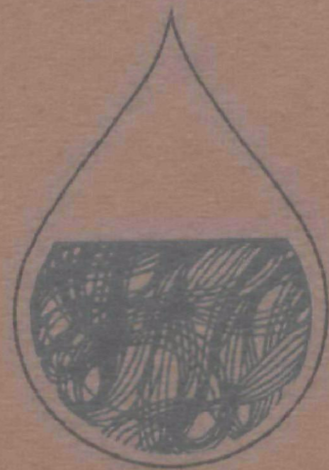
WATER QUALITY CONTROL AND MANAGEMENT

SNAKE RIVER BASIN



United States Department of the Interior/Stewart L. Udall, Secretary/ Federal Water Pollution Control Administration, Northwest Region/ Portland, Oregon

September 1968

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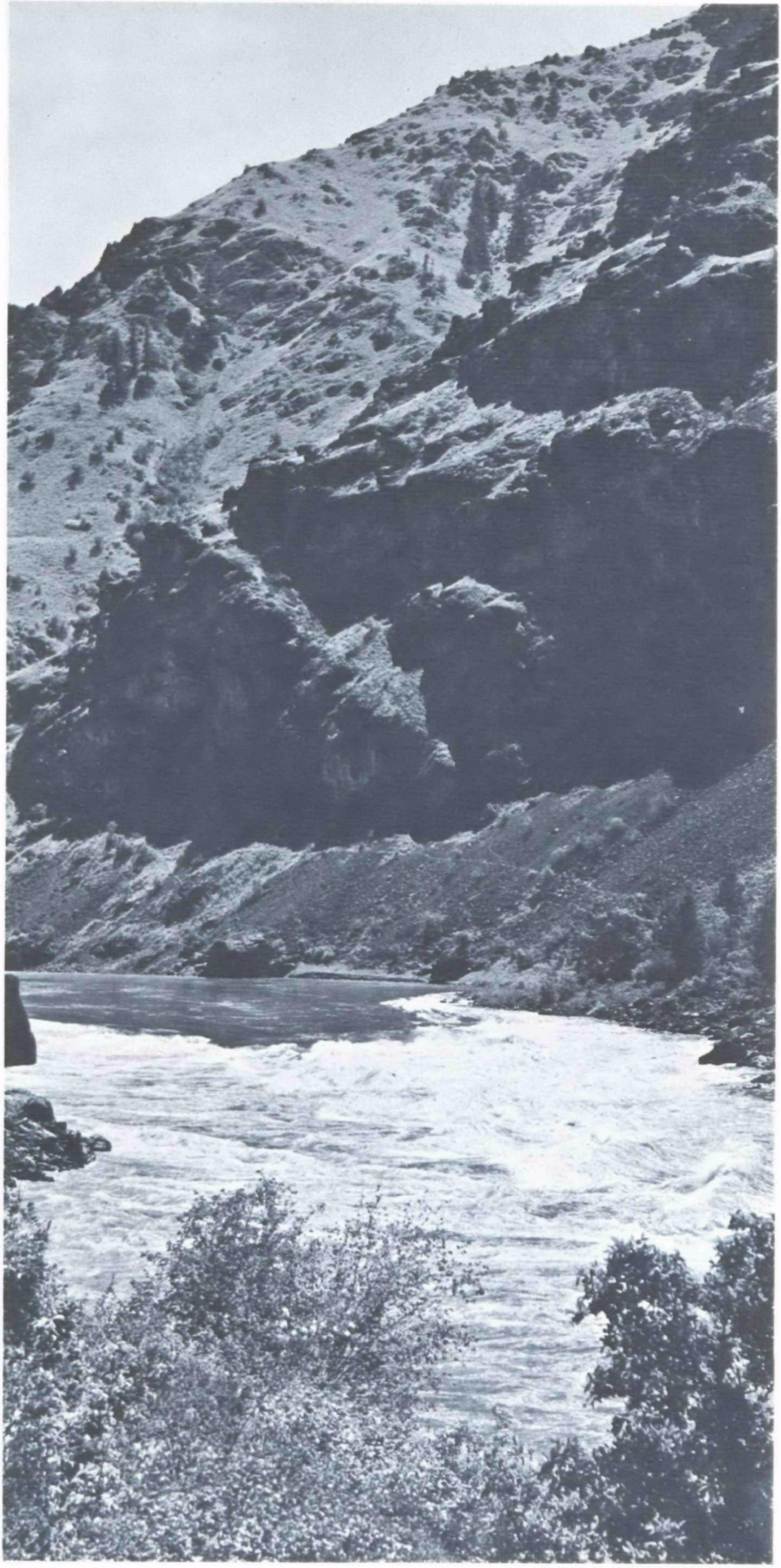
1. Hells Canyon: the deepest and narrowest velvety gorge in the United States, encloses the 1,000 mile long Snake River

INTRODUCTION



2. Many rapids break the Snake River into white water as the river dashes through the canyon. While landforms guarantee a limited threat of water pollution from population and industrial concentration, water resource development of the middle Snake could end the free-flowing of this beautiful river.

The Snake River is an intensively used and highly regulated river. As it sweeps across Idaho, turns northward to mark state boundaries, and finally bends westward through Washington, the waters of this river are controlled, stored and diverted for a multitude of uses. It will be even more intensively used and more highly regulated in the future as Idaho, in particular, grows in population and industrial complexity. It is a large river that means many things to many people.

To the people who live in the Snake Basin, the Snake means irrigation water to transform over three million acres of once-arid land into one of the Nation's most productive garden areas.

To sport and commercial fishermen who pursue salmon and steelhead, the Snake is the most important production area in the Columbia River system for anadromous fish.

To more than five million visitors each year, the Snake is a recreational playground providing swimming, boating, camping, and sightseeing.

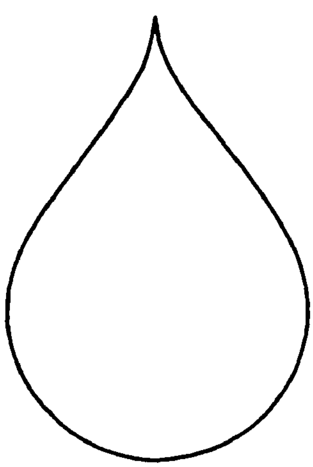
To people who enjoy all these uses, the Snake means change—change to accommodate a growing economy and population, change to improve water quality, and change to assure more efficient use of this valuable resource.

Water pollution threatens the present and future use of the Snake River. Dense aquatic growths, so heavy in places that they clog irrigation canals, flourish throughout the Snake's length. Fish kills occur nearly every year. Bacterial contamination occurs below most major population concentrations. Some portions of the Snake River are aesthetically offensive.

An opportunity—and a challenge—is offered to the people of the Snake Basin to guide the course of intensifying uses as the economy undergoes expansion and change. If the present uses and the inevitable changes of the future are to be endured without the burden of growing problems of water pollution, the people and their representatives in government and industry must institute prudent action programs—action programs supported by a public fully informed and aware of the water quality problems and their alternative solutions.

In the Snake River Basin, any meaningful action program requires husbanding of that water resource with management and regulation of the river's flow, giving full recognition to, and provision for, all the many water uses for which people value the Snake.

Since the first permanent settlement of the Snake River Basin, the history of development and economic growth has centered in the use of the river for irrigation and power production. Management and regulation of Snake River flows, suggested by custom and state laws which grew out of that history, have established these uses as the paramount criteria governing utilization of this most important of all resources in the Snake Basin. Continuation of these historical practices to the exclusion of consideration for more recent and emerging uses can result in significant losses



to the Pacific Northwest, to the Nation and, most importantly, to the people of the basin.

In the future, the Snake River must be utilized to accommodate more fully the changing emphasis among the varied uses which will loom large as economic change marches across the length and breadth of the Snake River Basin.

This is the thrust of this report: Better and more comprehensive management to accommodate changing and multiple uses of the Snake River water resources.

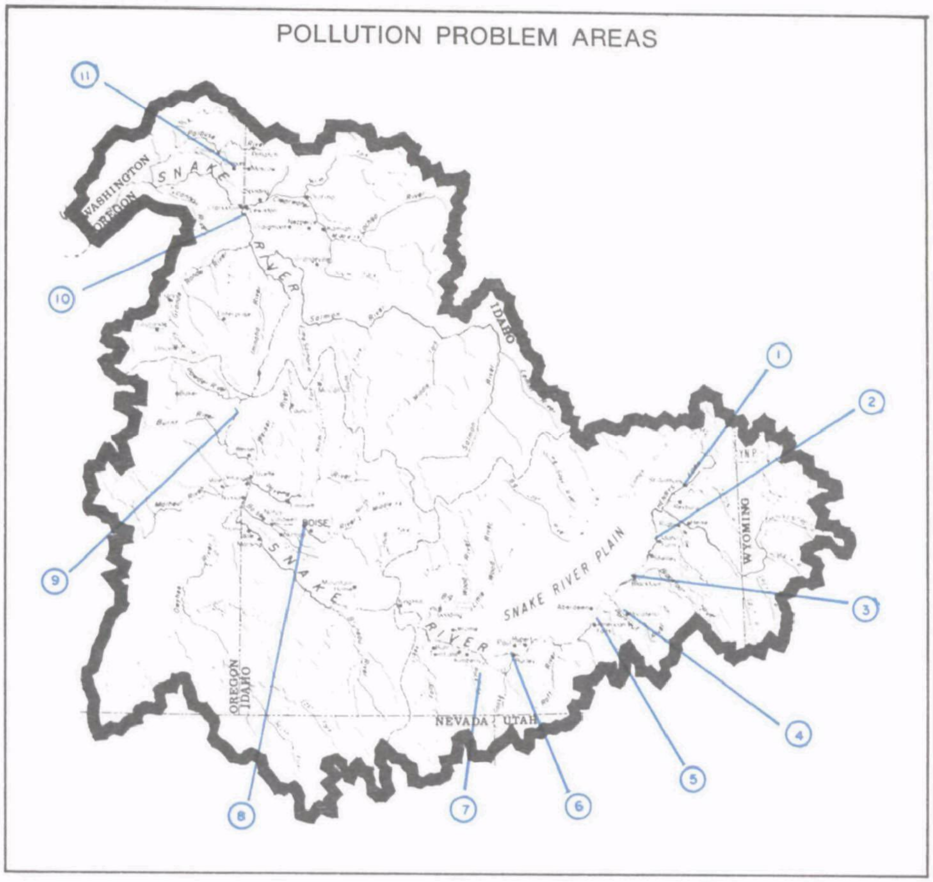
Although the importance of irrigation and power as present and future cornerstones of the Snake Basin economy cannot be minimized, new demands and expectations preclude water management programs dedicated solely to these uses. The goal, to be transformed into a fact accomplished, must be a water management program to adjust to the changing diversity and intensity of all water uses and water-use relationships. Only through a prudent water management program of action, supported by the best practicable treatment of wastes prior to discharge, can the damaging effect of water pollution and resultant restricted use be avoided. The right steps must be taken beginning now.

This report summarizes the findings of studies which have provided the inpetus to Federal-State water pollution control planning in the Snake Basin since 1962. It tells where pollution exists and why it exists. It tells what corrective action has already been initiated. It tells what further steps must be taken to preserve and enhance the quality of water resources of the basin. And it serves as a blueprint from which to build future programs for the water quality essential to the many uses and enjoyment of water in the Snake Basin.

SUMMARY

1. Water quality in the Snake River Basin and its tributaries is presently impaired for the uses of municipal water supply, water-contact recreation, production of anadromous and resident fish, and aesthetic enjoyment in the designated areas. Increasing quantities of wastes from municipal, industrial, and agricultural sources contribute to the restriction of water use; however, acceleration of water pollution is largely the result of the cumulative effects of these discharges and management practices by which a complex system of impoundments is operated primarily for irrigation and power purposes. Drastic modification of natural flow patterns when irrigation water is being stored or diverted too often reduces river flows and the ability of the river to assimilate wastes.

2. Fish kills, thermal pollution, and bacterial contamination are water quality problems common to the Snake. But the most chronic problem is the dense aquatic growths that interfere with the use of water for irrigation by clogging canals and that make portions of the river aesthetically offensive. Many impoundments and both natural and man-made inputs of nutrients make these growths more prolific.



Problem Area

1. South Fork Teton R. and Henry's Fork below the Teton R.
2. Snake River below Idaho Falls
3. Snake River above American Falls Res.
4. Portneuf River below Pocatello
5. American Falls Reservoir
6. Milner Reservoir
7. Rock Creek
8. Boise River
9. Brownlee-Oxbow Reservoir
10. Lewiston-Clarkston Area
11. South Fork Palouse River

3. A major step towards abating pollution in the Snake Basin climaxed with the establishment of Water Quality Standards by basin states and their approval by the Secretary of the Interior under the Water Quality Act of 1965. The criteria portion of the standards fixes objectives designed to upgrade polluted waters and to protect waters of high quality. They will be made effective through the implementation plans which require secondary treatment or its equivalent for all municipal and industrial wastes in 1972. Thus, water quality in most problem areas will certainly be improved. However, treatment alone will not solve all water quality problems.

4. Minimum streamflows, established and maintained for water uses requiring good water quality, are essential to water quality maintenance to meet expanding multiple uses of the Snake Basin water resources. Unless management programs provide firm minimum flows, in-stream water uses such as fishery and recreation will be impaired, even with a high degree of waste treatment. Total annual flows are sufficient in most

years to serve water quality, power, and irrigation if a management program can be designed to minimize wasteful spillage of flows, to coordinate reservoir releases, and to conserve irrigation water.

5. Present thermal pollution in the Snake Basin has resulted more from impounding the free-flowing stream than from waste heat discharged to the river. High water temperatures in the lower Snake (a migratory route for anadromous fish) now limit salmon and steelhead production and at times actually delay fish passage into the lower Snake system, the most important production area for anadromous fish in the Columbia Basin. Flow regulation from future reservoirs may improve the temperature regimen of the Snake; impacts on water quality should, therefore, be a part of future project analyses.

6. Ground water in the upper basin is a valuable and largely undeveloped resource consisting of almost 50 percent of the total ground-water reserves in the Pacific Northwest. The quality of this underground reservoir must be protected by proper disposal of low-level radioactive wastes from the National Reactor Testing Station (NRTS) near Idaho Falls, which overlies the recharge basin for the Snake River aquifer.

Teton

RECOMMENDATIONS

1. The most critical need in the Snake Basin, in addition to the actions already being taken by pollution control agencies, is the systematic management of present and future water resource development projects to reduce inefficient use of water and to permit all beneficial uses. The Idaho Water Resources Board, the State Reclamation Engineer, the Idaho Department of Health and the Bureau of Reclamation have already made initial efforts in this direction. Strengthening and coordination of these efforts with the efforts of the FWPCA, other water resource agencies, and the water users will expedite the following needed actions:

(a) Improvement of reservoir operating criteria and maintenance schedules to assist in providing a minimum streamflow from existing reservoirs for water quality to support in-stream water uses as well as to serve the needs for water withdrawal uses.

* (b) Recommendations for modification of existing statutes to recognize in-stream water uses as beneficial uses of the stream and to permit the establishment of base flows for water quality control.

(c) Improvement of irrigation conveyance systems and methods of application to crops to reduce excessive diversions and promote more efficient use of water.

(d) Evaluation of future water resource projects with respect to their impact on water quality and development of predictive tools to better define problems of water quality and flow management. In particular, consideration of water quality control in planning and design of future projects to take advantage of temperature regulation potential could improve water quality.

2. In addition to on-going state programs, a number of actions by State water pollution control agencies would contribute greatly to water quality maintenance in the Snake Basin. It is recommended, therefore, that the states consider the following needed actions:

(a) Mandatory certification and training of treatment plant operators—both municipal and industrial—to ensure the best possible treatment plant operation.

(b) Establishment of a waste discharge permit system in Idaho which would be compatible with those of Oregon and Washington in defining the nature and quantity of wastes being discharged and to set treatment requirements for specific locations.

(c) Development of regional organizations of city-industrial groups to plan, finance, and operate waste treatment facilities in the larger service areas.

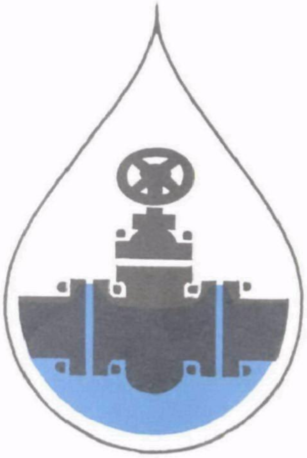
(d) Development of regulations controlling wastes from concentrated animal populations such as feedlots and dairies.

(e) Continued action by the State water pollution control agencies to assure the establishment of basin-wide secondary waste treatment by 1972 and the development of intrastate water quality standards.

3. The Federal government also has direct responsibility for controlling pollution in the Snake Basin. The following actions, taken by the appropriate agency, are a necessary part of the overall effort of pollution control:

(a) Secondary treatment, or its equivalent, should be instituted at the following Federal installations as required by Executive Order 11288:

Redfish Lake Recreation Area, USFS
Island Park Recreation Area, USFS
Alturas Lake Recreation Area, USFS
Elk City Ranger Station, USFS
Powell Ranger Station, USFS
Bungalow Ranger Station, USFS
Musselshell Work Camp, USFS
Slate Creek Ranger Station, USFS
Mountain Home Air Force Base, USAF
Anderson Ranch Dam, USBR
Black Canyon Dam, USBR
Black Canyon Dam Power Plt.,USBR
Cascade Dam, USBR
Deadwood Dam, USBR
Boise River Diversion Dam, USBR
Lucky Peak Dam, USACE
Minidoka Dam & Headworks,USBR
Ice Harbor Dam, USACE



(b) Federal agencies responsible for managing large portions of the basin or involved in construction activities should continue their efforts to improve erosion control practices that will reduce sediment loads to the basin's streams.

(c) The Atomic Energy Commission should assure retention of radioactive wastes within the boundaries of the NRTS station by eliminating discharges to groundwater and by adopting another method of treatment and disposal that would reduce the possibility of a contaminated ground-water supply. A monitoring system that will provide adequate warning of impending danger to ground-water and surface-water systems from present and future waste disposal practices should be maintained.

(d) Location of any proposed thermal power installation on the Snake River system should be reviewed to determine effects of wastes on the receiving stream. Provisions for control and adequate treatment of thermal discharge should be a prerequisite to such location in order to prevent irreparable damage to selected stream reaches.

