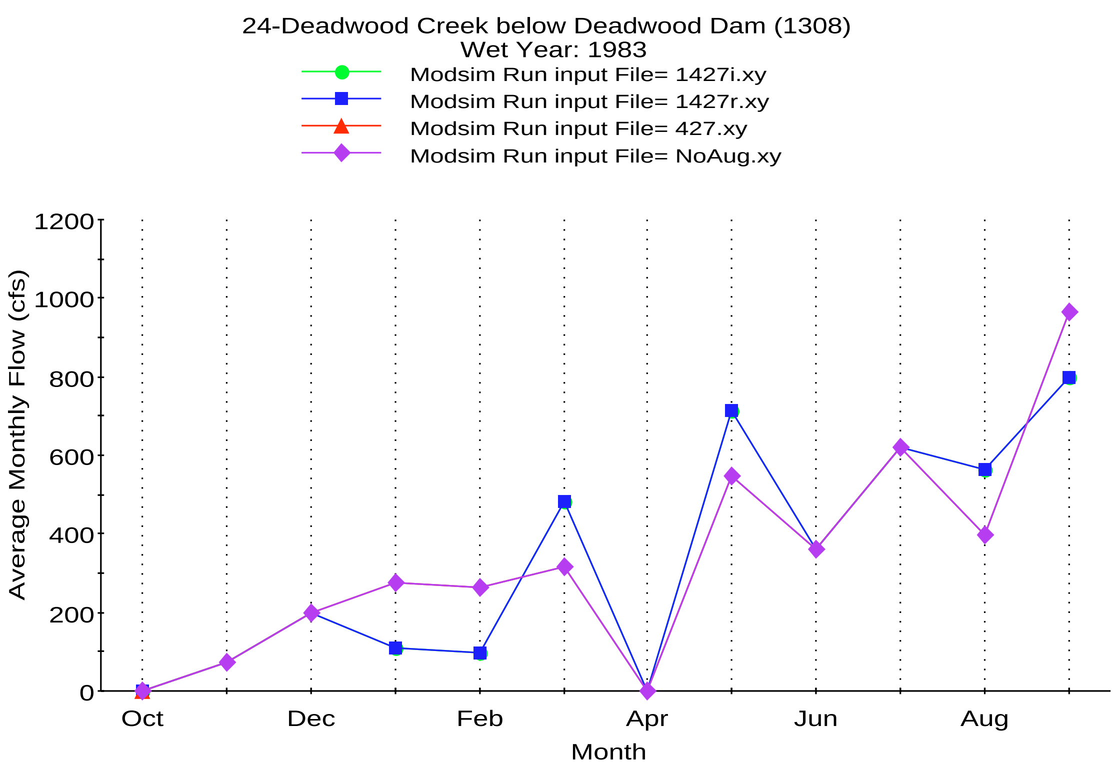

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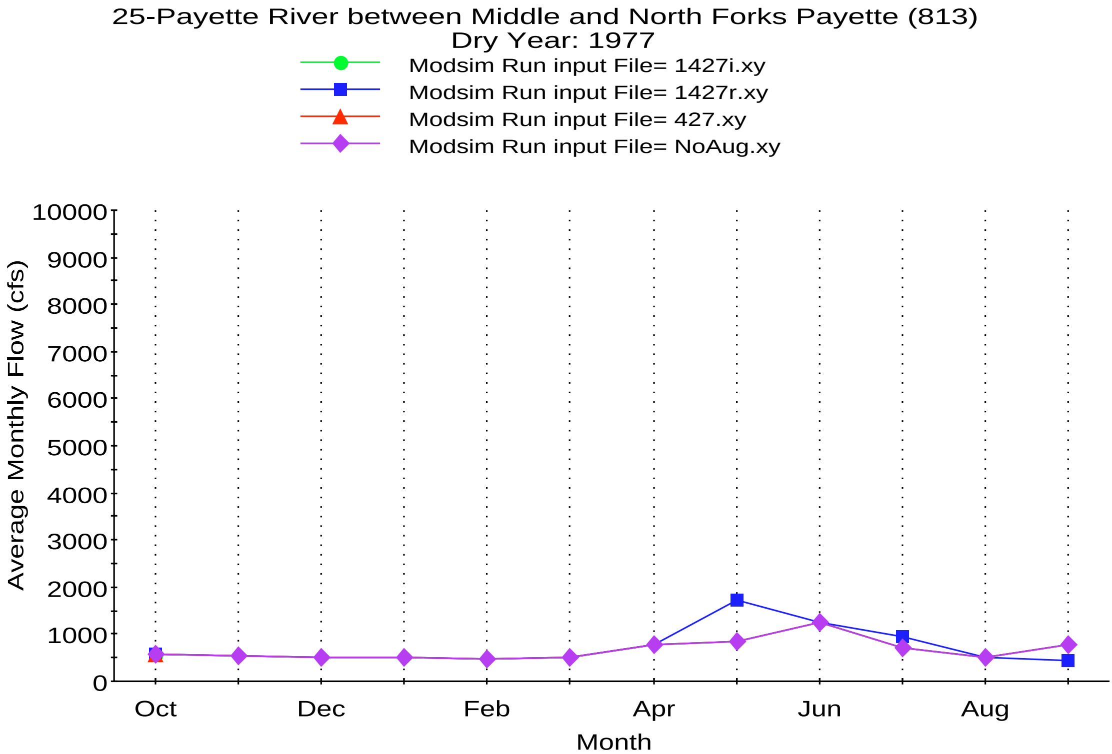

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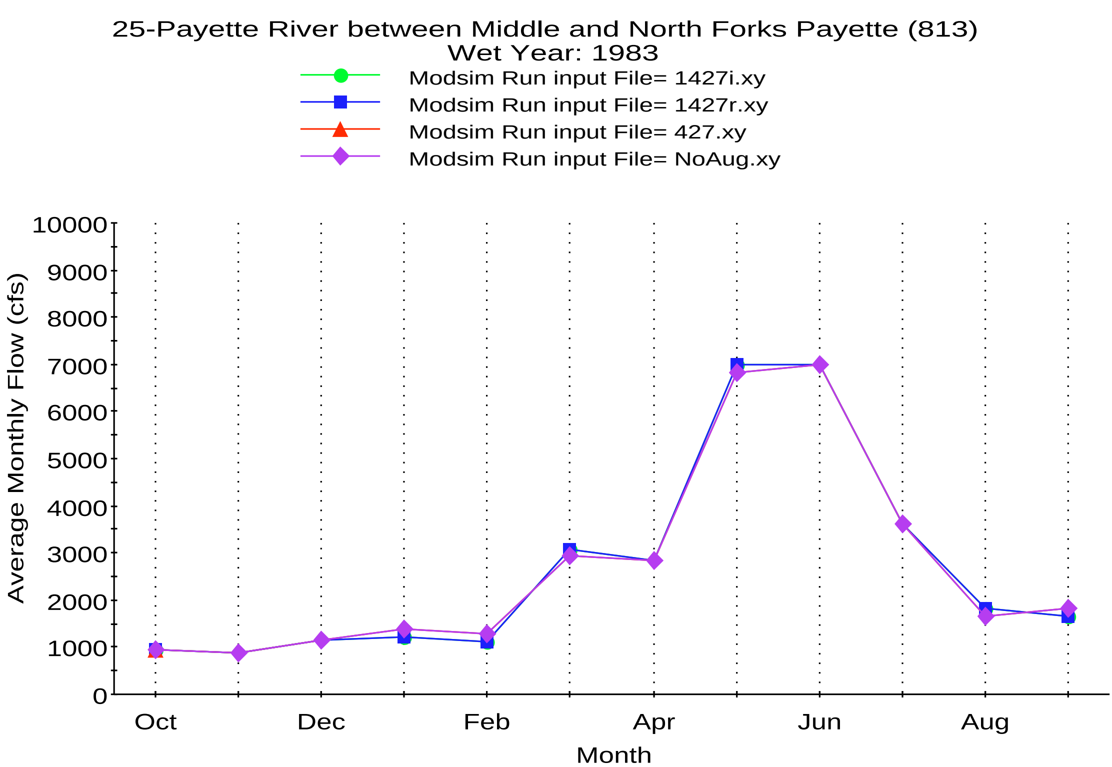

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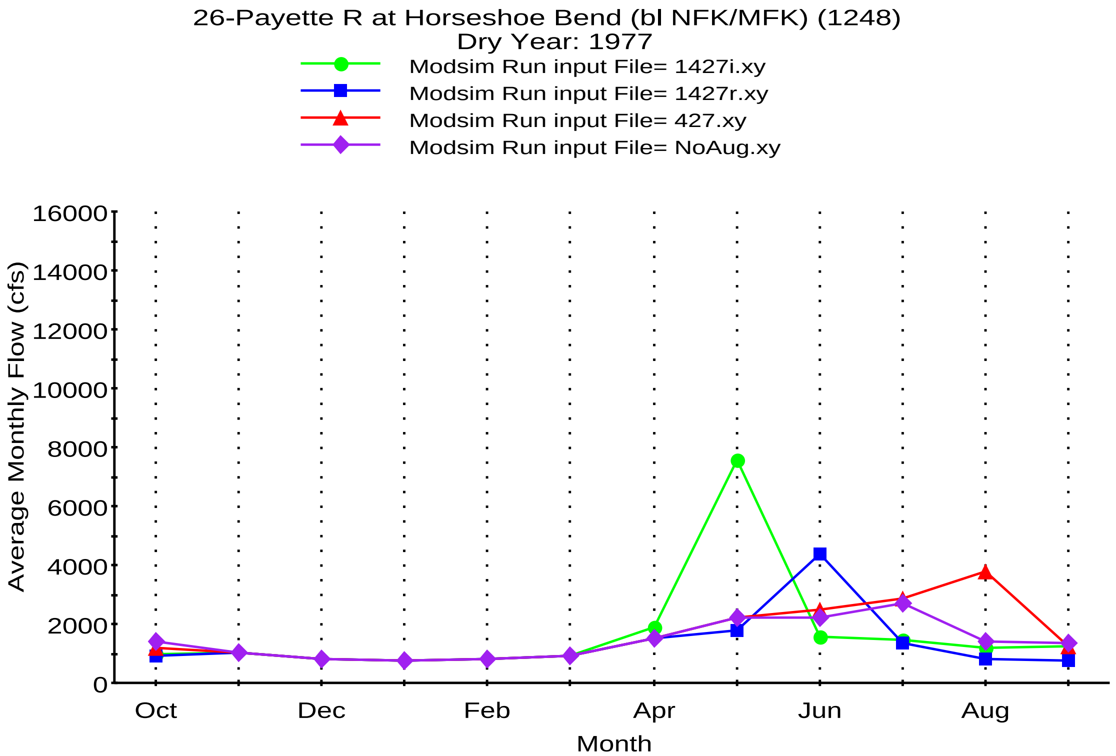

