The Central Snake River Basin

A Description of Bureau of Reclamation System Operation of the Boise and Payette Rivers

Bureau of Reclamation
Boise, Idaho
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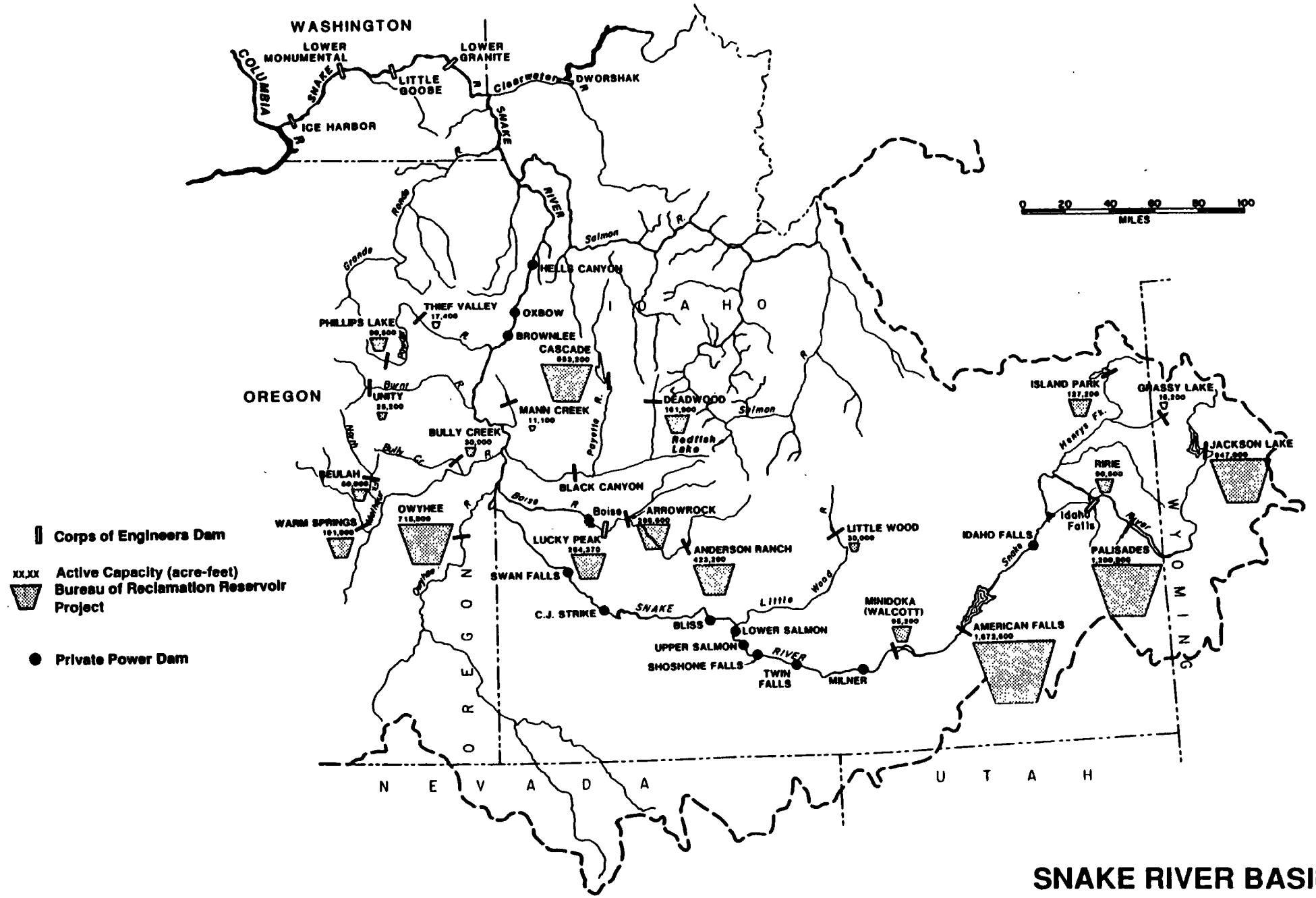

SNAKE RIVER BASIN

Acronyms and Abbreviations

BPA	Bonneville Power Administration
cfs	Cubic feet per second
Corps	United States Army Corps of Engineers
DSS	Decision Support System
ESA	Endangered Species Act
FCRPS	Federal Columbia River Power System
FERC	Federal Energy Regulatory Commission
IDWR	Idaho Department of Water Resources
IPC	Idaho Power Company
IWRB	Idaho Water Resources Board
kW	Kilowatts
M&I	Municipal and industrial
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
Reclamation	Bureau of Reclamation
RMP	Resource Management Plan
SOP	Standing Operating Procedures
SR^3	Snake River Resources Review
SSARR	Streamflow Synthesis and Reservoir Regulation
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

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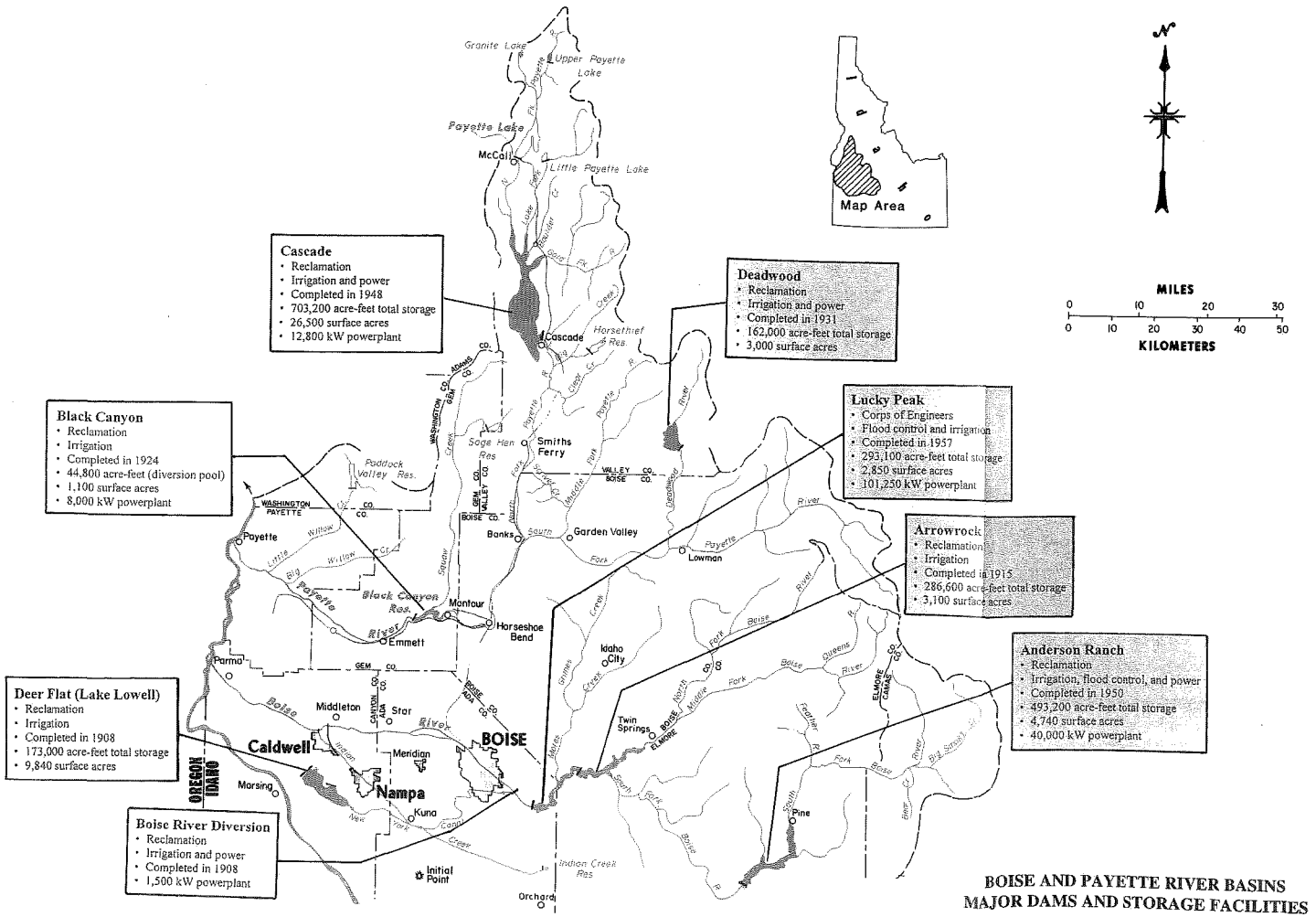


BOISE AND PAYETTE RIVER BASINS
MAJOR DAMS AND STORAGE FACILITIES

I. Introduction

The purpose of this document is to provide an overview of the operation of the Federal storage system in the Boise and Payette River basins in southwestern Idaho. The Boise and Payette Rivers are tributaries of the Snake River. Increasing demands and controversy over the use of Snake River resources require an understanding of the history of water development, river hydrology, characteristics of the dams and reservoirs, and the legal and institutional requirements for operation of the current system. Water operations in the past focused on out-of-stream diversions to irrigate land and storage operations for flood control. In recent years, additional demands on the water resource have focused primarily on instream uses including recreation and recovery of endangered species. Since 1991, the Bureau of Reclamation Reclamation) has been asked to provide water to augment flows in the lower Snake River for enhancement of endangered salmon. Part of this water is being provided from the Boise and Payette River basins. Reclamation also has been asked to modify operations to accommodate other species listed under the Endangered Species Act (ESA). Groups representing resident fishery, white water rafting, and water quality interests are asking for system operation changes to better accommodate their concerns.

The State of Idaho designates the Boise River basin as Water District 63 and the Payette River basin as Water District 65.

Consumptive use of the Boise and Payette Rivers is primarily for agriculture. However, it is important to recognize that irrigation development was well underway before storage was developed under Federal authorities. Some of the lands with the oldest water rights and a sufficient water supply remain under private irrigation. Privately developed lands, with an insufficient water supply, generally became part of the Federal project which supplies those lands with a supplemental water supply. Lands newly developed as part of the Federal project receive a full water supply from the project. Several points, which are further developed throughout this document, should be kept in mind in considering Reclamation operation of the Boise and Payette Rivers:

- Reclamation hold both natural flow rights and storage rights for project purposes. Water rights for the purpose of irrigation are generally appurtenant to the land.

- Water rights are administered by the State; Reclamation law, beginning with the 1902 Reclamation Act, provides that project operations will be conducted in conformity with state water law.

- Use of federally developed storage is closely controlled by three factors:

    - Federal law, including specific project authorizations
    - State water rights
    - Contracts for storage

This document is organized to provide basic information in early chapters and more specific and detailed information in succeeding chapters. Chapter II provides a description of the area, and chapter III provides a short history of water resource development in the Boise and Payette River basins. Major Federal and private facilities and water rights are discussed in chapter IV. Chapter V adds a general discussion of river system operations and includes a series of graphs of reservoir levels and river flows to illustrate the effects of water supply. River operations by function are expanded in chapter VI. Chapter VII identifies several issues related to operation of the river/reservoir systems. As an aid to the reader, a list of acronyms and abbreviations appears at the front of this document and a glossary of hydrologic and other terms constitutes chapter VIII.

II. Description of the Boise and Payette River Basins

Geography

Lower elevations of both basins consist of wide valleys and are semiarid with warm, dry summers and cold winters. Upper elevations of the two basins are forested and mountainous. Precipitation at the lower elevations averages about 10 inches annually 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.

The Boise River originates as three forks—the North Fork, Middle Fork, and South Fork—to the east and northeast of the city of Boise. Flow of the three forks is generally west and southwest to where they join to form the main stem about 20 miles east of the city of Boise. Mores Creek, and its major tributary, Grimes Creek, flow generally south, drain an area to the west of the three forks of the Boise River, and Mores Creek joins the Boise River main stem about 10 miles east of the city of Boise. The Boise River continues west through the city of Boise and past the edge of the city of Caldwell to join the Snake River at river mile 392.3 (see appendix A for an abbreviated river mile index of the Boise and Payette Rivers).[1] From this confluence downstream to the Oregon-Washington border, the Snake River forms the border between Idaho and Oregon. About 4,130 square miles including parts of Ada, Boise, Camas, Canyon, Gem, Elmore, and Payette Counties are drained by the Boise River.

The Payette River also originates as three forks—North Fork, Middle Fork, and South Fork. The North Fork originates in Payette Lakes and flows south to form the main stem (with the South Fork) near Banks, Idaho about 30 miles north of the city of Boise. Flow of the Middle Fork is southward to the confluence with the South Fork near Garden Valley (east of Banks). The South Fork, which is often considered the main stem, originates to the east, near the origin of the North Fork Boise River, and flows west. Near Lowman, Idaho, the South Fork is joined by a major tributary, the Deadwood River. From Banks, the main stem Payette River flows south and then generally west past the towns of Emmett and Payette to join the Snake River at river mile 365.0, about 27 miles downstream from the mouth of the Boise River. About 3,270 square miles in Boise, Gem, Payette, and Valley Counties are drained by the Payette River.

Water Supply and Historical Change of Flows

Figures 1 and 2 show the annual discharge of the Boise River at Lucky Peak and of the Payette River at Horseshoe Bend for the 30-year period of water years 1961-90. These points are upstream from any significant diversions and downstream from all significant runoff, i.e., runoff below these points contributes little to streamflow. During the 30-year period, average annual runoff of the Boise River at Boise, Idaho was about 2 million acre-feet. Average annual runoff of the Payette River at Horseshoe Bend was 2.3 million acre-feet.

[1]River miles are measured in the center of the stream starting at the mouth and going upstream. The Boise River enters the Snake River 392.3 miles upstream from the mouth of the Snake River which is located at Columbia River mile 324.3. That is, the mouth of the Boise River is 716.6 miles upstream from the Pacific Ocean.

Figure 1.—Natural Discharge of the Boise River Near Boise, Idaho

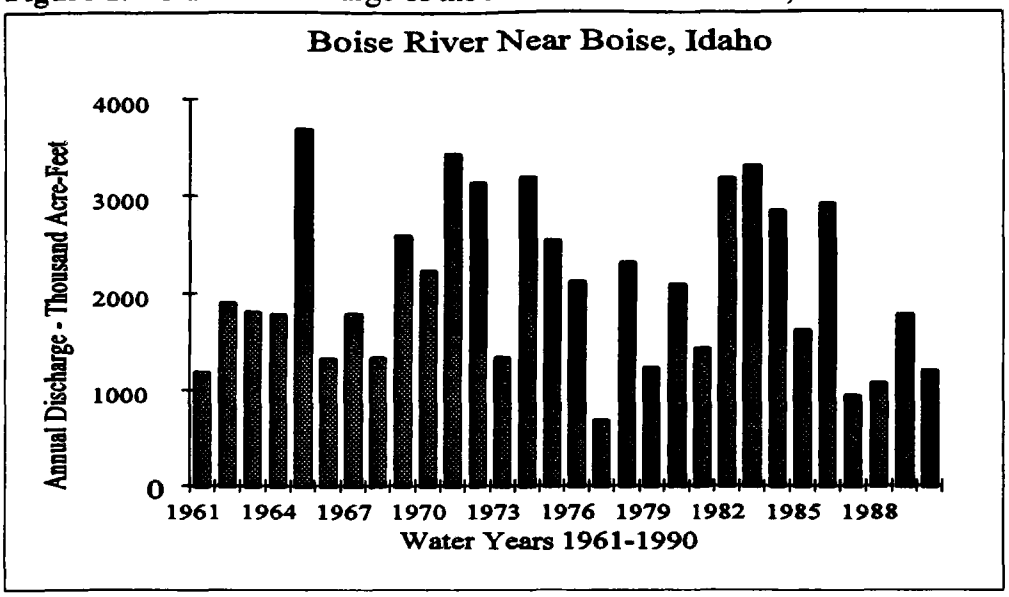
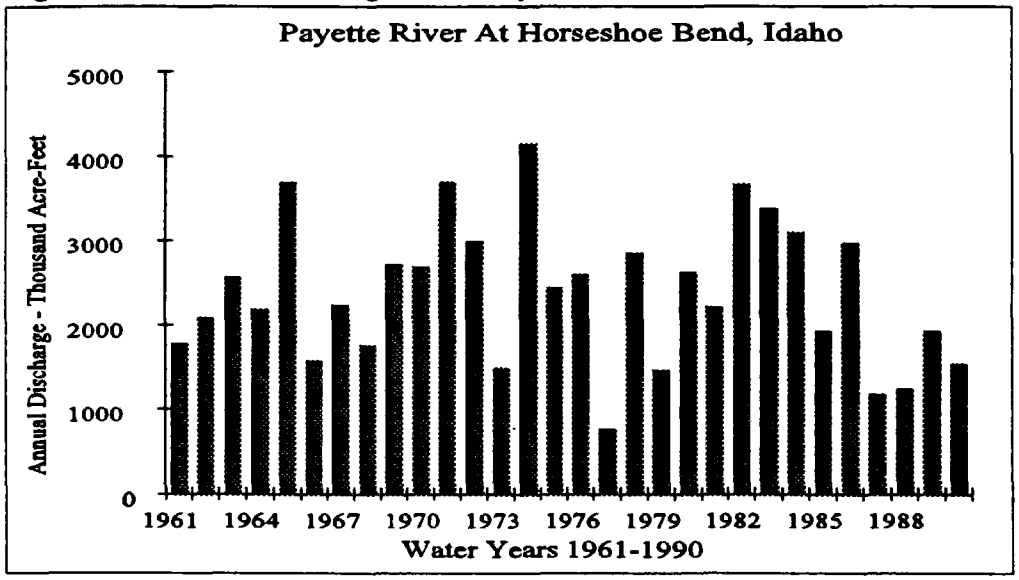


Figure 2.—Natural Discharge of the Payette River at Horseshoe Bend, Idaho



A comparison of the average monthly natural flow and observed flow (see chapter VIII for definitions) shows the effects of storage, diversion, and irrigation return flow on the river systems. For the Boise River, natural flow near Boise, Idaho and the observed flow at Parma, Idaho, near the mouth, were selected as there is very little natural runoff between Boise and Parma. Figure 3 shows this comparison.