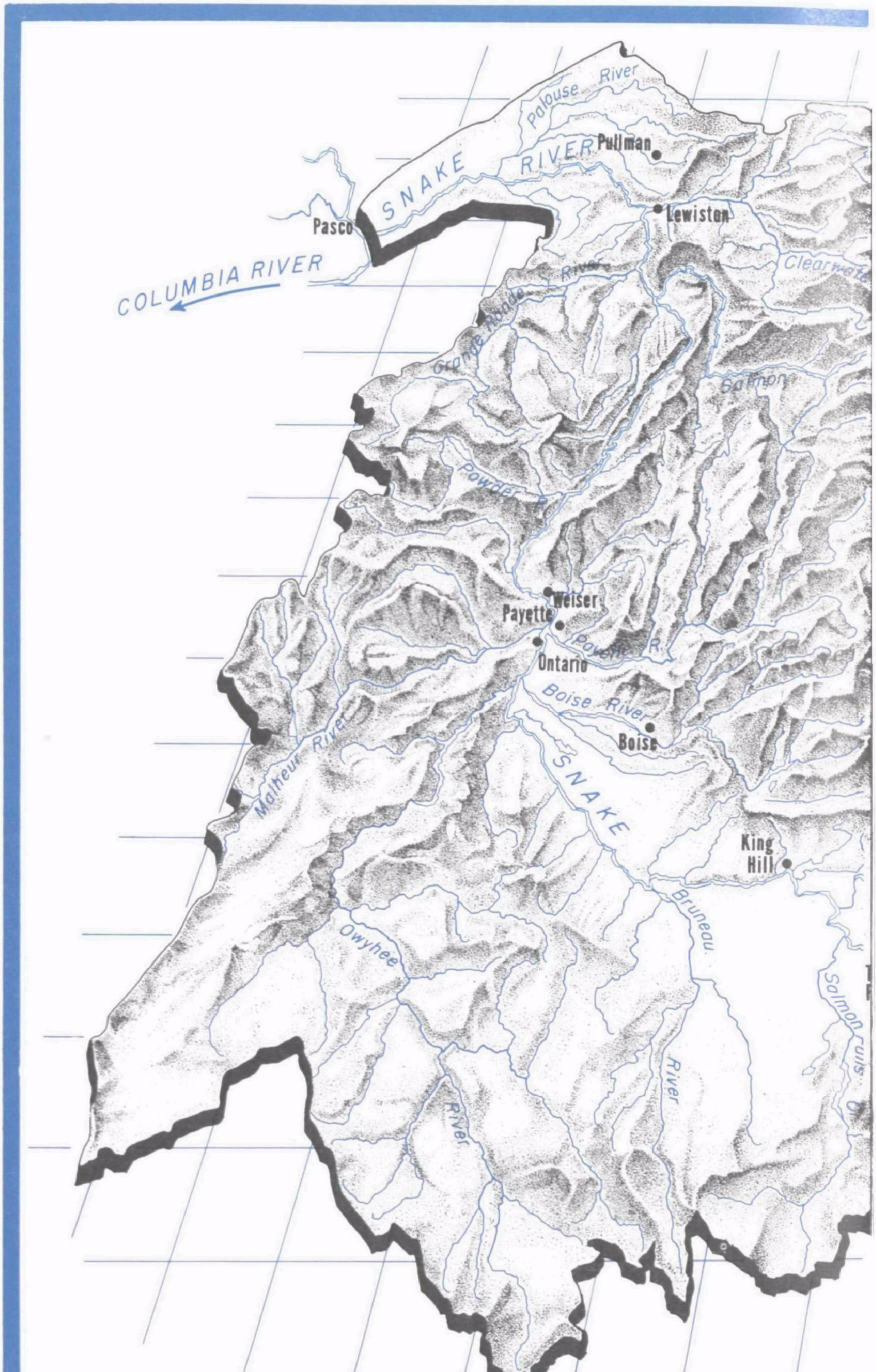
4. Remaining actions which would improve water quality may be considered the joint responsibility of State and Federal agencies. Cooperation of all levels of government to bring about the following would improve the basin's water quality management program:

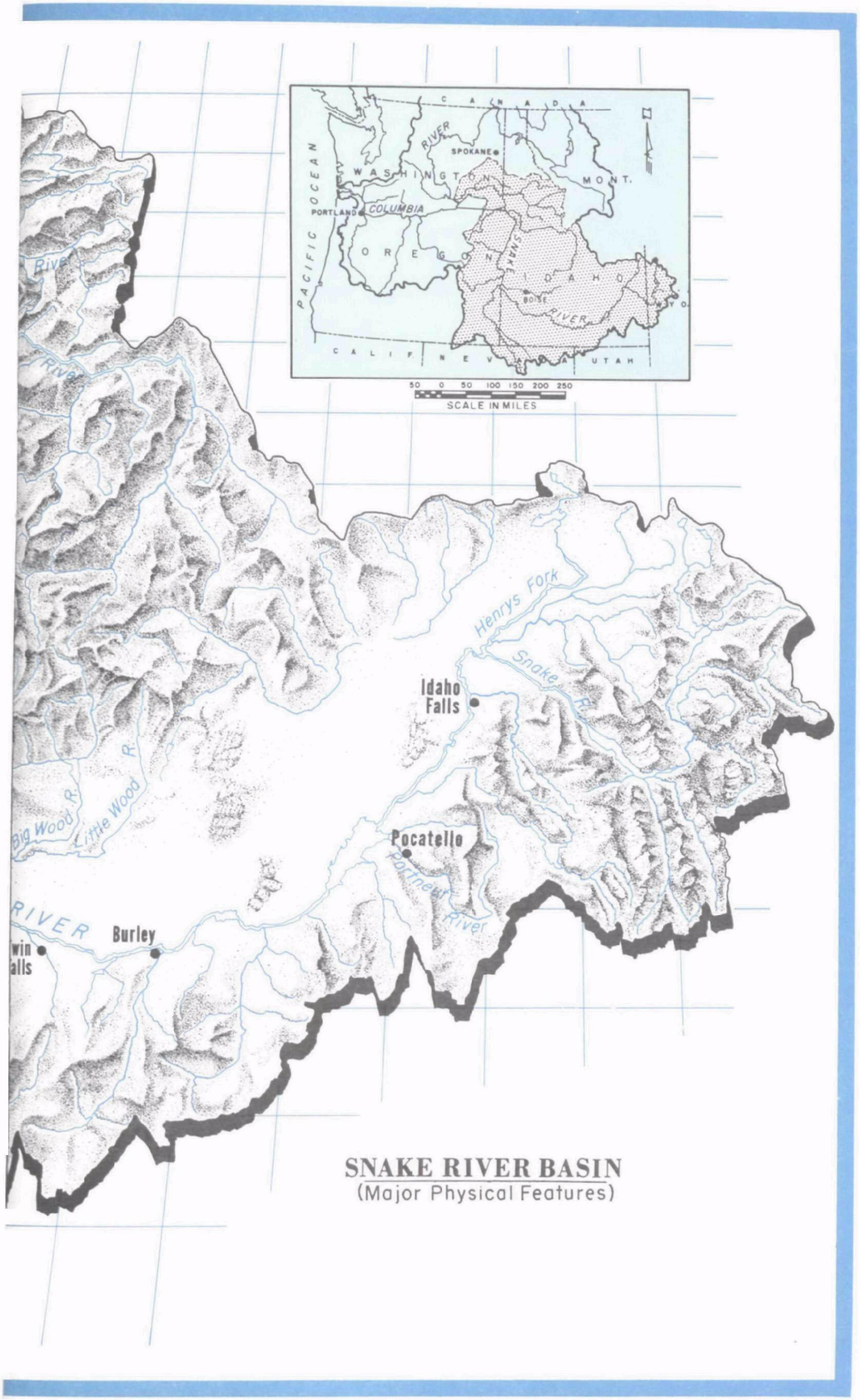
(a) Control of aquatic growths in the Snake Basin. The responsibility for this control extends beyond the scope of any one agency or organization. More information about the nature, causes, and possible methods of controlling the excessive productivity of the river is critical to the solution of the problem. State, Federal and university efforts should be directed toward such research. The FWPCA, through its National Eutrophication Research Program and its research grant program, can offer assistance and participation.

(b) Expansion of cooperative data collection and analysis programs of both the State and Federal governments to provide more complete knowledge of water quality in the Snake River system as a basis for sound decisions on flow regulation and waste treatment needs.

(c) Improvement of agricultural practices to ensure the maximum protection of the waters of the Snake Basin from adverse effects of fertilizers and pesticides. Careful selection of types of chemicals to be applied, determination of optimum application levels and sanctions against applications that occur within the immediate surface drainage of a watercourse are essential to a control program. The control should be instituted through education of individual farmers and through grower contracts covering production conditions and quality specifications for crops to be processed.

DESCRIPTION


Palouse River
Pullman
SNAKE RIVER
Pasco
Lewiston
COLUMBIA RIVER
Clearwater
Grande Ronde River
Salmon
Powder R.
Weiser
Payette
Payette R.
Ontario
Boise River
Boise
Malheur River
SNAKE
King Hill
Bruneau
Owyhee
River
River
Salmon Falls



SNAKE RIVER BASIN
(Major Physical Features)

The Basin

The Snake River begins in the northwest corner of Wyoming, flows through southern Idaho where it receives minor drainage from Utah and Nevada, travels northward to mark state boundaries between Idaho and Oregon and Idaho and Washington, and then flows through the Palouse hills to the Columbia River in the State of Washington. The river is over 1,000 miles long and drains an area of nearly 108,000 square miles. As the largest tributary of the Columbia River, the Snake River contributes one-fifth of the total discharge of the Columbia River system, about 33 million acre-feet of water each year.

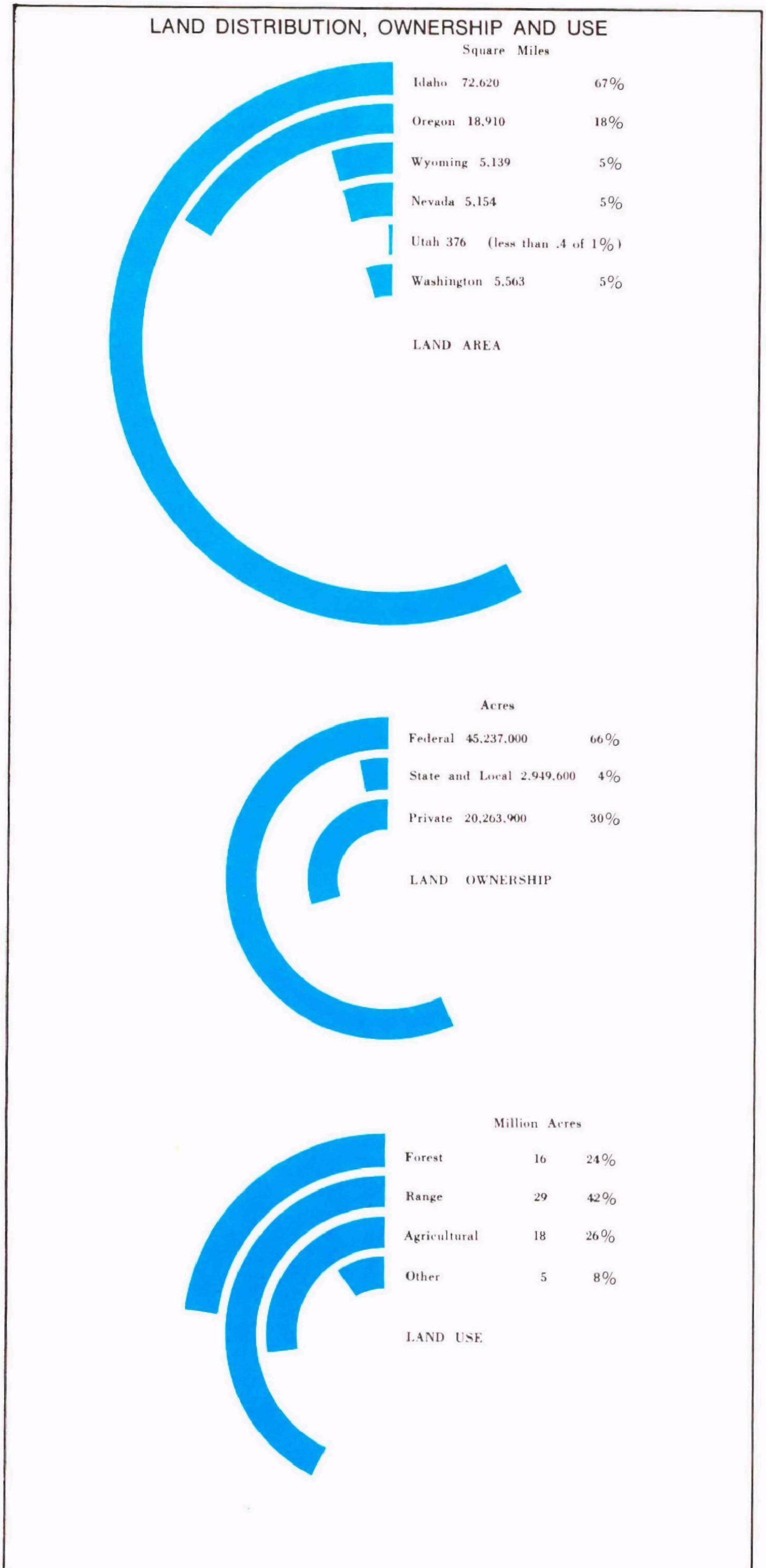
The Area

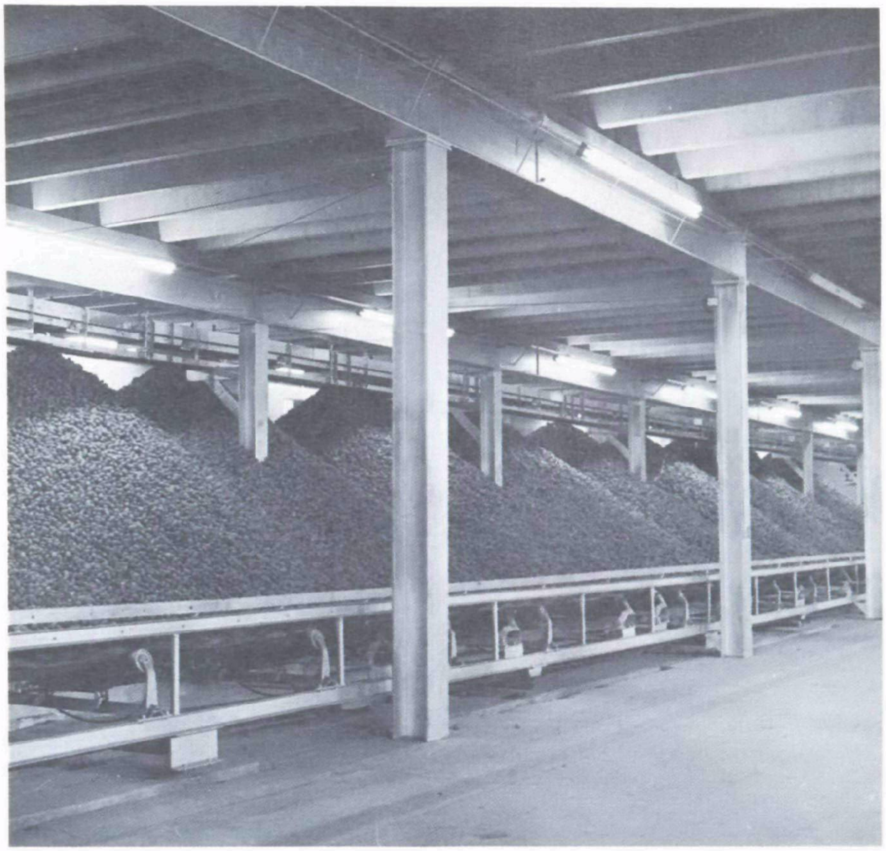
Most of the area is mountainous, but it is the lowlands of the Snake Plain and the finger valleys like those of the Boise, Payette, and Weiser Rivers which provide some of the world's most fertile farm areas and which are the focus of the agricultural economy and the home of most of the population.

Of the basin's total area, 42 percent is rangeland; 24 percent is forest; 26 percent is agricultural land; and the remaining 8 percent is divided among other uses. Land ownership of the basin is 66 percent Federal, 4 percent state and local, and 30 percent private.

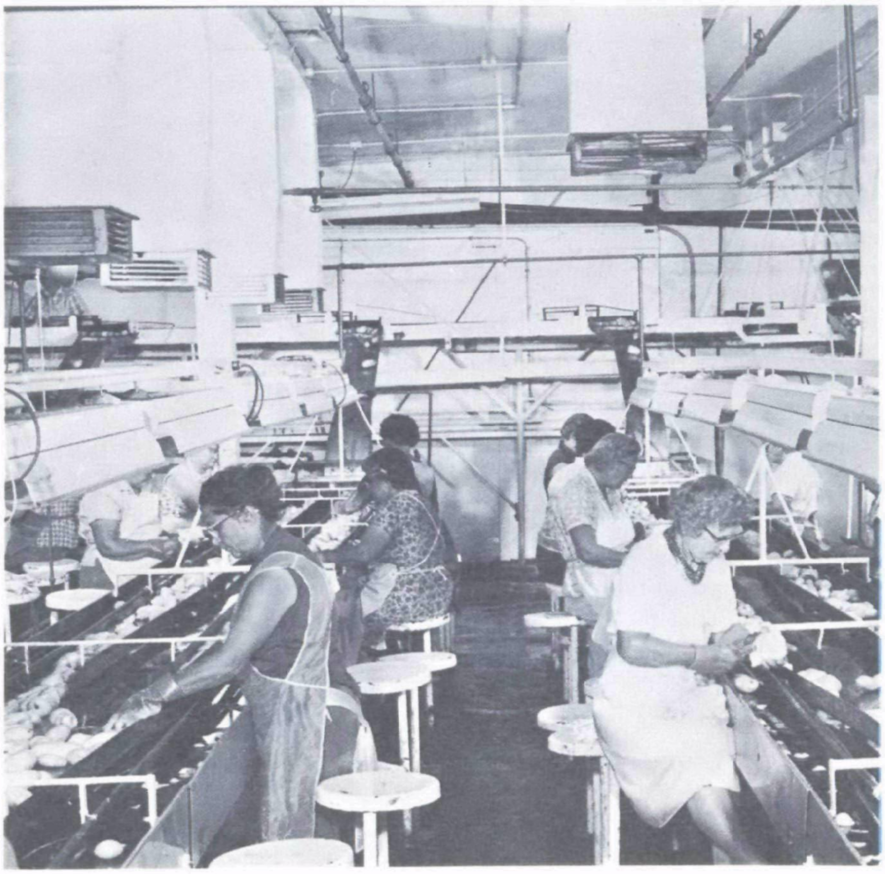
Present Population

In 1965, approximately 729 thousand people lived within the basin's boundaries. For analytical purposes, sixteen service areas or urbanized-industrialized locations have been defined. Over 65 percent of the total population lives in these areas, most of which are located in the Snake Plain. Population growth has been retarded by rural emigration, but the larger urbanized areas have experienced very rapid population expansion in the last two decades.





3., 4. Processing of millions of tons of potatoes each year requires immense amounts of water and produces huge amounts of wastes. In most plants the movements of the raw materials through the factory is conducted by using water as the medium of transport.

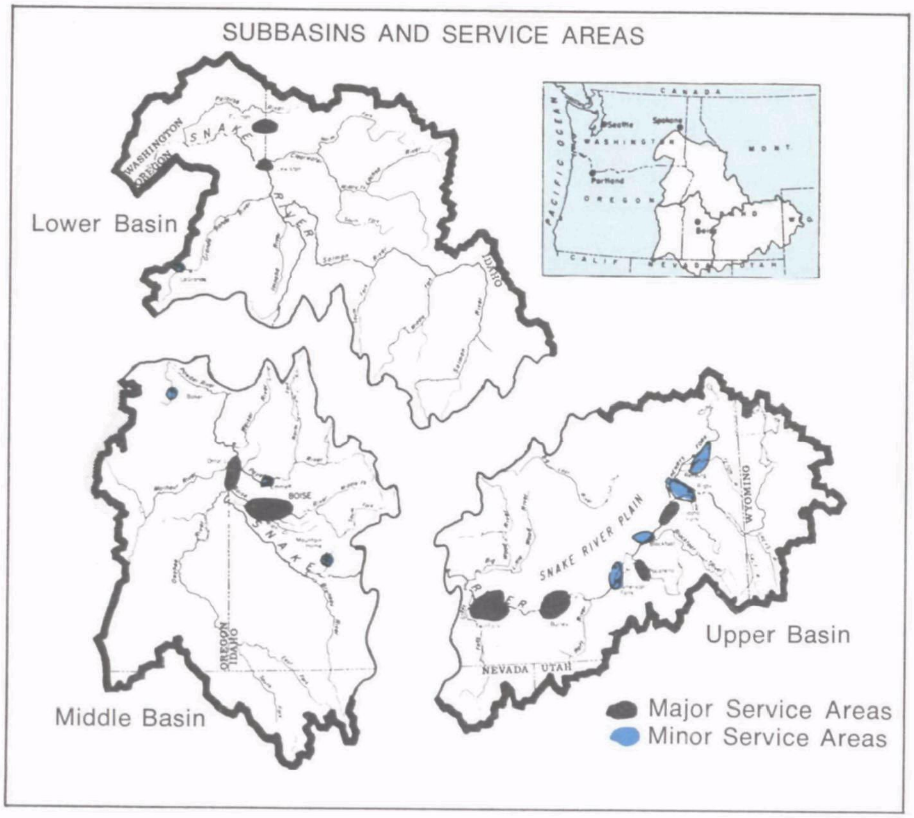


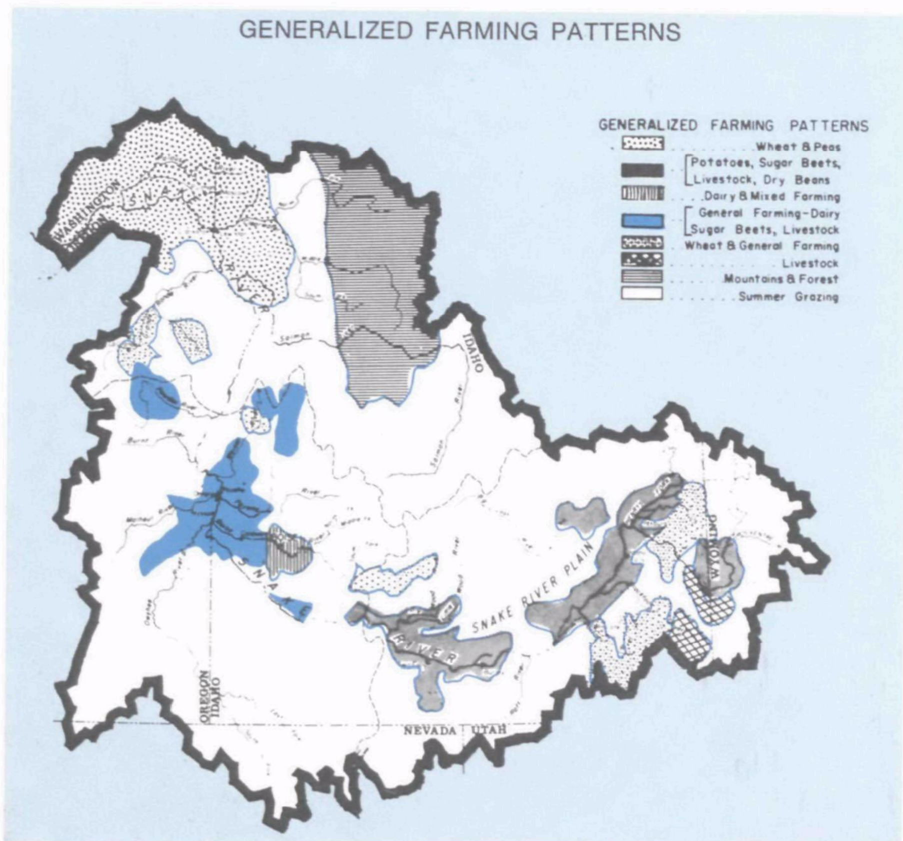
The Economy

Agriculture dominates the regional economy. The farms of the upper basin and the Snake Plain area of the central basin produce irrigated row crops, livestock, and dry farmed wheat. Unlike the diversified agriculture of the Snake Plain, which is dependent on irrigation, farming in the Palouse country of the lower basin produces mostly wheat and legumes.