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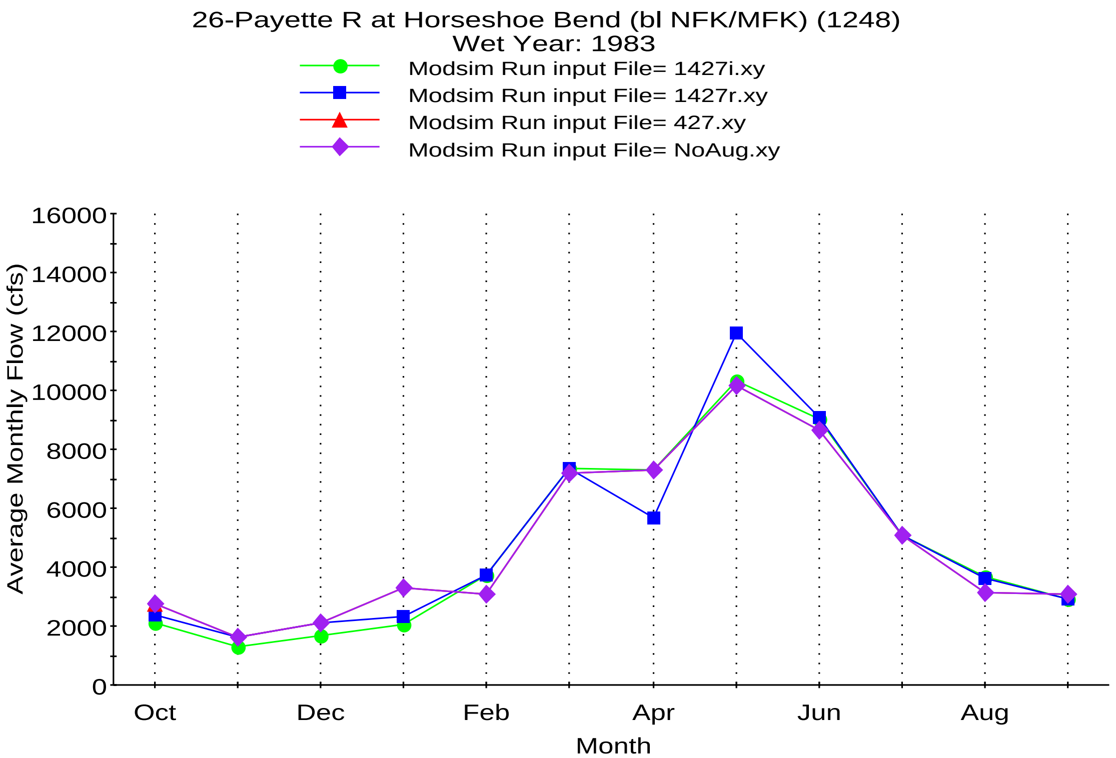

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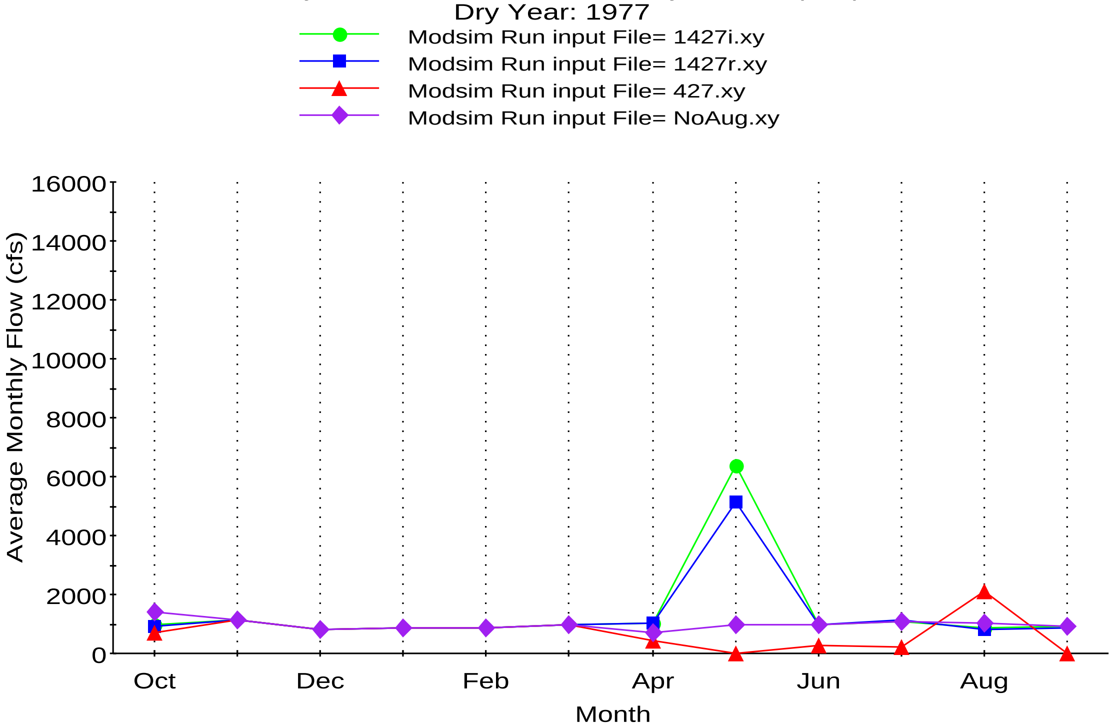
27-Payette River below Black Canyon Dam (796)
Dry Year: 1977



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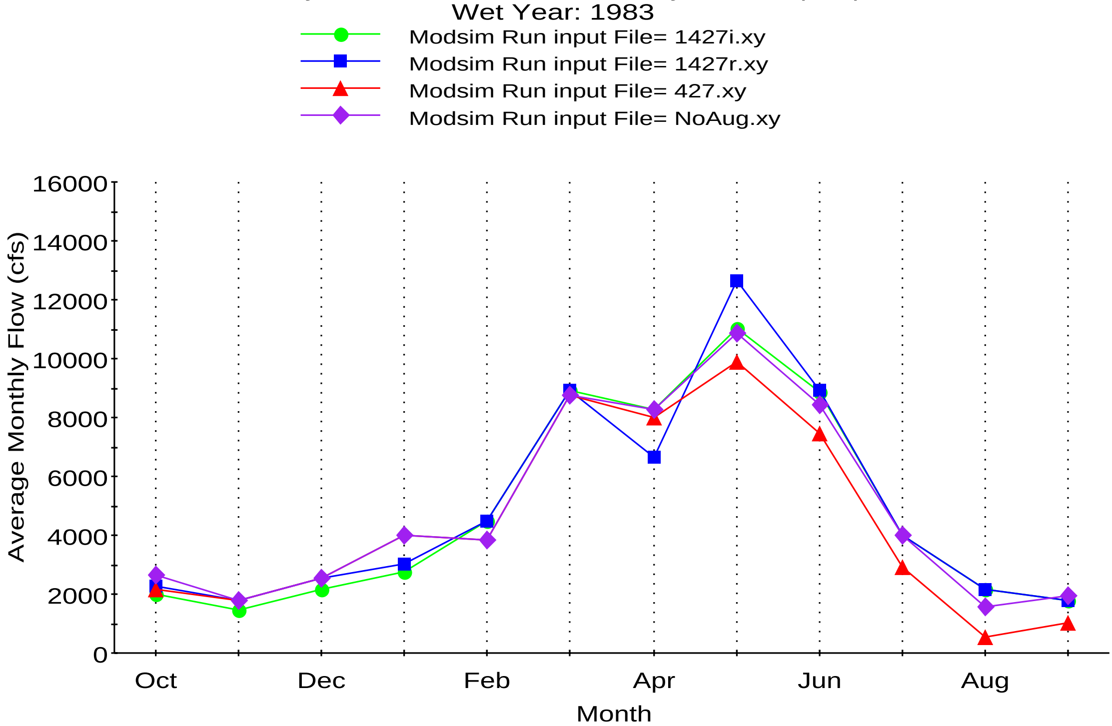
27-Payette River below Black Canyon Dam (796)
Wet Year: 1983