Figure 3.—Average Monthly Natural Flow and Observed Flow of the Boise River (at Parma, Idaho)

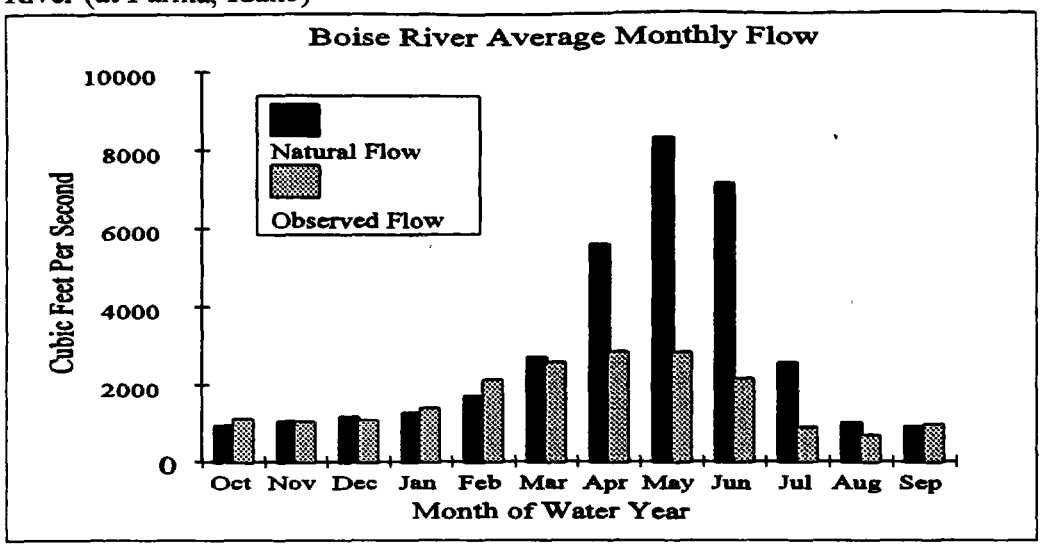
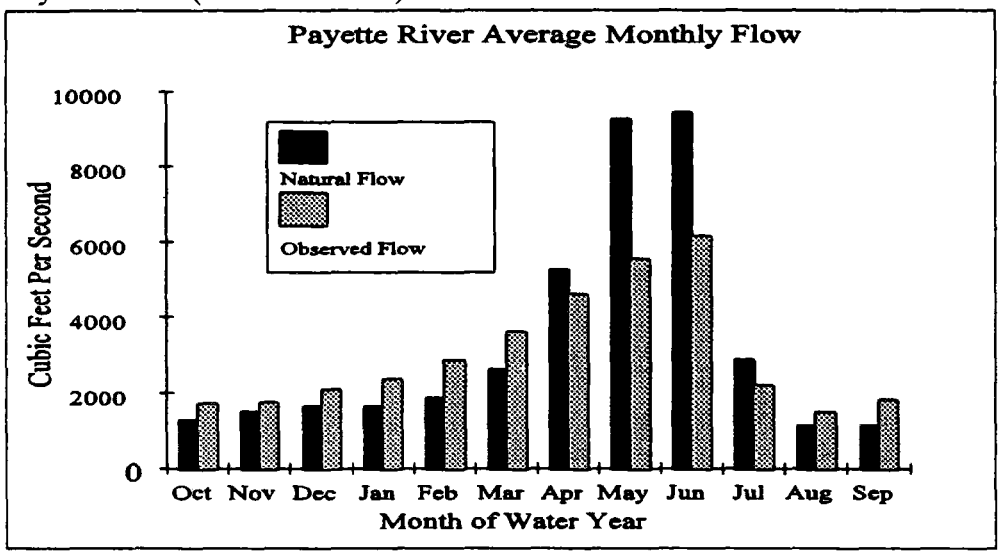


Figure 4.—Average Monthly Natural Flow and Observed Flow of the Payette River (near the mouth)



For the Payette River, the natural flow at Horseshoe Bend was compared to the observed flow at Payette, Idaho near the mouth of the Payette River. This comparison, shown in figure 4, illustrates the effect of storage and diversion on the flow of the Payette River.

Most runoff is from melting snow. The natural runoff pattern is low flow from August through February, increasing flow in March and April, high flow in May and June, and decreasing flow in July. Natural flows are moderated to a large extent since more than 1 million acre-feet of active storage capacity has been developed in the Boise River basin and more than 800,000 acre-feet have been developed in the Payette River basin.

III. History of Water Resource Development

Prior to Federal Development

In August 1862, miners found gold in Grimes Creek, about 40 miles north of the present city of Boise. The discovery caused a significant migration into the Boise River drainage and by 1863, 19,000 people had relocated to the area. The population was generally dependent on food and supplies imported from Oregon and Utah.

Although the population center was to the north in the mining areas, by the summer of 1865, most of the river bottom land in the Boise Valley was under irrigation; crops included grains, vegetables, and fruits. Irrigated agriculture expanded to higher lying bench lands as crop yields and produce prices increased. These lands, unlike the bottom lands, were more difficult to irrigate and water delivery was dependent on engineering expertise and capital. Companies with broad-based financial capability were formed by private investors to promote bench land development.

One of the early developments (1865) was the Ridenbaugh Canal which began as a modest undertaking of 2-1/2 miles to provide water for irrigating about 640 acres, to power flour and sawmills, and to transport logs. William B. Morris acquired the ditch and in 1877 filed for water rights of 100 cubic feet per second (cfs). In 1888, William H Ridenbaugh, nephew and successor to Morris, filed for water rights of 600 cfs. Through a series of transactions, interests were sold, and a main canal (12 miles), two branch canals (25 miles), a Nampa Canal through Deer Flat Valley (45 miles), and a chain of 10 reservoirs were constructed. One-third of the Boise River flow was required for the development in low water years. The system was acquired by the Nampa and Meridian Irrigation District in January 1906.

Another expansive effort was that of the Idaho Mining and Irrigation Company which in 1882 filed two claims totaling 3,000 cfs of water for mining, milling, and agriculture purposes and proposed construction of two canals. The New York Canal, which is currently one of the main diversion canals, was begun as an effort to provide water to the southern bench lands in the eastern area of the Boise Valley. The history of construction is mottled with several starts, financial failures, and repurchase of assets. In 1894, the New York Canal Company was formed from two groups of farmers, and 25 miles of canal were completed in 1900. The New York Canal Company was eventually succeeded by the current New York Irrigation District.

The Phyllis Canal, which extends some 35 miles from its head near Eagle Island, was the effort of the Idaho Mining and Irrigation Company for a canal to serve the western area of the Boise Valley. It was completed in 1891 and sold in 1902 to the Pioneer Irrigation District which also acquired the Caldwell Canal.

An effort to irrigate lands on the north side of the Boise River west of Middleton was initiated in 1874. Subsequently, additional filings and enlargements of the canal were made, and Howard Sebree extended the (Sebree) canal to a 20 mile-long system in 1888. This system was purchased by the Farmers Cooperative Ditch Company in 1902.

A canal company to divert water to the opposite side of the river from the Sebree Diversion was formed, sold, and resold. The canal was purchased by the Riverside Irrigation District in 1893 and increased to 30 miles in length by 1903.

Another major canal system was initiated by settlers in 1884 to irrigate lands in the vicinity of

Meridian, but little was accomplished until John Lemp became involved in 1887. First water was delivered in 1891. In 1901 the system was sold to the Settlers Canal Company which enlarged and extended the system to a 20-mile canal in 1905.

By 1900, an estimated 465 miles of canals, ditches and laterals had been constructed at a cost of about $1.8 million and 100,000 acres were capable of being irrigated. However, one of the major problems to irrigation was the low flow of the Boise River in the fall. As early as 1893 Governor William J. McConnell had criticized the excessive sale of water rights and asked the legislature to assist in the construction of storage. With an average flow of 810 cfs on September 1, there was enough water for irrigation of only 38,000 acres.

In Idaho, public land was acquired largely under the Homestead Act (1862), the Desert Land Act (1877), and the Carey Act (1884). The Carey Act was used quite extensively in the development of lands for irrigated agriculture production in the Snake River system. Under the Carey Act, each state, where irrigation was feasible, could select up to 1 million acres of arid Federal lands for reclamation (irrigation) by inducing private capital to construct the works necessary for irrigation. The Secretary of the Interior was authorized to ". . . donate, grant, and patent to the State free of cost for survey or price . . ." desert land for reclamation, cultivation, and settlement. The State Land Board was to approve the plans for development, set a price to be charged by the developing company, and provide supervision for the projects. The promoting company was to acquire a lien upon the lands of the settlers as security for payment of the obligation due for the water rights.

Although the Desert Land Act and the Carey Act were somewhat effective in promoting irrigation development by private enterprise, development was limited by the financial resources of the individual promoters and the state. As the less complex irrigation projects were completed, the Federal Government was pressured to provide financial help and increase water supplies through storage development. Early settlers often overestimated the available water supply, not realizing that natural flows in August and September were insufficient to dependably irrigate crops.

Dry years and the resulting loss of agricultural production and financial instability provided the impetus for construction of Federal storage.

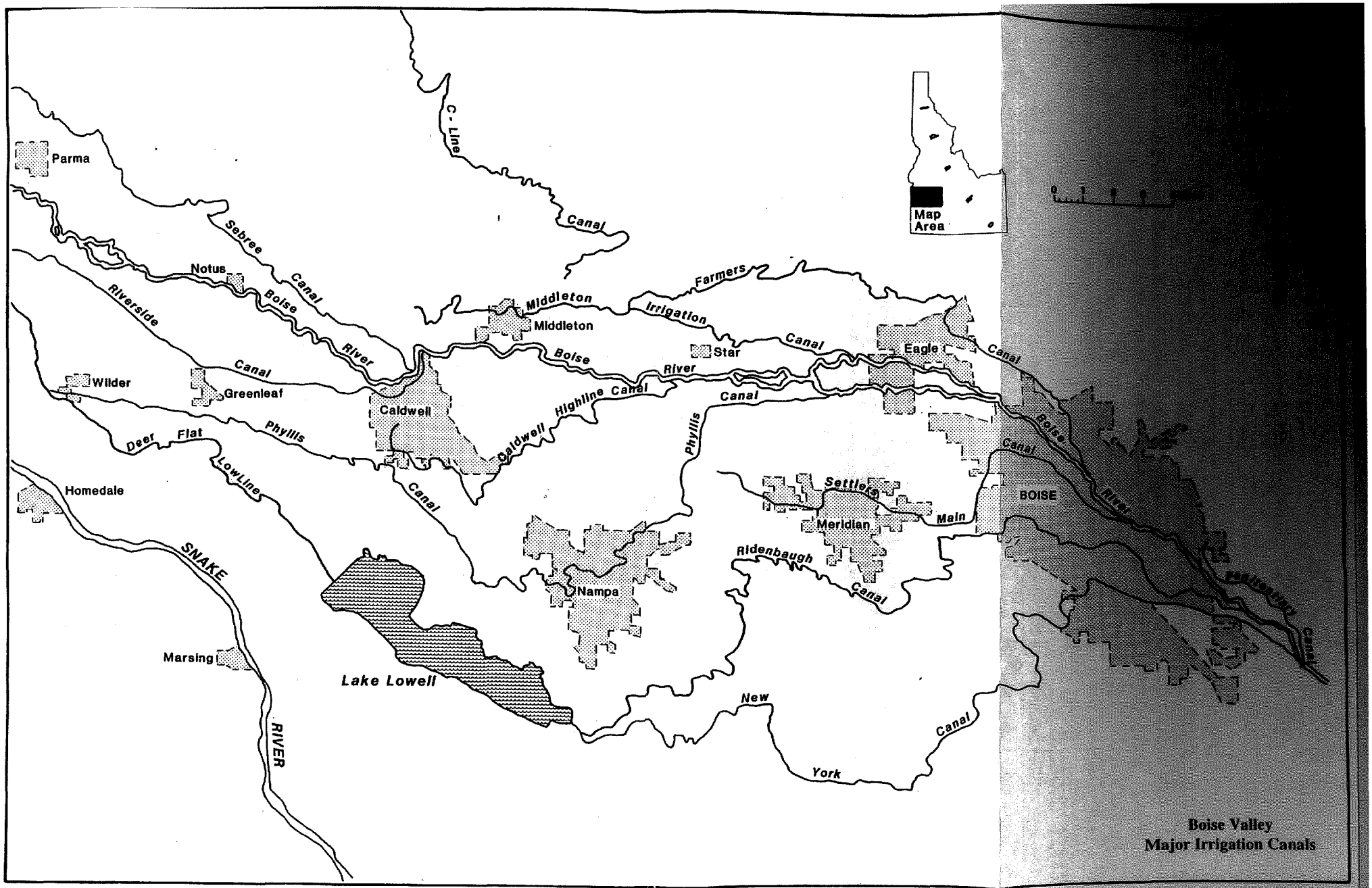
Federal Development

During the period of private irrigation development along the Boise River, the U.S. Geological Survey (USGS) had been formed and was actively classifying public lands and examining the geologic structure, mineral resources, and products of the national domain. The USGS reviewed opportunities for storage of water and irrigation of lands. One of the earliest assessments indicated in an 1889 report that the runoff of the Boise and Payette Rivers, with adequate regulation through storage, was sufficient to irrigate up to 350,000 acres.

In 1902, the USGS investigated potential storage sites at the headwaters of the Boise and Payette Rivers and proposed construction of storage facilities to irrigate an additional 200,000 acres.[1] Their investigations indicated that less than 70,000 acres of the acreage under cultivation received water and the water supply to half of that acreage was not adequate.

The opportunity for diverting water from the Payette River drainage into the Boise River

[1]Following passage of the Reclamation Project Act, signed June 17, 1902, the Reclamation Service was created within the USGS. In 1907, the Reclamation Service was separated from the USGS, and in 1923, it was renamed the Bureau of Reclamation.


Parma
C - Line
Canal
Sebree
Canal
Notus
Riverside
Canal
Boise
River
Wilder
Greenleaf
Middleton
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Irrigation
Canal
Star
Boise
River
Eagle
Canal
Caldwell
Highline Canal
Caldwell
Canal
Phyllis
Canal
Deer Flat
Phyllis
Canal
Low Line
Homedale
SNAKE
RIVER
Marsing
Lake Lowell
Nampa
Settlers
Main
Meridian
Ridenbaugh
Canal
New
York
Canal
Boise
Canal
BOISE
River
Map
Area
Boise Valley
Major Irrigation Canals

drainage was investigated in 1903 and further evaluation was recommended for the Black Rock Canyon site on the Payette River. The Secretary of the Interior suggested that a project encompassing the Boise and Payette River drainage might be considered. Petitions were prepared by the Boise Valley Irrigators Association requesting the Secretary to construct a Boise Federal Reclamation Project, and a formal request was submitted to the Secretary on March 27, 1904.

In February 1905, a report on the proposed Boise Project divided the project into three divisions—Payette Division, Boise Division, and Succor Creek Division. The project was approved by the Director of the USGS and by the Secretary in March 1905. The Payette Division of 72,000 acres (54,000 acres in the Boise Valley) was to consist of storage in Payette Lake, a diversion dam at the Black Rock Canyon, and enlargement of the Sebree and Riverside Canals. The Boise Division would consist of 274,000 acres on the north and south side of the Boise River and included enlargement of the Farmers' Union Canal, construction of a new canal, a diversion dam and powerplant on the Boise River, acquisition, enlargement, and extension of the New York Canal, construction of an offstream reservoir in Deer Flat Valley, and water distribution facilities. The Succor Creek Division was to serve 27,000 acres on the south side of the Snake River near the confluence of Succor Creek and would include a gravity and pumping system of main canals and distribution works.

As part of early agreements, Reclamation required that the Ridenbaugh Canal be purchased by the Nampa-Meridian Irrigation District and that none of the existing facilities owned by a corporation operating on a water rental basis would be used as part of the Boise Project.

Following authorization of the Boise Project, additional irrigation carriage facilities and storage facilities were constructed in the Boise River basin, comprising the current Arrowrock Division, and in the Payette River basin, comprising the Payette Division. Lands of the proposed Succor Creek Division were included in the Owyhee Project. (Chapter IV discusses the constructed Boise Project).

Most of the facilities and the irrigation development have now been completed or in place for several decades. Since the late 1970's, population growth has been rapid. A decline in irrigated agriculture accompanied this growth as lands were converted from agricultural uses to residential and other non-agricultural uses.

There is some water transfer between the Boise and Payette River basins. About 7,000 acres in the North Unit of the Payette Division are supplied with water from the Arrowrock Division (primarily irrigation return flows), and about 25,000 acres in the Arrowrock Division are supplied by water from Payette River (C-Line pumping plant).

Reclamation's 1992 Crop Report indicates that the total irrigation service area for the Boise Project was about 400,000 acres with nearly 280,000 acres in the Arrowrock Division and about 120,000 acres in the Payette Division. All of the land is located within Idaho with the exception of a few thousand acres located in Oregon between the Snake River and the Idaho State line. Of the total service area, about 325,000 acres were actually irrigated in 1992. Table 1 summarizes full and supplemental irrigation.

Table 1.—Boise Project Irrigated Acres (1992)

Division	Full Supply	Supplemental Supply	Total
Arrowrock	124,036	98,637	222,673
Payette	59,140	53,701	102,841
Total	173,176	152,338	325,514

Diversion of the surface water supply in the Boise and Payette River basins is primarily for irrigation of lands of the Boise Project. Although there are records of diversions for the Boise Project, the total consumptive use is not known. Studies are underway to compute consumptive use in the Arrowrock Division and the lands of the Payette Division in the Boise River drainage. Complicating the calculations are irrigated lands supplied by return flows and diversions from drains. There are no records for the latter.

In the Boise River basin, several thousand acre-feet of ground water are withdrawn annually, mostly for supplemental irrigation supply. However, this volume includes significant amounts of ground water for municipal and industrial uses. Ongoing studies are defining the ground-water supply, amounts pumped, and the relationship to surface-water uses.

IV. Overview of Facilities

As indicated in the previous chapter, Reclamation involvement in irrigation development of the region is the response of the Congress to requests for Federal participation. Federal involvement began primarily with the USGS, which began classification of public lands at the request of Congress. The 1902 Reclamation Act provided the broad authority under which the Reclamation Service (later the Bureau of Reclamation) operates to identify and pursue irrigation potentials. The Reclamation Project Act of 1939 provided additional broad authorities particularly in the area of expending funds and recovering construction charges on Federal reclamation projects. The Federal Water Project Recreation Act of 1965 (Public Law 89-72) further broadens authorities by essentially authorizing recreation and fish and wildlife enhancement as a function at all existing reservoirs. More recently, the Reclamation Recreation Management Act of 1992 (Title XXVIII of Public Law 102-575) provides some additional broad authorities. Other public laws, especially various flood control acts, provide further authorities for consideration and authorization of other functions. Specific authorizations of projects, divisions, and units or specific facilities are contained in a variety of individual project or facility authorizing acts and in some appropriation acts.

Federal Projects

There are only two Federal Projects associated with the development of irrigation and water and land resources in the Boise and Payette River basins. These are:

- Boise Project, constructed and operated by Reclamation
- Lucky Peak Project, constructed and operated by U.S. Army Corps of Engineers (Corps)

Boise Project lands extend from just east of the city of Boise along the Boise River and south to the Snake River to the confluence of the Boise and Snake Rivers. Boise Project lands also extend west along the Payette River from Black Canyon Dam and south to the area bounded by the Payette, Boise, and Snake Rivers. Project facilities furnish irrigation water to about 225,000 acres of project lands and 165,000 acres under special and Warren Act contracts from five reservoirs with a total active capacity of nearly 1.7 million acre-feet. The storage facilities are Anderson Ranch Dam and Reservoir, Arrowrock Dam and Reservoir, Deadwood Dam and Reservoir, Cascade Dam and Reservoir, and Deer Flat Dams and Lake Lowell. In addition, there

are 2 diversion dams, 3 powerplants, 7 pumping plants, more than 2,000 miles of canals and laterals, and several hundred miles of drains.

Lucky Peak Project consists of Lucky Peak Dam and Reservoir which were constructed for flood control and irrigation water supply with an active capacity of about 264,000 acre-feet.

Reclamation Project Authorizations

Initial facilities of the Boise Project were authorized under the 1902 Reclamation Act with subsequent authorization of specific facilities by the Secretary of the Interior or the President. From 1902 to 1910, the Secretary of the Interior had authority to approve construction after a finding of feasibility. The Act of June 25, 1910 modified the procedure to require the President to approve the authorization. Later, the 1939 Reclamation Act returned authorization authority to the Secretary of the Interior but a finding of feasibility had to be submitted to the President and the Congress. Authorizing legislation sometimes clearly states the authorized purpose of the project or facility but often indicates only that the project is to be constructed in accordance with a cited report.

The authorized purpose is an important consideration because it helps determine the limits within which a Federal facility can be operated. However, other Federal laws, not specific to Reclamation projects, may also affect project operation. Flood control, as a project function, was authorized after most facilities were constructed. Recreation, including fish and wildlife enhancement, is an authorized function at projects and reservoirs generally through legislation that was passed after the facilities were constructed. However, the general authorizations for recreation apply to management of water and land surfaces and the development of facilities for recreation or safety purposes; they do not authorize reallocation of the water supply for other purposes.