The basin has industrialized rapidly over the last two decades. Potato processing, sugar refining, and other types of food processing have expanded rapidly in the upper and central basins, and the lower basin has a diversified forest products industry. Indicative of the Snake Basin's importance to the economy of the Pacific Northwest and the Nation is the fact that about 25 percent of the Nation's potatoes and about 15 percent of the Nation's sugar beets are grown and processed within the the basin's boundaries.

Economic projections for the Snake Basin have been made, based on recent trends of production, and are intended to provide a framework for quantitative examination of the future impacts on water quality. Food processing is expected to remain the principal manufacturing activity for the region, with the volume of processed potatoes continuing to increase at a rapid rate. Output of canned, frozen, and otherwise prepared foods, other than potatoes and animal products, is projected to achieve the most marked growth in the future. In addition, phosphates and pulp and paper may also be expected to undergo increased production.





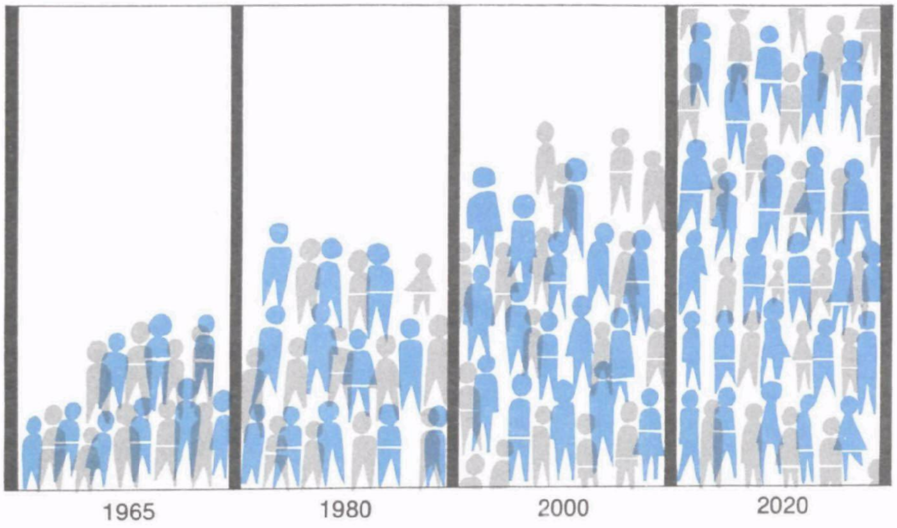
PROJECTED OUTPUT — MAJOR MANUFACTURED PRODUCTS

Product or Process	Projection Expressed in	1960	1965	1980	2000	2020
Phosphate products	tons/year output	165,000	270,000	390,000	720,000	1,020,000
Fertilizer	tons/year output	360,000	700,000	870,000	1,615,000	2,300,000
Wood pulp	tons/day capacity	650	650	950	1,400	2,100
Particle board	tons/day capacity	500	550	750	1,100	1,700
Sugar refining	tons/day capacity	18,700	24,600	27,400	39,100	55,500
Upper basin		(9,600)	(13,700)	(15,300)	(21,850)	(31,000)
Central basin		(9,100)	(10,900)	(12,100)	(17,250)	(24,500)
Potato processing	tons/day capacity	5,775	7,225	9,200	14,600	20,800
Upper basin		(4,275)	(5,425)	(7,300)	(10,400)	(14,700)
Central & lower basins		(1,500)	(1,800)	(1,900)	(4,200)	(6,100)
Milk products	million lbs/yr output	435	485	670	950	1,350
Meat	million lbs/yr output	150	180	320	460	520
Misc. canning & freezing	production index	100	130	235	460	780

POPULATION — 1965-2020

Thousands of Inhabitants

	1965	1980	2000	2020
SNAKE RIVER BASIN	729.2	934.7	1324.2	1909.6
Upper Basin	298.7	395.5	578.1	855.0
Central Basin	268.7	345.0	487.8	705.9
Lower Basin	161.8	194.2	258.3	348.7
MAJOR SERVICE AREAS	401.8	586.9	941.5	1482.4
Idaho Falls	52.3	83.3	139.1	228.0
Pocatello	47.7	74.7	128.7	211.0
Burley	24.5	35.6	56.6	86.0
Twin Falls	40.5	61.0	97.6	150.0
Boise	146.3	203.0	313.6	484.5
Ontario	24.6	35.7	57.3	88.5
Lewiston	38.1	55.2	90.4	148.0
Pullman	27.8	38.4	58.2	86.4
As % Basin Total	55.1%	62.8%	71.1%	77.6%
MINOR SERVICE AREAS	81.0	102.5	135.7	179.3
Rexburg	15.0	17.4	22.9	30.2
Rigby	9.1	11.7	15.4	20.3
Blackfoot	15.9	20.2	27.6	37.0
American Falls	4.1	4.8	6.2	8.0
Mountain Home	12.0	16.4	21.6	28.5
Emmett	4.0	5.2	6.8	8.9
Baker	10.0	13.4	17.6	23.2
La Grande	10.9	13.4	17.6	23.2
As % Basin Total	11.1%	11.0%	10.3%	9.4%
33 Upper Basin Communities	23.7	28.0	34.6	43.0
20 Central Basin Communities	19.9	23.0	28.0	34.3
44 Lower Basin Communities	40.8	47.6	58.4	61.8
As % Basin Total	11.6%	10.5%	9.1%	7.3%
RURAL	162.0	146.7	126.0	108.8
Upper Basin	65.9	58.8	49.4	41.5
Central Basin	51.9	48.3	42.9	38.0
Lower Basin	44.2	39.6	33.7	29.3
As % Basin Total	22.2%	15.7%	9.5%	5.7%



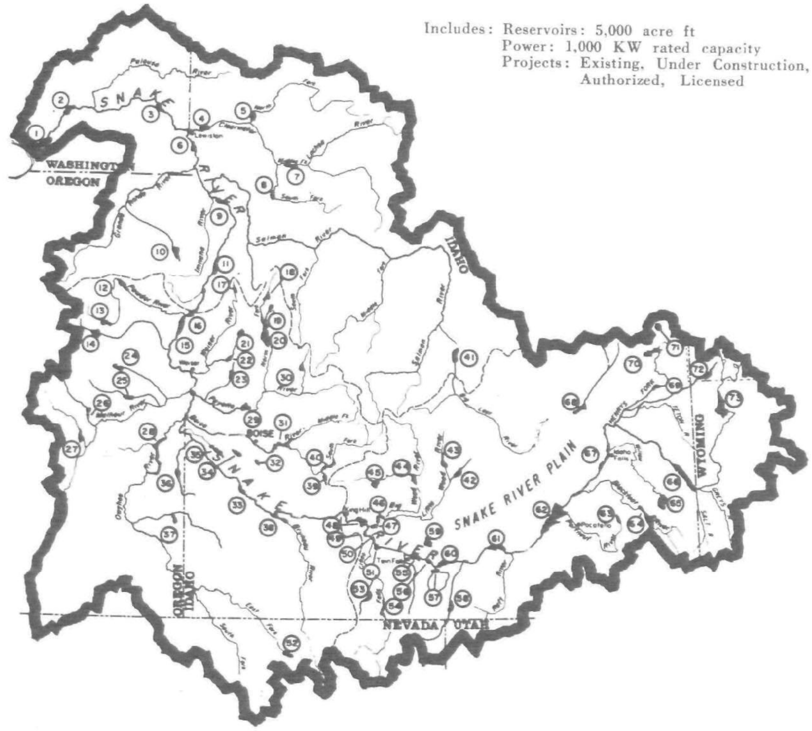
The economic projections presented in this report are deemed adequate to project impact of developments on water quality. Additional studies are under way by the Office of Business Economics of the Department of Commerce and will be used in the Columbia - North Pacific Region Framework Study, which is being made under the auspices of the Pacific Northwest River Basins Commission and the Water Resources Council. The Idaho Water Resource Board is making technically sophisticated studies of agricultural, municipal, industrial, and other water needs. Projections from these studies and those of projects proposed by the Bureau of Reclamation and the Corps of Engineers will be evaluated as to their effects on water quality as part of the continuous planning process to provide and maintain water quality for intended uses.

Future Population

Based on projected output and current population trends, the population for the basin was projected to 2020. It is estimated that by that time there will be two million people, most of whom will live in the major and minor service areas. The projected distribution of future population continues the established pattern.

5. Below Milner Dam a slim, uncharacteristic flow passes down the natural channel of the Snake River. Through the irrigation season little water reaches the channel, most of the flow of the Snake River being diverted to giant irrigation canals radiating out from the dam.

WATER RESOURCE PROJECTS



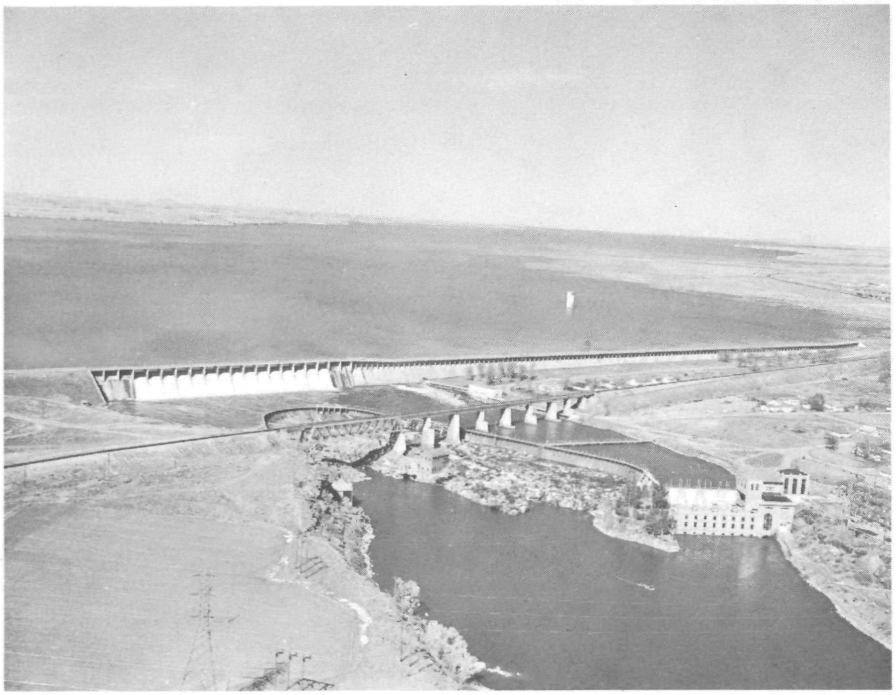
1. Ice Harbor
2. Lower Monumental
3. Lower Granite
4. Lewiston
5. Duorshak
6. Asotin
7. Penny Cliffs
8. Grangeville
9. High Mt. Sheep
10. Wallowa Lake
11. Hells Canyon
12. Thief Valley
13. Mason
14. Unity
15. Brownlee
16. Oxbow
17. Lost Valley
18. Payette Lake
19. Little Payette
20. Cascade
21. C. Ben Ross
22. Crane Creek
23. Paddock Valley
24. Willow Creek
25. Bully Creek
26. Agency Valley
27. Warm Springs
28. Owyhee
29. Black Canyon
30. Deadwood
31. Arrowrock
32. Pleasant Valley
33. Swan Falls
34. Hubbard
35. Lake Lowell
36. Sucker Creek
37. Antelope
38. C. J. Strike
39. Little Camas
40. Anderson Ranch
41. Mackay
42. Fish Creek
43. Little Wood
44. Magic
45. Twin Lakes
46. Malad (upper)
47. Malad (lower)
48. Bliss
49. Salmon Falls (upper)
50. Salmon Falls (lower)
51. Thousand Springs
52. Wildhorse
53. Cedar Creek
54. Salmon Falls Creek
55. Snoshone Falls
56. Twins Falls
57. Murtaugh
58. Goose Creek
59. Wilson
60. Milner
61. Minidoka
62. American Falls
63. Portneuf
64. Blackfoot
65. Grays
66. Palisades
67. Idaho Falls (upper middle lower)
68. Mud Lake
69. Ashton
70. Island
71. Henrys Fork
72. Grassy
73. Jackson Lake

Water Resources

Although at least twenty-one major tributaries may be distinguished, almost two-thirds of the Snake's total flow at the mouth is provided by three lower basin tributaries—the Salmon, Clearwater, and Grande Ronde—which enter well below the principal concentrations of population. Streamflow fluctuates greatly over the passage of the Snake with stream management strongly influencing flow in about two-thirds of the total drainage area. At Heise, the Snake carries about 4.7 million acre-feet in the average year. In the 250 miles from Heise to Milner Dam, irrigation withdrawals offset tributary inflows of 4.6 million acre-feet. At Milner, another 3.0 million acre-feet are withdrawn, virtually depleting the river's flow. Below Milner, substantial inflows from tributary springs augment mean flow to 6.2 million acre-feet at King Hill. The flow of the Snake is almost doubled as it passes through the central basin where it receives six important tributaries; of these, the Malheur, Owyhee, and Boise are heavily depleted by irrigation withdrawal, while the Payette, Weiser, and Powder Rivers discharge substantial portions of their waters to the receiving stream. Averaging 11.8 million acre-feet as it passes from the central basin at Brownlee Dam, the Snake flow triples in the terminal fifth of its course.

Occurrence of low flows critical to quality control is largely a function of the management regimen of the basin's waters. Low flows are most frequently the result of withholding water to build up storage for irrigation or of the actual diversion of a significant part of a stream to the fields. An exception to this rule exists in the Palouse River of the lower basin, where naturally low summer flows exist. The Portneuf River of the upper basin also suffers from intermittent low summer flows. To encompass both present water management capabilities and low flows which may be anticipated to recur in a cycle of dry years, hydrologic analysis in this report has been based upon the one-in-ten year recurrence of low flows.

Over 70 major impounding structures—existing, under construction, or authorized—act to modify natural flows and hundreds of additional project sites have been studied. Active storage capacity of these impoundments totals 11.6 million acre-feet or about 35 percent of the average annual Snake Basin contribution to the Columbia River. Through the upper and central basins, regulation is the principal determinant of streamflow; existing or authorized storage capacity here amounts to about 86 percent of average runoff. Development has been directed largely to the benefit of irrigators. There are 36 single-purpose irrigation dams in the basin, and 15 multi-purpose impoundments include irrigation among their functions. The high level of irrigation storage capabilities is accompanied by corresponding diversion capacity. There are 140 major gaged diversions of the flows of the upper and central basins. A substantial portion of the total water that is diverted is not gaged, particularly in the central basin.



6. American Falls Dam and reservoir, filled in this photograph, provides 1.7 million acre-feet of storage that is the key element in upper basin water management. In late summer much of the broad, shallow reservoir is empty, after downstream irrigation withdrawals have occurred.

Flows of the Snake River above Milner are regulated primarily by four Bureau of Reclamation reservoirs—Lake Walcott, American Falls, Palisades, and Jackson Lake—with active capacities totaling 3.8 million acre-feet. Over 97 percent of this storage is earmarked for irrigation use, and the regulation of the reservoirs is designed primarily to benefit irrigators.

7. The boat launching ramp of a private boating club located at American Falls Reservoir runs down to dry dust in August. The nearest water—the channel of the Snake River—is almost a mile away.

There is no systematized body of rules governing storage and release decisions relating to irrigation flows except an agreement with the Corps of Engineers to provide flood control on a forecast basis. Actual practice has been to fill the reservoirs in the early winter and allow surplus flows to spill in the spring. Stored flows are then released as needed for diversion during the irrigation season.

The actual responsibility of regulating storage and release schedules from the reservoirs rests with the Bureau of Reclamation. Once the water reaches the stream, a watermaster, elected by representatives of the irrigation districts, has the titular responsibility of regulating diversions. A unique group, the Committee of Nine, made up from the membership of the districts, has the responsibility of advising water companies with regard to water distribution questions. The system is apparently operated much more informally than defined responsibilities would indicate. Storage and release decisions are often discussed with and strongly influenced by the watermaster and the Committee of Nine.

Ground water is a valuable resource in the Snake Basin. The estimated supply of ground water constitutes well over half of the Pacific Northwest's total ground-water reserves, amounting to perhaps 160 million acre-feet of recoverable storage and 11 million acre-feet of annual recharge. Principal aquifers are in the lowlands, with the Snake Plain in the upper basin providing one of the world's outstanding water-bearing formations. Individual wells situated in this basaltic layer commonly yield more than 1,000 gallons per minute, some have achieved yields of 9,000 gpm. Ground-water problems include hardness, local mineral excesses, and degradation of quality as a result of irrigation and subsurface disposal of wastes.

8. Irrigation is the lifeblood to the agriculture of the Snake Plain, but also a major cause of pollution. Here ridge and furrow irrigation is used to grow sugar beets.

Water Uses

Irrigation

Irrigation far outweighs any other use of Snake River waters. In 1965 almost 3.4 million acres of the basin's lands were irrigated, an increase of one and a half million acres over the level existing 15 years ago. The economic patterns that have caused the Snake Basin to produce and process a steadily growing portion of the Nation's food supply maintain a steady pressure on irrigation capacity, because irrigation is a prerequisite to agricultural production in the Snake Plain. The water needs imposed by the level of irrigation development are enormous. The average water diversion rate in the area has been estimated at over four feet per acre. With the 1967 level of development, a total demand of 15 to 20 million acre-feet is indicated. With potential irrigation development, an eventual water need for irrigation purposes of up to 40 million acre-feet would be required.