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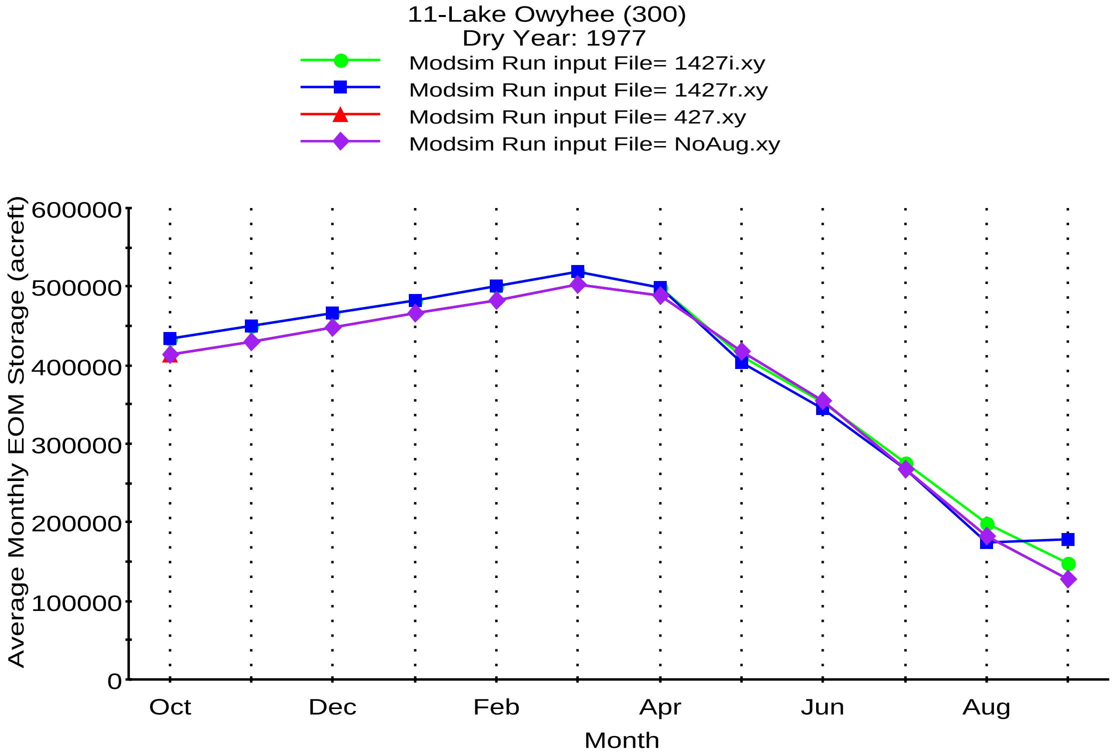

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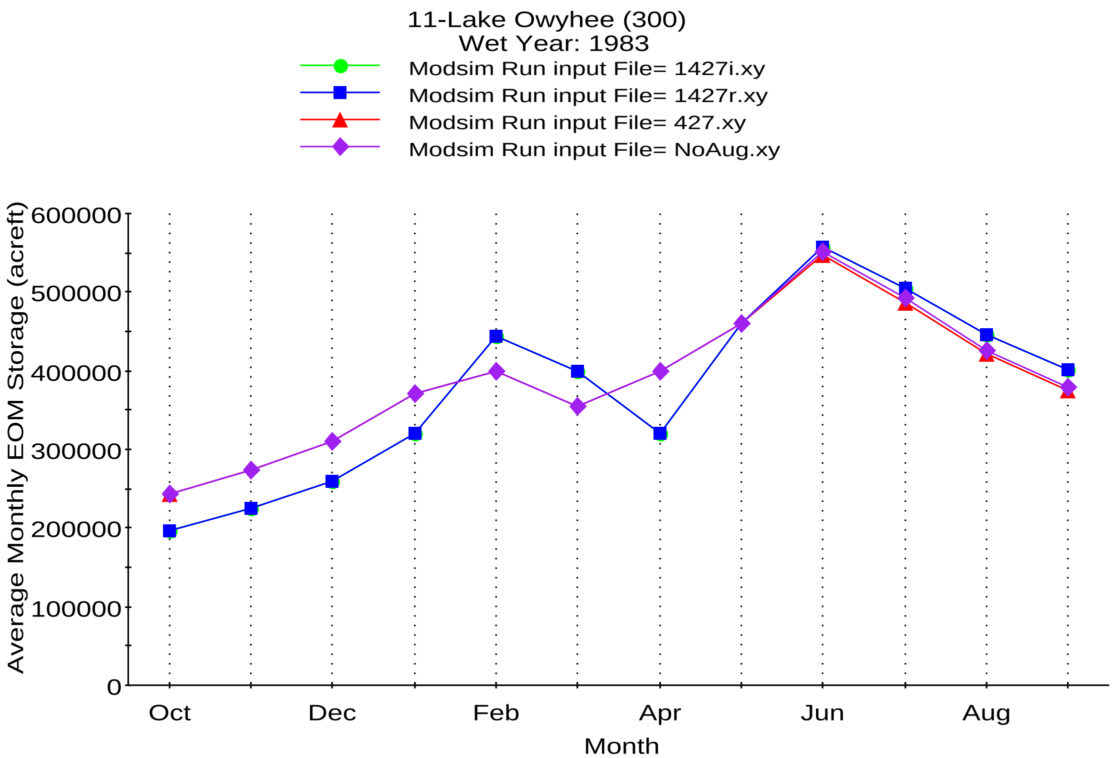

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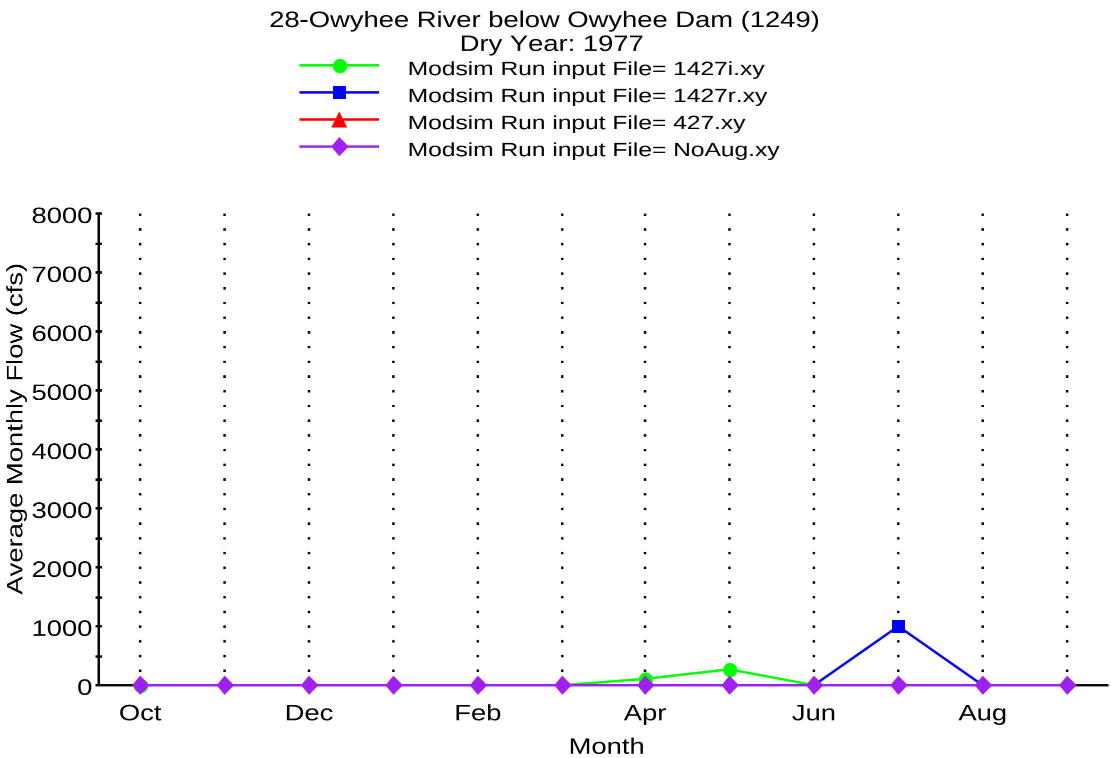

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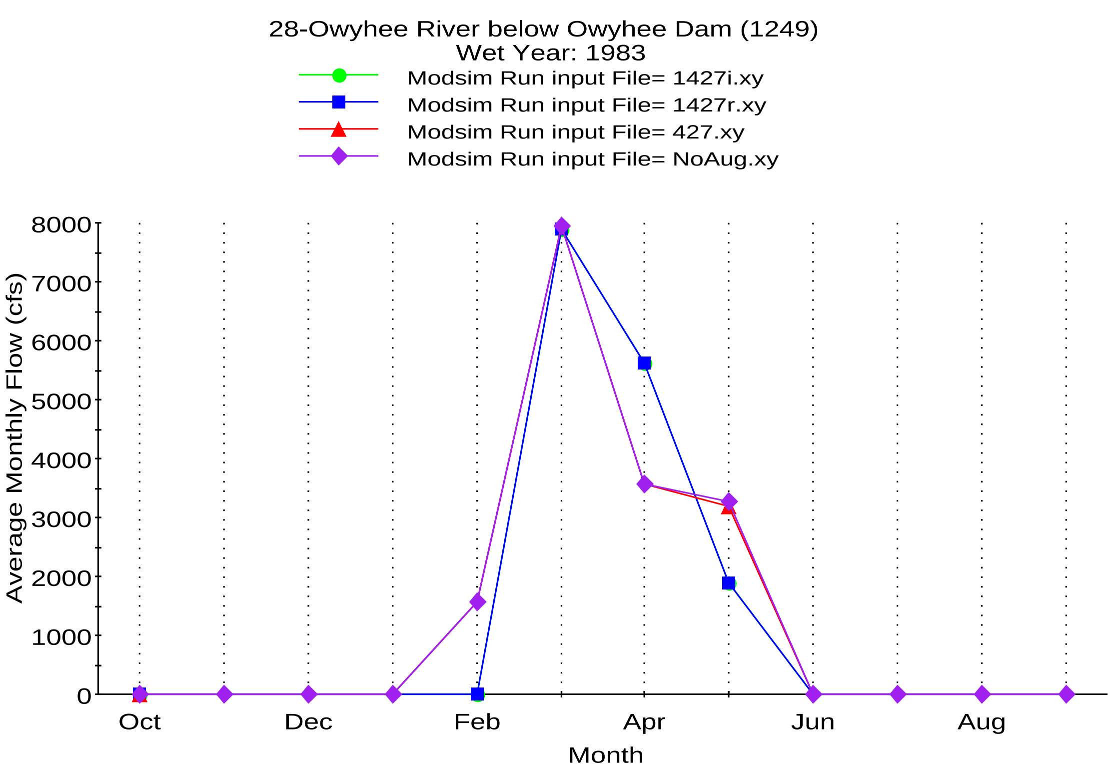