The Boise Project (originally called the Payette-Boise Project) was authorized under the Reclamation Act of 1902 by the Secretary of the Interior on March 27, 1905; construction of Deer Flat Reservoir was a specific item. Arrowrock Dam was approved by the Secretary on January 6, 1911; this authorization included construction of a powerplant at Boise Diversion Dam to supply power for the construction of Arrowrock Dam. On October 18, 1928, the Secretary found the Deadwood Dam and Reservoir feasible and the President approved construction on October 19, 1928. The entire Payette Division was found feasible by the Secretary on November 30, 1935 and was approved by the President on December 19, 1935. Anderson Ranch Dam and Reservoir were found feasible by the Secretary on June 25, 1940, transmittal approval was received from the President on July 30, 1940, and the report transmitted to the Congress on August 12, 1940 as required by the Reclamation Project Act of 1939. The act of August 24, 1954, authorized the Secretary to coordinate the operations of project facilities with other Federal installations and to modify contracts and to allocate an appropriate portion of costs to project functions in accordance with a revised allocation and repayment report dated September 21, 1953. The effect was to slightly change the authorized purposes (see "Reclamation Reservoir Cost Allocations").

Table 2 summarizes the original authorization of the Federal storage facilities constructed in the Boise and Payette River basins. There are no significant private storage facilities in either basin.

History and Operation of Federal Dams

The major dams, including two diversion dams, are discussed by basin in the order in which they were constructed. The capacities of the storage reservoirs are summarized in table 3.

Table 2.—Authorization of Federal Storage Facilities		
Facility and Construction	**Authorization**	**Original Authorized Purpose**
Boise River Basin		
Deer Flat Dams 1906-1908, 1909, 1911, 1913, 1938	Secretary of the Interior on March 27, 1905 (under Reclamation Act of 1902)	Irrigation
Arrowrock Dam 1911-1915, 1937	Secretary of the Interior on January 6, 1911 (under 1902 Reclamation Act)	Irrigation
Anderson Ranch Dam 1941-1950	Secretary of the Interior on June 25, 1940 (under Reclamation Act of 1939)	Irrigation, power, flood control, and conservation of fish and recreation
Lucky Peak Dam 1949-1957	Act of July 24, 1946	Flood control and irrigation
Payette River Basin		
Deadwood Dam 1929-1931	President on October 19, 1928	Irrigation and downstream power
Cascade Dam 1946-1948	President on December 19, 1935 as part of Payette Division. Appropriation was provided in the Act of June 28, 1941	Irrigation and power

Table 3.—Capacities of Federal Reservoirs					
Reservoir	**Elevation at Full Pool**	**Capacity (Acre-Feet)**			
		Active[1]	**Inactive[2]**	**Dead[3]**	**Total**
Boise River Basin					
Lake Lowell[4]	2531.2	159,400	--	--	159,400
Arrowrock	3216.0	286,600	--	--	286,600
Anderson Ranch	4196.0	423,200	41,000	29,000	493,200
Lucky Peak[5]	3055.0	264,370	28,730	--	293,100
Payette River Basin					
Deadwood	5343.5	161,900	100	--	162,000
Cascade	4828.0	653,200	50,000	--	703,200

[1]Space from which water can be released for specific purposes.
[2]Space from which water can be released but is normally retained for a specific purpose, e.g., Anderson Ranch inactive space is reserved for power head.
[3]Space from which water cannot be released by gravity flow because it is below the elevation of the lowest outlet.
[4]Active and total capacity figures for Lake Lowell were recently reduced because of sediment accumulation.
[5]Corps facility with irrigation water marketed by Reclamation.

Deer Flat Dams

The Deer Flat Dams consist of four earthen embankments that impound Lake Lowell in a natural depression southwest of Nampa, Idaho. These are the Upper, Middle (Forest Dam), and Lower Embankments and the East Dike. The Upper Embankment has outlets to feed the Deer Flat Caldwell Canal and Deer Flat Nampa Canal while the Lower Embankment has outlets to feed the Deer Flat North Canal and the Deer Flat Low Line Canal. The Middle Embankment is a low embankment (15 feet high) that helps close the reservoir near the Lower Embankment. There is also a low East Dike at the upstream end where the New York Canal enters the reservoir.

The Lower Embankment was constructed from 1906 to 1908 and modified in 1911, 1913, 1916, and 1938. The Upper Embankment was constructed in 1906 to 1908 and modified in 1909, 1911, and 1938. The Middle Embankment and the East Dike were constructed in 1911. Water storage began in 1909 and was accompanied by large amounts of seepage to the underlying aquifer. Seepage losses have been a continuing problem with losses as high as 135,200 acre-feet in 1911, 3 years after operation was initiated. Because of safety concerns at the Upper and Lower Embankments, the maximum water level was reduced by 5 feet in 1989 while plans were formulated for a permanent solution. The Upper and Lower Embankments were reconstructed from 1991 to 1993 and the water level restriction was removed.

Lands around Lake Lowell are part of the Deer Flat National Wildlife Refuge established in 1909 and are managed by the U.S. Fish and Wildlife Service (USFWS)

The normal operation of Lake Lowell is to fill the reservoir between irrigation seasons and release water as needed for irrigation. Filling is accomplished by release of water from Anderson Ranch and Arrowrock Dams. This water is passed through Luck Peak Dam and diverted at Boise River Diversion Dam to the New York Canal which carries the flow to Lake Lowell.

Boise River Diversion Dam

Boise River Diversion Dam is a concrete and masonry weir with removable crest. It was completed in 1908 on the Boise River about 7 miles southeast of the city of Boise. The dam diverts water to the New York Canal. A powerplant consisting of three 500-kilowatt units was completed in 1912 to supply power for construction of Arrowrock Dam. Because of age and operation and maintenance costs, the powerplant was removed from regular operation and placed on a ready reserve status in 1983.

Prior to spring high flows, stoplogs are installed to raise the pool. In the early spring, water is diverted to the New York Canal to fill Lake Lowell. During the irrigation season, water is diverted to the New York Canal on the left bank and to the small Penitentiary Canal on the right bank. At the end of the irrigation season the stoplogs are removed to lower the pool behind the dam. Lowering the pool avoids potential ice damage to the headgate.

Arrowrock Dam

Construction of Arrowrock Dam began in 1911 and was completed in 1915. At the time, it was the tallest dam in the world (structural height of 345 feet); the downstream face of the dam was resurfaced and the height was increased 5 feet in 1937. Lands around the Arrowrock reservoir are withdrawn by Reclamation and managed by the U.S. Forest Service (USFS).

Most of the runoff during the winter and early spring is held initially in Arrowrock Reservoir which is the first reservoir in the Boise system to be drafted to meet irrigation demand. Arrowrock is normally drafted to a pool of 28,000 acre-feet (below 10,000 acre-feet in drought years) before Lucky Peak Reservoir is drafted.

Anderson Ranch Dam

Anderson Ranch Dam was constructed during 1941-50 on the South Fork Boise River about 20 miles northeast of Mountain Home, Idaho. Preliminary work on the structure was halted during World War II and then resumed. The dam is a zoned earthfill structure, which at 456 feet high was the world's highest earthfill dam at the time of construction. The powerplant, with two units and a capacity of 27,000 kilowatts (kW), was completed in 1950; a later upgrade increased the capacity to 40,000 kW. Lands around Anderson Ranch Reservoir were withdrawn by Reclamation and are managed by the USFS.

A minimum release of 300 cfs is maintained from September 15 through the following March 31 and the minimum is increased to 600 cfs from April 1 through September 15 (releases are normally above 1,000 cfs during this period). Releases are managed conservatively to retain as much carryover as possible to meet the minimum streamflow requirements and to not exceed the powerplant capacity of about 1,600 cfs. However, releases of more than 5,000 cfs have been made during the flood control season.

Lucky Peak Dam

Construction of Lucky Peak Dam, an earthen structure, was initiated in 1949 and was completed in 1957. It is located on the Boise River about 8 miles southeast of the city of Boise. This Corps dam is operated primarily for flood control purposes with storage for irrigation marketed by Reclamation. In 1988, four of the five irrigation districts of the Boise Project Board of Control, under a Federal Energy Regulatory Commission (FERC) license, completed construction of a 3-unit powerplant which includes one 11,250-kW unit and two 45,000-kW units; total powerplant capacity is 101,250 kW.

Unless drought or flood control conditions are overriding, Lucky Peak Reservoir is generally filled by Memorial Day to provide recreation opportunities. In good water years, Lucky Peak is usually maintained nearly full until Labor Day. It is drafted to meet irrigation demand in September and October and typically maintained at a low level during the winter months for flood control purposes. In drought years, Lucky Peak is drafted when Arrowrock nears minimum pool level and releases from Arrowrock are insufficient to meet irrigation demand. This could be as early as late June. An attempt is made to provide a minimum streamflow of 150 cfs during the winter; however, during low water years the streamflow release has fallen to as low as 80 cfs.

Black Canyon Dam

Black Canyon Dam was constructed on the Payette River near Emmett, Idaho in 1924. This concrete, gravity structure with a structural height of 183 feet is a diversion structure for the Black Canyon Canal. A powerplant with two units of 4,000 kW each (powerplant capacity of 8,000 kW) was constructed as part of the original project and went into operation in 1925.

Black Canyon pool is maintained at a stable elevation of 2497.5 feet within narrow limits (less than 0.1 foot of elevation) during the irrigation season by adjusting releases from Deadwood, Cascade, and Black Canyon Dams.

Deadwood Dam

Deadwood Dam is a concrete arch structure constructed on the Deadwood River, a tributary of the Payette River. It is located about 25 miles southeast of Cascade, Idaho. The dam, completed in 1931, was the first major storage structure in the Payette system and was constructed with a primary objective of providing water for generation of electricity at

Black Canyon Powerplant to operate project pumps. Lands around Deadwood Dam were withdrawn by Reclamation and are managed by the USFS.

In the Payette system, releases for irrigation demand are met first from Deadwood Dam, usually in the months of July and August, to minimize the draft of Cascade Reservoir. After Labor Day, the draft of Deadwood Dam is reduced and late season irrigation demand is met by releases from Cascade Reservoir. A minimum target release of 50 cfs during the winter was established after the installation of new outlet gates in the fall of 1990. A minimum pool of 50,000 acre-feet is a target established by administrative decision. Deadwood and Cascade Reservoirs are informally managed for flood control with the goal of limiting flow at Horseshoe Bend to 12,000 cfs.

Cascade Dam

Cascade Dam was constructed on the North Fork of the Payette River near Cascade, Idaho in 1946-48. The dam is a zoned earthfill structure with a crest length of 785 feet. Idaho Power Company (IPC) owns and operates a 12,800-kW powerplant under a FERC license at the dam. Lands around Cascade Reservoir were withdrawn and are managed by Reclamation.

The water surface of Cascade Reservoir is held as high as possible for recreation and water quality. Most late season irrigation releases in the Payette system are made from Cascade Reservoir. The target for winter releases is a minimum of 200 cfs, and a minimum pool of 300,000 acre-feet (250,000 acre-feet active storage) has been established by administrative decision. Cascade and Deadwood Reservoirs are informally managed for flood control with the goal of limiting flow at Horseshoe Bend to 12,000 cfs.

Other Dams and Reservoirs

There are numerous small dams and reservoirs independently developed and operated in the Boise and Payette River basins. Most consist of earthen dams with impoundments of less than 1,000 acre-feet. The larger reservoirs are located in the Payette River basin and include:

Little Payette Lake (13,165 acre-feet) operated by Lake Fork Irrigation District

Horse Thief Basin (4,900 acre-feet) operated by the Idaho Department of Fish and Game

Paddock Valley (25,100 acre-feet) operated by Little Willow Irrigation District

Other small reservoirs that are a part or have some association with Boise Project operations include Hubbard Reservoir in the Arrowrock Division and the privately developed and operated reservoirs of the Lake Reservoir Company in the Payette River basin.

Hubbard Dam and Reservoir

Hubbard Dam and Reservoir were built by the Idaho-Iowa Lateral and Reservoir Company about 1902 and purchased by Reclamation about 1912. This small offstream reservoir (about 4,000-acre-foot capacity) is located about 12 miles southwest of Boise and is fed by the New York Canal. The primary purpose of the reservoir is for emergency short-term storage for dewatering the New York Canal should a failure in the canal occur downstream. It also serves a flood control function for Boise River by storing flows diverted to the New York Canal. During the irrigation season, flows are diverted through the reservoir to increase the flexibility of routing water supplies to some canals. Reclamation retains permanent easement for the dam and a flood easement on the reservoir lands but the

State of Idaho has fee title to the dam and underlying land and a large portion of the reservoir area.

Payette Lakes

The Lake Reservoir Company operates four reservoirs in the upper Payette River basin to provide a water supply for irrigation. These include Upper Payette Lake (3,000 acre-feet) Granite Lake (2,900 acre-feet), Box Lake (1,300 acre-feet), and Payette Lake which provides the largest amount of active storage (35,200 acre-feet). Payette Lake Dam, a gravity concrete structure, was completed in 1944 at the outlet of Payette Lake on the North Fork of the Payette River near McCall, Idaho. The Lake Reservoir Company, which owns and operates the dam, maintains the lake level within a 6.5 foot elevation range. Informal coordination of operations between Reclamation and the Lake Reservoir Company allows Payette Lake to remain at a higher elevation (delay some storage releases for irrigation) for a longer period than would be possible with completely independent operation. Some of the early demand for storage in Payette Lake is met by releasing water from Cascade Reservoir. This coordination provides benefits to both bodies of water.

Reclamation Spaceholder Contracts

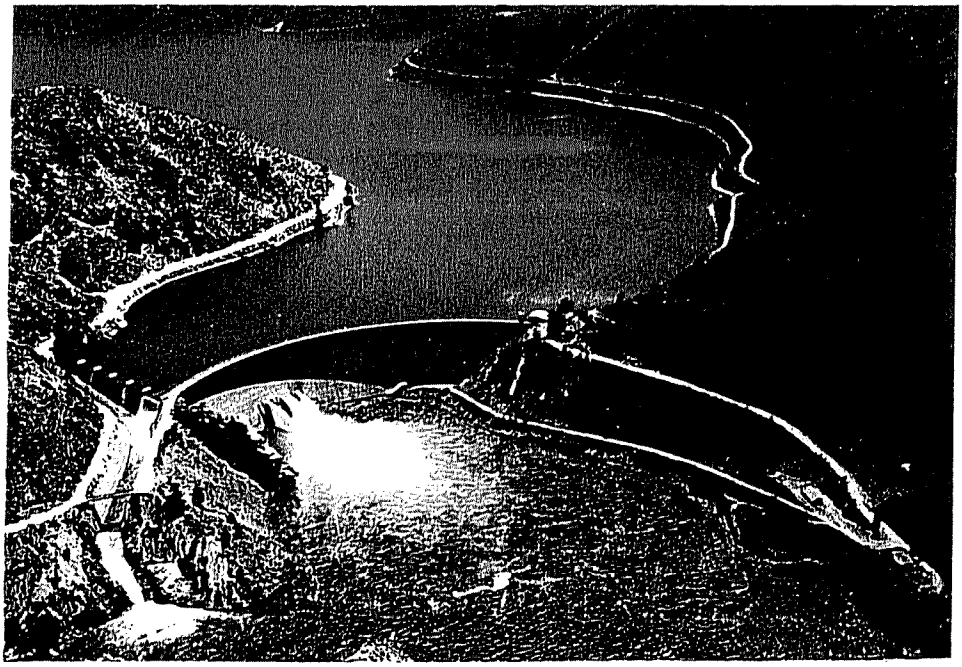
Reclamation Projects are authorized with the intent of recovering the capital and operating costs from the direct beneficiaries. Over time and with experience in developing large projects, the Congress has changed the procedures and rules to achieve this goal. Currently, the capital and operating costs of a project are allocated among the benefitting functions, e.g., irrigation, flood control, power, fish and wildlife, etc. In some cases, the benefitting entities are widespread and cannot easily be identified or there is a national interest in the benefit, e.g., flood control, anadromous fish enhancement, and migratory bird enhancement. These costs are made nonreimbursable meaning that the people of the United States pay these costs through general taxes. Where costs are assigned to functions that benefit specific entities, the costs are made reimbursable, and repayment contracts to recover the reimbursable costs are signed with the benefitting entities. Capital costs assigned to the irrigation function are to be fully repaid without interest over a specific time period (as low as 10 years in the early 1900's to about 50 years at present depending on the type of contract). Reclamation irrigation repayment contracts are generally spaceholder contracts or water service contracts. Annual operating costs (operation, maintenance, replacement, and power costs) are included in the repayment contracts.

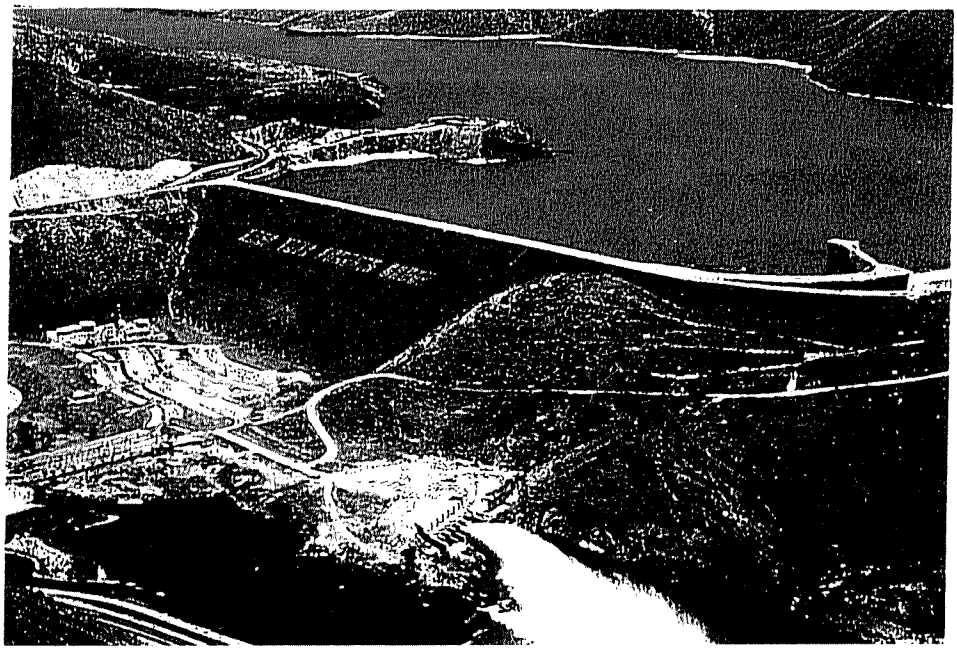
Project capital costs are seldom reallocated, a process that requires the Congress to reauthorize the project to recognize additional project functions or to recognize a significant change in project operation. Annual operating costs are computed annually and allocated to the various functions. Currently, there is there is an interim reallocation of annual operating costs based on the Lineweaver concept to reflect changes in benefits. Changes in the contracts must be approved by all of the signing entities.