(Total R.O. = only 33 million)
11.6 pres. act. storage

Fishery

Several distinct and significant fisheries exist in the Snake Basin and are a unique and valuable resource of the area. Most important of these in terms of broad economic impact is the migratory salmon fishery of the lower basin. The watershed's resident fish include salmonid and warm-water game fish. Both classes are intensely sought by sport fishermen. The anadromous fishery, in addition to being a source of recreational fishing, is also an important source of the commercial salmon catch of the Pacific banks and the Columbia River, contributing an estimated eight million pounds annually. Over 300,000 fish—about 61 percent of the anadromous fish other than blue-back passing McNary Dam—enter the Snake system each year and make the lower Snake the most important production area in the Columbia River system. While summer runs are the largest upstream migration, migrant salmon utilize the waters of the lower basin throughout the year. By far the most important tributary for fish production is the Salmon River.

Resident salmonids abound in the Snake River Basin and provide a high quality game fishery. Trout of various species occur throughout the basin and Kokanee, a prized type of landlocked salmon, is found in a few lakes. Warm-water game fish, though generally considered less desirable than the salmonids, are nevertheless intensively pursued by sportsmen, particularly in the reservoirs and in those areas which are suited to production of salmonid fish.

Municipal and Industrial Water Supply

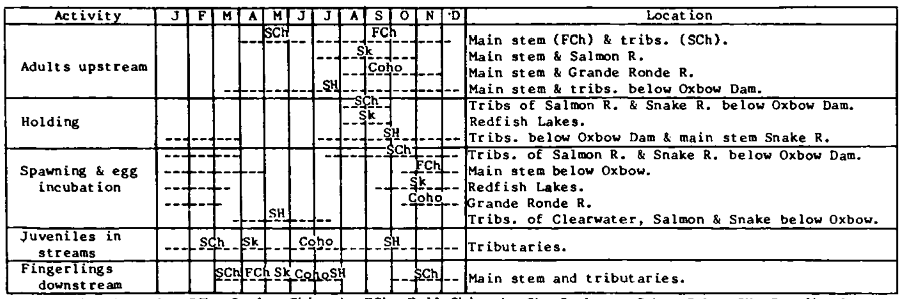
There are roughly two hundred individual municipal water supply systems and an additional one hundred industrial plants which provide their own water supplies in the Snake Basin. These cities and industries, together with the unincorporated population of the basin, require over 360 million gallons of water a day (mgd). Ground water is the principal source supplying municipal and and industrial water requirements in the basin; over 70 percent of the municipal population is served by ground water only, another 25 per-

ESTIMATED MAXIMUM RUNS OF SALMON AND STEELHEAD TO THE SNAKE RIVER SYSTEM *

Species	Columbia River Past McNary Dam	Snake River	% of Columbia
Fall Chinook	97,500	66,300	68
Spring Chinook	222,100	122,200	55
Steelhead	172,600	114,800	66.5
Total	492,200	303,300	61.6

* Data Source: U. S. Fish and Wildlife Service

ESTIMATED SPORT FISHING EFFORT: HARVEST AND EXPENDITURES



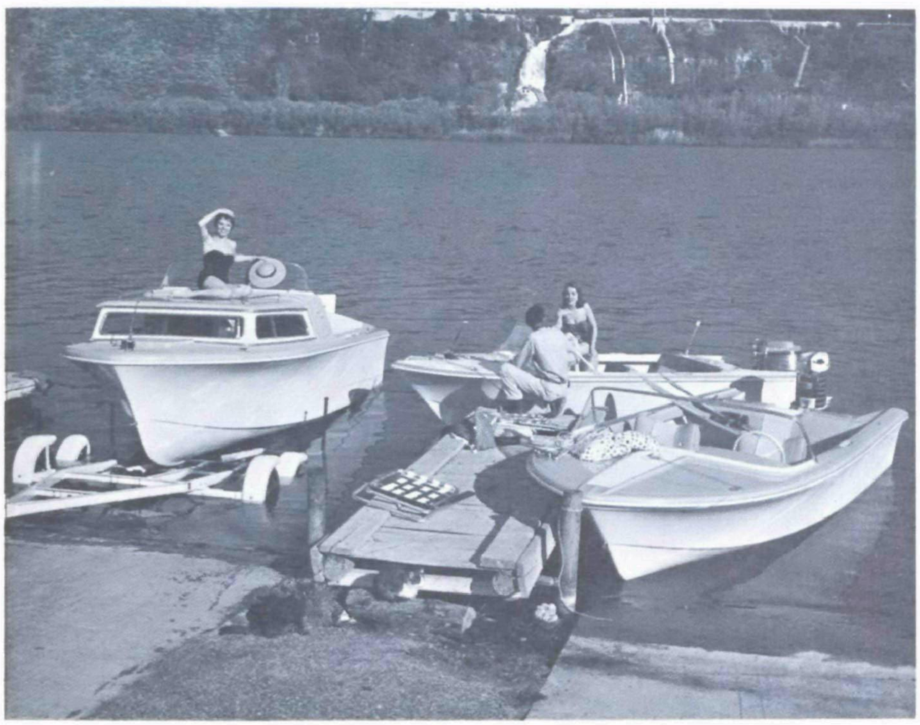
Species legend: SCh--Spring Chinook; FCh--Fall Chinook; Sk--Sockeye; Coho--Coho; SH--Steelhead.

ANADROMOUS FISH ACTIVITIES

Study Areas	Resident Fish a/			Adult Anadromous Fish: Steelhead			Adult Anadromous Fish: Salmon		
	Angler-Days	Catch	Expenditures b/	Angler-Days	Catch	Expenditures c/	Angler-Days	Catch	Expenditures d/
Salmon River	71,500	290,000	$ 413,270	110,000	27,000	$ 635,800	136,000	40,000	$786,080
Clearwater River	60,000	208,000	346,800	83,000	18,000	479,740	--	--	--
Grande Ronde River	86,000	243,000	497,080	11,000	3,000	63,580	4,800	1,200	27,740
Imnaha River	7,000	27,000	40,460	5,300	1,300	30,630	1,600	400	9,250
Snake River c/	4,500	25,000	26,010	25,000	11,000	144,500	4,000	1,100	23,120
Pine Creek	2,400	10,000	23,120	1,200	300	6,930	260	65	1,500
Asotin Creek	--	6,000	13,870	--	--	--	--	--	--
Other Tributaries d/	--	--	--	--	--	--	--	--	--
	235,400	809,000	$1,360,610	235,500	60,600	$1,361,180	146,660	42,765	$847,690

a/ Includes immature anadromous fish.
b/ Rate of $5.78 per angler-day derived from data in National Survey of Hunting and Fishing, Circular 120, USDI, 1960.
c/ Snake reach between Lewiston and Powder River.
d/ No data available.
Source: U. S. Fish and Wildlife Service. Survey of Middle Snake Basin. November 1964.

9. The mailboat, Idaho Queen, carries passengers up the Snake River where they enjoy sightseeing and fishing.



10. Hot, dry summers in the Snake Valley make boating and recreation popular on the Snake River.

cent is served by a combination of surface and ground water, and only four communities are served by surface water alone. Most significant industrial water users have developed adequate independent ground-water supplies, though a few are served by municipal systems. Ground-water supplies are generally of suitable quality and require only disinfection. Further treatment is generally associated with surface sources.

Municipal and industrial water requirements have been projected by applying the factors for use per capita or per unit of output to projected population and output levels. The demand for municipal and industrial waters in the Snake is expected to increase more than threefold by 2020, amounting to 512 mgd by 1980, 810 mgd by 2000, and 1,140 mgd by 2020. Municipal and industrial demands are expected to remain nearly equal throughout the planning period. Water supply needs of the Snake Basin are becoming increasingly concentrated. At the present time, over three-fourths of the total municipal and industrial requirements occur in the eight major service areas; and this percentage is expected to increase steadily.

Recreation

The waters of the Snake support a variety of types of recreation. Intensity of use is generally unmeasured; but recreational sites are numerous and observation indicates that these sites are used extensively. Perhaps the most obvious indication of the generally felt need for water-related recreational sites is the streamside municipal park; almost every town has such a site. Boating and swimming are popular in the river and the reservoirs. In fact, the average number of visitor days on publicly administered reservoirs offering boating and swimming opportunities has averaged 1.6 million in recent years. Sport fishing is an even greater attraction in the basin than boating. The U. S. Fish and Wildlife Service has estimated that the anadromous fishery resource of the lower basin is primarily responsible for approximately 2.7 million angler days of sport fishing in the Pacific Northwest. Scattered surveys at other places indicate 20,000 fisherman days for American Falls and Palisades Reservoirs, and up to 12,000 fisherman days for Wallowa Lake.

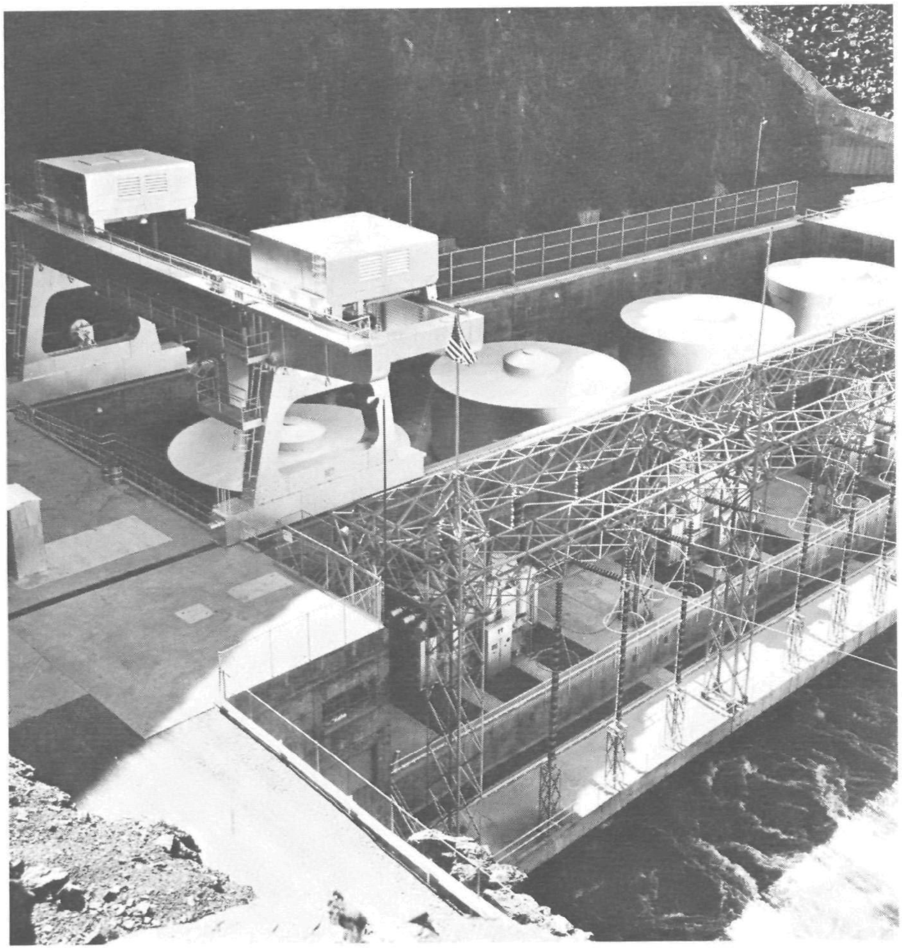
Outdoor recreation contributes substantially to the economy of the basin. Each fall the Twin Falls area experiences an influx of hunters in pursuit of migratory waterfowl. The high Wallowas in Oregon and the Clearwater drainage in Idaho have experienced considerable recreational development, with guides and suppliers serving the large numbers of campers, hikers, fishermen, and hunters who annually make use of the outstanding forest and water resources of these areas.

Hydroelectric Power

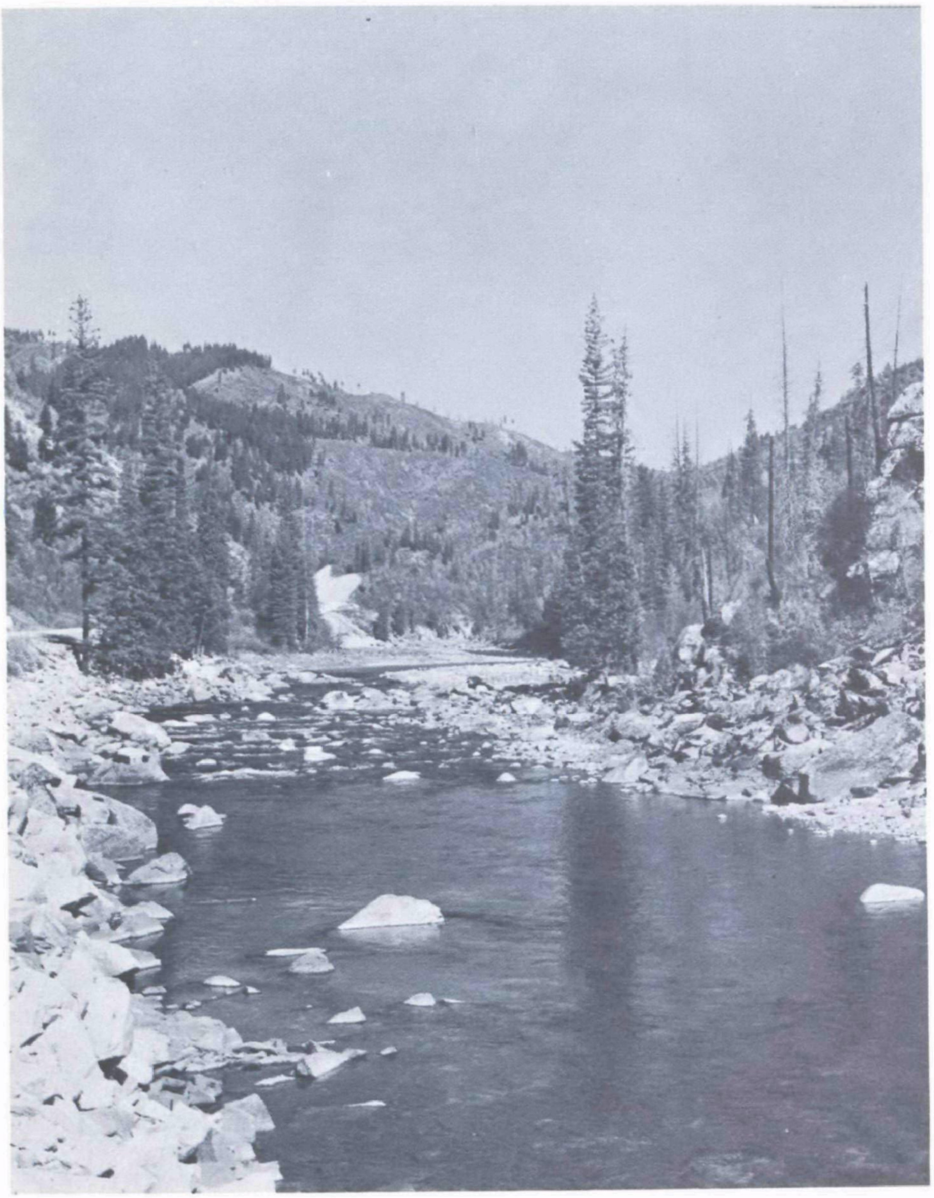
A number of hydroelectric power dams impound the Snake River and its tributaries, and construction of several mammoth generating facilities is scheduled before 1980. While electric power production does not constitute a depletion of the resource, it does have effects on water quality. Impounding the waters usually has both beneficial and detrimental quality-modifying effects, while the operation of turbines to meet integrated power system schedules may impose irregularities in streamflow.

Navigation

With completion of a scheduled series of Columbia and Snake River dams, the Columbia's navigational pool for barge traffic will extend to Lewiston and Clarkston on the lower Snake River. Quality requirements for navigation are insignificant, and the quality effects of navigation are generally not severe. Accidental spills, unregulated bilge pumping, and deposits of silt and sand from channel dredging, however, bear the potential for localized and intermittent quality degradation.



11. Capable of generating more electricity than any other plant in Idaho is the 450,000 kilowatt Brownlee Dam powerhouse, completed in 1959 by Idaho Power Company. The huge rockfill embankment that stores Snake River water for the powerhouse was the world's second-highest such structure at the time of its completion.

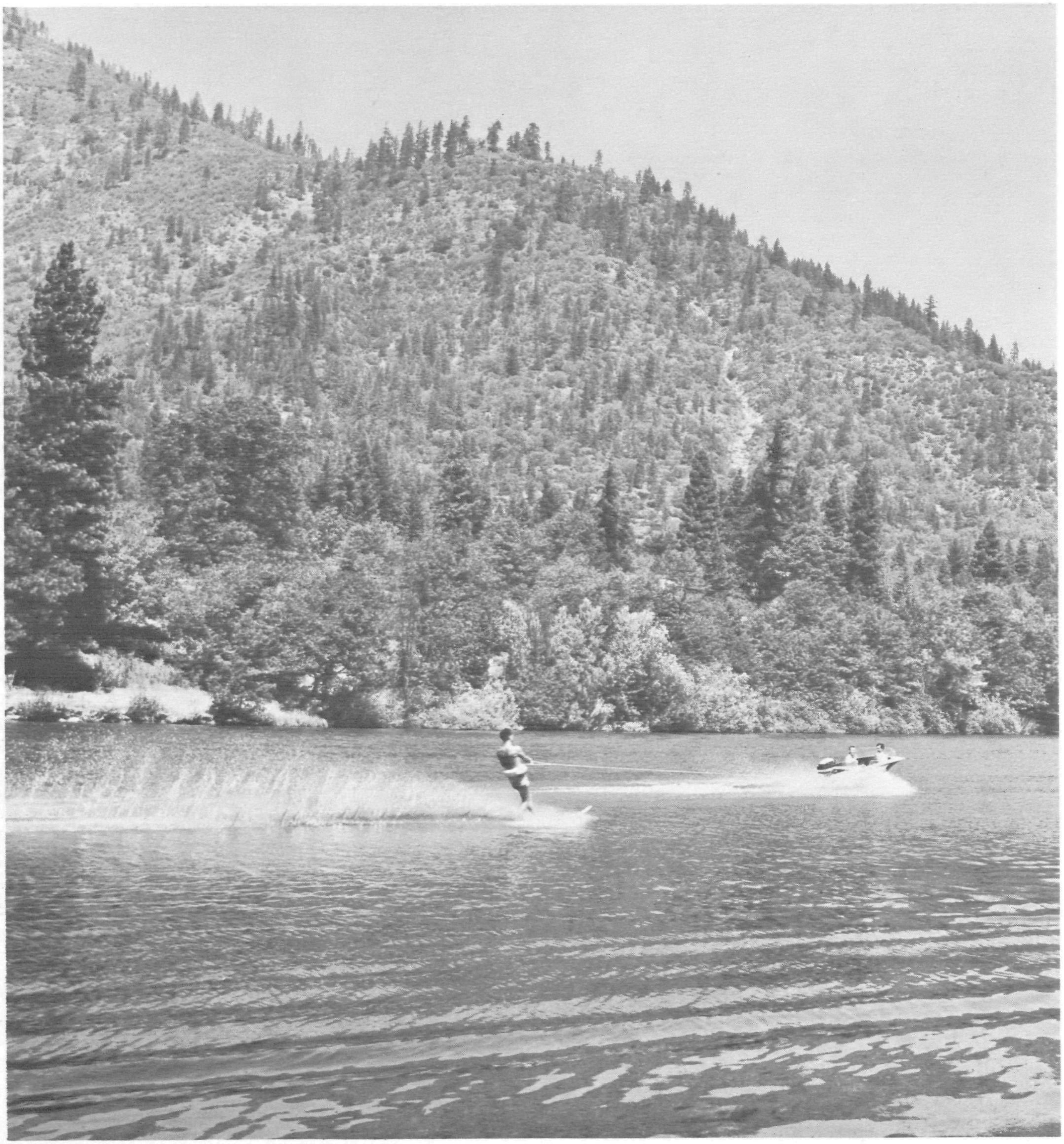


12. An unpolluted river, the Lochsa, exemplifies the scenic and recreational resources of the non-irrigation watercourses of the Snake River Basin.

Aesthetics

The importance of the aesthetic quality of water has been demonstrated by the inhabitants of the Snake River Basin who have concentrated beside the Snake River and a few major tributaries. All but two of the larger communities of the basin—Nampa and Mountain Home—are located along the banks of a river. The Snake River has historically been—and continues to be—the main east-west line of passage between the northern Pacific Coast and the regions of the Nation lying beyond the Rockies. Thus, those who live in the area and those who pass through it are constantly in view of water.