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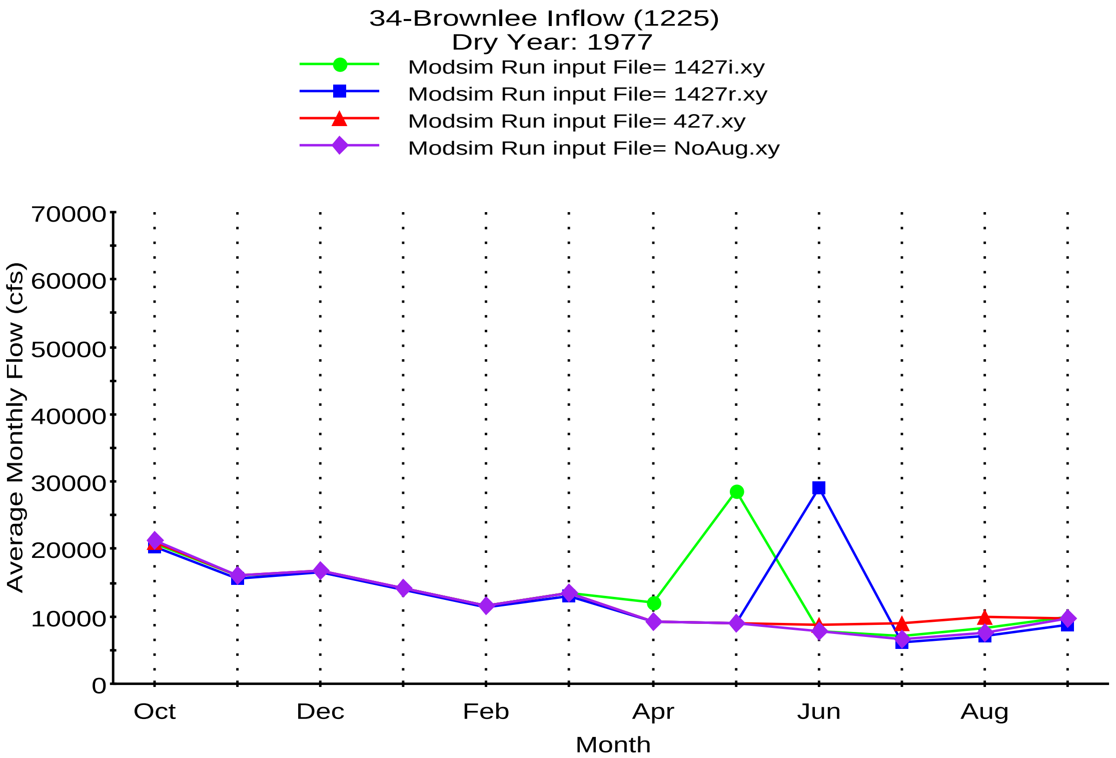

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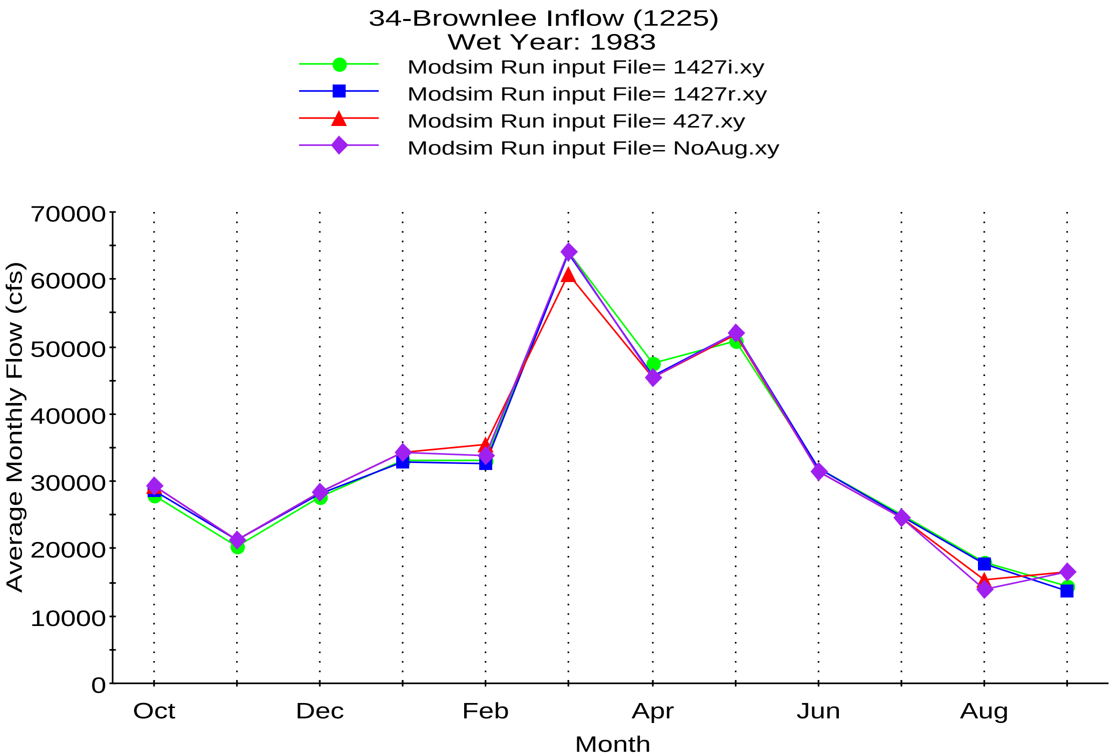

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Attachment E Fiscal Impacts (Agriculture)

This section discusses a framework for analyzing the effects increased flow augmentation would have on receipts and expenditures of cities, counties, and states.

Methodology

Fiscal impacts are usually specific to the city, county, and state levels and are directly dependent on how and where water would be obtained for flow augmentation and how the acquisition of water was implemented. Much of the Snake River basin lies in Idaho; however, parts of Wyoming, Nevada, and Oregon could also have fiscals impacts from increased flow augmentation. Each state has its own particular tax structure; therefore, fiscal impacts could vary from state to state. Modeled reductions in water supply could be linked to changes in tax collections and the effect on budgets. At this point in the study of improving migration for anadromous fish, specific impact locations are not available. Therefore, a programmatic overview was completed of: 1) how fiscal impacts could be analyzed once specific affected localities were identified, and 2) the types of general fiscal impacts that might occur if a decision were made to provide additional flow augmentation.

A decision to include increased flow augmentation from the Snake River basin as a part of the Corps' preferred alternative to improve migration conditions for salmon would lead to a detailed site-specific fiscal analysis of all areas that would be affected by changes in water usage. While tax and user fees are always subject to conditions in the general business cycle, data from the tax base of each affected city, county, and state could be analyzed to estimate changes in receipts. Any change in receipts, of course, reflects on the level of services provided.

Affected Environment

Fiscal impact analysis projects the changes in receipts and expenditures of a political jurisdiction (city, county, state) resulting from a new development, a major change in the output (gain or loss) of an industry or business, or in this case, a change in the amount and allocation of water in the Snake River basin. Economic impacts consist of changes to the overall economy, while fiscal impacts consist of changes in tax and user fee receipts to state and local governments, as well as potential changes in expenditure requirements.

City, county, and state governments rely on various tax revenue sources to provide goods and services to the citizens of those entities, including police, fire, roads and highways, public education, public assistance, and various other services. In particular, property, sales, and income taxes are generally relied on to generate most of the revenue necessary to support budgets. Other use/consumption taxes such as motor fuel, alcohol, tobacco, estate, and severance taxes are other sources of revenue.

The underlying economic foundation for tax collection is the assessed value of property (property taxes), the amount of taxable retail sales (sales tax), and the amount of taxable income (state and Federal income tax) generated by individuals and businesses. Policy decisions that change the amount and allocation of resources, in this case water, can impact taxes generated; that can directly impact the ability of governments to provide goods and services.

Tax revenues, especially those derived from sales and income taxes, are always subject to conditions in the business cycle and the cyclic ups and downs of the agricultural economy. Policy decisions to increase flow augmentation that directly affect tax revenue sources would lead to evaluation of specific entities' tax bases and the changes in tax revenues that would occur. The link between changes in water supplies that affect irrigation, recreation, and hydropower and the corresponding potential impact on city, county, and state fiscal budgets may not always be directly apparent; however, key links can be traced to demonstrate how fiscal impacts would be analyzed.