All of the repayment contracts for Reclamation storage in the Boise and Payette River basins are spaceholder contracts that include an annual payment for the reimbursable cost of construction and for operation and maintenance. A spaceholder contract means that Reclamation sold each contractor (spaceholder) a share of the reservoir space, not a specific amount of water to be delivered each year. Carryover rights were also established, meaning that spaceholders could retain unused stored water from one year to the next. Under this system a water user's supply of storage water is a function of the space contracted, carry-over storage from previous years, and accrual to storage in the current year. The total amount of water to be delivered in a single year to a spaceholder cannot exceed the

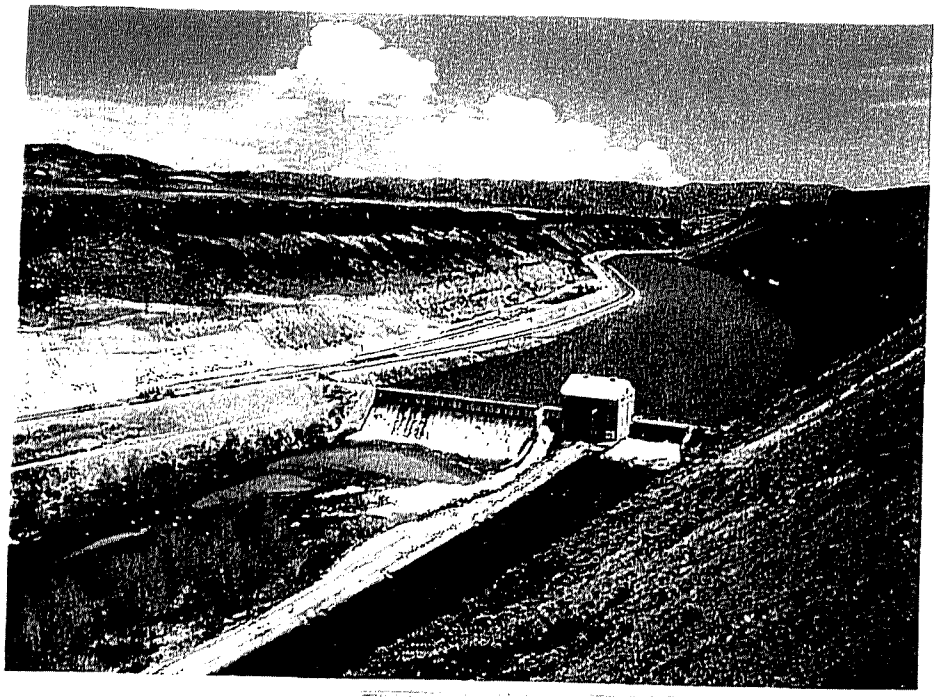
Anderson Ranch Dam

Arrowrock Dam





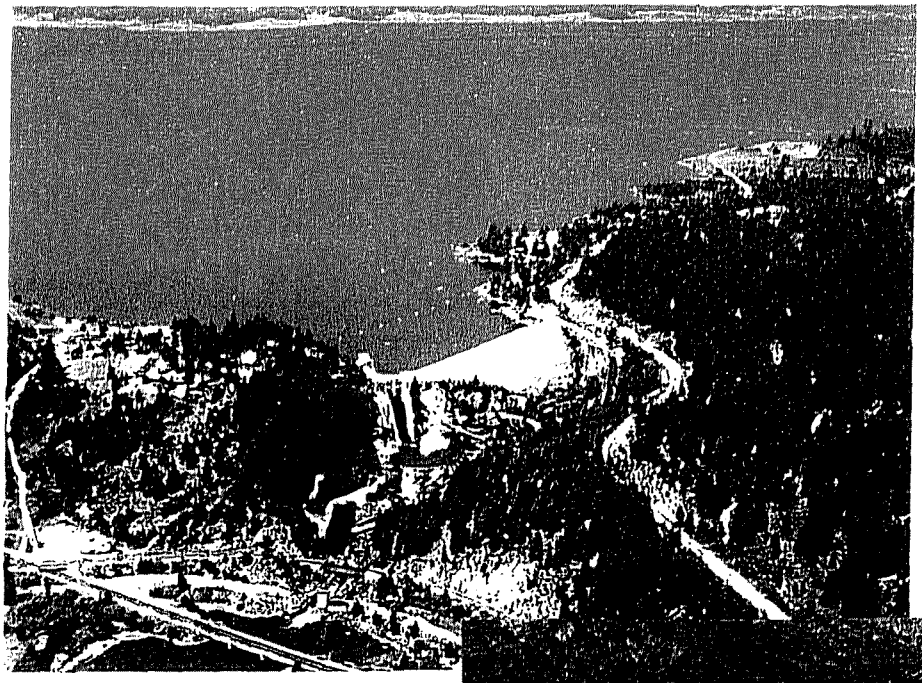
Lucky Peak Dam



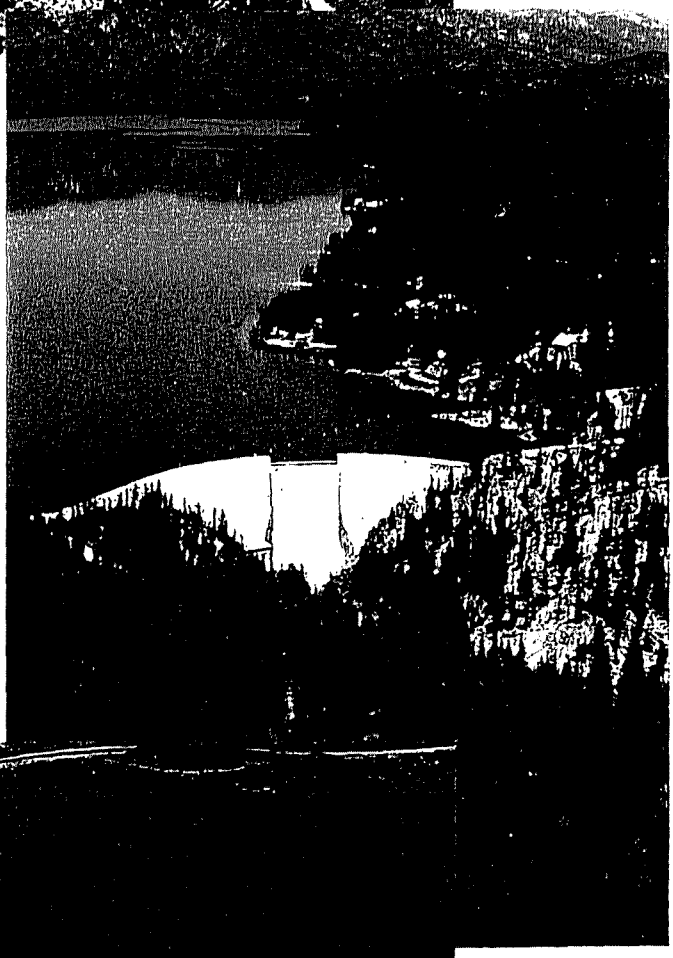
Boise River Diversion Dam

Hubbard Dam

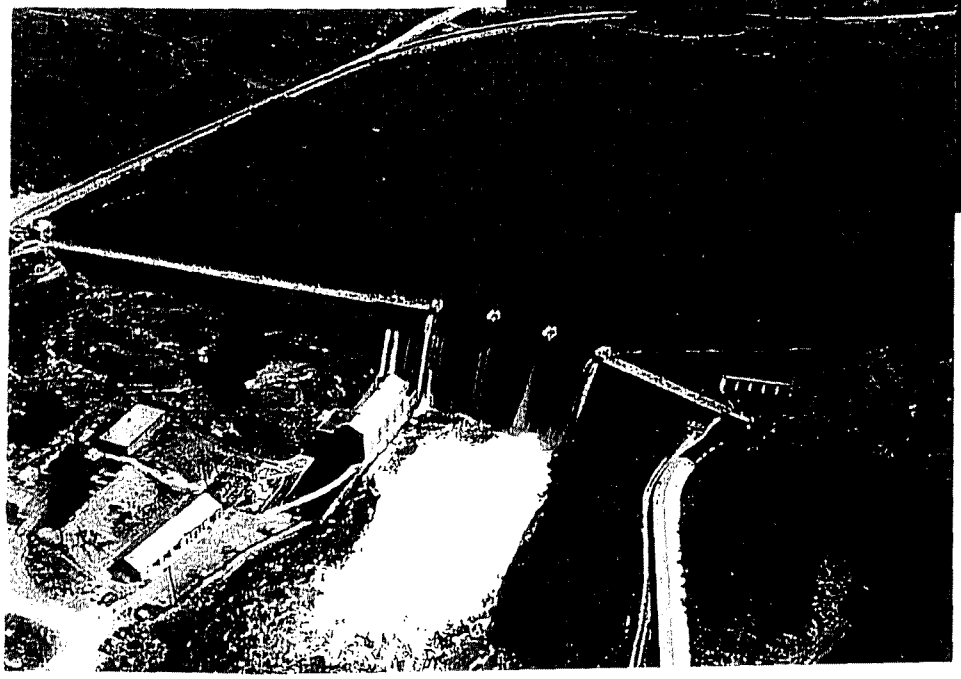
Deer Flat Lower Embankment
(Lake Lowell)



Cascade Dam



Deadwood Dam



Black Canyon Dam

olume of the contract space if all space in the reservoir fills, but some contracts allow more than that to be carried over if the reservoir does not fill. Most of these spaceholder contracts are held in perpetuity but can be sold to another entity with approval of Reclamation under Idaho State water law. Spaceholder contracts in Lucky Peak Reservoir are 40-year term water service contracts that can be renewed.

A list of spaceholders in the Federal reservoirs of the Boise and Payette River systems and the capacities and contracted space are included as appendix B.

With spaceholder contracts, Reclamation's operational control is limited to water in the uncontracted space and the inactive space. If all the active reservoir space has been marketed or contracted, all of the water in the active space of the reservoir is under control of spaceholders. hat is the case for Federal reservoirs in the oise, but not in the Payette system. All of the active space of Anderson Ranch, Arrowrock, and Lucky Peak Reservoirs have been contracted or formally assigned to specific uses. In the Payette system there remain 95,000 acre-feet uncontracted and unassigned—69,600 acre-feet in Cascade Reservoir, and 25,400 acre-feet in Deadwood Reservoir. These 95,000 acre-feet are at present assigned to flow augmentation. (See Appendix B for further details of capacity assignments.)

Spaceholder contracts make possible another concept—water banking. Under these contracts, the spaceholders can accumulate water in their contracted space and they may rent that water. To avoid problems with possible forfeiture of use (under State law a water right holder retains the right only if the water is used for a beneficial purpose), the State authorized creation of a water bank and defined the water bank as a beneficial e under State law.

In poor water years, when not all of the spaceholder storage is filled, each spaceholder gets his/her carryover from previous years and an amount of the accrued water supply proportionate to the contracted storage space. During normal and above normal years, the spaceholder storage space usually fills and the supply may exceed the amount used by the spaceholder who may carry over the excess or market it to a rental pool.

Spaceholder contracts are an important part of reservoir operation as the contract language, in part, defines the operating limits. For example, the contracts often stipulate that Reclamation will maximize the storage of water for irrigation use. These spaceholder contracts are in marked contrast to conventional repayment and water service contracts often used at other Reclamation projects. With water service contracts, Reclamation essentially delivers a specific amount of water or an entitlement and the water that remains in a reservoir after delivery of the specified entitlements is under Reclamation's control.

Reclamation Reservoir Cost Allocations

Construction Costs

At the time of construction, the space in Lake Lowell and Arrowrock Reservoirs was intended for irrigation. By the time it became evident that these reservoirs would not provide adequate irrigation water, the concept of multiple-purpose development had begun to take root. Anderson Ranch Reservoir was authorized for irrigation, flood control, power, and conservation of fish and recreation. Between authorization and construction of Anderson Ranch Dam, another reservoir, Lucky Peak, was authorized for flood control, and the concept of an integrated operation developed. Even Lake Lowell was indirectly integrated into a joint flood control-irrigation plan. In the Payette Division,

Deadwood Reservoir was authorized as a power facility to be used to provide storage releases for the generation of power at Black Canyon Powerplant and Cascade Reservoir was authorized for irrigation. Thus facilities, originally undertaken for irrigation and power generation have been converted to multiple purpose uses by making necessary additions and by improving plans for their use. If the change in use is significant, Congressional action is required.

In 1953, the allocation of costs for the Boise Project was revised (and authorized by the Act of August 24, 1954) to recognize these changes. At that time, the Boise Project had been in existence for nearly half a century, the costs of most features had been allocated to the appropriate functions, and suitable arrangements for their repayment had been completed. But the 1953 allocation also represented a change in previous allocations and repayment plans for some parts. Major parts in the 1953 revised allocation included:

Arrowrock Division
- Anderson Ranch Dam and Powerplant
- Arrowrock Dam
- Deer Flat Dams
- Boise River Diversion Dam and Powerplant
- Arrowrock Dam Alterations
- Canals, Drainage, and Miscellaneous Facilities

Payette Division
- Cascade Dam
- Black Canyon Dam and Powerplant
- Deadwood Dam
- First Unit
- Second Unit

In the 1953 revision, the capital cost of the Arrowrock Division was allocated to irrigation (52.7 percent), flood control (33.7 percent), and power (13.6 percent). The capital costs of the Payette Division were allocated to irrigation (91.6 percent) and power (8.4 percent). For the total Boise Project, the allocation was irrigation (65.6 percent), flood control (22.5 percent), and power (11.9 percent). Power was suballocated with 32.78 percent to irrigation power and the remainder to commercial power. Costs assigned to flood control are considered nonreimbursable.

All contractual obligations for the Arrowrock Division, except for costs associated with recent safety of dams work at Lake Lowell, have been repaid. Although most contractual obligations for the Payette Division have been repaid, some entities still have small amounts to be repaid on their contracts.

Annual Operating Costs

Annual operating costs include operation, maintenance, replacement, and power costs needed to operate and maintain the facility over an extended period. At present, all of the reservoirs provide multipurpose benefits. This change is recognized by allocating annual operating costs among several functions.

Allocation of annual operating costs for fish and wildlife, recreation, and flood control uses the Lineweaver allocation method (adopted by the PN Region in 1974). This method recognizes that all reservoirs provide substantial benefits to recreation and fish and wildlife (e.g., flatwater boating, water skiing, reservoir fishery, wetlands, etc.) and, through the use of operating rule curves, provide flood control benefits. Table 4 summarizes the annual operating cost allocation. Costs allocated by the Lineweaver method to recreation, fish and wildlife, and flood control are non-reimbursable.

Water Rights

Hydraulic mining in the west was an early activity that required diversion of a large amount of water for transport to another place of use. As a result, the prior appropriation doctrine of water rights

Table 4.—Allocation of Annual Operating Costs for Reclamation Reservoirs (percent of total cost)					
Reservoir	**Flood Control**	**Recreation**	**Fish and Wildlife**	**Irrigation**	**Power**
Arrowrock	46.0	4.0	4.0	46.0	0.0
Anderson Ranch	28.4	4.0	4.0	28.1	35.5
Black Canyon	0.0	4.0	4.0	42.0	50.0
Cascade	25.0	4.0	4.0	16.3	50.7
Deadwood	18.2	4.0	4.0	8.5	65.3

was developed in the west. Because of the arid conditions, this doctrine was also adapted for irrigation, and the riparian doctrine of water rights that developed in the more wet climate of the east was discarded throughout much of the west as inappropriate.

Under the prior appropriation doctrine, a person could use water from a stream without ownership of abutting land provided that the use did not interfere with an earlier use. Priority of appropriation became the recognized principle, with the courts ultimately determining the priority sequence and the amount of water of each appropriation. A law regulating the appropriation of water and affirming the prior appropriation doctrine was passed in 1881 while Idaho was a Territory. The Idaho State Constitution affirmed that streams belong to the State. Legislation has established a procedure through which appropriation of water is made by application to the State Engineer (currently the Director of the Idaho Department of Water Resources). For administrative purposes, the State of Idaho has divided the Snake River into three sections. The Boise and Payette drainages are placed in the lower third of the Snake River.

Water rights are administered by the State and are issued by date of appropriation for specific quantities, diversion points and places of use, and purposes. The 1902 Reclamation Act and subsequent Federal legislation affirm that the states are responsible for administering appropriative water rights within their borders. The earliest water rights for irrigation in the Boise and Payette River basins predate any storage development and are for diversion of flow at a specific rate (often called natural flow rights). Under the prior appropriation doctrine, natural flow rights are satisfied in order of priority based on date. When the water supply is limited, a water right holder with an earlier natural flow right is likely to receive a greater supply than a water right holder with a later date.

Development of storage facilities led to water rights for storage of a quantity of water (storage rights). Storage rights, along with natural flow rights, are satisfied in order of priority based on the date of the appropriation, i.e., the earliest rights must be met first. If earlier rights cannot be met, then water cannot be stored. All of the storage in a reservoir may have one priority date, but if a reservoir was increased in size at a later date, there may be a second priority date associated with the increase. As an example, Arrowrock Reservoir has storage priorities with two dates, the first associated with the original construction and the second associated with the increase in the storage capacity created by increasing the crest height.

In the case of storage, the relative priority among spaceholders is established in the repayment contracts. In general, spaceholders have equal

access to storage accruals, however, unequal access and priorities may be established in the contracts (see "Water Rental Pools" in chapter VI).

The right to use water for irrigation is an appurtenance to the lands served, whereas water rights for other purposes such as power and municipal and industrial (M&I) water supply are generally not. Water rights for irrigation are often managed collectively by some entity such as an irrigation district.

Reclamation holds title to the water rights associated with Reclamation storage facilities in the Boise and Payette River basins. These rights were acquired in accordance with the laws of Idaho. Offstream storage in Lake Lowell is filled through a natural flow right (specified in flow, not quantity) with diversion at the New York Canal. This offstream storage is filled between irrigation seasons. The earliest right associated with storage in Arrowrock Reservoir also specifies a diversion rate and not a quantity.

In the water rights process in Idaho, a permit is issued as a temporary right during development and a license is issued later. When a court takes action to settle water rights, the resulting decision on water rights converts the earlier permits and licenses to decreed water rights.

Court action in the Boise River basin early in the century established priority among water right holders by decree and established procedures for distributing water during periods when flow was inadequate to satisfy those rights. After many years of conflicting, overlapping water rights, a claim by the Farmers Cooperative Ditch Company was filed in 1902 against the Riverside Irrigation District, et al., in an action to define the surface water rights. On January 18, 1906, Judge George Stewart signed the "Stewart Decree" for irrigation diversions from the Boise River covering water rights for the period June 1, 1864 through April 1, 1904. The case was appealed to the State Supreme Court and remanded to the District Court to determine water duties; testimony was taken in 1914. Although a final decree was never entered, in 1919, Judge E. L. Bryan issued a continuing order which is still in effect. This Stewart Decree affected 135 individual water rights totaling 3,221 cfs which are often termed old water rights (dates of rights are mostly earlier than 1900, five are between 1906 and 1915). When the water supply is inadequate to fulfill all rights at 100 percent, the latest water rights successively to the oldest water rights are cut to 75 percent as needed. If further cuts are needed, the procedure is repeated with a cut to 60 percent of the water right.

The Bryan Decree signed by Judge E. L. Bryan on February 14, 1929 was appealed to the State Supreme Court which remanded it to the District Court to resolve some questions. The Bryan Decree provides a procedure similar to Stewart Decree for meeting water rights but affects water rights primarily with priority dates later than 1900. Judge Chas. E. Winstead signed a continuing order in 1932, and that order remains in effect today.

Water rights developed after these decrees are permits and licenses. For example, a license has yet to be issued for Lucky Peak.

An adjudication of the Payette River basin concluded with the Payette River Basin Decree in the 1980's and the conversion of earlier rights to decreed rights.

Changes in water rights, such as diversion point or use, require an application to and approval by the Idaho Department of Water Resources (IDWR). If the change exceeds 50 cfs or 5,000 acre-feet, the change must also be approved by the Idaho State Legislature.

Table 5 summarizes the storage rights for Reclamation facilities of the Boise Project.

Table 5.—Reclamation Storage Rights					
Reservoir	**Rate (cfs)**	**Volume (acre-feet)**	**Priority**	**Document**	**Date Issued**
Lake Lowell	1,354.58	--	12/14/03	Bryan Decree	------
Arrowrock	8,000		1/13/11	License	10/17/24
Arrowrock	--	15,000	6/25/38	License	3/29/55
Deadwood	--	163,000	12/31/26	License[2]	1/16/42
Cascade	--	700,000	12/24/37	License[2]	11/7/62
Anderson Ranch	--	493,161	12/9/40	License	12/17/56
Lucky Peak[1]	--	293,050	4/12/63	Permit	[3]5/20/87

[1]Storage marketed by Reclamation.
[2]Converted to decreed right by Payette River basin decree in the 1980's.
[3]Date of amendment.

V. General System Operation

This chapter provides an overview of operation of the Boise and Payette River/reservoir systems. More detailed description by function is provided in chapter VI.