Intensity of water-based recreation, increasing prevalence of streamside residence, and ubiquity of the stream-bank park all testify to the growing appreciation of the importance of water's presence to the social well-being of the basin's inhabitants. The nature of the physical environment is recognized, locally as well as nationally, to be important in terms of community feeling, productivity, and personal satisfaction.



13. Water skiers enjoy the placid waters of Wallowa Lake, situated in the center of a vast recreational region east of La Grande. Swimmers and fishermen are also attracted to the lake. Nearby are picnic and overnight camping units, and in the towering Wallowa Mountains is the Eagle Cap Wilderness Area, which may be reached only by hiking or horseback.

WATER QUALITY PROBLEMS

Water quality problems exist in the Snake River system in the form of impaired uses of water or of potential uses lost because of degraded water quality. The most dramatic problem has been the loss to the fishery. Fish kills have occurred at Milner Reservoir in 1960, 1961, 1962, and 1966; at American Falls Reservoir; and in the Portneuf and lower Boise Rivers. In each case the cause has been a combination of inadequately treated toxic or oxygen-demanding wastes and low streamflows. The fishery has also been affected by occasional high water temperatures in the lower Snake, preventing the migration of salmon up the system for several weeks.

Other problems have been less intensive but have also resulted in impaired water use. For example, the City of Twin Falls was forced to abandon its Snake River water supply as a result of tastes and odors associated with decay of aquatic growths and other waste loads in Milner Reservoir. Bacterial contamination has also made water-contact recreation undesirable in several stretches of the river.

The most chronic problem in the Snake River is the damages caused by aquatic growths which break loose from the rocks or shallow stream beds and float downstream in rafts or sink in deep, slow-moving pools to create bottom oxygen demand. Irrigators have suffered increased costs and inconvenience when these dense masses of aquatic vegetation have interfered with water transmission, recreationalists have abandoned certain areas because of the disagreeable appearance of aquatic growths, and the fishery in American Falls Reservoir has been adversely affected by heavy algal blooms.

14. Milner Reservoir was the scene of recurring fish kills in the early nineteen-sixties, the result of the discharge of untreated industrial wastes, streamflow interruption by upstream storage reservoirs, and ice cover. Thousands of fish were piled in windrows on the banks or floated entangled in thick water weeds. Institution of primary waste treatment by potato processors provided a three-year relief from fish kills. But in the early winter of 1966 a fourth massive kill occurred.

Water quality problems in the Snake are best described in terms of the water quality standards which prescribe the criteria for each use and serve as a guide in defining problem areas. A detailed discussion of these criteria will not be presented in this report; a table in the appendix shows the specific levels of criteria required for each use in the Snake River.

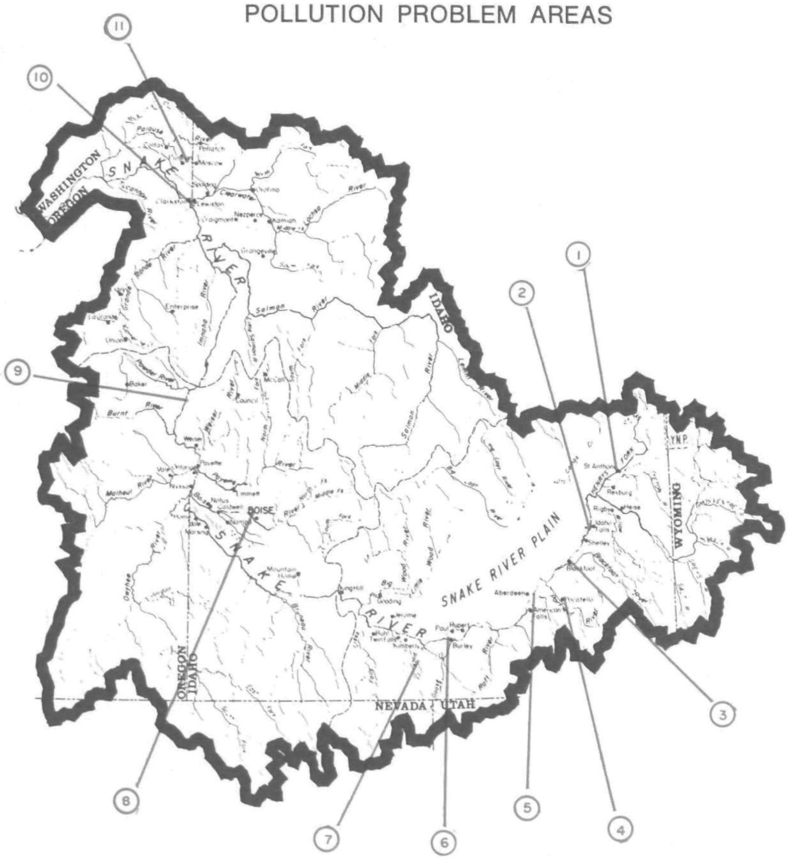
Dissolved Oxygen Depletion

Dissolved oxygen (oxygen held in solution in a given amount of water) provides the basic respiratory supply for most living aquatic organisms, including not only fish and other higher life forms but also the bacteria which consume organic matter. When oxygen levels are depleted, fish and other desirable organisms are inhibited or killed and the stream or reservoir can be converted into an odor-producing nuisance.

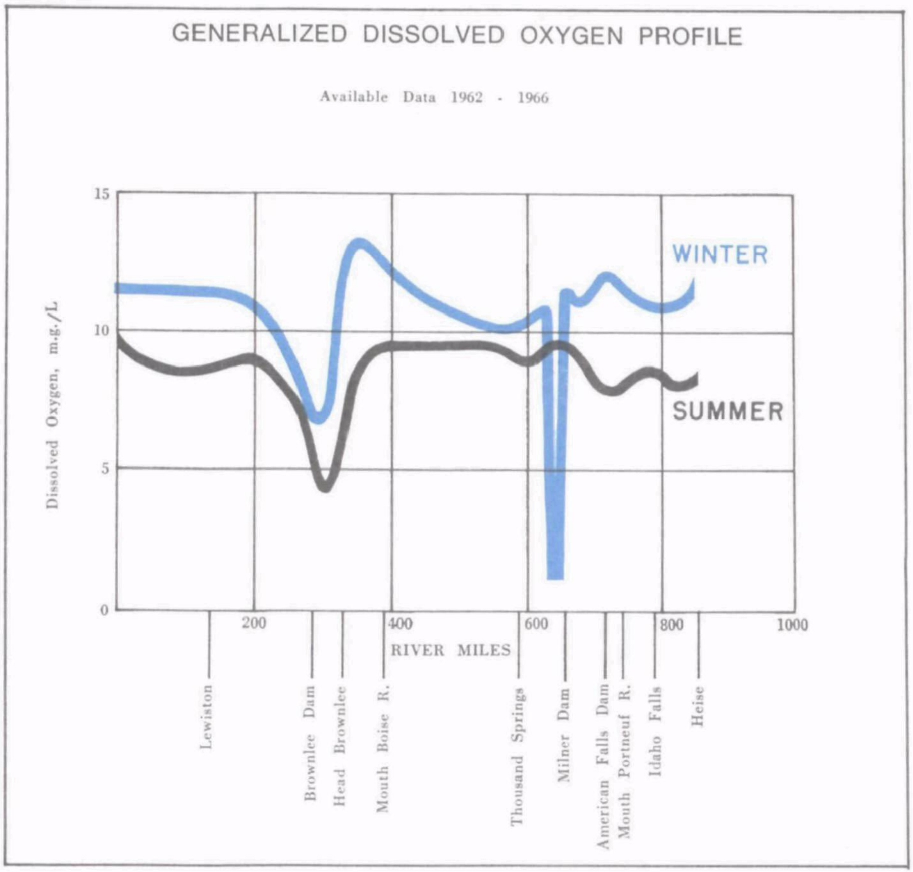
Instances of low dissolved oxygen occur intermittently in the South Fork Teton River and Henrys Fork below the Teton River; in the Boise River; and in American Falls, Milner, and Brownlee Reservoirs. A generalized dissolved oxygen profile of the main stem Snake under summer and winter conditions shows severe depressions occurring at Brownlee and Milner Reservoirs. The levels of oxygen are at times substandard (below 5 mg/liter) in other reaches of the lower river. Levels in irrigation drains and in the lower Boise River have approached zero. Fish kills have occurred in Milner and American Falls Reservoirs and in the lower Boise River because of depleted oxygen levels.

The principal causes of dissolved oxygen problems are the extreme low flows caused by the operation of storage reservoirs, by irrigation withdrawals, and by untreated or inadequately treated wastes. Because organic wastes also use up oxygen when they decompose, the small quantity of oxygen which exists under low flow conditions is quickly depleted; even with a high degree of waste treatment, enough water must be available to assimilate residual loadings to the stream. The principal source of organic wastes causing dissolved oxygen depletion is potato and sugar processing, but inadequately

POLLUTION PROBLEM AREAS



Problem Area	Problem Conditions	Causes
1. South Fork Teton R. and Henry's Fork below the Teton R.	Low dissolved oxygen (DO) High bacterial counts	Flow depletion due to irrigation withdrawals. Flow interruption due to diversion structure maintenance. Roger's Bros. potato wastes (Rexburg). Rexburg municipal sewage.
2. Snake River below Idaho Falls	Low DO. High bacterial counts	Streambed dried by irrigators withdrawing water prior to discharge from upstream reservoirs. Flow interruption due to diversion structure maintenance. Municipal and industrial wastes.
3. Snake River above American Falls Res.	High bacterial counts	Blackfoot municipal wastes.
4. Portneuf River below Pocatello	Low pH, high PO_4, sludge beds & high bacterial counts.	Phosphate processing by J. R. Simplot & FMO Co. Septic tank drainage. Untreated dairy waste. Flooded pastures.
5. American Falls Reservoir	Aquatic growths, DO. depression. High pesticide levels. High sediment concentrations.	High nutrient levels. Algal decomposition. Agricultural runoff. Residual waste loads.
6. Milner Reservoir	Low winter DO. High bacterial counts. Aquatic growths.	Municipal wastes—Burley, Heyburn. Food processing waste—J. R. Simplot, Ore-Ida Foods, A & P Streamflow depletion due to irrigation storage.
7. Rock Creek	Turbidity. High bacterial counts. Odor problems.	Amalgamated Sugar Co., feedlots, municipal wastes.
8. Boise River	Low DO. Sludge beds. High pesticide levels. High bacterial counts.	Municipal & industrial waste. Flow interruption for Lucky Peak Dam maintenance.
9. Brownlee-Oxbow Reservoir	Low DO. Aquatic growths. Odors.	Algal decomposition. Residual wasteloads.
10. Lewiston-Clarkston Area	High bacterial counts.	Inadequate municipal & industrial waste treatment.
11. South Fork Palouse River	High sediment concentrations. High bacterial counts. Low DO.	Low flows coupled with municipal waste discharge from Moscow and Pullman.



15. Organic sludge deposits, such as these on the Boise River below Notus, were common a few years ago, a result of the discharge of untreated wastes of food processing. Such sights have largely disappeared from the Boise River, but are not infrequent at other main stem Snake locations in the central basin.

treated municipal wastes contribute to the problem, as do decomposing aquatic growths.

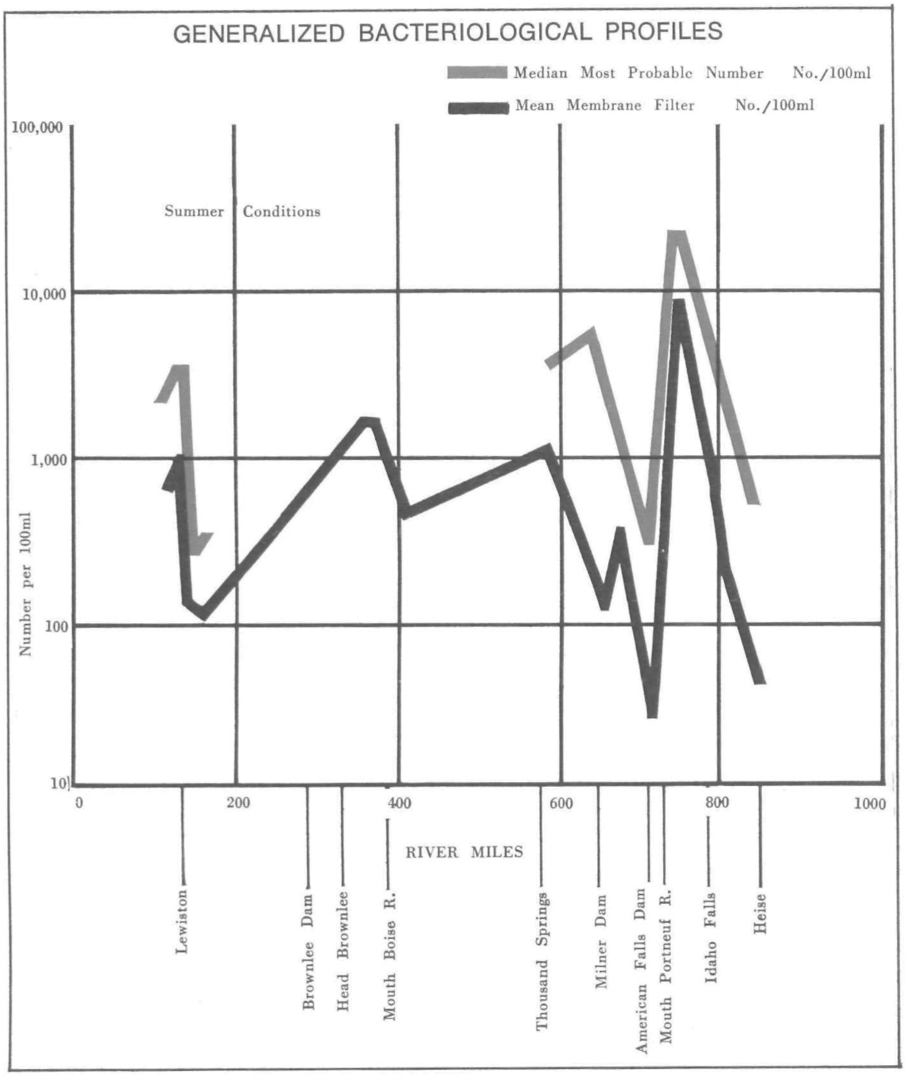
Bacterial Pollution

The coliform group of bacteria is used to measure the bacterial deterioration of water quality because these bacteria occur in the fecal matter of all warm-blooded animals, including man. Although these may also be found in plants or in the soil, their presence in a body of water is usually considered evidence of fecal contamination. Such contamination is an indication of a possible health hazard from accompanying pathogenic bacteria and viruses and restricts the use of that water for water-contact recreation or drinking water supplies.

In general, coliform densities below service areas or population centers in the Snake Basin are high enough that the water is considered unsuitable for water-contact recreation. High bacterial concentrations are found in the Burley and Idaho Falls-Shelley areas and in the central basin below the mouth of the Boise River. The Boise River has consistently displayed high bacterial counts. Generally, levels above 1,000 MPN are considered too high for water-contact recreation.

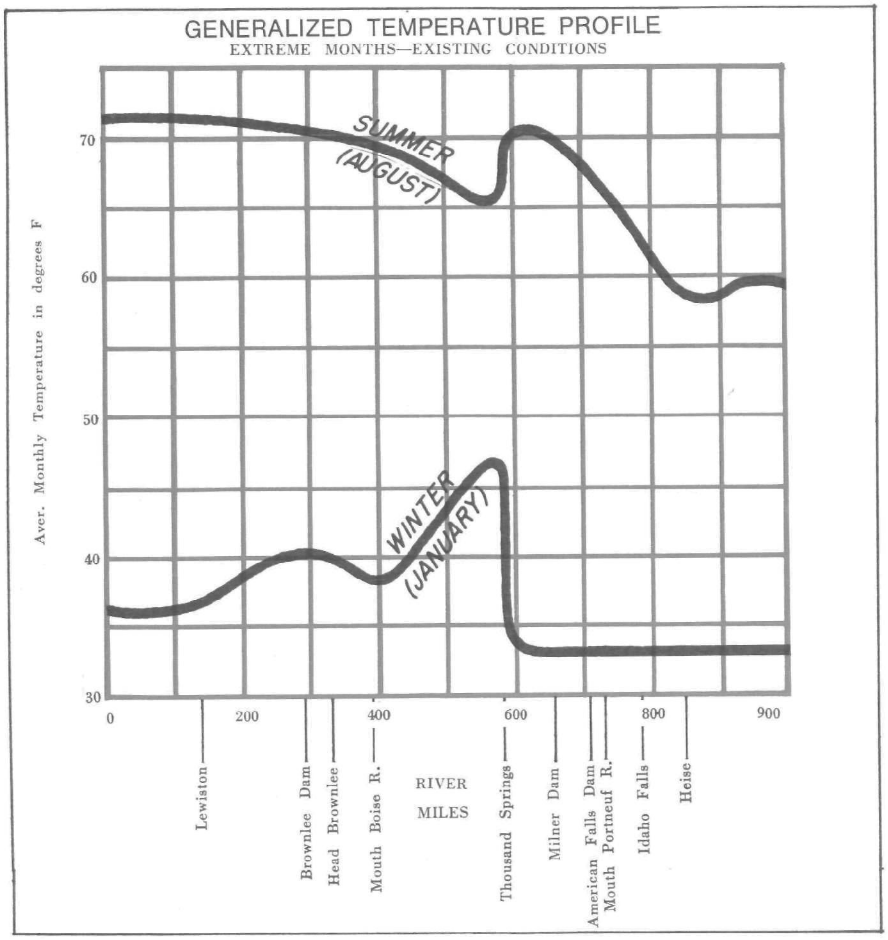
The cause of bacterial pollution in the Snake Basin poses a difficult problem of evaluation. Discharges of sanitary sewage are unquestionably responsible for many of the problems, particularly below population concentrations. However, a significant portion of the problem is derived from the large animal populations and from runoff from the heavily irrigated agricultural basin.

Animal populations are concentrated to the extent that their wastes exert a distinct effect on water quality in several stream reaches. Half of the basin's cattle are found within twenty miles of either side of the Snake and Boise Rivers in three areas: (1) along the Snake River between Lake Walcott Reservoir and the mouth of the Big Wood (Malad) River, (2) in the lower Boise River Valley, and (3) in the central basin between Adrian and the head of Brownlee Pool. In these three areas about 800,000 cattle—and significant num-



16. Thousands of beef animals are fenced into these fields outside Burley, Idaho. Drainage from lands containing such concentrated animal populations constitutes a significant source of water pollution.

bers of the other farm animals—are clustered in about 5,300 square miles. Their relative closeness to the rivers in areas laced with irrigation drains ensures that the wastes of these animals constitute a significant source of bacteria.



Thermal Pollution

Water temperature is critical to the anadromous and resident fisheries of the Snake Basin and to the aesthetic quality of many of the system's streams. Anadromous fish require relatively low temperatures to migrate, spawn, and develop; higher temperatures delay migration, accelerate disease, and generally reduce the survival rate of young fish. In addition, high temperatures stimulate the productivity of aquatic plants, act as a catalyst to algal blooms, and reduce the dissolved oxygen resource of the stream.

High temperature levels—above the 68° F. criterion set for anadromous and resident fish—exist in the central and lower main stem Snake River each summer. High water temperatures also plague the many reservoirs of the system, particularly Brownlee, where stratification occurs and top layers are thoroughly warmed by solar radiation. A most dramatic temperature problem occurred in the fall of 1967 when the Chinook salmon run remained in the cooler waters of the Columbia River at the mouth of the Snake for almost a month until temperatures in the lower Snake River dropped several degrees.

The cause of temperature problems is related to the impoundment of the free-flowing stream and the use of the system for irrigation. Flow depletion due to storage and diversion and the surface return of irrigation waters warmed on fields combine with solar radiation to increase temperature levels.

Disposal of cooling waters used in nuclear power generation may cause additional thermal pollution in the Snake River system. Battelle-Northwest has proposed the western side of American Falls Reservoir on the Snake River as a typical site for a nuclear power installation. The addition of any heat burden to this stretch of the river would raise water temperatures even higher during summer months.