An overview of tax revenue sources in Idaho provides an illustration of how fiscal impacts could be traced. The three major sources of tax revenue in Idaho that would be evaluated are sales tax, income tax, and property tax:

- The sales tax is 5 percent of retail sales and rentals of tangible personal property and certain admission fees (hotel/motel). Exemptions apply to utilities, motor fuel, prescription drugs, and tangible personal property used in manufacturing, farming, processing, mining, and fabricating. A portion (7.75 percent) of sales tax receipts is distributed to Idaho counties and eligible cities based on a formula. In fiscal year 1997, the State collected $623.9 million in sales taxes and distributed $47.8 million to counties and cities. The State also distributes to counties an amount equal to 6 percent of the sales tax receipts as reimbursement for the exemption of business inventory property. This amounted to $37 million in fiscal year 1997.

- Personal income tax is based on Idaho taxable income and ranges from 2 to 8.2 percent. In 1997, State income tax revenue was $831 million. Corporate income tax is up to 8 percent of Idaho taxable income. In 1997, State corporate income tax revenue was $138 million.

- Property taxes are established and collected by individual counties and taxing districts to provide local services. These taxes do not generate revenue for State use; however, the State is responsible for overseeing property tax procedures. In 1997, property tax charges in Idaho were about $764 million.

Table 6-30 summarizes Idaho's assessed valuation and property tax charges by county for tax year 1997. The property tax charge was approximately 1.45 percent of the assessed value for all classes of property.

Table E-1 Idaho Assessed Valuation and Property Tax Charges in 1997.

County	Assessed Valuation ($1,000)	Property Tax Charge ($1,000)
Ada	12,945,840	218,356
Adams	224,810	2,321
Bannock	1,767,072	40,971
Bear Lake	252,513	3,041
Benewah	436,225	4,667
Bingham	965,572	16,131
Blaine	3,906,412	26,568
Boise	324,347	3,522
Bonner	2,483,129	24,134
Bonneville	2,283,394	44,848
Boundary	465,573	4,854
Butte	102,125	1,467
Camas	75,563	744
Canyon	3,345,584	56,785

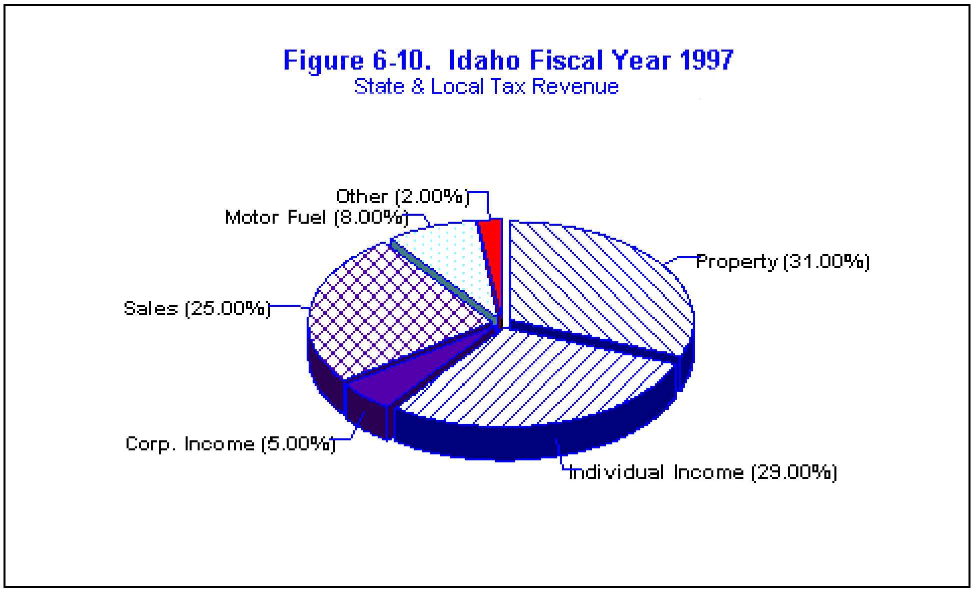
Table E-1 Idaho Assessed Valuation and Property Tax Charges in 1997.		
County	Assessed Valuation ($1,000)	Property Tax Charge ($1,000)
Caribou	510,531	6,391
Cassia	829,453	10,966
Clark	86,081	622
Clearwater	539,900	5,396
Custer	399,083	2,597
Elmore	656,460	10,149
Franklin	260,176	3,757
Fremont	581,418	6,203
Gem	436,313	5,021
Gooding	486,642	6,379
Idaho	692,551	5,521
Jefferson	479,532	6,525
Jerome	601,902	9,318
Kootenai	5,175,025	73,028
Latah	1,100,474	19,748
Lemhi	447,764	3,300
Lewis	211,237	2,752
Lincoln	160,805	2,293
Madison	567,052	8,132
Minidoka	664,087	8,297
Nez Perce	1,934,795	32,070
Oneida	144,729	2,168
Owyhee	362,892	4,298
Payette	545,885	8,855
Power	647,267	9,441
Shoshone	552,801	8,643
Teton	348,354	2,816
Twin Falls	2,083,671	33,385
Valley	1,281,717	11,798
Washington	408,498	5,381
Total	52,775,255	763,659
Source: State of Idaho 1997 Property Tax Levies, Associated Taxpayers of Idaho.		

Idaho property tax collections for 1997 are summarized by property type in table 6-31.

Table E-2 1997 Idaho Property Tax Collections.	
Property Type	Collections($ millions)

Residential	417.9
Commercial/Industrial	232.1
Agricultural	50.7
Timber	12.5
Mining	2.5
Operating	47.9
Total	763.3
Source: State of Idaho 1997 Property Tax Levies, Associated Taxpayers of Idaho.	

Figure E-1 illustrates taxes collected in Idaho for fiscal year 1997 according to revenue sources.



Source: Idaho State Tax Commission, 1997 Annual Report.

Environmental Consequences

hile changes in water supply can influence receipts from sales, income, and property taxes, care should be taken not to extrapolate short-term conditions into long-run norms. Various other external factors also interact in the economy, including the phase of the general business cycle and conditions in the agricultural economy. A key determinant of the impact on city, county, and state budgets, in the case of agriculture, is the ability of producers to change and adapt to the availability of the water resource. Factors like ability to substitute crops, changes in the mix of labor and capital, and the economic operating thresholds of farms, processing plants, and shippers will over time determine the economic viability of these farms and firms and the subsequent tax generation ability.

In general the greater the level of processing and handling of a commodity in the local area, the greater the potential for economic and fiscal impacts. For example, a commodity that is trucked to Portland or Salt Lake after harvest generates less value added to the local economy, and subsequently less tax revenue, than a commodity like potatoes that may be processed, reconstituted into various products, and shipped from the local area to markets. Changes in water supply that affect crops not processed locally would have less local economic impact than would changes that affect potato crops.

Table E-3 identifies potential linkage between tax generation and changes in the usage of Snake River water supplies.

Table E-3 Potential Linkage Between Changes in Usage of Snake River Basin Water Supplies and Tax Generation

Item	Sales Tax	Income Tax	Property Tax
Changes in Usage of Water Supply	Change amount of taxable retail purchases by irrigators and recreation users; Change associated second-round retail purchases; Both backward and forward linked.	Change the value of agricultural output from irrigated farms; Change taxable income from agricultural industry; Change value of goods and services of recreation providers; Change taxable income from recreation industry.	Change income producing capability of irrigated land and business property that provides recreation goods and services; Change assessed valuation of property.
Budgets Affected	City, county, state	State and Federal	County
Fiscal Impacts	Change in sales tax collections; Change in resulting distribution to cities, counties, and states.	Change in state and Federal income tax collections; Change in subsequent appropriations to state and Federal governments.	Change in county property tax collections.

Attachment F – Hydropower Avoided Costs

Avoided cost data used in the Hydropower Economic analysis were estimated using the Aurora model as explained in the methodology section.

Table 6-__. Mean Monthly Avoided Cost by Operation Year
(real 1998 $/MWh)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2002	23.91	25.18	27.86	28.97	27.45	21.64	19.19	18.30	19.52	22.66	25.03	25.38
2003	24.65	25.48	28.45	29.36	27.85	22.36	19.58	18.57	21.07	23.20	27.81	27.20
2004	25.48	25.99	29.77	29.67	28.65	24.14	19.72	18.40	20.87	24.38	30.48	29.62
2005	25.83	26.37	29.88	29.41	27.46	22.38	19.72	16.21	18.03	24.62	32.45	31.74
2006	25.52	26.05	29.77	29.98	27.55	22.43	19.86	15.37	17.06	23.46	37.59	31.33
2007	25.66	25.81	29.44	27.23	26.45	24.96	21.13	14.80	15.42	22.61	36.61	33.70
2008	24.11	25.31	29.14	26.76	27.10	24.69	21.12	14.07	14.81	21.24	27.80	32.35
2009	23.68	25.29	29.29	26.13	25.68	24.78	20.92	13.90	14.92	22.09	29.32	32.80
2010	23.29	25.22	27.06	27.25	26.40	24.20	19.63	13.89	14.94	20.34	30.53	33.55
2011	23.19	24.67	28.24	28.07	27.12	24.09	19.43	14.01	15.20	22.28	36.90	33.32
2012	23.18	24.67	28.92	27.59	25.72	23.34	18.61	13.95	14.89	21.60	36.00	32.50
2013	23.61	24.57	28.12	28.66	27.02	23.09	19.13	13.95	14.69	20.74	31.32	28.43
2014	23.51	25.34	29.92	28.47	27.40	21.73	19.75	13.81	14.60	20.89	28.75	29.88
2015	23.50	25.85	29.49	29.48	25.53	21.31	18.81	13.67	14.56	19.87	26.73	31.12
2016	23.25	25.09	29.65	29.26	25.11	21.34	18.20	13.74	14.51	19.17	35.22	32.08
2017	22.43	24.57	30.22	28.87	24.86	21.07	16.38	13.76	14.48	19.47	32.27	31.22
2018	22.30	24.60	29.73	29.04	25.56	21.45	17.03	14.04	14.89	20.60	31.87	27.44
2019	23.29	24.60	29.55	27.02	23.56	20.86	16.33	13.83	14.65	21.00	27.72	29.05
2020	21.44	23.12	28.96	28.13	23.42	21.50	17.63	13.94	15.44	23.01	28.32	27.01
2021	21.82	24.09	28.95	28.20	24.28	21.48	15.96	13.87	14.95	21.29	28.08	31.05

Source: Aurora modeled output with mean fuel price escalation converted to real 1998 dollars using a generalized inflation rate of 2.50 percent.