Precipitation in the area is low in the summer and early fall, and higher during the late fall, winter, and spring. Much of the winter precipitation accumulates as snowpack in the higher elevations. This produces natural 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.

Storage reservoirs are constructed and operated to change the flow regime for some purpose. Based on project authorities, the reservoir systems in the Boise and Payette Rivers are operated primarily for irrigation water supply, project power, and flood control. Hydroelectric power generation, recreation, and fish and wildlife functions (other than maintaining streamflows) are secondary or incidental to the project operations, i.e., generally, water is not specifically released for those purposes. Project operations must release natural flows to meet earlier natural flow rights.

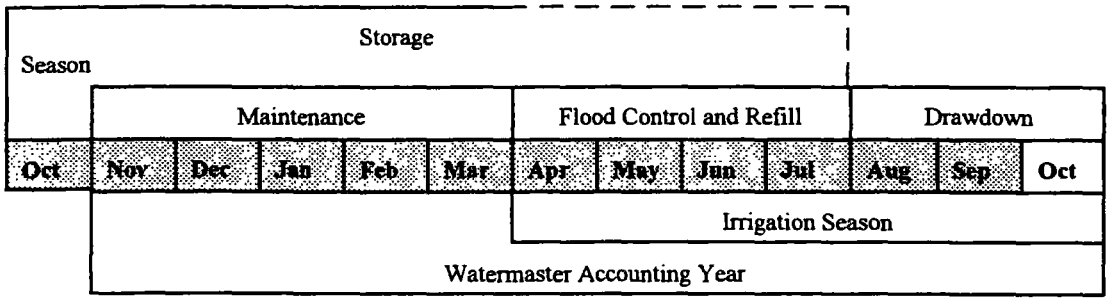
Although the Boise and Payette systems are operated separately, the four reservoirs of the Boise River system are operated as a unified storage system and the two reservoirs of the Payette River system are operated as a unified system. In that way, the capability of the storage reservoirs is maximized. 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. 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 contracts with the spaceholders allow the system to be operated more efficiently than would be possible if each reservoir were operated independently strictly following individual storage right priorities and functions associated with each individual reservoir. This allows for more flexible

operations and a much greater chance that reservoirs will fill to meet project functions.

Water operations are defined by several "seasons" or "years" of reference and do not follow the regular calendar year. For example, hydrologic data are arranged by water year defined as October 1 through September 30, e.g., the 1994 water year began on October 1, 1993 and ended on September 30 of 1994. Spaceholder contracts for the Snake River basin specify that the storage season begins on October 1 and extends until there is no more water to be stored and that the irrigation season begins on April 1 and extends to October 31. In keeping with the end of the contract irrigation season, the water accounting system used by the watermaster runs from November 1 to October 31.

There are three general operating seasons based on climatological pattern, runoff, and irrigation demand: (1) Maintenance from November through March, (2) Flood Control and Refill from April through July, and (3) Drawdown from August through October. This general pattern coincides with the Watermaster's accounting period. Drawdown for flood control, storage release for irrigation demand, and reservoir refill may occur in the same time frame for different reservoirs because of elevation difference and the demand for irrigation at lower elevations. Also, it is important to recognize that the beginning and ending of the three operating seasons can vary widely with weather conditions and the water supply. The various operating seasons and the accounting period are shown in figure 5.

Figure 5.—Operating Periods and Seasons (Water year shown by shaded blocks)



Maintenance Period

The primary function of reservoir operation during the Maintenance period of November through March is to carry over and store water to the extent allowed by flood control requirements. Water is released as necessary to meet downstream natural flow rights. By the beginning of November, the reservoirs have been drawn down as the result of meeting summer irrigation needs and/or to meet a maximum elevation that provides the required flood control space. Inflow is stored, if there is more space than needed for flood control, or released as needed to maintain the general winter flood control space. Accrual of water is normally very slow as streamflows are low because of the cold temperatures at the elevation of the reservoirs. In addition to meeting natural flow rights, water is released from some reservoirs to meet minimum streamflows for protection or enhancement of fish and other wildlife. After January 1, anticipated spring flooding becomes a factor. Depending on the size of the snowpack, the flood control space will be decreased, maintained, or increased.

Flood Control and Refill Period

Spring snowmelt and irrigation demand at lower elevations may begin in April. During the Flood Control and Refill period of April through July, reservoir storage and outflow are continuously adjusted on the basis of runoff forecast to provide space for flood control as needed and to assure refill of the reservoirs. Irrigation demands during the early part of this season are usually met from natural streamflows but may require some release of storage. During the latter part of this period, irrigation demands may be met by a combination of natural streamflow and release of storage. In recent years, some water has also been released downstream to meet requirements for augmentation flows in the lower Snake for ESA-listed salmon (see chapter VI for more detail).

Drawdown Period

During the Drawdown period of August through October, storage is released to meet irrigation demands or to reach a reservoir elevation that provides the required flood control space in November. Irrigation demands must be met in varying degrees from storage releases, and there is constant adjustment of reservoir releases to maintain water as high in the system as possible and to use water from reservoirs with the greatest refill capability. In very poor water years the Drawdown period may begin as early as April.

Standing Operating Procedures

Standing Operating Procedures (SOP's) are documents that contain instructions and all of the necessary information for consistent operation of a dam and reservoir over a long period. Reclamation prepares an SOP for each Reclamation dam and reservoir primarily for the use of local facility workers and the immediate supervisor. The SOP usually includes (1) an emergency preparedness plan that provides instructions to follow in the event of various emergencies, (2) a directory of personnel including those of emergency services and cooperators for communications purposes, (3) general information on the facility, (4) technical data on structural, mechanical and electrical details, and (5) information on reservoir operations including filling and release of water, inflow forecasting, and specific operating criteria. These documents are controlled and numbered, which allows additions, corrections, and updates to be tracked carefully. Deviation from the SOP requires concurrence of upper management.

General Operating Activities

Tables 6 and 7 (next page) show general operating activities for the Federal reservoirs in the Boise and Payette River systems.

Typical Reservoir Contents and Riverflows

Reservoir contents and flows in various stream reaches in the Boise and Payette River basins vary depending on many factors. These factors include the daily, seasonal, and annual precipitation; reservoir contents at the end of the storage season; air temperature; natural streamflow; irrigation demand; etc. Reservoir contents and streamflow at any instant provide some information on the system operations, but reservoir contents and riverflows can markedly differ in a few weeks or even a few days. In addition, riverflows may change greatly in a few hours and reservoir contents and riverflows can vary greatly with the water supply. However, charts of riverflows and reservoir contents can provide a general overview of the range of operations.

The contents of six reservoirs and the outflow at five dams were selected for illustrating operations during a good, average, and poor water supply year. The 1992 water year was selected as

Table 6.—Summary of Boise System Reservoir Operating Activities				
Activity	Anderson Ranch Reservoir	Arrowrock Reservoir	Lucky Peak Reservoir	Lake Lowell
Refill target date	Late June	Late June	End of May	April 1
Flood control operation	Formal system rule curve			Informal
Minimum flood control space[1]	None	None	50,000 acre-feet November 1-March 31	None
Average winter release (Dec-Feb 1961-1990)	627 cfs	815 cfs	848 cfs	None
Minimum winter release target (official)	300 cfs	None	150 cfs	Not applicable
Minimum pool target (unofficial)	70,000 acre-feet	28,700 acre-feet	28,730 acre-feet	None

[1] November 1-December 31; total of 300,000 acre-feet in Anderson Ranch, Arrowrock, and Lucky Peak with 165,000 acre-feet in Arrowrock and Lucky Peak and a total of 150,000 acre-feet from January 1 to February 28.

Table 7.—Summary of Payette System Reservoir Operating Activities		
Activity	Cascade Reservoir	Deadwood Reservoir
Refill target date	Late June	Late June
Flood control operation	Informal system rule curve	
Minimum flood control space[1]	152,000 acre-feet	38,000 acre-feet
Average winter release (December-February 1961-1990)	674 cfs	2 cfs[2]
Minimum winter release target	200 cfs	50 cfs[3]
Minimum pool (unofficial)	300,000 acre-feet	50,000 acre-feet

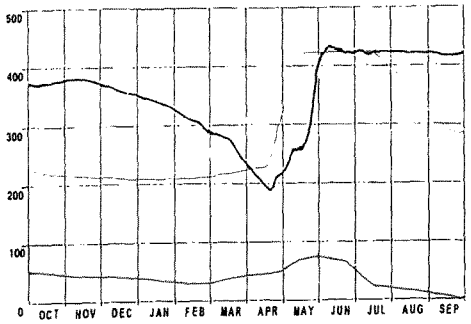
[1] Until spring forecasts are available.
[2] Average has been 63 cfs since gates were replaced in 1990.
[3] Since 1990. Low flow control was not possible before gates were replaced in 1990.

a recent, very poor water supply year while 1980 was selected as an average year and 1983 was selected as a very good water year. Runoff of the Boise River was 38 percent of normal in 1992 and 159 percent of normal in 1983. Runoff of the Payette River was 44 percent of normal in 1992 and 129 percent of normal in 1983.

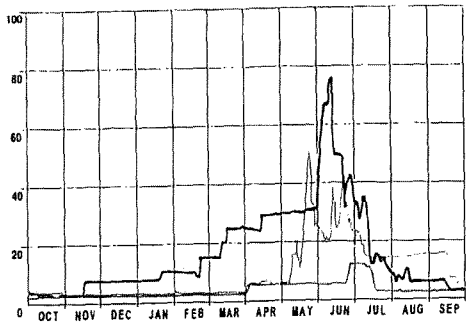
Figure 6 illustrates typical reservoir content and outflows for good, average, and poor water years. The reader is cautioned that some factors other than water supply are reflected in the charts. For example, reservoir releases for downstream salmon flow augmentation were not made in 1980 and 1983. Also, low flow releases from Deadwood Reservoir during the winter were not possible prior to 1992 when the gates were replaced.

Figure 6.—Typical Content and Outflow of Boise Project Reservoirs

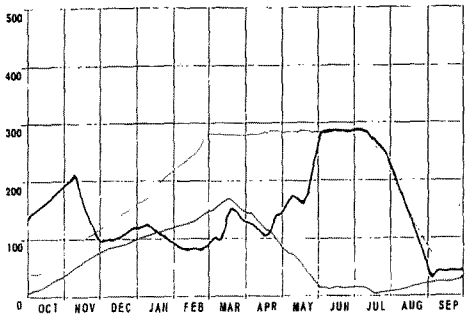
Contents of Anderson Ranch Reservoir
(1,000 acre-feet)



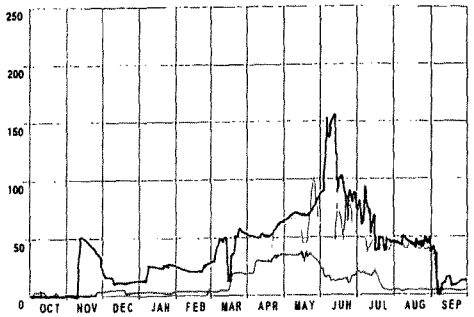
Outflow of Anderson Ranch Dam
(100 cubic feet per second)



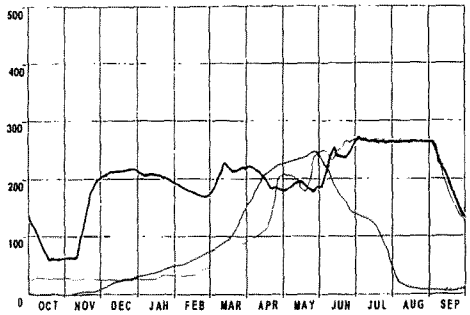
Contents of Arrowrock Reservoir
(1,000 acre-feet)



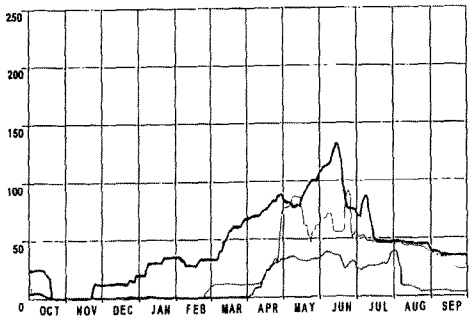
Outflow of Arrowrock Dam
(100 cubic feet per second)



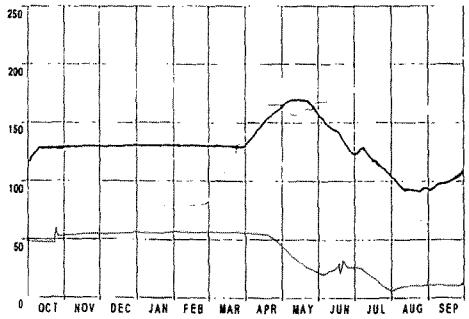
Contents of Lucky Peak Reservoir
(1,000 acre-feet)



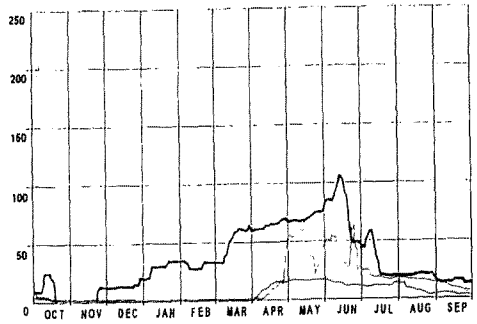
Outflow of Lucky Peak Dam
(100 cubic feet per second)



Contents of Lake Lowell (Deer Flat Dams)
(1,000 acre-feet)



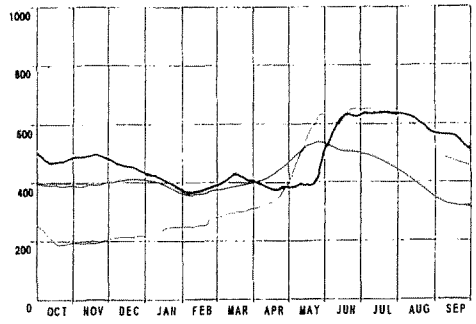
Outflow of Boise R. Diversion Dam
(100 cubic feet per second)



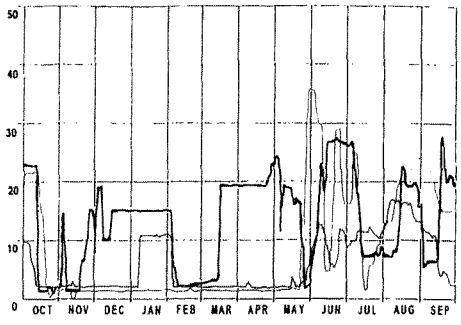
——— 1983 (Good water supply) —— 1980 (Average water supply) —— 1992 (Low water supply)

Figure 6.—Typical Content and Outflow of Boise Project Reservoirs (continued)

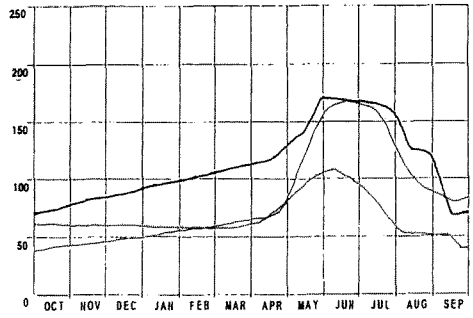
Contents of Cascade Reservoir
(1,000 acre-feet)



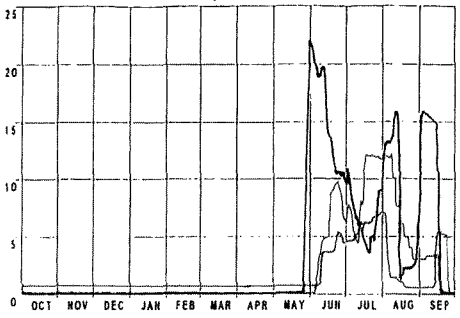
Outflow of Cascade Dam
(100 cubic feet per second)



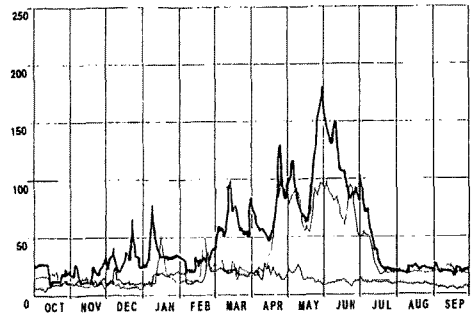
Contents of Deadwood Reservoir
(1,000 acre-feet)



Outflow of Deadwood Dam
(100 cubic feet per second)



Outflow of Black Canyon Dam
(100 cubic feet per second)



——— 1983 (Good water supply) ———1980 (Average water supply) ———1992 (Low water supply)

VI. Detailed Operation by Function

The purpose of early Reclamation storage development was generally limited to irrigation. In some cases, hydroelectric power generation was added for facilities operation, construction, or to pump water to higher lands. Development of Arrowrock Reservoir and Lake Lowell in the Boise system and Black Canyon Dam and Deadwood Reservoir in the Payette system provided limited opportunity for use other than irrigation water supply. When additional storage was developed— Anderson Ranch and Lucky Peak Reservoirs in the Boise system and Cascade Reservoir in the Payette system—capability to meet flood control, recreation, fish and wildlife enhancement, and power generation increased greatly. At the same time, passage of laws that required consideration of other functions at existing facilities and new facilities helped change the character of Reclamation project development. The Boise Project system of reservoirs has evolved into a true multipurpose operating system. Nonetheless, the dominant operating functions remain irrigation and flood control. Although the storage space and the use of water are dedicated to specific purposes, the way water is moved among the reservoirs can accommodate other purposes. This is especially true of the Boise River system, but is less true of the Payette River system.

For regulatory purposes, the Boise River downstream of Lucky Peak Dam is naturally divided into three distinct parts. The first section, from Boise River Diversion Dam to the Caldwell Highline Canal is carefully regulated by the watermaster. All water is measured and divided according to the decrees and licenses.

In the second section, from the Caldwell Highline Canal to the Notus Bridge, all water is measured but the regulation of diversions is more tolerant as return flows from upstream operations provide much of the water and little water is needed to be released from storage to meet the demands.

From the Notus Bridge to the Snake River, return flows provide sufficient water to meet all water rights. Although there is no need for regulation and none is provided, all water is measured and recorded.

Flood Control

Boise River System

Flood control operation of the Boise River system is based on several flood control acts (but particularly the Flood Control Act of 1944) which authorize flood control operations at all Reclamation reservoirs. The ultimate control of operations for preventing flooding is a Corps responsibility. Flood control operations followed a November 20, 1953, Memorandum of Agreement until 1985. A more comprehensive Water Control Manual for operation of the Boise River was prepared in 1985 and adopted by a Memorandum of Agreement dated September 25, 1985. This manual continues to be used at present.

Although flood control and reservoir filling for irrigation water supply are contradictory, accurate forecasts and properly designed flood control criteria can reduce conflicts to a minimum.

In the Boise River system, a total of 974,200 acre-feet of storage is used for joint irrigation and flood control operations. The flood control objective is to limit the flow at the Glenwood gauge (near the Glenwood Bridge in the city of Boise) to 6,500 cfs. Regulation of the three reservoirs is based on forecasts of expected runoff volumes from the Boise River watershed. Reclamation and the Corps prepare independent

forecasts based on regression and correlation techniques using snowwater content and precipitation as the primary variables and jointly agree on the operational runoff volume forecast. In addition a daily mathematical model (Streamflow Synthesis and Reservoir Regulation (SSARR)) is used by the two agencies for short-term forecasting and regulation. Forecasts are also prepared by the Northwest River Forecast Center-National Weather Service, the Natural Resources Conservation Service (NRCS), and the Boise Project Board of Control for their own use.

From November 1 through December 31 a minimum of 300,000 acre-feet of space is maintained in the three reservoirs and at least 165,000 acre-feet of this space in Arrowrock and Lucky Peak Reservoirs. From January 1 through March the minimum space in the three reservoirs is 150,000 acre-feet with a minimum of 55 percent in Arrowrock and Lucky Peak Reservoirs. The actual space requirement from January 1 through the end of the flood control season is based on estimated runoff and rule curves as discussed below (see attachment C for Boise River rule curves).