Suspended Solids

Sediment and suspended solids result in turbid conditions which hamper fish spawning, recreation, and the aesthetic beauty of the river. In the spring, turbidity is particularly noticeable in the main stem in the lower basin and in lower basin tributaries such as the Palouse, Tucannon, and Asotin Rivers. During periods of high runoff, sediment concentrations reach objectionable levels throughout the basin. Inorganic materials are visible in the waters of the Portneuf River below the J. R. Simplot phosphate - processing plant near Pocatello and result in thick, unsightly bank and bottom deposits. In addition, irrigation returns are a summer source of localized turbidity.

Aquatic Growths

Perhaps the most characteristic water quality problem of the Snake River Basin is the excessive aquatic growths which detract from the beauty of the streams, clog irrigation canals, and eventually die, creating sludge deposits and oxygen demands. Thick blooms of algae make the waters of the upper and central basins a characteristic opaque green. Floating rafts of algae are prevalent on the surface of the Snake and form clinging slimes where they adhere to rocks and banks. As these growths die and decay, they release nutrients for new growths and become a principal source of oxygen demand in the basin. They cause a noticeable fluctuation in dissolved oxygen levels during night and day as the plants' respiration and transpiration processes alternate. An August 1967 fish kill in American Falls Reservoir was attributed to algal oxygen demand.

17. Aquatic vegetation manifests itself throughout the southern sweep of the Snake River in the form of rooted growths, uprooted and floating growths, algal slime clusters, and water of the color and seeming consistency of pea soup.

L. Walcott

The cause of these excessive aquatic growths is related to the high concentrations of basic nutrients—nitrogen and phosphorus— in the Snake system. The main sources of waste phosphorus in the basin are the J. R. Simplot Company and the FMC Corporation near Pocatello. Phosphate concentrations rise steadily through the upper basin, then jump enormously at the head of American Falls Reservoir, where the Portneuf River deposits these wastes. In addition, natural phosphate levels, irrigation return flows, municipal wastes, animal wastes, and the decay of aquatic biota all contribute to the nutrient balance which stimulates aquatic growths.

Another factor compounding the problem is the system of impoundments on the Snake River. When a free-flowing stream is changed into a series of pools, the aquatic environment becomes more susceptible to algae and other plant productivity. Temperature, stratification, and detention time all serve to increase biological productivity.

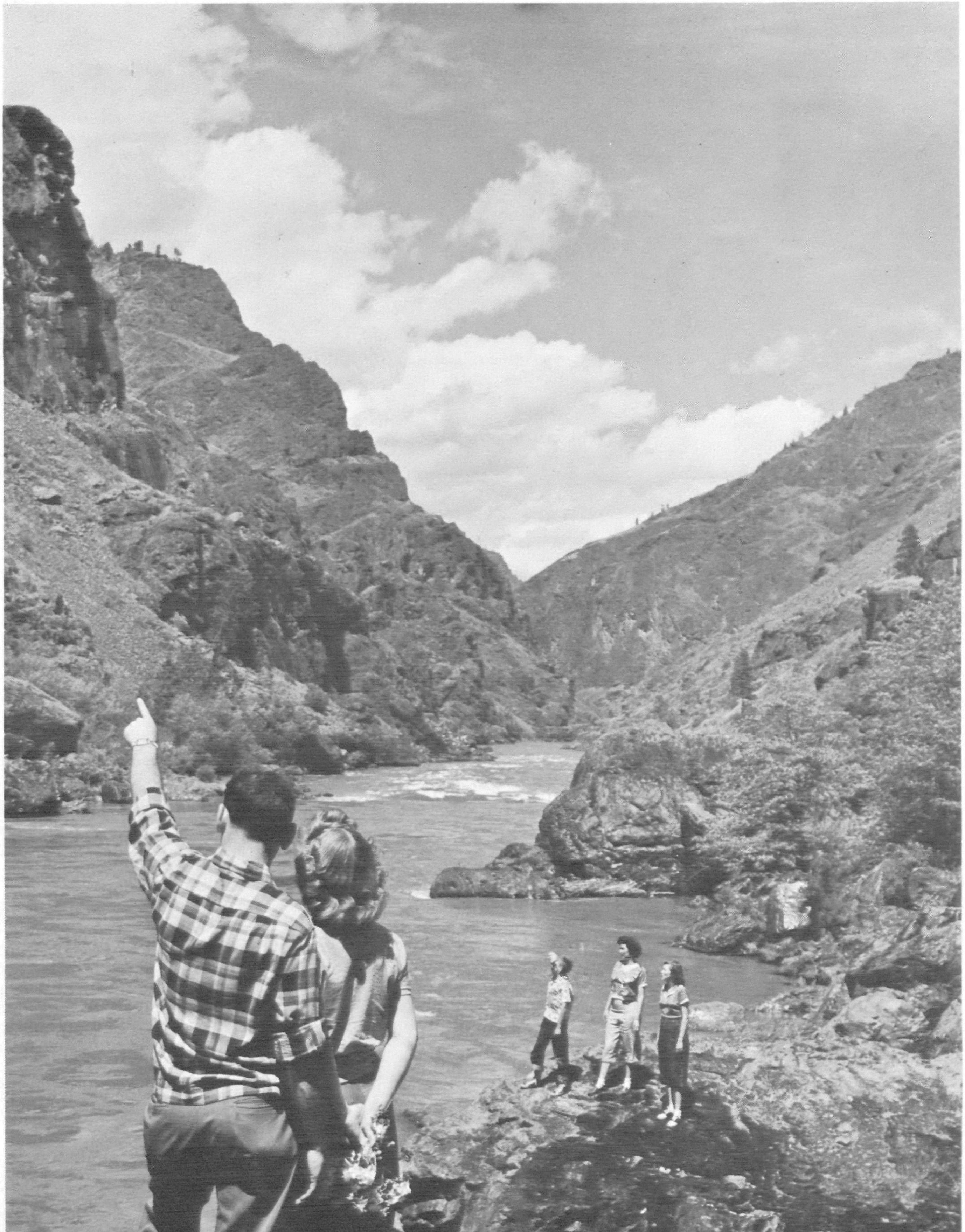
Toxic Substances

Toxics have resulted in intermittent water quality problems at several points in the basin. Highly acid waste discharges to the Portneuf River have been reported to result in a pH low enough to kill fish. A brief survey of incidence of pesticides in the Boise River by the USGS during the summer of 1965 showed that concentrations of dieldrin in the lower river were at a level generally intolerable to fish. Fall 1964 fish kills at C. J. Strike Reservoir were attributed to pesticides when chlorinated hydrocarbons were found in the fish. Dead fish in American Falls Reservoir in 1966 also showed lethal levels of pesticides. Thus the evidence that there is a continual, and not always sublethal, presence of pesticides in the waters passing through major agricultural areas of the watershed continues to accumulate.

Radioactivity

The Atomic Energy Commission's National Reactor Testing Station (NRTS) at Arco, Idaho disposes of low-level liquid radioactive wastes by discharging to ponds for seepage into the ground or by discharging directly to the ground beneath the NRTS. Since a major portion of NRTS lies within the ground-water recharge area for the Snake River Plain aquifer, the most productive aquifer in the United States and the largest ground-water reserve in the Pacific Northwest, the potential for ground-water contamination has concerned water resources agencies since the installation was established. The monitoring system maintained by the AEC has not shown dangerous levels of radioactivity in ground water except directly below the installation. The FWPCA has recommended, however, that injection of these wastes be eliminated to safeguard the ground-water reservoir—so vital to the State of Idaho and to the Pacific Northwest.

18. The National Reactor Testing Station near Idaho Falls is the world's largest and most advanced nuclear testing complex. The cooling towers shown are an example of adequate treatment of waste heat. Low level radioactive wastes at this station are injected directly into the ground water and could threaten the Snake Plain aquifer.



19. The use of high quality water extends beyond the bounds of physical contact with the resource. Here towering cliffs channel spectacular rapids and provide scenic enjoyment.

EXISTING POLLUTION CONTROL PRACTICES

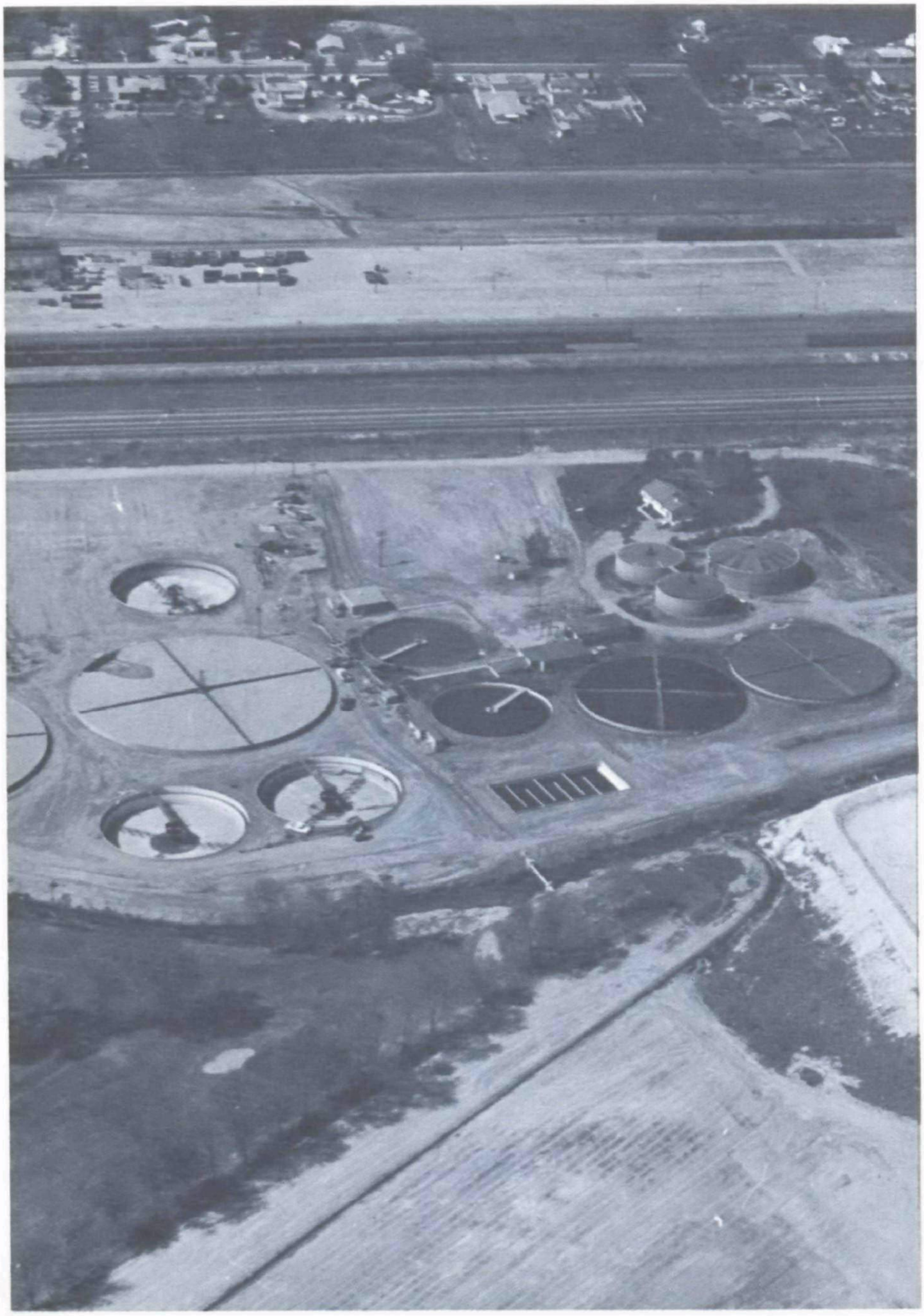
The existing programs to control water pollution in the Snake River Basin range from energetic state activities to Federal financial assistance to broad interagency planning. Primary responsibility rests with the state agencies; other programs are designed to offer assistance and provide capabilities beyond the scope of state water pollution control budgets. The following section summarizes the many activities directed toward abating pollution in the Snake Basin.

Waste Treatment

Cities, states, Federal agencies, and industries have exerted increasing efforts in recent years to control pollution in the Snake River Basin. Initially the principal pollution control efforts were made by cities and states in developing and improving facilities for the treatment of municipal wastes. As the industrial activities in the basin grew, industries joined in pollution control efforts. Three factors have led to the growth of treatment capabilities: (1) public awareness of the threat of water pollution has created a climate of opinion favorable to advancing waste treatment; (2) energetic activities of state agencies have provided the impetus for programs to control waste discharge; and (3) Federal construction grants have helped to make treatment plants available to communities.

Before 1954 the Snake River Basin was largely agricultural; the only points in the stream system receiving concentrated wastes were those at or below municipalities. After 1954, however , there was a rapid increase in industrial activities in the basin, with concurrent increases in population density and waste production. Consequently, more than half of the existing municipal treatment facilities were constructed after 1959. Between 1959 and 1965 the total population served with municipal waste treatment facilities rose from 88,000 to over 380,000. Although pollution was not entirely prevented by this energetic construction program, greater problems would have occurred in many more areas if action had not been taken.

Treatment facilities for industrial wastes also have been increased and



20. Under construction here, the Nampa, Idaho sewage treatment plant provides secondary waste treatment for the City of Nampa, for the giant Amalgamated Sugar Company refinery at Nampa (clarified wastes are piped through the conduit crossing Indian Creek), for the General Foods Company vegetable freezing plant, for the Western Idaho Potato Growers potato processing plant, and for several smaller food processing firms. The combined treatment facility achieves a considerably higher than average waste reduction efficiency while lessening construction and operating costs of waste treatment for all participants in its use.

improved in recent years. Industrial waste treatment has, for the most part, come into being since 1960 and, because of the complex nature of industrial wastes, lags somewhat behind municipal waste treatment. Through the combined efforts of state pollution control agencies and industries and despite the problems of having to develop new, specific treatment methods for potato, sugar and other food-processing wastes, the overall level of industrial waste treatment has risen rapidly. Although there are still problems to overcome, many technical obstacles to effective treatment have been solved with commendable competence and ingenuity by state and industrial personnel.

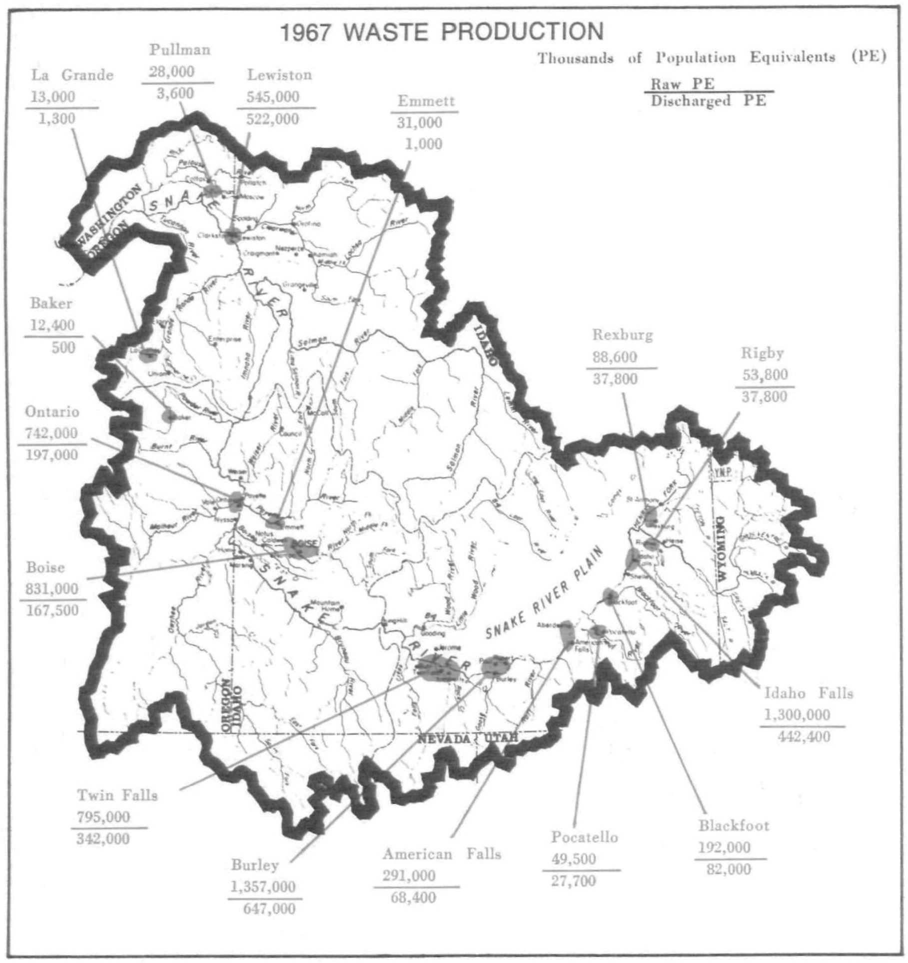
Total organic wastes generated in 1967 were equivalent to that produced from a population of 6.4 million people*; after treatment about 2.6 million population equivalents (P.E.) were discharged to the basin's streams—a reduction of almost 60 percent. Of the discharged load, over 90 percent or 2.4 million P.E. were from industrial sources, of which half emanated from potato processing. A summation of major waste loading sources by area can be found in the appendix. Seventy-five percent of the basin's discharged wastes occur in the Idaho Falls, Burley, Twin Falls, and Lewiston service areas.

Water Quality Standards

The concept of water quality standards is not a new idea to the Pacific Northwest states. Water quality objectives were established and adopted in 1952 by an interagency group, the Pacific Northwest Pollution Control Council. This group, consisting of representatives of both Federal and state agencies, established criteria for evaluating water quality requirements for the uses occurring in the Snake Basin. These criteria were revised in 1959, 1965, and 1966 to account for changes in water uses and waste loadings. The objectives provided the basis for the formulation of water quality standards as required by the Federal Water Pollution Control Act as amended by the Water Quality Act of 1965.

* Population equivalent equal to 0.17 lb.-5-day biochemical oxygen demand per person per day.

21. The Amalgamated Sugar Company's Paul, Idaho refinery achieves a reported waste reduction efficiency equal to that of secondary treatment through use of an ingenious system of primary treatment and waste water recycling.



The adoption of water quality standards by the Snake River Basin states is probably the most significant action taken in recent years to combat pollution. Water quality standards are composed of two parts: the criteria designed to protect present and future water uses of interstate waters through establishment of quality levels which must be maintained; and a plan of implementation which outlines the necessary pollution abatement procedures which will be taken within the next five years to ensure that these criteria are met on a continuing basis. In addition to pollution control programs for domestic and industrial wastes, the implementation plans have recognized other pollution problems such as combined sewer overflows, agricultural waste waters, vessel and marina pollution, animal feedlots, land erosion, and mine drainage. As an added impetus to the standards program, the Secretary of the Interior and most states have instituted a basic policy requirement for all water quality standards which states that the highest and best practicable treatment available under existing technology will be applied for all sources of pollution. In addition, the Secretary has stated that all standards will contain an anti-degradation provision which ensures that interstate waters whose existing quality is better than the established standards as of the date on which such standards became effective will be maintained at that existing high quality. These very important considerations will ensure a forward-thrust program of pollution control and tend to enhance the quality of our water resources.

Water quality standards for Idaho, Oregon, Washington and Nevada have been substantially approved by the Secretary of the Interior. Standards for Wyoming and Utah are currently under review by the Secretary. Once the standards are accepted by the Secretary, they become Federal as well as state standards.

As part of the formal adoption procedure, public hearings were held in each state to solicit public view of the proposed standards and to enlist the support of various citizen groups and public agencies for established water uses and criteria. Comments and suggestions from these groups and other Federal agencies were incorporated into each water quality standards package. A copy of the complete set of each state's water quality standards is available to the public upon request from the following state agencies: Oregon State Sanitary Authority, Washington Water Pollution Control Commission, and the Idaho State Board of Health.

Minimum waste treatment requirements calling for secondary treatment of all municipal wastes and secondary treatment, or its equivalent, of all industrial wastes have been established in all water quality standards for the interstate waters of the Snake River Basin. The plan of implementation emphasizes that such degree of treatment will be placed in operation at the majority of projects by 1972. Waste treatment needs for the basin and established time schedules for meeting these needs as outlined in the state water quality standards implementation plans are summarized in the appendix.