Attachment G Powerplant Characteristics

The following parameters were used to determine the potential monthly energy production for the modeled power plants for each scenario. If power curves were not available, nameplate values were used and/or efficiencies were adjusted to reflect unit upgrades. If modeled forebay elevations were not available, a constant forebay elevation was assumed.

Powerplants	Efficiency (Percent)	Maximum Power Rating (MW)	Design Head (Feet)	Maximum Flow Capacity (cfs)	Other Assumptions
Federal Powerplants					
Palisades	84	176.5	226.2	10,452	Variable forebay, Constant tailwater elevations
Walcott	80	28.0	50	-	Variable forebay, Constant tailwater elevations Minimum pressure head 39.0 ft, so that power was not produced when the reservoir was below 4236 feet (inactive capacity) Hydraulic capacity at maximum power plant capacity 6,660 cfs
Anderson Ranch	84	40.0	330.0	-	Variable forebay, Variable tailwater elevations Hydraulic capacity at maximum powerplant capacity 1800 cfs
Black Canyon	80	10.2	112.0	-	No modeled storage data - constant forebay elevation of 2497 feet (full reservoir) Variable tailwater elevations Design hydraulic flow capacity 3000 cfs
Non-Federal Powerplants					
Upper Idaho Falls	90	7.5	-	6,000	Constant head 17 feet
City Idaho Falls	90	7.5	-	6,000	Constant head 17 feet
Lower Idaho Falls	90	8.5	-	7,540	Constant head 17 feet
Gem State Power	90	24	-	7,000	Constant head 43 feet
American Falls	84	112.4	57.8	14,769	Variable forebay, variable tailwater elevations
Milner	91	57.5	-	10,452	Constant head 148 feet
Twin Falls	85	52.1	-	4,960	Constant head 142 feet
Shoshone Falls	95	12.5	-	788	Constant head 198 feet
Upper Salmon Falls	81	18.0	43.8	10,452	Constant forebay, variable tailwater elevations

Powerplants	Efficiency (Percent)	Maximum Power Rating (MW)	Design Head (Feet)	Maximum Flow Capacity (cfs)	Other Assumptions
Plant A					
Upper Salmon Falls Plant B	84	19.5	-	6,300	Constant head 35.5 feet
Lower Salmon Falls (Hagerman)	84	60	-	15,200	Constant head 55.5 feet
King Hill (Bliss)	81	80.0	77.8	13,500	Constant forebay, variable tailwater elevations
C.J. Strike	93	89.0	88.1	12,800	Constant forebay, variable tailwater elevations
Swan Falls	75	27.2	26.1	16,348	No modeled storage data - constant forebay elevation of 2314 feet Constant tailwater elevation Design hydraulic flow capacity 3000 cfs
Lucky Peak	84	101.2	239.0	6,592	Variable forebay, variable tailwater elevations
Owyhee Dam	84	5.5	280.0	253	Variable forebay, constant tailwater elevations
Owyhee Tunnel	95	8.1	72.0	1,600	Variable forebay, constant tailwater elevations
Cascade	95	14.0	81.0	2,000	Variable forebay, constant tailwater elevations

Attachment H Water Quality by Hydrologic Unit Codes

The water quality status of Reclamation reservoirs and the downstream reaches that may be affected by current operations is shown in the following table G-1. This information was compiled from Section 303 (d) of the CWA and identifies stream reaches by hydrologic unit codes (HUC) originally developed by the USGS; these are further subdivided by prominent landmarks or towns. The furthest upstream reaches tend to have little or no water quality problems and support all uses. Water quality problems tend to increase downstream and include not only introduced substances but also temperature and flow changes that limit some uses. These problems are identified for each reach. Sediments, high temperature, bacteria, and low dissolved oxygen have the greatest impact on beneficial uses within the area of impact. Reservoirs and stream reaches listed as supporting all uses do not have significant water quality problems.

Table H-1 Water Quality Status of Reclamation Reservoirs and Affected Downstream Reaches

Stream	Stream Reach	Pollutants[1]
HUC 17040101		
South Fork Snake River	South Fork Snake River and Jackson Lake	All uses supported
South Fork Snake River	Jackson Lake to Gros Ventre River	All uses supported
HUC 17040103		
South Fork Snake River	From Gros Ventre to Grays River	All uses supported
HUC 17040104		
South Fork Snake River	Palisades Reservoir to Irwin[2]	Flow alteration
South Fork Snake River	Irwin to Heise[2]	Flow alteration
HUC 17040201		
Snake River	South Fork Snake River from Heise and main stem Snake River to Bonneville County line downstream of Idaho Falls	All uses supported
HUC 17040202		
Henrys Fork	Island Park Reservoir[4]	All uses supported
Henrys Fork	Island Park Reservoir to Ashton	All uses supported
HUC 17040203		
Henrys Fork	Ashton to South Fork Snake River	All uses supported
HUC 17040206		
Snake River	Bonneville County line to Ferry Butte[3]	Nutrients, sediment, DO, flow alteration
Snake River	Ferry Butte to American Falls Reservoir[5]	Sediment
Snake River	American Falls Reservoir[6]	Nutrients, sediment, DO
Bannock Creek	Headwaters to mouth	Sediment, nutrients, pathogens
HUC 17040208		
Portneuf River	Chesterfield Reservoir to American Falls Reservoir	Bacteria, nutrients, sediment

Table H-1 Water Quality Status of Reclamation Reservoirs and Affected Downstream Reaches		
Stream	Stream Reach	Pollutants[1]
HUC 17040209		
Snake River	American Falls Dam to Eagle Rock[5]	Sediment
Snake River	Eagle Rock to Massacre Rock[5]	Sediment
Snake River	Massacre Rock to Lake Walcott[7]	Sediment, DO, pesticides
Snake River	Milner Lake[7]	Nutrient, sediment, DO, flow alteration
HUC 17040212		
Snake River	Milner Dam to Murtaugh[8]	Nutrient, sediment, DO, thermal modification, flow alteration, pathogens
Snake River	Murtaugh to Twin Falls Reservoir[8]	Nutrient, sediment, DO, pathogens, NH_3
Snake River	Shoshone Falls to Rock Creek[8]	Sediment, nutrient, temperature
Snake River	Rock Creek to Cedar Draw[8]	Sediment, nutrient, temperature
Snake River	Cedar Draw to Clear Lake Bridge[8]	Sediment, nutrient, temperature
Snake River	Clear Lake Bridge to Mud Creek[8]	Sediment, nutrient, temperature
Billingsley Creek	Headwaters to Snake River[8]	Nutrients, sediment, DO, flow alteration, NH_3
Snake River	King Hill Diversion to Bliss bridge[8]	Sediment
Snake River	Bliss Reservoir[8]	Nutrients, sediment, DO, flow alteration, pathogens, NH_3
Snake River	Cassia Gulch to Big Pilgrim Gulch[8]	Sediment, nutrient, temperature
Snake River	Big Pilgrim Gulch to King Hill[8]	Nutrient, DO, flow alteration
HUC 17040221		
Little Wood River	Little Wood River Reservoir	Nutrient, sediment, DO, flow alteration, pathogens
Little Wood River	East Canal Diversion to Silver Creek	Nutrient, sediment, DO, flow alteration, pathogens
Little Wood River	Silver Creek to Richfield	Nutrient, sediment
Little Wood River	Richfield to Big Wood River	Nutrient, sediment, DO, flow alteration, pathogens
HUC 17050101		
Snake River	King Hill to Highway 50 bridge	Sediment
HUC 17050103		
Snake River	C. J. Strike River to Castle Creek	Sediment
Snake River	Castle Creek to Swan Falls	Sediment
Snake River	Swan Falls to Boise River	Nutrient, sediment, DO, flow alteration, bacteria, pH
HUC 17050110		
Owyhee River	Lake Owyhee	Mercury

Table H-1 Water Quality Status of Reclamation Reservoirs and Affected Downstream Reaches		
Stream	Stream Reach	Pollutants[1]
HUC 17050112		
Boise River	Arrowrock Reservoir	All uses supported
Boise River	Lucky Peak Reservoir	All uses supported
HUC 17050113		
South Fork Boise River	Anderson Ranch Reservoir	All uses supported
South Fork Boise River	Anderson Ranch Dam to Arrowrock Reservoir	All uses supported
HUC 17050114		
Boise River	Lucky Peak Dam to Star[9]	Flow alteration
Boise River	Star to Notus[9]	Nutrient, sediment, DO, temperature, bacteria
Boise River	Notus to Snake River[9]	Nutrient, sediment, DO pathogens, temperature
HUC 17050115		
Snake River	Boise River to Weiser River	Nutrient, sediment, bacteria
HUC 17050116		
North Fork Malheur River	Beulah Reservoir to Malheur River	Fecal coliform bacteria
HUC 17050117		
Malheur River	Namorf to Snake River	Chlorophyll α, pesticides, fecal coliform bacteria
HUC 17050118		
Bully Creek	Bully Creek Reservoir to Malheur River	Chlorophyll α, fecal coliform bacteria
HUC 17050119		
Willow Creek	Pole Creek to Malheur River	Chlorophyll α, fecal coliform bacteria
HUC 17050120		
Deadwood River	Deadwood Reservoir	All uses supported
Deadwood River	Deadwood Dam to South Fork Payette River	All uses supported
South Fork Payette River	Deadwood River to mouth	All uses supported
HUC 17050122		
Payette River	Black Canyon Dam to Snake River[12]	Nutrient, bacteria, temperature
HUC 17050123		
North Fork Payette River	Cascade Reservoir[10]	Nutrient, pathogens, DO, pH
North Fork Payette River	Cascade Dam to mouth	All uses supported
HUC 17050201		
Snake River	Weiser (town) to Brownlee Dam	Sediments, DO, pH
Snake River	Brownlee Reservoir	Mercury