Reclamation and the Corps begin semi-monthly operational forecasts in January and continue making the forecasts until the end of the flood control season, from April 15 to July 1. Snowmelt usually begins in the first 2 weeks of April but may occur earlier, and flood control releases usually begin before April 1. If the probability of controlling flows to 6,500 cfs at the Glenwood gauge is less than 50 percent before April 1, flood control releases of up to 10,000 cfs can be made. After April 1, the probability of not controlling flows to 6,500 cfs should be 80 percent or greater before exceeding a release of 6,500 cfs at the Glenwood gauge.

Payette River System

Flood control operations in the Payette system follow informal agreements but much of the operation is similar to that in the Boise River basin. The major control objective is to limit the flow at the Horseshoe Bend gauge to 12,000 cfs. Reservoir flood control space, following the informal system flood control rule curves, is assigned 20 percent to Deadwood Reservoir and 80 percent to Cascade Reservoir.

Irrigation

The Boise Project includes some interbasin transfers of water. Some water from the Payette River is pumped to a canal system that provides water to lands in the Arrowrock Division. At the same time, some of the return flows (drainwater) from lands in the Arrowrock Division are used as a water supply for lands in the Payette Division. The rights to divert this water is included in a number of contracts.

Arrowrock Division

The initial and continuing purpose of Reclamation storage is to provide a reliable water supply for irrigation. In the Arrowrock Division, Reclamation provides a full water supply to about 124,000 acres and a supplemental water supply to about 99,000 acres. The operating organization for the Arrowrock Division is the Boise Project Board of Control created by contracts between Reclamation and the five irrigation districts representing the water users that make up the project. Reclamation operated the project through April 1, 1926. At that time operation of most facilities was turned over to the Board based on the Act of December 5, 1924, known as the Fact Finders' Act. Reclamation retained operation and maintenance of certain "Reserved Works."

In 1990, operation and maintenance of the first ½ mile of the New York Canal was transferred to the Board of Control. Operation and maintenance of the Boise River Diversion Dam and the headworks to the New York Canal were transferred to the Board of Control in 1992.

Arrowrock Dam and Reservoir; Anderson Ranch Dam, Reservoir, and Powerplant; and the powerplant at Boise River Diversion Dam continue to be "Reserved Works," operated and maintained by Reclamation. Lucky Peak Dam and Reservoir are operated by the Corps.

At the end of an irrigation season, releases from Lucky Peak are reduced to the minimum stream maintenance flow and water is stored and accumulates in the three reservoirs. Water is diverted at Boise River Diversion Dam to fill Lake Lowell by a target date of April 1. The main factors limiting the filling of Lake Lowell are weather that could cause icing and damage to the New York Canal and the natural flow rate of the river.

The irrigation season is considered to extend from April 1 to October 31. The Boise Project Board of Control and independent water users request water from the watermaster of District 63 who distributes water to those who have natural flow rights and/or contracts with Reclamation for stored water. The watermaster tallies requests, asks for release of water from the storage reservoirs, and makes a daily estimate of the natural flow available and credits it to the appropriate water users. When the rate of diversion of a water user is greater than the credited natural flow, the remainder of the diversion is charged to the user's stored water supply. If the user's stored water supply has been exhausted the diversion rate is limited to the natural flow right.

The watermaster determines the amount of water that must be released at Lucky Peak Dam. Reclamation releases water from Anderson Ranch and Arrowrock Reservoirs as necessary to provide this water. Releases from Lucky Peak Dam are normally about 4,500 cfs during peak periods of irrigation demand.

At the end of the irrigation season, Reclamation, in conjunction with the watermaster, determines the amount of unused stored water in the three reservoirs. Carryover is permitted by Anderson Ranch and Lucky Peak contracts; no carryover is permitted by Arrowrock contracts.

Payette Division

In the Payette Division, flow at the Horseshoe Bend gauge is typically maintained between 2,000 and 2,600 cfs to meet downstream irrigation needs. Black Canyon Reservoir must be maintained within less than 0.1 foot of full pool level to maintain the required operating head for diversion canals. Releases from Cascade and Deadwood Reservoirs are adjusted to maintain the pool level and to avoid spilling water. At the end of the irrigation season flows are reduced but Black Canyon Reservoir is maintained at full pool except as otherwise required for maintenance.

Water Rental Pools

Spaceholder contracts and Idaho State law allow operation of rental pools. These pools allow spaceholders to offer water for rent to other entities that are in short supply.

Water rental pools (as they are now called) operate under State of Idaho law and at the direction and under the rules of the Idaho Water Resources Board (IWRB). Prior to 1991, a rental pool was often called a water bank, but that term is now used as the official umbrella name for all water rental pools in the State. The water rental pool concept has been unofficially in existence since 1937 in the upper Snake. In 1979, the State Legislature authorized the establishment of water banks and rental pools statewide as a means to share water. Local water rental pool rules and leasing prices are determined by the local water rental pool organization and then subsequently approved or denied by the IWRB.

The Boise River Water Rental Pool is under the administrative jurisdiction of Water District No. 63 Rental Pool Committee, and the Payette Water Rental Pool is under the jurisdiction of the Water District No. 65 Water Rental Pool Committee. The watermaster administers the rental pool under guidance of the committee. Reclamation as the storage facility owner and contractor is also involved and must approve the rules and rates for Federal storage as well.

Payment rules for those who provide space to the two water rental pools are similar. Spaceholders who offer water for rent before July 1 receive a proportionate share of proceeds from any such water that sells. Spaceholders who offer water for rent after July 1 receive proceeds from any sales on a "first come" basis after all water offered before July 1 is sold.

Rules for purchase of rental water differ between the two rental pools. Both pools are operated primarily for irrigation and therefore purchase for irrigation is the first priority. Within the irrigation uses there are two classes that are defined differently in the two rental pools. Purchase of water for other beneficial uses has the lowest priority.

In order to protect spaceholders who do not sell storage water, a "last-to-fill" rule was adopted. This rule states that any water sold for use outside the river basin will be the last to fill for the next year. This was imposed to prevent spaceholders who have good overall water supplies from profiting at the expense of overall refill the following year (each spaceholder accrues water proportionately to his owned space). If water is sold through the rental pool, the reservoir space drafted must be refilled the next year. Without the "last-to-fill" rule, all spaceholders would in effect contribute to the refill of the rented water.

The price for rented water is set by the local water rental committees. Water from the Boise Rental Pool, in 1997, cost $6.50 per acre-foot for any use. Water from the Payette Rental Pool for use above the mouth of the river cost $2.70 an acre-foot. Water rentals for non-irrigation purposes for use below the river mouth is $5.40 per acre-foot and includes $0.75 per acre-foot for administration cost.

Since 1991, State law requires that water for augmentation of downstream salmon flows must be administered through the rental pools. Reclamation consigns water to the rental pools, pays the administration charge ($0.75 per acre-foot in the Boise and Payette), and then releases the water for downstream flow augmentation.

Table 8 summarizes District 63 and 65 Water Rental Pool contributions and sales for the period 1990-1995. Prior to 1991, most of the non-irrigation purchases were made by IPC for power generation. Since 1991, Reclamation has purchased most of the non-irrigation water for salmon flow.

Boise Project Board of Control

The operating entity of the Arrowrock Division is the Boise Project Board of Control which was created by contracts between the five major irrigation districts and Reclamation. These irrigation districts are Big Bend, Boise-Kuna, Nampa & Meridian, New York, and Wilder. Each of the irrigation districts elect representatives in proportion to the acreage served by the district, and the Board elects a Project Manager for day-to-day operation and maintenance.

Table 8.—District 63 and 65 Water Rental Pool Activity (Acre-Feet)				
Year	Consigned	Purchases		
		Irrigation	Reclamation[1]	Total[2]
District 63 (Boise River)				
1990	11,182.0	11,182.0	0	11,182.0
1991	2,764.2	2,764.2	0	2,764.2
1992	1,831.7	1,831.7	0	1,831.7
1993	23,039.0	0.0	23,039	23,039.0
1994	40,702.9	4,752.9	35,950	40,702.9
1995	27,000	0	27,000	27,000
1996	38,588	588	38,000	38,588
1997	([3])	([3])	38,000	([3])
District 65 (Payette River)				
1990[4]	61,175	0	61,175	61,175
1991[4]	104,525	2,000	102,525	104,525
1992[4]	138,615	48,615	90,000	138,615
1993[4]	129,971	0	129,971	129,971
1994	67,772	5,889	61,883	67,772
1995	157,019.2	3,789.5	145,300	[5]157,109
1996	161,040.5	3,789.5	151,300	[6]161,040.5
1997	([3])	([3])	155,000	([3])

[1]Includes Reclamation space and other rental purchases used for salmon flow augmentation. Under State law, Reclamation consigns the water to the rental pool and pays the administrative charge for this use.
[2]To date, all consigned water has been purchased
[3]Information not available.
[4]Data not firm, watermaster records began in 1994.
[5]Includes 7,957.8 acre-feet for hydropower (Horseshoe Bend powerplant)
[6]Includes 5,951 acre-feet for hydropower (Horseshoe Bend powerplant)

Black Canyon Irrigation District

Operation of the conveyance systems of the Payette Division has been turned over to the Black Canyon Irrigation District. Reclamation continues to operate Cascade Dam and Reservoir, Deadwood Dam and Reservoir, and Black Canyon Dam, Reservoir, and Powerplant as reserved works.

Watermaster

Water rights are issued and administered by the State of Idaho. The watermaster for District 63 (Boise River) is elected each year by water users in the Boise River drainage, and the watermaster for District 65 (Payette River) is elected by water users in that drainage. As indicated in the "Irrigation" discussion, the watermaster accounts water deliveries and water user storage credit daily and adjusts deliveries according to demand

and water availability. At the end of the water year, the watermasters prepare an accounting of water diversions for the IDWR as required under State law.

Power

In the Boise and Payette River basins, there are Federal and non-Federal hydroelectric powerplants. Federal powerplants are located at Anderson Ranch Dam, Boise Diversion Dam, and Black Canyon Dam. Non-Federal powerplants are located at Lucky Peak Dam, at a private dam on the Middle Fork Boise River near Atlanta, at Cascade Dam, and on a canal near Horseshoe Bend.

Power generation is currently incidental to flood control and irrigation water supply operations of the Boise Project. Although Deadwood Reservoir was constructed to provide water for power generation at Black Canyon Dam, water is not released specifically for power generation in normal operations. The IPC has a natural flow water right of 200 cfs that is senior to the storage right for Cascade Reservoir. Reclamation is obligated to release natural inflow up to 200 cfs for operation of the IPC powerplant at Cascade Dam.

Federal Powerplants

The first Federal hydroelectric powerplant on the Boise River was constructed at Boise River Diversion Dam to supply power for construction of Arrowrock Dam. Power is included as a project function at Anderson Ranch Dam and at Black Canyon Dam. The Anderson Ranch powerplant, uprated in 1986, and the Black Canyon powerplant continue to generate power. The powerplant at Boise River Diversion Dam was placed in a ready reserve status in 1983 due to age and maintenance costs. Rehabilitation of that powerplant is scheduled to begin in fiscal year 1999. Power generated at the Federal facilities is used for facility operation and irrigation pumping and the remainder is marketed by the Bonneville Power Administration (BPA). Power generated at the Black Canyon Powerplant provides energy for operation of the Black Canyon Irrigation District pumps and pumping water at Reclamation's Owyhee Project.

Non-Federal Powerplants

The IPC owns and operates the powerplant at Cascade Dam under a FERC license and has a natural flow right of 200 cfs that predates construction of Cascade Dam.

Four of the five irrigation districts that comprise the Boise Project Board of Control (the New York Irrigation District does not participate) own and operate the powerplant at Lucky Peak Dam under a FERC license. Under an agreement with the owners, the Lucky Peak powerplant is operated by the city of Seattle. Releases for irrigation, flood control, and stream maintenance are made through the powerplant up to the powerplant capacity. Power generation is incidental to water released for other uses.

A private powerplant with a capacity of 150 kW is located at Kirby Dam, a small dam on the Middle Fork Boise River at Atlanta, Idaho. In Horseshoe Bend, Idaho, a bypass canal feeds water to a small privately developed powerplant that has a capacity of 9,500 kW.

Summary

There are three federally owned powerplants (one in ready reserve status), and four non-federally owned powerplants located within the Boise and Payette River basins. Table 9 summarizes the powerplants.

Table 9.—Hydroelectric Powerplants		
Site	**Nameplate Rating**	**Owner/Operator**
Federal Powerplants		
Anderson Ranch Dam	40,000 kW	Bureau of Reclamation
Black Canyon Dam	8,000 kW	Bureau of Reclamation
Boise River Diversion Dam	1,500 kW	Bureau of Reclamation (Currently in ready reserve)
Non-Federal Powerplants		
Cascade Dam	12,800 kW	Idaho Power Company
Horseshoe Bend	9,500 kW	Horseshoe Bend Hydroelectric Company
Kirby Dam	150 kW	Atlanta Power Company
Lucky Peak Dam	101,250 kW	Boise Project Board of Control (except New York Irrigation District) (owner) City of Seattle (operator)

Fish and Wildlife

Authorities for construction of the storage facilities associated with the Boise Project do not include fish and wildlife enhancement except for Anderson Ranch Dam and Reservoir. However, various agreements and administrative decisions recognize subsequent Federal laws that focus on fish and wildlife protection and enhancement. These include target flows and pools which are not absolute values but goals to be met within the capability of the system and availability of the water supply. It is recognized that these targets cannot be achieved under all conditions. Withdrawn lands around reservoirs are managed for fish and wildlife to the extent possible including the lands around Lake Lowell that are managed by the USFWS as part of the Deer Flat National Wildlife Refuge.

Operations specifically related to fish and wildlife enhancement include minimum or target streamflows below dams and conservation pools at reservoirs. Minimum releases of 300 cfs from September 15 through March 31 and 600 cfs for the remainder of the year are maintained at Anderson Ranch Dam. The minimum streamflow target below Lucky Peak is 150 cfs but flows drop as low as 80 cfs in low water years. In the Payette River basin, the target minimum release is 200 cfs at Cascade Reservoir and 50 cfs at Deadwood Reservoir. (See tables 6 and 7 for target conservation pools and minimum winter releases.)

In the Payette system, water is typically released early from Deadwood Reservoir. This helps maintain Cascade Reservoir at a higher pool level to enhance water quality and fish resources which support bald eagles, osprey, and other wildlife around the reservoir.

In recent years, as much as 172,000 acre-feet from storage in Boise Project reservoirs have been released for downstream salmon flows (see "Endangered Species Act" section).

Recreation

In the Boise system, Lucky Peak and Anderson Ranch Reservoirs provide most of the recreation opportunities associated with reservoirs. Lucky Peak, located less than 1 hour from about one-third of the population of Idaho, receives most of

the recreation use. Recreation opportunities at Lucky Peak Reservoir are supported by maintaining the water elevation as high as possible throughout the recreation season. This is accomplished by first using the storage in Arrowrock Reservoir to meet irrigation needs, thereby maintaining Lucky Peak at a high water level. When Arrowrock is fully drawn down, the drawdown of Lucky Peak Reservoir begins. Water is not released from Anderson Ranch Reservoir to maintain the water level of Lucky Peak Reservoir.

Floating a 5-6 mile reach of the Boise River from Barber Dam (diversion structure upstream from the Ridenbaugh Canal diversion) to the center of the city of Boise is a popular summertime activity. A flow of about 1,500 cfs is the maximum safe limit while very low flows also create hazards. Boise Project activities, generally accommodate this recreation activity; however, water is not released specifically for recreation.

In the Payette system, water is released early from Deadwood Reservoir. This operation helps maintain the Cascade Reservoir pool at a high elevation for recreation at the reservoir and enhances flows for recreational boating on the South Fork of the Payette River.

The reach of the South Fork of the Payette River from the Deadwood River confluence to Banks, Idaho and part of the North Fork are recognized as world-class whitewater rivers. As a result, maintaining flows within certain limits during the recreation season is of major concern to advocates of whitewater boating and rafting. Project operations generally accommodate these activities by adjusting releases among reservoirs; however, water is not released specifically for recreation.

Another aspect of reservoir management is the safety of downstream recreationists. This is addressed through reservoir release criteria that specify minimum time periods between flow increases. Although release criteria are based on multiple objectives, in the Payette system these rules are primarily intended to reduce the impact of flow changes to fishermen and others along the streams. Reclamation operating procedures specify allowable increments over minimum time period based on starting flows of less than or more than 1,000 cfs. For example, the allowable increase in flow from Deadwood Reservoir, starting from very low flows, is only 100 cfs per day, but increases of 250 cfs are allowed each 3 hours when the flow is already greater than 1,000 cfs.

In the Boise system, operating procedures for changes in releases from Anderson Ranch Dam apply to increases and decreases of flow, specific times of the year, and allowable change in flow over specific time periods. For example, the allowable flow increase during the period of April 1 to September 15 is 35 cfs each 10 minutes. Although these operating procedures rules help protect recreationists, the primary purpose is maintenance and protection of the high quality fishery.

Operating procedures for release changes at Arrowrock Dam are not needed since there is no free flowing reach when Lucky Peak Reservoir is full. Operating procedures for Lucky Peak Dam do not address flow changes. However, operators try to limit changes to 500 cfs per day or 500 cfs in the morning and 500 cfs in the afternoon. This operation reduces hazards for river users, allows irrigation districts to prepare for the increased flows, allows individuals to place sand bags to avoid flooding, and reduces the loss of trees into the river due to sudden dewatering of the banks.

Municipal and Industrial Water Supply

Throughout the region, M&I water supplies have historically been pumped from ground water. Volume of use and the quality of ground water in

the Boise Valley have become concerns in recent years. In response some surface storage has been purchased by utilities; however, M&I use of surface water supplies remains insignificant compared to irrigation use. The most recent surface water right for M&I is a water right for 23 cfs issued to United Water Idaho to provide some of the water for operation of a new municipal water treatment plant on the Boise River. Since the Boise River is fully appropriated, the only available flows for this 23-cfs water right occur when Lucky Peak Reservoir is spilling for flood control purposes.

Endangered Species Act (ESA)

In recent years, Reclamation has modified water operations in the Snake River basin above Brownlee Reservoir to help protect and recover species that have been listed under the ESA. By April 1992, Snake River sockeye salmon and spring/summer and fall chinook salmon stocks were listed by the National Marine Fisheries Service (NMFS) under the ESA. In January 1993, five species of aquatic snails that inhabit the middle Snake River, were also listed (four endangered and one threatened) by the USFWS.

Reclamation, BPA, and the Corps (the operating agencies), have participated in ESA Section 7 consultations with NMFS and USFWS on the effects that operation of the Federal Columbia River Power System (FCRPS) may have on the listed salmon and snails. The upper Snake River has been tied to these consultations because of requirements to release reservoir storage to improve salmon migration conditions in the lower Snake River and Columbia River reaches.

Since 1991, Reclamation has provided salmon flow augmentation storage releases from the Payette, Boise, and upper Snake River basins. All of this water is administered under the rental pools as required by State law and includes releases from Reclamation space and purchases from water users. Table 10 summarizes information on the source and volume of storage that has been provided annually from above Brownlee Dam. Table 11 summarizes similar information for that portion of the water released from the Boise and Payette River basins.