FWPCA Activities

The Federal Water Pollution Control Administration has provided assistance in the pollution control activities in the Snake River Basin. The Administration, as directed by Congress in the Federal Water Pollution Control Act, is dedicated to a strong program of pollution control and abatement throughout the Nation. The Pacific Northwest Regional Office of the Administration provides these functions in the Snake River Basin. A description of the actions taken by the Regional Office to control pollution in the Snake River Basin is provided below.

Construction Grants

With the enactment of the Federal Water Pollution Control Act, revised in 1965, the Federal government provided for a Federal sewage treatment works construction grants program to help finance the building of local sewage treatment plants. The Federal government recognized that wastes discharged from municipal sewers are one of the major causes of water pollution. The rapid growth of population and its continuous trend toward urban centers have resulted in a tremendous increase in the volume of such wastes.

Since the 1956 Act, a total of 111 Federal grants have been made in the Snake River Basin to help communities build needed sewage treatment facilities. Grant funds involved in these projects have totaled over $6 million in support of total eligible project expenditures in excess of $21 million. Almost three-fourths of the 111 grant projects have already been completed and placed in operation. The remaining projects are either under construction or preparing to go under construction in the very near future.

The construction grants section of the Federal Act has been amended three times since its initial passage in 1956. The trend of financial assistance has provided greater flexibility and broader coverage each time the Act has been amended. Today's legislation allows municipalities to qualify for a basic Federal grant of 30 percent of the eligible cost of a project. A grant of 40 percent can be made in those states which agree to match the basic 30 percent Federal grant. The Federal grant may be increased to 50 percent if the state agrees to pay at least 25 percent of the project cost and if enforceable water quality standards have been established for the waters into which the project discharges. A grant may be increased by 10 percent—to 33, 44, or 55 percent, as appropriate—if the project is certified by an appropriate metropolitan or regional planning agency as conforming with a comprehensive metropolitan area plan.

The States of Washington and Oregon have enacted legislation to qualify their municipalities for consideration for the higher Federal grant percentages. The State of Idaho has not yet considered cost-sharing legislation to achieve higher Federal grant percentages. Oregon and Idaho have provisions for tax allowances on waste treatment facilities.

Program Grants

Section 7 of the Water Pollution Control Act authorizes an appropriation of $10 million annually for fiscal years 1968 through 1971 for grants to state and interstate agencies to assist them in meeting the costs of establishing and maintaining adequate pollution control programs. Each state is allotted $12,000, and the remainder of the funds is distributed on the basis of population, financial need, and the extent of the water pollution problems facing the state.

By June 1968, the fiscal 1968 allocation to states of the Snake River Basin totaled $255,886, distributed as follows: Idaho, $41,337; Oregon, $91,445; Washington, $123,104.

Research and Demonstration Grants

The Federal Water Pollution Control Act authorizes the Federal Water Pollution Control Administration to conduct research directed toward controlling water pollution problems. It also provides for grants to public or private agencies and individuals demonstrating new and improved methods of water pollution control.

Major water quality problems in the Snake River Basin have been attributed to the large waste loads discharged by its many potato-processing plants. Federal research and demonstration grants have, therefore, been aimed at new methods of providing treatment for such wastes.

The FWPCA Pacific Northwest Water Laboratory at Corvallis has been participating in pilot plant studies for the secondary treatment of potato wastes at Burley, Idaho for the 1966-67 and 1967-68 potato-processing season in cooperation with the State of Idaho and the Idaho Potato Processors Association. This research is aimed at demonstrating successful secondary treatment of potato wastes through primary treatment and either completely mixed anaerobic lagoons followed by mechanically aerated lagoons in series or mechanically aerated lagoons alone.

The demonstration grant program is also involved in the problem of potato wastes through a grant to the R. T. French Company for demonstrating full-scale aerobic secondary treatment of potato-processing wastes with mechanical aeration. The grant of about $480,000 of the $700,000 total cost will cover two years of operation. It is hoped that the study will demonstrate aerobic biological treatment of potato wastes, develop

22. Sediment control structure in small draw, Flagstaff watershed improvement project, Wallowa-Whitman National Forest. By means of sharp-crested weir and crest gage, peak water flows can also be calculated. Extensive contouring and grass seeding has been done in this area to reduce surface runoff, erosion, and stream sedimentation.

design criteria for such treatment plants, and establish construction and operation costs.

Further research on potato wastes might include methods for secondary treatment of potato starch plant wastes and treatment of solids resulting from secondary treatment plants developed for potato wastes.

Other research applicable to the Snake River Basin should include the study of wastes from feedlots, water quality impacts of irrigation return flows, and water quality aspects of algal ecology.

Interstate Enforcement Actions

Despite efforts by cities, states and industries to control and to prevent pollution, serious pollution problems, as described previously, have developed in the basin. Increased efforts to combat these problems have stimulated increased involvement of the Federal government in pollution matters of the basin. Significant elements of the involvement include the calling of a "Conference in the Matter of Pollution of the Interstate Waters of the Snake River and its Tributaries (Idaho-Washington)," on January 15, 1964.

Results of the conference were increased awareness of the need to correct pollution-creating problems in the Lewiston-Clarkston area and the development of a plan of action to correct the existing pollution. Ensuing action led to some improvement in waste treatment practices and plans to improve other practices when the Lower Granite project is completed.

Federal Installations

There are over 800 Federal installations in the Snake River Basin, ranging from a complex industrial-research operation of the Atomic Energy Commission to Forest Service campgrounds and local post offices in small towns. Wastes from these installations have a significant impact on the water quality of the Snake River Basin. Under Executive Order 11288, these installations have been ordered to literally clean house as an example to others in the basin and to the rest of the Nation. The Order directs each agency to present to the Bureau of the Budget each year a phased and orderly plan that shows measures and facilities needed by the agency to correct or prevent pollution. These plans are reviewed by the FWPCA and project priorities are established on the basis of the severity of the pollution problem in regard to legitimate water uses, enforcement actions, and applicable water quality standards. Secondary treatment or its equivalent is the minimum treatment that is acceptable under the order for all projects.

Other Federal activities must also comply with Executive Order 11288 to reduce pollution from such activities to the lowest practicable level. The head of each Federal department, agency, or establishment must conduct a review of loan, grant, and contract practices of his own organization to determine what water pollution requirements set forth in the order must be met by borrowers, grantees, or contractors. As a result of such reviews, pollution control practices are incorporated in many programs involving Federal participation. Urban renewal projects now require the construction of separate storm and sanitary sewer systems rather than combined sewers. The nationwide highway construction program, financed with Federal funds and administered by the Bureau of Public Roads, is now being conducted in accordance with practices aimed at preventing water pollution either during construction or during periods of operation and maintenance. The various agencies consult with the Federal Water Pollution Control Administration in an effort to ensure maximum consideration of water quality in their activities.

Public Information

The public information program of the Federal Water Pollution Control Administration is designed to present facts about water pollution control to the news media, interested groups and organizations, and the public in general. The program serves the public's right to know what the FWPCA is doing and trying to accomplish. It also serves those who need particular information in order to participate effectively in water pollution control programs.

Planning

Under the Water Pollution Control Act, the Secretary of the Interior is charged with the responsibility of preparing comprehensive programs in cooperation with the states to eliminate pollution of interstate waters. Under the direction of the Secretary, the FWPCA has been conducting studies in the Snake Basin to develop a program to delineate water supply and water quality requirements for the present and the future.

The FWPCA also has the responsibility of participating in the Water Resources Council Task Force Study of the Columbia-North Pacific Region. Such participation adds to the awareness of all Federal and state agencies concerning water quality and pollution control problems and the importance of water quality control in the planning of land and water resource development projects.

Since enactment of the flow regulation amendment to the Federal Water Pollution Control Act in 1961, over 20 construction agency projects have been reviewed by FWPCA in the Snake River Basin. Each has been examined for its water quality regulation capability and/or its diversionary and land waste impact on water quality. A list of potential reservoir developments can be found in the appendix.

Most recently, the FWPCA has been involved with other bureaus and offices of the Department of the Interior in studying the resources potential of the Middle Snake River. The study included several alternative hydropower dam and reservoir sites, including High Mountain Sheep, Appaloosa, and Pleasant Valley. Each alternative was evaluated to determine its beneficial and detrimental effects on all water uses.

Surveillance

In addition to the water quality data collected under programs of the state pollution control agencies, the U. S. Geological Survey, the agencies of the Department of Agriculture, the state and Federal fishery agencies, and the colleges and universities, FWPCA has maintained monitoring stations on the Snake River at Payette in the central basin and at Wawawai and Ice Harbor in the lower basin and has made several seasonal surveys to identify water quality conditions, waste sources, and corrective measures required to achieve desired water quality.

Other Federal Programs

Financial Assistance

In addition to construction grants made available through the FWPCA, other Federal agencies assist states and local communities in funding for facilities to handle domestic wastes. The Department of Housing and Urban Development is able to make loans for water and sewer facilities; the Department of Commerce can provide grants and loans for public works in economically distressed areas; and the Farmers Home Administration can provide grants and loans for water supply and waste treatment and disposal systems for rural communities.

23. Automatic water quality monitors, maintained by the FWPCA, provide a continuous record of such criteria as dissolved oxygen and temperature. The most recent installation in the Snake Basin has been at Milner Reservoir.

Land Management and Construction

One of the undesirable impacts on water quality is production of sediment and resultant turbidity from construction activities such as those of the Federal Highway Administration, Bureau of Public Roads, Department of Defense, Bureau of Reclamation, Forest Service, Soil Conservation Service, and other agencies involved in disruption of the surface soils. Guidelines have been developed by each agency to control production of unwanted sediment. Executive Order 11288 requires agencies involved in construction activities to prevent pollution from their activities.

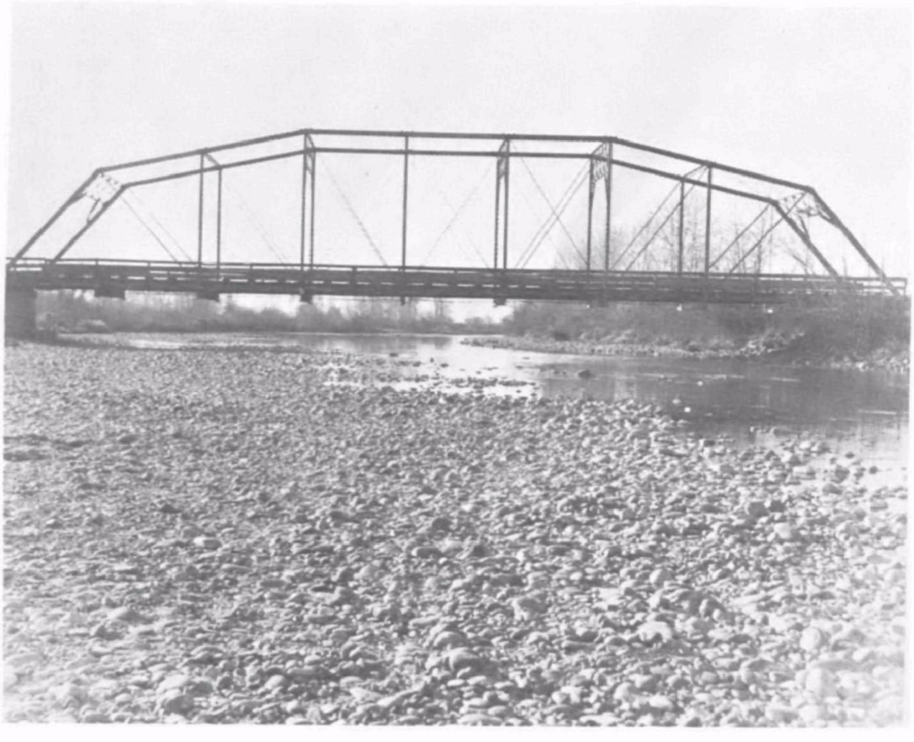
Even more significant in the Snake Basin are the effects on water quality resulting from management of land and water resources under Federal ownership. Since about 67 percent of the basin is owned by the Federal government, the responsibility, also covered by Executive Order 11288, of taking the lead in improving water quality through better management rests in Federal hands. The various land management agencies have developed required treatment and management procedures to reduce the impacts on water quality from land runoff.

A few examples of ongoing programs typify the concern of land management agencies for water quality. The Agricultural Research Service has a watershed study on Reynolds Creek designed to identify the meteorological, soil, water, and management relationships. In addition, a laboratory facility is located at Twin Falls to research soil, water, and plant relationships. Two areas of concern are the high sediment yields from erosion of the Snake Plains in the upper and central Snake basins and the Palouse soils in the lower basin, which are the subject of studies by the Agricultural Research Service, Soil Conservation Service, Agricultural Extension Service, and Washington State University at Pullman, Washington. Because of the large percentage of rangeland, erosion control by reseeding, grazing control, removal of brush by herbicides and road building practices of the Forest Service and Bureau of Land Management are important. The Vale Project, under the sponsorship of the Bureau of Land Management, is a good example of developing a system involving irrigation to provide vegetation for soil stability as well as for forage for both domestic animals and wildlife.

The Corps of Engineers provides specifications in construction contracts to minimize adverse effects on water quality and fishlife. The Bureau of Public Roads under the Federal Highway Act of 1966 has developed, with the assistance of the Soil Conservation Service, guidelines for minimizing erosion effects on streams, lakes, and reservoirs. Most of the basin is included in soil and water conservation districts, and there are five small watershed projects completed under P.L. 566 with Soil Conservation Service sponsorship; many more are in various stages of planning and investigation.

REMAINING NEEDS

24., 25. The Boise River in spring and in winter: the point is immediately below the City of Boise, a major waste source. Contraction of winter flows as a result of upstream reservoir storage and dam maintenance has been a prime cause of stream pollution.



Many actions—both state and Federal—have already been taken to abate pollution in the Snake Basin. Other actions are planned and will be made effective through the state implementation plans which require secondary treatment of all municipal and industrial wastes by 1972. These actions will certainly improve water quality in most problem areas. But these programs are directed principally toward one phase of water pollution control—waste treatment. And waste treatment alone will not solve the existing or future problems of water quality in the Snake Basin.

The need that remains is an action program, instituted by the state and Federal governments as partners, which will guarantee minimum streamflows necessary to maintain the water quality required for full utilization of the water resource.

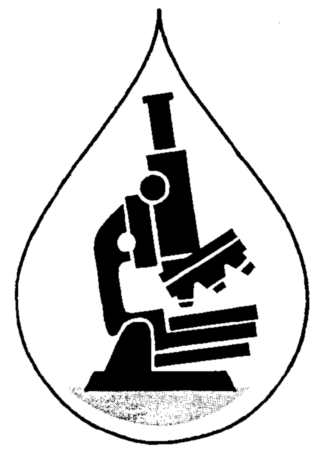
This chapter describes the essential elements of such a program. It enumerates how present use and management have denied the necessary minimum flows; it prescribes the adjustments which must be made to accommodate all water uses; it recognizes some of the difficulties in making these changes; and it details other measures required for present and future water quality maintenance.

Streamflow Management Program

Flow management is the key to any meaningful program for present and future water quality control in the Snake Basin because the river is intensively developed and highly regulated by impoundments. Minimum streamflows are essential for maintaining water quality even with a high degree of waste treatment. Secondary treatment can be expected to lessen oxygen demand from organic materials by 85 percent or more with reductions nearing 100 percent achieved with some methods of advanced waste treatment. But even if the wastes are provided complete treatment, including removal of nutrients, minimum streamflows will still be required to assimilate residual waste loads and other organic loads from uncontrollable sources.

Water quality has been largely neglected in the operating regimen of the present regulatory system. Requirements for irrigation, power production, and local flood control have generally been met without reference to possible effects on water quality. Consequently, radical alterations have been imposed on the natural flow pattern of the Snake River system with two significant detrimental effects on quality: winter flows are sorely diminished as reservoirs are filled for the irrigation season; and summer flows are radically depleted at points below irrigation diversions.

The history of development and economic growth in the Snake Basin has centered in the use of the river for irrigation and power production. The laws and the customs founded on this heritage have established management and regulation practices which use the river for these purposes. Early reservoir operation schedules, established before the expansion of water resource development and before the technology of predicting low flows had advanced, were designed to fill reservoirs early in the winter as insurance against unexpected low flows in the spring. Spring flows were then spilled during most years. But while the science of forecasting drought flows by use of computers has advanced and while water uses patterns have changed, bringing recreation, fisheries, and aesthetic enjoyment into prominence, the old laws and customs of operation remain. Although the importance of irrigation and power as present and future cornerstones of the Snake Basin economy cannot be minimized, water management programs cannot be dedicated solely to these uses. The continued expansion of the Snake Basin economy will depend on the full utilization of its water resource.



What is needed is a management program, supported by legislative changes, which recognizes the need for, and the value of, minimum stream flows for water quality maintenance.

Such management programs are already being explored by the Idaho Water Resources Board, the State Reclamation Engineer, and the Idaho Department of Health. Under the proposed network analysis, water quality needs would be considered along with other water needs. It is particularly appropriate that Idaho take the lead in developing a management program for the Snake since most of the basin is within that state and since the impoundments so critical to the management system are all in Idaho. The responsibility of developing a program, however, does not rest entirely with the State of Idaho. Federal agencies, in particular the Bureau of Reclamation and the FWPCA of the Department of the Interior. are in a position to lend valuable assistance to the State's efforts. The Bureau of Reclamation controls most of the existing reservoirs in the basin and is planning much of the future development; and the FWPCA has been closely involved with water quality maintenance in the Snake since 1962. Coordination and cooperation among these and other state and Federal agencies is essential to formulate and establish a new streamflow management program for the Snake Basin. The new program will require changes—changes which will lead to better and more efficient use of the water resource.

Changes in Operation and Maintenance Schedules

The quickest and most economic means of providing minimum flows for water quality maintenance is to change present reservoir operational procedures. Under present levels of water resource development and waste loadings, minimum required flows could be maintained in most problem areas by simply altering reservoir filling schedules to allow base flows to pass during the fall and winter. The reservoirs would not fill as quickly but, nevertheless, would fill with spring flood waters that normally are allowed to spill.

Specific operating criteria—a systematic scheme which considers water quality in operational schedules—must be established to minimize wasteful spillage. The techniques to forecast flow patterns are developing rapidly and can be applied to reservoir operation in the Snake Basin. The Idaho Water Resources Board, the Bureau of Reclamation, and the FWPCA are all working on models, adaptable to the computer. which will better define the river's flow and drought probability and relate streamflow, wasteloadings, and water quality. Use of such tools will permit a more systematic operation of existing reservoirs to serve all uses within the annual water budget. Past flow records show the value of improved operation. In the last twelve years of record, including several moderately dry years, flows passing Milner Dam have been more than adequate both to maintain water quality and to furnish the allocated irrigation water. But because of present regulation, these flows did not occur on the required time schedule and spring flows were wasted as they spilled over upstream storage reservoirs. If some flow had been allowed to pass upstream reservoirs in the fall and winter, spring flood flows would have filled the reservoirs, thus providing for both instream and withdrawal uses.

Reservoir maintenance and coordination of reservoir releases and diversions are other management practices which have prevented stream flow maintenance. When flows are cut off so structures may be repaired, water quality suffers drastically. If large diversions are made before the released water reaches the point of diversion, flows are also interrupted. Both practices must be changed as part of a management program to maintain flows for water quality.

Provision of minimum flows for quality through operational and maintenance changes in existing reservoirs is particularly appropriate to Milner Pool and the lower Boise River. In neither case is it necessary, under present conditions, for water to come from storage; sufficient flow is available in all but the most critical years with prudent water management above Milner Dam and with physical alterations to Lucky Peak Dam to allow passage of flow past diversions in times of maintenance. Streamflow regulation requirements also exist in the Snake River above American Falls Reservoir and on the South Fork of the Teton River. In both streams, water quality has been degraded when flow was interrupted for maintenance of diversion structures or when large scale irrigation diversions have occurred before upstream storage reservoirs began their release. In all of the problem areas, alteration of schedules and procedures in a manner that would recognize water quality requirements would do much toward correcting the problem.

Changes to Conserve Irrigation Water

The second element of the proposed management program for the Snake, and perhaps of equally high priority as the first one, is conservation of irrigation water. Streamflows for water quality can be substantially increased by improvement of irrigation conveyance systems and methods of application to reduce excessive diversions and to promote more efficient use on the fields.