Table H-1 Water Quality Status of Reclamation Reservoirs and Affected Downstream Reaches		
Stream	Stream Reach	Pollutants[1]
Snake River	Brownlee Reservoir to Idaho Border	Summer temperature
Snake River	Oxbow Dam to Hells Canyon Dam	Summer temperature
HUC 17050202		
Burnt River	Clarks Creek to Snake River	Flow alteration, summer temperature
HUC 17050203		
Powder River	National forest boundary to Sutton Creek	Fecal coliform bacteria
Powder River	Sutton Creek to Thief Valley Reservoir	Fecal coliform bacteria
Powder River	Thief Valley Reservoir to Snake River[15]	DO, flow alteration, temperature, fecal coliform bacteria
HUC 17060201		
Salmon River	Headwaters to East Fork Salmon River[18]	Sediment
Yankee Fork Salmon River	Headwaters to Salmon River[18]	Sediment, habitat alterations
HUC 17060203		
Salmon River	Pahsimeroi River to North Fork Salmon River[18]	All uses supported
HUC 17060208		
South Fork Salmon River	Headwaters to Rice Creek[18]	Sediments
South Fork Salmon River	Rice Creek to Buckhorn Creek[18]	Sediment, nutrients, pathogens, ammonia
South Fork Salmon River	Buckhorn Creek to Salmon River[18]	Sediment
South Fork of East Fork Salmon River	Headwaters to Salmon River[18]	Sediment
HUC 17050120		
Deadwood River	Headwaters to Deadwood Reservoir[11]	Sediment
HUC 17050124		
Weiser River	Galloway to Snake River (includes Mann Creek Reservoir)[13]	Nutrients, bacteria, DO, sediment, temperature
HUC 17050110		
Owyhee River	Black Willow Creek to Owyhee Dam[14]	DO
Owyhee River	Mouth to Black Willow Creek[14]	Chlorophyll α, fecal coliform, toxins (DDT and Dieldrin)
HUC17060101		
Snake River	Hells Canyon Dam to Washington border	Summer temperature
HUC 1760103		
Snake River	Clearwater River to Oregon border	Temperature, pH
HUC 17060104		
Grande Ronde River	Wallowa River to headwaters[16]	Habitat modification, sedimentation

Table H-1 Water Quality Status of Reclamation Reservoirs and Affected Downstream Reaches		
Stream	Stream Reach	Pollutants[1]
HUC 17060105		
Wallowa River	Wallowa River to Tanner Gulch	Summer pH, temperature
Wallowa River	Wallowa River to Five Points Creek	DO, flow modification, periphyton, fecal coliform
Wallowa River	Mouth to Wallowa Lake[17]	Flow and habitat modification, summer pH, summer temperature, fecal coliform (fall through spring), sediment
HUC 17060107		
Snake River	Clearwater River to Palouse River	Total dissolved gas, DDT, 4,4'-DDE, Dieldrin
HUC 17060110		
Snake River	Palouse River to mouth (Columbia River)	Total dissolved gas, 4,4'-DDE, PCBs, DO, pH, temperature, Dieldrin

1 DO = dissolved oxygen, NH_3 = Ammonia, pH = measure of acidity, also includes adverse flow regimes

2 This listing is directly controlled by the releases from Palisades Reservoir. There are no major diversions within this reach that affect this flow. Winter flows are needed below the reservoir to provide for adequate winter fish habitat.

3 Nutrients in this reach are contributed by treated and untreated domestic sewage, animal wastes, irrigation return flows, and industrial discharges. Primary sediment sources are from irrigated agriculture and construction. The dissolved oxygen deficiencies are associated with domestic and industrial waste effluents and/or the decay of algae from abundant growth due to excess nutrients.

4 This reach does not have any listed pollutants; however, about 1,000-acre-foot minimum storage in Island Park Reservoir prevents excessive sediment discharge into Henrys Fork.

5 This reach has a significant amount of irrigation return flows. Construction, grazing, and reservoir discharge also contribute sediments.

6 The Portneuf River and Bannock Creek drain directly into the reservoir and, along with the inflow of the Snake River, contribute to the pollutants in the reservoir. When the reservoir storage is below about 50,000 acre-feet, sediment in the discharge exceeds the state turbidity standard.

7 Many agricultural irrigation returns drain into the Snake River in this reach and may contribute most of the pollutants.

8 Milner Dam discharge causes heavy impact to the middle Snake River. Reservoirs within the middle Snake River are for power generation and Reclamation has little influence on their operation. Under the FERC license for Milner powerplant, a minimum flow of 200 cfs must be released, if available. But on occasion, the flow is reduced to zero. Flows below Milner Dam are primarily replenished by agricultural drains, tributaries, ground-water flow, and geothermal sites. Over 80 agricultural and natural drains have been noted in this reach on the north and south sides of the Snake River rim. During dry years, over 60 percent of the flow in the middle Snake River is from groundwater; the largest inflow being from the Snake River aquifer. During low flow periods, sediments are not flushed from the river. Gradually aquatic macrophytes begin to grow on the sediments producing nuisance algal growth. Low flows reduce the river's capacity to assimilate nutrient loads.

9 A minimum discharge of 80 cfs is recommended. The area along the stretch of the Boise River from Lucky Peak to the Snake River is heavily populated and has many agricultural return flows, confined livestock feeding lots, and urban drainage that would contribute to pollutants.

10 These listings are due to the inflow pollutant load, nutrient recycling in the shallow reservoir, and biological activity within the reservoir. The reservoir can be operated to reduce nutrient levels, algal production and improve fish habitat. Dissolved oxygen can be critical during winter periods of ice cover which prevents the natural oxygen exchange with the stored water. A target minimum pool of 300,000 acre-feet is recommended to reduce chances of fish kill within the reservoir during periods of dissolved oxygen depletion. Reclamation

and the State of Idaho have conducted water quality model studies on Cascade Reservoir to determine possible operational changes that can improve existing water quality and reduce the risk of winter fish kills. The model indicated that a minimum pool of 250,000 acre-feet during a dry year would result in a minimal volume of water suitable for trout survival. If subsequent dry years occurred, the reservoir may not be filled to the minimum pool. The volume of water suitable for trout survival with a 400,000-acre-foot minimum pool is much greater, although maintenance of a high-minimum pool would reduce the amount of water discharged from the reservoir for downstream activities. Water quality problems within the reservoir can impact downstream aquatic habitat.

[11] Silviculture and roads in this area contribute sediments to the Deadwood River.

[12] This is due primarily to return flows below the dam. Over the past several years, some flow augmentation releases have been routed downstream during the summer months to reduce water quality problems associated with irrigation returns to the lower Payette River.

[13] These pollutants are typical of irrigation return flows and animal waste runoff.

[14] Low dissolved oxygen levels can be attributed to releases from the bottom of the reservoir. The primary outlet is at elevation 2370 feet which is 300 feet below the normal water level.

[15] Discharges, when the reservoir is below minimum pool, contribute excessive sediments downstream.

[16] The Grande Ronde River is the only eastern Oregon tributary with anadromous fish.

[17] The Wallowa River pollutants will impact the Grande Ronde River.

[18] Forest activities, livestock management, and roads increase sediment loads.

[19] The Salmon River and Grande Ronde River are affected by irrigation return flows.

Attachment I Communities Within the Irrigation Service Areas

Economic Diversity Index. The Economic Diversity Index is a summative index based on the economic diversity of industries within a community. Communities with only one industry (such as agriculture or timber resources) are inordinately affected by swings in the economic/market cycle, in that residents have few opportunities for alternative employment. Communities with more diverse economics have greater options for their residents, thus can tolerate economic swings with fewer adverse effects.