Table 10.—Flow Augmentation Provided from the Snake River Basin above Brownlee Dam

Year	Natural Flow	Volume (acre-feet)		
		Reclamation Noncontracted and Powerhead	Rental From Water Users	Total
1991	-	40,000	160,000	200,000
1992	-	90,000	0	90,000
1993	-	324,000	100,000	424,000
1994	-	383,000	45,000	428,000
1995	-	141,000	286,000	427,000
1996	16,000	155,000	251,000	422,000
1997	18,000	156,000	253,000	427,000

Table 11.—Flow Augmentation Provided from the Boise and Payette River Basins			
	Volume (acre-feet)		
Year	Reclamation Noncontracted and Powerhead	Rental From Water Users	Total
1991	28,900	73,600	102,500
1992	90,000	0	90,000
1993	118,000	35,000	153,000
1994	97,800	0	97,800
1995	119,200	52,800	172,000
1996	133,000	56,300	189,300
1997	133,000	60,000	193,000

Under ESA Section 7 requirements, Reclamation consults with NMFS and the USFWS on the effects of the salmon water releases on listed snails and salmon. The 1995 Biological Opinion, issued by NMFS and USFWS, directs Reclamation to provide 427,000 acre-feet of water for salmon flow augmentation each year through 1998 and to concurrently use a release regime that will not jeopardize listed snail species in the middle reach of the Snake River. This requires that Reclamation consult with NMFS and USFWS each year once water supply/sources are firm.

IPC has in the past agreed to release some of the 427,000 acre-feet from Brownlee Reservoir in a pattern to provide a greater instantaneous flow for salmon in the lower Snake River and Columbia River than could otherwise be furnished by directly passing the water from upstream Reclamation reservoirs. Reclamation has seasonally scheduled its upstream releases to backfill Brownlee in such a way as to benefit hydropower generation at various IPC powerplant facilities. BPA has reimbursed IPC for costs incurred in the shaping operations.

VII. Other Issues

Irrigation, power, fishery, wildlife, recreation, ecological and other interests have concerns and most want more water. But more water is not possible; the only possibility is change in the use of the current water supply. It is important to recognize that many uses of water are mutually exclusive, i.e., an increase in one use requires a decrease in some other use. As an example, an increase of instream flows requires out-of-stream uses to be decreased, storage reservoir elevations to be lowered, or both.

In addition to requests for more water, there are requests for different operations. Any change in river/reservoir operation will have negative effects on some uses and positive effects on other uses. Releasing water for a shorter period at a greater rate may benefit one type of recreation while diminishing another type of recreation or diminishing recreation at another site.

Boise Valley Ground Water

An intensive effort is underway in the Boise Valley to improve understanding of the ground water in the lower Boise River basin. Conversion of the desert lands to flood irrigated agriculture significantly altered the hydrology of the area. Tremendous amounts of surface water were added to the ground water system, in many areas raising the ground-water level several hundred feet. For instance, during the first year of operation, losses from Lake Lowell were nearly equivalent to the storage and much of this went directly into the underlying aquifer. In 1911, after 3 years of operation, reservoir losses into the surrounding earthen banks and seepage were as high as 135,000 acre-feet.

For many years, this new, relatively shallow ground water provided an inexpensive and readily available supply which is now extensively used throughout the valley. Since the late 1970's, however, there has been a reduction in irrigated acreage, a tremendous increase in population, and the worst drought documented in the valley since records have been kept. Ground-water levels in some areas appear to be declining and there are now heightened concerns that the ground-water resources may be in jeopardy.

To help address these concerns, the Treasure Valley Hydrologic Modeling Process was initiated. This multi-year study is being led by the Idaho Department of Water Resources with several entities including the USGS providing technical and other support roles. The purpose of this comprehensive effort is to add information to current data to develop a model for answering complex management questions.

Snake River Basin Water Rights Adjudication

A general adjudication of 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, (The State of Idaho, ex rel. v. The United States; the State of Idaho; and all claimants to the use of water from the Snake River Basin Water System). Reclamation claims use of water in the Snake River basin for several Reclamation projects. The adjudication of water rights includes Federal reserved water rights associated with the Nez Perce Tribe and the Shoshone-Bannock Tribes of the Fort Hall Indian Reservation. The adjudication is ongoing, without an identifiable date for a conclusion.

Included in the adjudication are all water rights (surface and ground water) claimed by individuals and entities in the Snake River basin. There are more than 62,000 separate claimants, including landowners, irrigation districts, canal companies, State and Federal agencies, and municipalities. Previous 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. Tribal claims for instream flows (fish habitat, channel, and riparian maintenance) with a time immemorial priority date are for greater than 36 million acre-feet of water, an amount greater than the average annual flow of the Snake River at Lewiston, Idaho.

Water Acquisition for ESA Considerations

On March 2, 1995, the National Marine Fisheries Service provided a Biological Opinion on the operations of the Federal Columbia River Power System. In its March 15, 1996, Record of Decision, Reclamation accepted the Reasonable and Prudent Alternatives in that Biological Opinion. This called on Reclamation to provide 427,000 acre-feet of water from the Snake River basin for salmon flow augmentation in the lower Snake River and Columbia River. Reclamation is obligated to take such actions as are necessary to ensure, by 1998, a high likelihood of providing

that amount of water each year. Accordingly, Reclamation has initiated a program to acquire reservoir storage space and natural flow rights throughout the drainage above Lower Granite Dam so that a reliable water supply can be obtained to meet the 427,000 acre-foot requirement. To date, Reclamation has purchased about 22,500 acre-feet of storage space in Jackson Lake and Palisades and American Falls Reservoirs, and 35,000 acre-feet in Lucky Peak Reservoir. Under this program, Reclamation will purchase natural flow and storage space rights only from those willing to sell, at a fair market value, and in accordance with State water rights. This water, along with annual water rentals, will be combined to meet the salmon flow augmentation requirement of 427,000 acre-feet.

Title Transfer

As part of the second phase of the Administration's National Performance Review, Reclamation is undertaking a program to transfer title of facilities that could be efficiently and effectively managed by non-Federal entities and are not identified as having national importance. This effort is a recognition of Reclamation's commitment to a Federal Government that works better and costs less. The transfer of title will divest Reclamation of the responsibility for operation, maintenance, management, regulation, and liability for the project. The transfer of title to a project will, in effect, sever Reclamation's ties with that project.

Criteria and procedures are being developed to assure that transfers will safeguard national interests and will benefit the nation.

Resource Management Plans

Reclamation is conducting a multi-year program to prepare resource management plans (RMP) for all major facilities. These plans are intended to address the management of water and land surfaces including protection of natural, recreational, archeological, historical, and other resources. Reservoir operations are generally excluded, but adjustments in reservoir operations that do not diminish benefits to the spaceholders or major project functions can be considered.

This program is guided by Federal law (Public Law 102-575) and policies aimed at ensuring that Federal lands are managed to serve a wide range of public purposes. These coordinated management plans are prepared to clearly set goals, objectives, policies, and priorities related to competing uses, guide decision-making, and resolve conflicts.

Reclamation's resource management policy is to ensure and encourage resource protection, conservation, and multiple use. Management practices and principles, in accordance with existing Federal laws, regulations, and policies, are to be applied to protect fish, wildlife, and other natural and cultural resources. The policy also provides for public health and safety, public access, and a wide variety of outdoor recreational opportunities to accommodate the increasing public demand to use Reclamation land and water areas.

An RMP for Cascade Reservoir was completed in 1991 and will be revised on a 10-year cycle. The only other RMP schedule for Boise Project reservoirs is an RMP for Black Canyon Reservoir in 1998.

Snake River Resources Review (SR^3)

Reclamation is conducting a comprehensive review of the multipurpose operations and related resources in the Snake River basin above Brownlee Dam. The goal of the SR^3 is to develop an information network and decision support system (DSS) that can be used to coordinate the operation of the 10 Reclamation projects and indicate resource tradeoffs in various system scenarios. SR^3, to be completed in the

year 2000, will enhance, refine, and confirm Reclamation's ability to make sound resource decisions in the Snake River basin.

The information network will consolidate basin information so it can be shared among Federal, State, tribal, and local government entities and be used more efficiently. The DSS being developed will improve Reclamation's ability to analyze operation for traditional uses, such as irrigation, flood control, and power generation, when considering other demands such as releasing water for recovery of endangered salmon in the lower Snake and Columbia Rivers, protecting in-basin ESA listed species, recharging aquifers, providing water for municipal and industrial use, improving water quality, improving recreation opportunities, protecting cultural resources and Indian trust assets, and protecting and enhancing fish and wildlife habitat.

Coordination with other Federal and State agencies and tribal governments that are gathering data or conducting studies within the basin is underway. This will help avoid duplicating efforts and allow partnerships in the development of the information network and DSS. The general public, water users, and other State, local, and Federal agencies are invited to participate in SR^3 through a public outreach program.

Reservoir Conservation Pools

Some interests would like to establish official conservation pools at all Reclamation Reservoirs. Establishing a conservation (minimum) reservoir pool is intended to maintain valuable reservoir resources such as good water quality, reservoir fish populations, wildlife habitat, and recreation uses that would be lost if a reservoir were completely drained. These resource assets often evolve over a period of time but are secondary to the original purposes for which a reservoir was constructed. Virtually all reservoirs of the Boise Project offer these kinds of resource values which could be enhanced by establishment of conservation pools.

None of the reservoirs in the Boise Project have an official conservation pool, although there are de facto minimum pools (dead storage and administratively established minimum pool targets). In dry years, storage supplies are more heavily used to meet irrigation demands, and other uses may suffer accordingly. Reclamation attempts to maintain pools as high as possible but must meet contractual and other legal responsibilities.

Conservation pools would compete directly with irrigation water supplies, possibly some flood control operations, and resource values in other reservoirs. Establishment of conservation pools would require active participation and negotiation by all interests.

Instream Flow Management

There is a formal minimum instream flow for the South Fork of the Boise River (downstream from Anderson Ranch Dam). This river reach has a high quality trout fishery that is sustained by year-round release of water from Anderson Ranch Reservoir. The minimum release is 300 cfs from September 15 through March 31 and 600 cfs from April 1 to September 15. Flow change criteria are also established, primarily to protect fish. Although there is also a minimum release of 80 cfs from Lucky Peak Dam for flow of the Boise River, the target release is 150 cfs, and the Idaho Department of Fish and Game own storage to help achieve flow targets.

Operations of other reservoirs of the Boise Project attempt to meet target minimum flows as summarized in tables 6 and 7. A winter minimum flow is possible and has been met from Deadwood Reservoir since 1990 when gates that could be operated at low flow were installed.

Water Quality

In the Boise Valley, the water quality of the Boise River downstream of Star, Idaho (about RM 34) is a major concern. The lower river is

composed primarily of irrigation return flows which bring a variety of agricultural chemicals, soil particles, and farm wastes into the river. The quality of ground water is another issue in the Boise Valley. Large population increases in recent years, increased municipal and industrial use of ground water, and septic tank disposal systems are having a significant effect on quantity and quality of the aquifers. Currently, Federal, State and local entities have several studies underway to address these concerns.

In the Payette River basin, the water quality of Cascade Reservoir, is a major concern. Algae blooms have been so severe that livestock drinking the water have been poisoned. Several studies are ongoing to address the treatment of sewage upstream at the city of McCall, livestock grazing around the lake and runoff of livestock wastes into the lake, and maintenance of water levels.

Water quality in the Payette River downstream of Black Canyon Dam is heavily impacted by sediment, nutrients, and bacterial contamination from irrigation drainage. State and local entities are currently developing waste load allocations which will be implemented to bring the lower Payette River into compliance with State water quality standards.

VIII. Glossary

Active Capacity or Storage—Amount of storage space that can be filled and the water released for specific purposes.

Carey Act (1894)—Donated lands to states for reclamation purposes. Tracts sold by states were limited to 160 acres to be used for irrigated farming.

Conservation Pool—A reservoir pool elevation or volume of water that is to be considered a minimum. Conservation pools are usually established to maintain fish and wildlife resources, water quality, or recreation capability.

Consumptive Use—Use that permanently removes the water from the system.

Cost Allocation—A method of distributing the construction costs and the annual operating costs of Federal reservoirs among the benefitted functions. (Law and policy then determine whether some or all of the costs are reimbursable and repayment requirements for construction and annual operation.)

Dead Storage—Water that lies below the outlet of a dam and cannot be released by gravity flow.

Desert Land Act of 1877—Authorized the sale of 640-acre tracts of arid lands in four States and eight territories to persons who would irrigate them within 3 years. Changed to 320-acre tracts in 1890.

Federal Water Project Recreation Act of 1965 (Public Law 89-72)—Provides for recreation and fish and wildlife enhancement at water resource developments.

Flood Control Act of 1944 (58 Stat. 887)—Set forth statutory procedures for future coordination of plans with the Corps, Reclamation, and the states. Gave Congress the responsibility for coordinating work of the Corps and Reclamation. Caused Reclamation to discontinue using the authority of the Secretary of the Interior to authorize large projects. Virtually all reclamation projects were subsequently authorized by Congress.

Homestead Act (1862)—Provided free farmland to settlers who would live on and cultivate the land.

Inactive Capacity or Storage—Amount of storage space that is not normally emptied but is maintained for a specific purpose such as hydraulic head for power generation or a conservation pool.

Irrigation Season—Defined in spaceholder contracts as April 1 to October 31.

Minimum Flood Control Space—The space maintained in reservoirs during the winter months to be able to hold the rapid runoff of rain-on-snow events.

Minimum Reservoir Pool—The lowest reservoir elevation or pool volume reached with normal operations.

Natural Flow—Flow that occurs, or would occur, in the absence human intervention including storage development and out-of-stream diversions.

Non-reimbursable Costs—These are costs identified through a cost allocation where the beneficiary is generally the nation, e.g., anadromous fish protection and enhancement and migratory bird protection and enhancement.

Observed Flow—Actual measured flow of a stream.

Operational Head—Hydraulic head (elevation of water) needed to operate the facilities, especially the flow of water to canals and powerplants.

Power Head—Hydraulic head (elevation of water) for operation of hydroelectric generators.

Prior Appropriation Doctrine—The water rights system used throughout the western United States. Under this doctrine, water diverted for a beneficial use is based on the principle of "first in time is first in right."

Reach Gain/Loss—Amount of water that enters (or leaves) a river reach between two points, i.e., the amount of flow at a downstream point minus the flow at an upstream point equals the reach gain (loss).

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 western states (later 17 western states). Requires the Secretary to comply with State water law.

Reclamation Act of 1939—Authorized the Secretary of the Interior to plan and construct projects for multiple purposes in addition to irrigation. These included navigation, flood control, water power, municipal water supply, and other miscellaneous purposes.

Reclamation Recreation Management Act of 1992 (Public Law 102-575, Title XXVIII)—Extends some of the authorities on recreation and fish and wildlife enhancement at water resource developments.

Reimbursable Costs—These are costs allocated to a function that are required to be repaid by the beneficiary. The amount of reimbursability depends on the function and is governed by various public laws. As an example, costs allocated to an irrigation function are to be repaid without interest while costs assigned to power are to be repaid with interest.

Reserved Works—Facilities of a Federal project that are "reserved" for operation and maintenance by the United States. Facilities transferred to other entities for operation and maintenance are termed "transferred works.

Riparian Doctrine—A system of water rights developed whereby only landowners with property abutting the stream could divert water.

River Basin—The geographic area drained by a river.

Snake River Basin Adjudication—An ongoing legal proceeding to identify all of the water rights in the basin.

Storage Season—Begins on October 1 and extends to the date that no more water is available for storage.

Spaceholder Contract—A type of repayment contract in which storage space is purchased in contrast to purchasing a specific amount of water. The amount of water that accumulates in that storage space belongs to the purchaser.

Target (Flow or Pool)—As used in this document, a target is a goal that is usually greater than the minimum requirement and cannot be achieved under very poor water conditions.

Upper Snake River—The reach of the Snake River extending from Milner Dam to the headwaters. The middle Snake River is usually described as the reach from Milner Dam downstream to Brownlee or Hells Canyon Dam. The lower Snake River is the reach from Hells Canyon Dam to the confluence with the Columbia River.

Water District 63—One of the State administration districts, the Boise River basin.

Water District 65—One of the State administration districts, the Payette River basin.

Water Bank—All of the water rental pools (see Water Rental Pool) and all of the natural flow water rights market. Also used to indicated the IWRB marketing process of that water.

Water Rental Pool—State authorized mechanism to allow more efficient use of water. Spaceholders are allowed to consign water to the water rental pool which sells the water.

Water Service Contracts—A type of repayment 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.

Water Year —Begins on October 1 and extends to September 30 the following year. Water years are designated the same as the calendar year they end in, i.e, water year 1995 began on October 1, 1994 and ended on September 30, 1995.

Withdrawn Lands—Federal lands that are taken from the public domain for specific uses.

Appendix A

Abbreviated River Mile Index

Appendix A

Abbreviated River Mile Index

The following list is a greatly reduced river mile index of the Boise and Payette Rivers. The mouth of the Snake River is located at river mile 324.3 of the Columbia River (confluence with the Columbia River) i.e., 324.3 miles upstream from the mouth of the Columbia River at the Pacific Ocean. The mouth of the Payette River is located at river mile 365.0 of the Snake River and the mouth of the Boise River is located 27.3 miles further upstream at river mile 392.3.

River Mile Location	Description	Drainage Area (square miles)	Water Elevation (feet)
365.0	Payette River		
	0.0 Mouth	3,270	2120+
	4.1 Gauging Station, USGS, #2510 near Payette, Idaho	3,240	2144
	8.3 Big Willow Creek		
	34.2 Fuller Island		
	34.2 Check Dam - Farmers Co-op Canal		
	37.2 Check Dam - Last Chance Canal		
	38.2 Gauging Station, USGS #2495, near Emmett, ID	2,680	2404
	38.7 Black Canyon Dam	2,680	2498
	38.7 Canyon Canal & Black Canyon Canal		
	43.6 Squaw Creek		
	0.0 Mouth	330	2498
	8.8 Diversion Dam		
	47.7 State Hwy. Bridge - Montour, ID		
	57.0 State Hwy. 15 Bridge - Horseshoe Bend, ID	2,247	
	57.7 Idaho Power Co. Diversion Canal (R bank)		
	60.8 Gauging Station, USGS #2475, near Horseshoe Bend, ID	2,230	2631
	72.4 Banks, ID		
	72.9 North Fork Payette River		
	2.8 Gauging Station, USGS #2460, near Banks, ID	933	3088
	16.0 Gauging Station, USGS #2455, near Smiths Ferry, ID	893	4510
	31.2 Big Creek		

River Mile Location	Description	Drainage Area (square miles)	Water Elevation (feet)
	38.6 Gauging Station, USGS #2450, at Cascade, ID	626	4743
	39.9 Powerplant, Idaho Power Co.		
	40.2 Cascade Dam and USGS Gauge #2445, Cascade Reservoir at Cascade, ID	620	4828
	52.0 Gold Fork River		
	0.0 Mouth	185	4828
	6.9 Gauging Station, USGS #2435, near Roseberry, ID	143	4870
	7.5 Gold Fork Diversion Dam		
	8.0 Gold Fork Dam	140	
	53.9 Lake Fork		
	0.0 Mouth	90	4828
	17.5 Gauging Station, USGS #2425, near McCall, ID	64	5080
	18.0 Lake Fork Dam and USGS Gauge #2410, Lake Fork Reservoir near McCall, ID	64	5117
	75.4 Payette Lakes Dam, USGS Gauge #2385, Payette Lake at McCall, ID	144	4990
72.9	State Hwy. 15 Bridge at Banks, ID	1,260	2790
80.3	Middle Fork Payette River		
	0.0 Mouth	340	2992
	21.4 Silver Creek		
80.3	South Fork Payette River (main stem continues as South Fork)	860	2992
103.5	Deadwood River		
	0.0 Mouth	224	3690
	18.0 Deadwood Dam, USGS Gauge #2360, Deadwood Reservoir near Lowman, ID	112	5334
106.0	Gauging Station, USGS #2350, at Lowman, ID	456	3794

River Mile Location	Description	Drainage Area (square miles)	Water Elevation (feet)
392.3	Boise River		
	0.0 Mouth	4,130	2117
	3.8 Gauging Station, USGS #2130, near Parma, ID	3,970	2200
	14.0 Gauging Station, USGS #2125, at Notus, ID	3,820	2291
	16.4 Eureka Canal		
	21.1 U.S. Hwys. 20, 26, and 30, Interstate 80N, Caldwell, ID		
	21.9 Farmers Cooperative Sebree Canal		
	32.4 Caldwell Highline Canal		
	31.2 USGS Gauge #2100 near Middleton, ID	3,050	
	38.0 Lower end of Eagle Island South Channel of Boise R. past Eagle Island		
	1.2 Phyllis Canal		
	5.8 Warm Springs Canal		
	40.4 Middleton Canal		
	41.2 Mason-Catlin Canal		
	41.7 Dry Creek		
	46.0 Dry Creek Canal		
	46.4 Upper end of Eagle Island		
	48.0 Glenwood		
	50.4 Farmers Union Canal		
	51.5 Fairview Bridge - Boise, ID		
	52.0 Settlers Canal - Diversion Dam		
	52.8 Gauging Station, USGS #2055, at Boise, ID	2,760	2680
	53.7 Broadway Bridge - Boise, ID		
	55.9 City Canal - Diversion Dam		
	56.7 Cruzen-Perrant Canal		
	58.3 Ridenbaugh Canal - Diversion Dam		
	58.8 Gauging Station, USGS #2025, at Barber	2,690	2753
	59.0 Barber Dam	2,690	2767
	61.4 Boise River Diversion Dam - New York Canal		
	64.0 Gauging Station, USGS #2020, near Boise, ID	2,680	2827
	64.0 Lucky Peak Dam and USGS Gauge #2015, Lucky Peak Reservoir near Boise, ID	2,680	3060

River Mile Location	Description	Drainage Area (square miles)	Water Elevation (feet)
70.5	Mores Creek		
0.3	Gauging Station, USGS #2010, near Arrowrock, ID	426	
23.8	Idaho City, ID		
75.4	Arrowrock Dam and USGS Gauge #1490, Arrowrock Reservoir at Arrowrock Dam	2,210	3216
79.4	South Fork Boise River		
0.0	Mouth	1,304	3210
26.1	Danskin Bridge		
41.5	Gauging Station, USGS #1905, at Anderson Ranch Dam	982	3854
43.5	Anderson Ranch Dam and USGS Gauge #1900, Anderson Ranch Reservoir at Anderson Ranch Dam	980	4196
44.9	Little Camas Creek		
59.0	Gauging Station, USGS #1860, near Featherville, ID	635	4220
88.5	Gauging Station, USGS #1850, near Twin Springs, ID	830	3254
97.3	North Fork Boise River	3474	
0.0	Mouth	382	
97.3	Middle Fork Boise River (main stem)	382	3474
129.0	Atlanta, ID		

Appendix B

Spaceholder Contracts

Spaceholder Contracts - Boise Project, Arrowrock Division (Acre-Feet)[1]				
Spaceholder	Anderson Ranch	Arrowrock	Lucky Peak	Total
Ballentyne Ditch Company.	376		1,300	1,676
Boise City Canal Company			1,000	1,000
Boise Project Board of Control		232,264		232,264
Big Bend Irrigation District	3,887	236		4,123
Boise-Kuna Irrigation District	112,149	6,747		118,896
Nampa & Meridian Irrigation District	77,784	5,584		83,368
New York Irrigation District	41,006	2,414		43,420
Wilder Irrigation District	125,108	7,819		132,927
Ridenbaugh Canal (Nampa &Meridian Irrigation District)	15,137	3,994		19,131
Boise Valley Irrigation Ditch Company	961		2,500	3,461
South Boise Mutual Irrigation Company	543		500	1,043
Canyon County Water Company			6,000	6,000
Capitol View Irrigation District	460		300	760
Fairview Acres Lateral Association.			1,500	1,500
Eagle Island Water Users			1,718	1,718
Eureka Water Company			2,800	2,800
Farmers Union Ditch Company	5,727	2,926	10,000	18,653
Farmers' Coop. Ditch Company		1,207		1,207
Middleton Irrigation Association.			6,380	6,380
Middleton Mill Ditch Company			4,620	4,620
New Dry Creek Ditch Company	1,296		3,000	4,296
New Union Ditch Company			1,400	1,400
Pioneer Ditch Company	2,174		500	2,674
Pioneer Irrigation District	25,582	21,399	16,000	62,981
South Boise Water Company			700	700
Settlers Irrigation District	5,810	1,810	10,000	17,620
Thurman Mill Ditch Company			800	800
U.S. Forest Service		200		200
J.R. Simplot Co. & Micron Tech	3,000			3,000
United Water of Idaho	1,000			1,000
Idaho Dept. of Fish & Game			50,000	50,000
Trinity Springs, Ltd.	800			800
Reaquired for Salmon Flow Augmentation			40,932	40,932
Uncontracted	400			400
Uncontracted Streamflow			102,420	102,420
Total Active Capacity	423,200	286,600	264,370	974,170

[1]As of November 1997. Pending review of contract entitlements.

Spaceholder Contracts - Boise Project, Payette Division (Acre-Feet)[1]			
Spaceholder	**Cascade**	**Deadwood**	**Total**
Amyx, Heffner, or Heffner		266	266
Black Canyon Irrigation District	241,148		241,148
Bruce, James		131	131
Canaday, Michael	485	603	1,088
Cofield, Dewey	17		17
Curtis, John		92	92
Davison, David	3		3
Edwards, Charles	1,583		1,583
Emmett Irrigation District	10,050	51,387	61,437
Farmers Cooperative Irrigation Company, Ltd.	38,893		38,893
Gatfield, Eugene		1,207	1,207
Hunter, Robert		377	377
Lowe, Michael	42		42
Lower Payette Ditch Company	10,050		10,050
MacGregor, Carol L.		885	885
McConnel, Alva Lon	644		644
McConnel, Alva B.		712	712
M.C. Shelly Family Trust	633		633
Nicholson, Thomas P. and Diana R.		472	472
Noble Ditch Company, Ltd.	10,050		10,050
Reay, David B.	21		21
Smith, Ronald		644	644
Snyder, Marion	63		63
Thornton, John		75	75
Contracted Space Totals	313,682	56,851	370,533
Uncontracted Space	339,518	105,049	444,567
Total Active Capacity	653,200	161,900	815,100

[1]As of October 1997. Pending review of contract entitlements.

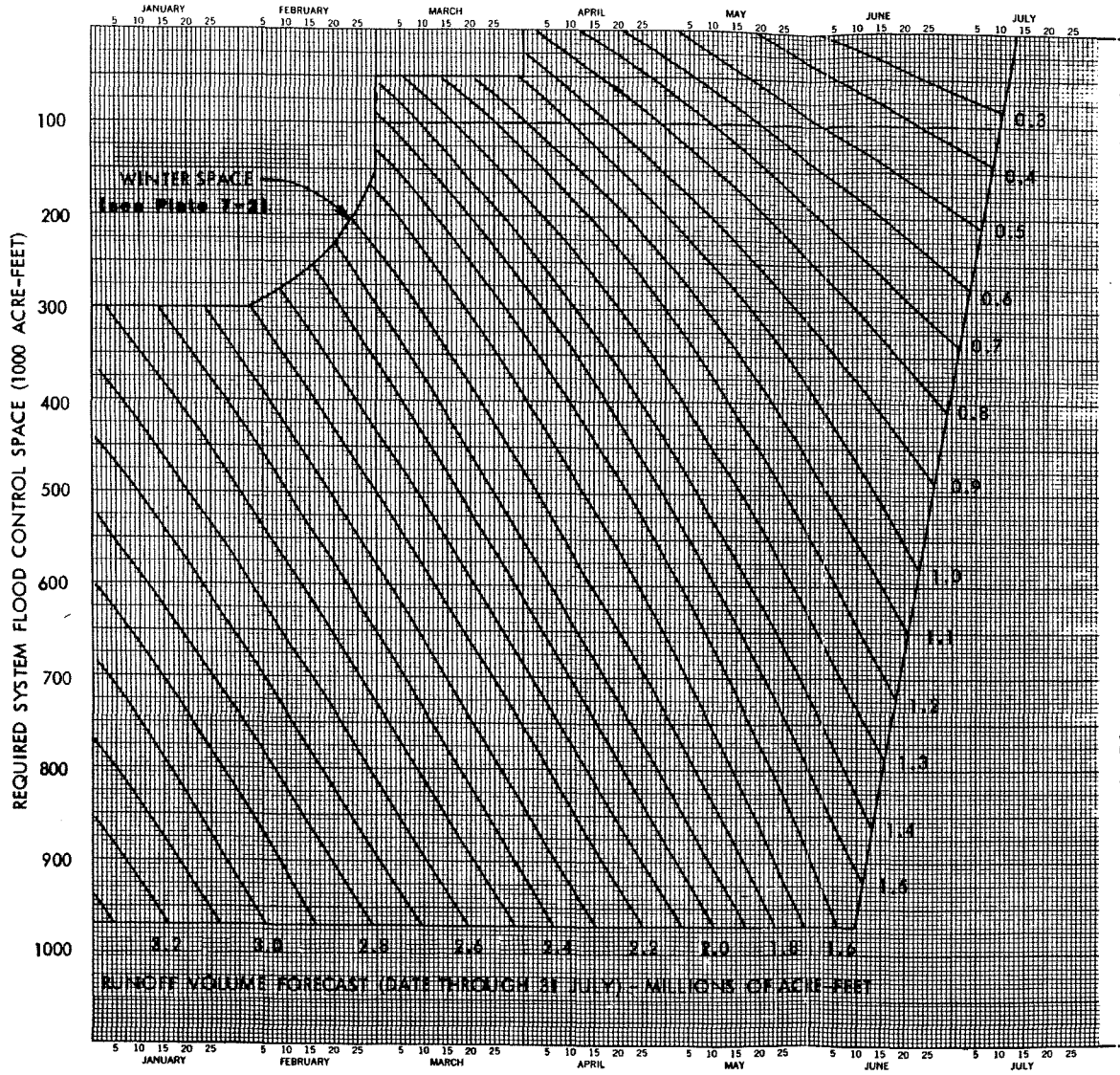
Reservoir Space in Bureau of Reclamation Reservoirs—Boise and Payette River Basins (Acre-Feet)

Reservoir	Total Capacity	Active Capacity				Inactive	Flood Surcharge[2]	Dead
		Total	Contracted[1]	Formally Assigned To Other Uses	Formally Assigned to Flow Augmentation			
Anderson Ranch	493,200	423,200	422,800	[3]400	0	[4]41,000	10,500	29,000
Arrowrock	286,600	286,600	286,600		0		14,250	
Cascade	703,200	653,200	313,700	[5]269,900	69,600	[6]50,000	157,000	
Deadwood	162,000	161,900	56,850	[7]79,650	25,400	[8]100	29,600	
Lucky Peak[9]	293,100	264,370	71,020	[10]152,420	[11]40,930	[12]28,730	13,905	
TOTALS	1,938,100	1,789,270	1,150,970	502,370	135,930	119,830	225,255	29,000
TOTAL (Formally assigned)				638,300				

1. Except for Lucky Peak, all contracts are spaceholder (share of reservoir capacity) repayment contracts. Lucky Peak contracts are spaceholder water service contracts which are up for renewal in 2005 - 2008.
2. Above the spillway and not storable.
3. Designated for mitigation of Safety-of-Dams repairs to Deer Flat Dam.
4. Reserved for power head.
5. Includes 250,000 acre-feet for minimum pool and 19,900 acre-feet designated for reservoir evaporation accounting.
6. Reserved for sediment control and needed for use with 250,000 acre-feet minimum pool to maintain water quality and endangered bald eagles.
7. Includes 49,900 acre-feet for minimum pool and 29,750 acre-feet reserved for Deadwood River streamflow maintenance.
8. Nominal amount.
9. Corps of Engineers facility with irrigation water marketed by the Bureau of Reclamation.
10. Boise River streamflow maintenance of which 50,000 acre-feet is reserved for the Idaho Department of Fish and Game.
11. Reacquired or acquired as mitigation by Reclamation for salmon augmentation flows.
12. Corps of Engineers dead pool for reservoir fishing.

Appendix C

Boise River Flood Control Rule Curves



NOTES:

1. Parameters represent forecasted Lucky Peak Lake natural inflow volumes between forecast date and 31 July. Operational rule curves were derived as follows:

a. Flood Control: For a given volume forecast, the flood control space required for 1-percent forecast error risk and the space which could be refilled with a 90-percent chance were determined. If the refillable space plus 100,000 acre-feet exceeded the flood control space value, the flood control space value was used. If the refillable space (90-percent chance) plus 100,000 acre-feet were less than the flood control space, then the value used was the refillable space plus 100,000 acre-feet and the flood control space.

b. Safety Factors - Operational Flood Control Curves:

FLOOD CONTROL ASSURANCES
(Control to 6,500 cfs at Glenwood Bridge)

Forecast Date (Thru 31 July)	Assumed Volume Forecast Error (Under Forecast) (Acre-Feet)	Percent Chance of Volume Error (Smaller Volume)	Flood Control Space (1000 Acre-Feet)
1 January	860,000	95	0
16 January	780,000	95	0
1 February	700,000	95	0
15 February	640,000	95	0
1 March	590,000	95	0
16 March	490,000	95	0
1 April	400,000	95	0
16 April	380,000	95	0
1 May	370,000	95	0
16 May	360,000	95	0
1 June	350,000	95	0
16 June	310,000	95	0

REFILL ASSURANCES
(Total System - 974,143 Acre-Feet)

Forecast Date (Thru 31 July)	Assumed Volume Forecast Error (Over Forecast) (Acre-Feet)	Percent Chance of Volume Error (Larger Volume)	Refill Assurance (1000 Acre-Feet)
1 January	610,000	95	0
16 January	550,000	95	0
1 February	490,000	95	0
15 February	450,000	95	0
1 March	410,000	95	0
16 March	350,000	95	0
1 April	280,000	95	0
16 April	270,000	95	0
1 May	140,000	80	0
16 May	110,000	75	0
1 June	40,000	60	0
16 June	10,000	52	0

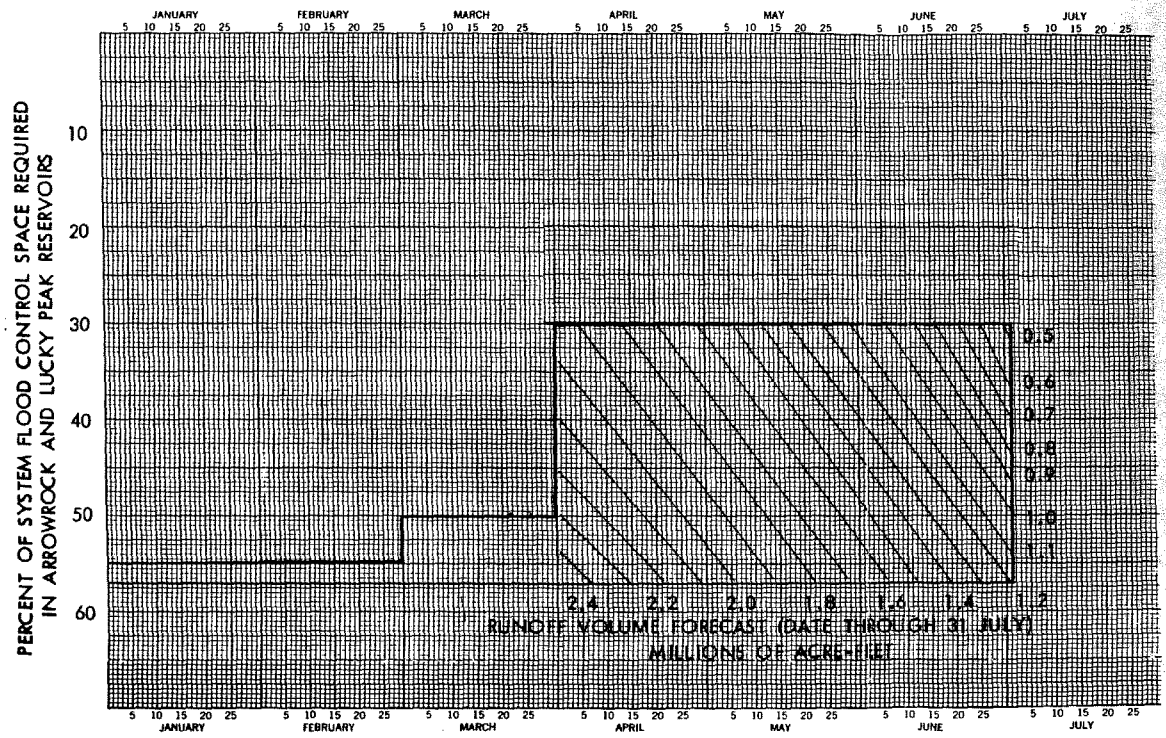
2. To determine total vacant space required in all three reservoirs, select parameter corresponding to predicted runoff between that date and 31 July, then read the ordinate of this parameter corresponding to forecast date.

3. Minimum of 50,000 acre-feet of space required in Lucky Peak reservoir from 1 January through 31 March.

Boise River Reservoirs
Boise River Basin, Idaho

OPERATIONAL FLOOD CONTROL RULE CURVES

U. S. Army Corps of Engineers
Walla Walla District
Hydrology Branch
December 1982



NOTES:

1. Parameters represent forecasted Lucky Peak Lake natural inflow volume between the forecast date and 31 July. Distribution curves were derived based on the following assumptions:

a. Arrowrock-Lucky Peak Release Schedule.

Date	Assumed Allowable Flow of Boise River at Glenwood Bridge (cfs)	Assumed Irrigation Diversions, Lucky Peak to Glenwood Bridge (cfs)	Total Assumed Allowable Flow Lucky Peak Dam (cfs)
1 Apr-30 Apr	6,500	1,600	8,100
1 May-31 May	6,500	3,700	10,200
1 Jun-31 Jul	6,500	3,800	10,300

b. Percentage values are based on (1) the 1-percent forecast error with an Arrowrock-Lucky Peak local volume forecast, (2) the 85-percent upper confidence limit runoff sequence, and (3) a constant 300-cfs inflow (1 April - 31 July volume equivalent) from tributaries. Percentages were determined by dividing the Arrowrock-Lucky Peak local flood control space requirement by the Boise River system flood control space requirement for a given Lucky Peak Lake natural inflow volume forecast.

c. Arrowrock-Lucky Peak Local Volume Forecast and Standard Error. The Arrowrock-Lucky Peak local volume forecast is determined by multiplying the forecasted Lucky Peak Lake natural inflow volume by the appropriate contribution factor shown below:

Forecast Date	Contribution Factor	Standard Error (AF)	Forecast Error [0.3281(Forecast Error)]
1 April	0.6331	103,400	33,900
15 April	0.6270	86,950	28,500
1 May	0.6209	70,500	23,100
15 May	0.6196	70,500	23,100
1 June	0.6182	70,500	23,100
15 June	0.6300	70,500	23,100
1 July	0.6418	70,500	23,100

2. To determine the minimum percentage of system flood control space required in Arrowrock-Lucky Peak reservoirs, select the parameter corresponding to the projected runoff between that date and 31 July. Then read the ordinate of this parameter corresponding to the forecast value. This ordinate is the minimum percent of the system flood control space required in Arrowrock-Lucky Peak reservoirs. The minimum space required is the minimum percent multiplied by the system flood control space requirement.

The following allocation has been made of the acre-feet of storage capacity available:

Reservoir	Flood Control	Dead	Total
Arrowrock	286,600	0	286,600
Lucky Peak	264,300	28,800	293,100
Total Space	550,900	28,800	579,700

Boise River Reservoirs
Boise River Basin, Idaho

FLOOD CONTROL SPACE DISTRIBUTION CURVES

Percent of system flood control space required in Arrowrock and Lucky Peak Reservoirs

U. S. Army Corps of Engineers
Walla Walla District
Hydrology Branch
December 1982