Harris et.al. developed economic diversity index scores with a range of -10 to +10 for Snake River basin communities. Higher positive scores represent higher economic diversity in communities; -10 indicates a community that is totally dependent on agriculture. The scores (for communities that have been evaluated) are reported below

Communities Within The Flow Augmentation Irrigation Service Areas

Service Area	Community	1996 Population	Growth/Trend 1990-1997 (Percent Change)	Economic Diversity Index
Western Wyoming				
	Afton	1,820	0.0	-0.41
	Alpine	460	0.8	-
	Auburn	220		2.57
	Bedford	110		-
	Etna	70		-
	Fairview	150		-
	Freedom	50		-
	Grover	100		-
	Hoback Jct.	500		-
	Jackson	5,614	0.2	-
	Jenny Lake	32		-
	Kelley	200		-
	Moose	50		-
	Moran Jct.	200		-
	Smoot	70		-
	Thayne	302		-
	Wilson			-
Eastern Idaho				
	Aberdeen	1,553	0.1	1.72
	Alridge	-	-	-

Communities Within The Flow Augmentation Irrigation Service Areas				
Service Area	**Community**	**1996 Population**	**Growth/Trend 1990-1997 (Percent Change)**	**Economic Diversity Index**
	American Falls	4,341	0.2	0.68
	Ammon	5,849	0.2	-3.66
	Ashton	1,106	0.0	1.98
	Basalt	449	0.1	-3.35
	Blackfoot	10,406	0.1	2.34
	Chester	-	-	-
	Chubbuck	8,876	0.1	1.07
	Drummond, ID	40	0.1	-8.98
	Firth	453	0.1	-2.94
	Fort Hall	-	-	-0.53
	Goshen	-	-	-
	Hamer	96	0.2	-1.67
	Heise	84	-	-
	Idaho Falls	48,079	0.1	2.58
	Iona, ID	1,042	0.0	-0.92
	Lewisville	542	0.2	-3.54
	Lincoln	300	-	-
	Lorenzo	100	0.0	-
	Marysville	200	0.0	-
	Menan	709	0.2	-1.36
	Moreland	-	-	-
	Newdale	372	0.0	-2.94
	Parker	315	0.1	-5.57
	Pauline	-	0.0	-
	Pingree	100	0.0	-
	Pocatello	51,344	0.1	1.86
	Rexburg	14,204	0.0	2.55
	Rigby	2,703	0.0	2.55
	Ririe	609	0.0	-1.12
	Riverside	-	-	1.07
	Roberts	608	0.1	0.64
	Rockford	50	0.0	1.12
	Rockland	297	0.1	-2.13
	Shelley	3,803	0.1	2.51
	Springfield	100	-	-
	St. Anthony	3,129	0.0	2.01
	Sterling	70	0.0	-
	Sugar City	1,332	0.0	-1.12
	Taber	-	-	-
	Teton	630	0.1	-3.11
	Thornton	150	-	-
	Ucon	881	0.0	-2.06
	Warm River	11	0.2	-
				Ave. -0.67

Communities Within The Flow Augmentation Irrigation Service Areas				
Service Area	**Community**	**1996 Population**	**Growth/Trend 1990-1997 (Percent Change)**	**Economic Diversity Index**
Southern Idaho "The Magic Valley"				
	Acequia	118	0.1	-5.57
	Albion.ID	341	0.1	-2.30
	Bliss	217	0.2	1.44
	Bruneau	100	-	-
	Bruneau Hot Springs	-	-	-
	Buhl	3,797	0.1	1.17
	Burley	9,498	0.1	2.33
	Castleford	188	0.1	-0.20
	Declo	290	0.0	-2.65
	Dietrich	151	0.2	-3.70
	Eden	353	0.1	-1.00
	Filer	1,644	0.1	2.82
	Glenns Ferry	1,387	0.1	-0.36
	Gooding	3,135	0.1	1.86
	Grandview	406	0.2	-0.58
	Hagerman	698	0.2	2.25
	Hansen	930	0.1	-0.20
	Hammett	200	-	-
	Hazelton	431	0.1	-0.24
	Heyburn	3,014	0.1	-1.00
	Hollister	168	0.2	-2.53
	Jerome	7,292	0.1	2.29
	Kimama	-	-	-
	Kimberly	2,646	0.1	1.80
	King Hill	100	-	-
	Malta	187	0.1	-1.60
	Marion	-	-	-
	Minidoka	66	0.0	-1.65
	Mountain Home	8,988	0.1	0.44
	Murtaugh	143	0.1	-0.44
	Oakley	694	0.1	0.36
	Paul	932	0.0	1.88
	Raft River	-	-	-
	Richfield	430	0.1	-1.24
	Rock Creek	-	-	-
	Rogerson	65	-	-
	Roseworth	100	-	-
	Rupert	5,669	0.0	-
	Shoshone	1,365	0.1	2.31
	Tuttle	25	-	-
	Twin Falls	31,989	0.2	2.58
	Wendell	2,251	0.1	0.12

Communities Within The Flow Augmentation Irrigation Service Areas				
Service Area	**Community**	**1996 Population**	**Growth/Trend 1990-1997 (Percent Change)**	**Economic Diversity Index**
				Ave. -0.05
Western Idaho	**“ The Treasure Valley”**			
	Boise (City)	152,737	0.2	2.34
	Bowmont	50	-	-
	Caldwell	21,089	0.1	2.55
	Cambridge	442	0.2	-
	Eagle	6,577	1.0	1.79
	Emmett	5,242	0.1	2.33
	Fruitland	2,963	0.2	2.03
	Garden City	8,714	0.4	-5.30
	Givens Hot Springs	-	-	-
	Greenleaf	781	0.2	-2.06
	Homedale	2,344	0.2	3.28
	Kuna	2,815	0.4	1.79
	Letha	100	-	-5.30
	Marsing	929	0.2	-0.72
	Mayfield	-	-	-
	Melba	298	0.2	0.34
	Meridian	20,627	1.2	2.31
	Middleton	2,282	0.2	1.72
	Midvale	205	-	-
	Murphy	75	-	-
	Nampa	37,558	0.3	2.58
	New Plymouth	1,532	0.2	-0.41
	Notus	422	0.1	-1.60
	Orchard	10	0.0	-
	Oreana	25	0.0	-
	Parma	1,717	0.1	0.38
	Payette	6,647	0.2	2.57
	Pearl	8	0.0	-
	Reynolds	-	-	-
	Riddle	25	0.0	-
	Roswell	30	0.0	-
	Silver City	-	-	-
	Star	-	-	-
	Swan Falls	-	-	-
	Weiser	5,167	0.1	2.33
	Wilder	1,315	0.1	1.68
Southeast Oregon	Adrian	135	0.0	-
	Nyssa	2,970	0.1	1.80
	Ontario	10,290	0.1	2.02
	Owyhee	-	-	-
	Rockville	-	-	-

Communities Within The Flow Augmentation Irrigation Service Areas				
Service Area	**Community**	**1996 Population**	**Growth/Trend 1990-1997 (Percent Change)**	**Economic Diversity Index**
	Vale	1,510	0.0	1.77
				Ave.=0.84
Northern Nevada -	**Duck Valley Reservation**			
	Mountain City	1,333	-	-
	Owyhee		-	-
	Patsville		-	-
	Riddle		-	-
	Wild Horse		-	-
North-Central Idaho				
	Baker	100	-	3.30
	Carmen	10	0.0	-2.06
	Challis	1,123	0.0	2.57
	Salmon	3,233	0.1	3.28
				Ave.=1.77
Northeast Oregon (Grande Ronde)				
	Cove	600	0.2	-
	Elgin	1,715	0.1	0.84
	Enterprise	2,020	0.1	2.23
	Imbler	310	0.0	0.64
	Imnaha	-	-	2.57
	Island City	865	0.2	1.53
	Joseph	1,255	0.2	0.64
	La Grande	12,415	0.1	2.57
	Lostine	235	0.0	-
	Summerville	150	0.1	-
	Union	1,955	0.1	1.53
	Wallowa	755	0.0	0.31
				Ave.=1.42

A summary of characteristics of communities in the Snake River Basin, and potential outcomes of the flow augmentation scenarios that would be suggested from the literature about community response to economic change are:

1. Rural communities are likely to be affected differently by the flow augmentation scenarios, depending upon their capacity to adapt to change and the resources they have to develop economic and social alternatives. (Harris, 1996:152)

2. Most communities in the Snake River Basin are experiencing slow steady population and economic growth, increasing at the rate of 1-2 percent per year in this decade.

3. The economic diversification of most communities is increasing correspondingly, which enhances the ability of communities to adjust to economic change.
4. Communities within commuting distance of larger urban areas (usually within 25 miles) are more resilient to economic change than more isolated communities.(Doak, 1996)

5. Isolated rural communities in the Snake River Basin are experiencing slow steady change in population composition, reduced local employment, and diminished economic revenue flow. The character and quality of life in communities changes accordingly.

6. Communities that are small, isolated, and lack economic infrastructure are limited in employment alternatives for rural community residents.(Harris, 1996)

7. A reduction in the agricultural economy of small isolated communities will result in a reduction in the physical capacity (infrastructure), and economic and human capital of small isolated communities to absorb and adjust to economic change.(Harris, 1996:154)

8. A reduction in the agricultural economy of isolated communities will reduce the stability of employment career patterns of farm workers, employment will become more uncertain, shorter term, with fewer alternative opportunities for area residents.

9. Family stability, security, and functionality of displaced family workers may change as a result of change in employment opportunity within rural communities.

10. A shift in water supply in isolated small communities is likely to force an "economic uncoupling" from the primary products economy and corresponding employment. Family employment and economic survival is likely to become more complex if residents remain in rural areas. (Water Transfers in the West, 1992)

11. Small isolated rural communities with a Diversity Index Score of less than 1.0 are quite vulnerable to the differential flow augmentation scenario conditions, and likely to experience more adverse effects from reductions in water supply than larger communities near larger urban areas.

12. Change in the economic base for communities can be, but is not always detrimental, in that communities with alternative employment opportunities can make the economic and social transitions and perhaps even be healthier in the long run. Many forest-dependent or military based communities have prospered as a result have forced change within a few years, while others have withered.

13. Small isolated agricultural communities are likely to face more difficult problems in adjusting to major changes in water supply to a region. A reduction in water supply is likely to force an "uncoupling from the agricultural economy and by farm workers, which in turn, will force organizational change in rural communities.

14. Experience with small towns that have lost sawmills indicates that it may take a decade or more for small communities to adjust and rebuild the local economy. Further, some towns take longer than others, apparently as a product of their human capital and the nature of state and federal program assistance (Harris 1996:154. Support for economic development programs, and transfer payments to local governments can make a critical difference to the resilience and vitality of communities, and the quality of life of area residents.