During the 1965 irrigation season, diversions by the upper Snake Basin's 62 irrigation companies amounted to 6.55 million acre-feet of water—an average of 6.5 acre-feet per acre. The maximum withdrawal per irrigated acre was 15.7 acre-feet and the majority of irrigation companies used more than the average application. Even considering the substantial losses that often occur in transmission, these figures are inordinately high. Experience elsewhere indicates that when careful application and transmission procedures are used, ridge and furrow irrigation on the soil types that exist in the basin should require withdrawals of no more than 4 to 4.5 acre-feet per acre and sprinkler irrigation should require even less.

Irrigation withdrawals of these dimensions contribute to water quality degradation for at least two reasons: they unnecessarily deplete the stream; and they cause significant increases in sediment, mineral, and nutrient loads. Such diversions reflect again the customs that developed when there was plenty of water and few competitive uses in the Snake Basin, thus allowing the use of water without regard to the requirements of other users. The increasing water resource development in recent years and the development of recreation and tourism as important industries necessitates changes to reduce losses in canals and ditches and to promote better and more efficient application of water to the land—if less water needs to be withdrawn from the stream, more water is available for these other expanded uses.

26. Ridge and furrow irrigation methods are the norm in Snake Basin agricultural areas. When compared to sprinkler irrigation, the practice is wasteful in its use of water, facilitates erosion, and promotes leaching.

27. Sprinkler irrigation is being used on at least half of the lands currently being brought under irrigation in the Snake River Basin. Though equipment costs are high, over-all costs are less than those of ridge and furrow methods in cases where pumping costs for water deliveries are significant. The method is to be preferred, too, for its effect in conserving water and by reason of the lesser damage to water quality it inflicts.

Present regulation of diversions can be improved by complete gaging of all diversions. Conveyance systems should guarantee that the gaged withdrawal is delivered to the farmer and not lost enroute through evaporation and seepage. To reduce such losses, canals should be lined or closed system transmission and pipelines should be substituted for open canal systems.

Application of the water to the land is equally important to its efficient use. The fact that a few of the larger, newer irrigation projects in the basin have been extremely economical in their use of water is significant. These projects employ the use of sprinkler methods of application. While the cost of sprinkler equipment has retarded the widespread adoption of this method by established irrigators, it has notable advantages that have led to its use on newly irrigated land. Careful sprinkling obtains equivalent yields with a third less water than ridge and furrow application, a method practiced by about 80 percent of the basin. Sprinklers can be used on hillsides and broken country while ridge and furrow irrigation requires a gentle, regular gradient. And perhaps most importantly, sprinklers minimize leaching and reduce the amount of eroded material, nutrients, and bacteria that find their way to the streams due to land overflow or runoff.

As the Snake Basin adjusts to the changing times and a diverse economy, the conservation of irrigation water occupies a critical place in the order of requirements for maintaining minimum streamflows for water quality in the Snake system.

Changes in State Water Laws

Modification of the reservoir management system of the upper Snake River to provide minimum streamflows for water quality has been proposed as an economical and reasonable solution to many of the Snake's water pollution problems. Yet these changes conflict sharply with prevailing interpretations of the western water rights doctrine and Idaho's water law.

Idaho's water law traces to an 1881 irrigation enactment of the territorial legislature that largely expresses an underlying assumption that water is basically an agricultural-industrial tool. All surface and ground waters are constitutionally defined to be public waters and the constitution provides ". . .that the right to divert and appropriate the unappropriated waters of any natural stream to beneficial uses, shall never be denied . ." Beneficial uses recognized by the constitution are domestic, mining, agriculture, and milling—having that order of priority of allocation established in the event of shortage. Power is recognized as a non-withdrawal use.

Clearly the constitution does not recognize the establishment of instream water rights for water quality as beneficial. As late as 1965, in an Act establishing the Idaho Water Resources Board, the statute reads: "Subject to the primary use of water for the beneficial uses now or hereafter prescribed by law, minimum streamflow for aquatic life and the minimization of pollution shall be fostered and encouraged and consideration shall be given to the development and protection of water recreation facilities." The implication is that if there is plenty of water to satisfy all beneficial uses listed, minimum flows for water quality will be encouraged.

Like the reservoir operation and maintenance schedules and the inefficient use of irrigation water, this water law reflects the past. It should be modified to recognize the necessity of minimum streamflows for instream uses and the water quality needed to support those uses.

Such a modification will not be easy, but without the change there is not now, and never will be, any assurance that the Snake will remain a river in the true sense of the word. No matter how much holdover storage is developed to provide flow for instream uses, that flow could be appropriated and removed, leaving the stream dry.

The change in the Idaho water law to recognize instream uses as beneficial uses of water and to permit the establishment of firm, undeniable base flows is the third element of the basin's proposed water management program, giving legal basis to the other changes prescribed. But while the modification of the law will require time—time to inform the people and their representatives of the need and impact of the change or the consequences of no change—other uses must be served through management. The right to the use of water does not mean that the use cannot be regulated so other users can benefit from the same water resource.

Changes in Public Attitude

By far the most important task in establishing a new management program for the Snake water resources is convincing the people of the basin that changes are essential to their present and future economy and that the proposed changes will not damage or inconvenience their present activities. It is easy to understand the concerns of irrigation and mining interests to whom water is so necessary for existence; these industries, along with power, have made the Snake Basin what it is today. The purpose of the proposed management program is not to sacrifice these uses—ample water will be made available to serve and expand these cornerstones of the Snake's economy. But the people involved in these same industries must recognize the shifting emphasis in water use patterns and relationships and the importance of these new uses to the basin's present and future well-being.

In recent years, the basin has supported runs of various species of fish which, combined annually, contribute over 8 million pounds of commercial fish and over 2.7 million angler days of sport fishing; these uses will expand with establishment of minimum flows. Recreation, particularly in the upper basin, is becoming bigger each year—and it will one day be a major resource in the region if water quality is maintained. And most important, people and industry are coming to the basin, attracted either by the aesthetic qualities of the region or by the availability of water.

The opportunity—and the challenge—is offered to the people of the Snake Basin to guide the course of intensifying uses as the economy undergoes expansion and change. If the basin economy is to grow without the burden of growing water pollution problems, the people and their representatives in government and industry must adjust their attitudes which put water as basically an agricultural - industrial tool. They must recognize that a management program which accommodates the full utilization of the water resources, minimizing waste and inefficiency, will not only make the expansion of instream water uses possible but will also improve withdrawal uses, increasing the potential for future development.

Achievement of good water management and the flows needed to support all uses can only succeed with the support of the people, fully informed and aware of the basin's problems and their solutions.

Changes With Future Water Resource Development

Future regulation, developing to a point far beyond that existing today, will impose even stronger requirements for consideration of water quality in the planning and management of the Snake system. Planning for future development and flow regulation is a fifth element essential to the basin's water management program.

Although sufficient water is now available through the system to provide water quality protection, future storage developments will diminish that protection. Ambitious proposals for additional water development and management include: a series of power and navigation dams which will convert the lower basin into a series of deep, slow-moving pools; subsurface storage of flood flows in the upper basin; inter-basin diversions; and carry-over storage in the upper basin to provide for a dry period equal to the 1931-1942 drought.

Some 23 reservoir projects with a total storage capacity of 8.4 million acre-feet or about 25 percent of the total Snake Basin runoff appear to be feasible under current economic conditions. Potential projects in the central and upper basins would store 6.5 million acre-feet—about half the average runoff from these two basins.

Additional reservoir projects are in various stages of planning, and several large-scale irrigation projects, which would utilize both surface and ground-water supplies, are being investigated. In addition to the increasing storage capabilities and resultant increases in irrigation, there have been proposals for future inter-basin diversions to the southwest from the Columbia River watershed, including the Snake system.

The effects of future water resource developments in which water quality impacts are ignored are obvious; the problems created by past management of the Snake River regulatory system will intensify, and water quality will deteriorate throughout the basin. Increased storage capacities will allow flow curtailments for longer periods; more irrigated acreage will result in increased comsumptive water use, further depleting downstream flows; inefficient irrigation practices will add nutrients, salts, and organics to basin streams, further degrading water quality; and impoundments, located primarily for one use, will have increasing detrimental effects on water quality.

As holdover storage is developed with construction of Lynn Crandall and other smaller dams, and with emplacement of the various facilities envisaged in the Southwest Idaho Water Development Project, guaranteed flows for water quality protection will have to be maintained through the inclusion of water quality as a project function in Federal reservoirs. Essentially complete control of Snake River flows will be possible under the level of development considered and proper utilization of storage capacity could result in considerable benefit to present and future water quality. By recognizing downstream flow requirements and water quality impacts in project development plans and by providing water quality control storage when needed in future storage developments, high quality water can be maintained in most areas of the Snake Basin. Close coordination between construction agencies and water quality management agencies is required as future development is planned. Each project must be evaluated for both its good and bad impacts on water quality and water use. Storage to provide minimum streamflows or a project's design and operation to improve water quality are two facets of future development which must be considered by the proposed management program.

Specific storage requirements and quality impacts have been made by the FWPCA in cases where planning is well advanced. In some cases these needs are presented as an alternative to changes in management or to advanced waste treatment. In others, the flows and storage required are necessary with proposed development and increased waste loadings. In a third category are the quality impacts and benefits which could be derived from future developments, both public and private.

FUTURE FLOW REGULATION. Places in which minimum streamflow requirements or regulation for quality control could be provided out of proposed storage reservoirs include the South Fork Teton River, the upper Snake River from the Idaho-Wyoming border to Milner Dam, the middle Snake, the Portneuf River, the Boise River, the Grande Ronde River, Palouse River and the Payette River. Water quality control studies of individual reservoir development proposals have been conducted by the FWPCA in several of these areas to determine minimum flows required to maintain acceptable quality conditions. In most areas, proper management of the existing regulatory system would provide flows to maintain satisfactory quality under present loadings. Under future waste loadings and flow conditions imposed by future reservoir development, however, proper management alone will not satisfy flow requirements, and reservoir releases specifically for water quality control will be required. Flow regulation needs, based on maintaining quality under low flow conditions expected to recur on a 1-in-10 year frequency interval have been computed for several of the problem areas mentioned above.

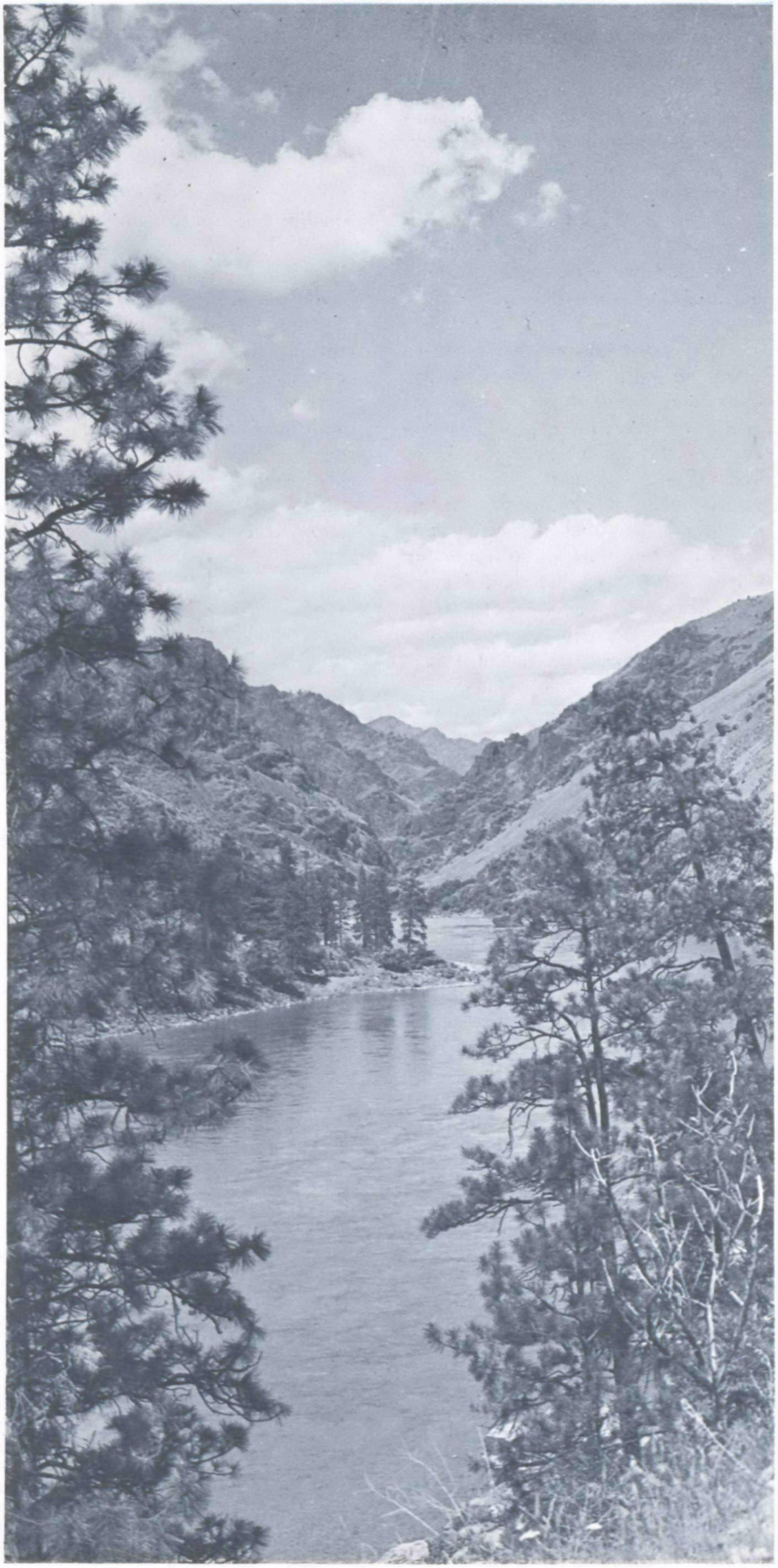
Because of the absence of gaging records on South Fork Teton, it has not been possible to determine incremental flows required on a 1-in-10 year frequency interval to maintain acceptable DO concentrations in the reach below Rexburg. Computations of the dissolved oxygen profile of the reach indicate that about 11,000 acre-feet annually should be allowed to pass Rexburg under projected 1980 loading conditions. If management of present flows is not changed, this 11,000 acre-feet annually could be provided from upstream storage earmarked especially for water quality control. Teton Reservoir, which is presently under construction by the U. S. Bureau of Reclamation, is ideally located to provide this storage. Unfortunately, water quality control has not been included as a project function in this 315,000 acre-foot reservoir development, and unless the storage can be secured from this reservoir in the future, alternative means of maintaining South Fork quality must be utilized.

In the Portneuf Basin, water quality deficiencies that may be alleviated by flow regulation occur in Portneuf River between the mouth of Marsh Creek and the town of Pocatello. Marsh Creek Project, a 40,000 acre-foot reservoir development under consideration by the U. S. Army Corps of Engineers, could regulate runoff to maintain flows in Portneuf River. An estimated 3,600 acre-feet of storage at Marsh Creek site would be required in the Portneuf River to maintain summer flows above the 20 cfs required to maintain satisfactory quality for fishery and recreation purposes.

Flow requirements to maintain dissolved oxygen levels above 75 percent saturation or no less than 5 mg/1 based on a 600 cfs minimum flow in Milner Reservoir have been computed for projected 2020 waste loadings, assuming that in-plant controls and waste treatment will be provided to remove 90 percent of the oxygen demand. The computations indicate that 600 cfs would barely maintain dissolved oxygen concentrations at 5.0 mg/1 under ice cover conditions and 2020 loadings. Dissolved oxygen concentrations would approach 75 percent of saturation during some months with minimum flows of 600 cfs. At no time, however, would dissolved oxygen standards criteria be met with flows below 600 cfs. Lower treatment efficiencies attainable by present methods dictate an immediate need for the 600 cfs minimum flow through Milner Pool. Even with improved treatment levels expected to be implemented within the next few years, minimum streamflows of 600 cfs will be required because of the growth of raw waste production.

As an alternative to adjusting the management system and in order to evaluate conditions imposed by future water resource projects, storage requirements to maintain 600 cfs minimum flow through Milner Reservoir have been estimated. The amount of water needed, based on a 1-in-10 year recurrence interval under existing regulation practice, is an estimated 140,000 acre-feet annually. This volume is the actual amount needed in Milner and does not reflect instream losses or carryover requirements which would increase the required storage space substantially. Palisades and American Falls Reservoirs are ideal sources of flow regulation for the Milner reach. The space in these reservoirs is completely allocated to other purposes (primarily irrigation), however, and it is doubtful that any reallocation of storage for water quality could be accomplished in these existing developments. The most likely potential source of quality control storage is Lynn Crandall Reservoir (1,620,000 acre-feet) which is now in the planning stages. Other reservoir sites now under investigation that could furnish this storage are Granite Creek (430,000 acre-feet) and Alpine (878,000 acre-feet).

Water quality control studies of the Boise Basin were conducted in connection with the Corps of Engineers' investigation of the potential Twin Springs Reservoir (600,000 acre-feet). Flows required to maintain minimum dissolved oxygen levels to support proposed uses of the lower Boise River under 2020 waste loading conditions (about 100 cfs) could be provided by an annual draft-on-storage of 98,000 acre-feet.
Flow regulation in the South Fork and main stem Palouse Rivers could be used to alleviate low DO and associated quality deficiencies caused



28. The gateway to Hells Canyon and the middle Snake where private and public power groups vie for the chance to build hydro power projects. Planning of any projects must consider impacts on quality and the possibility of regulating temperature with cold water releases.

by land drainage and treated waste discharges from the cities of Moscow and Pullman. Storage in the Potlatch Reservoir site on the main stem Palouse River could be released downstream to control quality in the main stem Palouse, but some means of transporting flows from the reservoir to the headwaters of the South Fork Palouse would be required to alleviate the effects of the Moscow-Pullman waste discharges. Preliminary studies indicate that an annual draft-on-storage of about 56,000 acre-feet would be required to maintain DO levels in the South Fork Palouse River above 6.5 mg/1 under projected 2020 loading conditions. Because of the high cost of transporting quality control flows to the South Fork Palouse Basin, however, it appears some alternative means of attaining quality objectives, such as tertiary treatment of collectable wastes or transporting of these wastes to the main stem Palouse River, would be more economical.

Water quality control studies of the Grande Ronde River Basin were conducted in connection with the Corps of Engineers' investigation of flood control storage at the lower Grande Ronde and Catherine Creek reservoir sites. About 15,000 acre-feet of storage space for water quality control would be required in Catherine Creek Reservoir to maintain DO levels above 6 mg/1 in Catherine Creek and the Grande Ronde River below Catherine Creek under 2020 waste loading conditions.

Studies on the resources potential of the middle Snake River have recently been conducted by the U. S. Department of the Interior. These studies were initiated because of the proposed High Mountain Sheep Dam, a private power project of Pacific Northwest Power Company. This study evaluated the impacts of several alternative potential dam and reservoir sites between the existing Hells Canyon Dam and the confluence of the Grande Ronde River with the Snake on other uses of the Snake River and the Columbia River. Three reservoir sites — Appaloosa, High Mountain Sheep, and Pleasant Valley —were considered.

The study concluded that only the Appaloosa site with a re-regulating reservoir would meet the acceptable criteria for balanced multiple-purpose development in the middle Snake River. Although the annual energy generation from this project would be slightly less than that from the other proposals, the Appaloosa Dam and Reservoir have the capability to improve water quality and thus the anadromous fish passage and production of the lower and middle Snake.

Principal water quality benefits would be streamflow regulation for temperature improvement. The power penstocks for the Appaloosa powerplant would be served by multi-level intake structures which could withdraw water from selected depths within the reservoir for temperature control.

The foregoing discussion on flow regulation to provide minimum stream flows for water quality shows only a few alternatives for the basin's future water resource development. It does point out, however, a fifth and last element of the proposed management program—that, as future developments are planned, the water quality impacts, both positive and negative, must be considered. Through proper coordination and planning, future development can improve water quality by providing storage for minimum flows and by regulating temperature with cold water releases from purposefully designed projects.

Other Needs for Water Quality Maintenance

Although streamflow management is the key to water quality maintenance in the Snake Basin, other needs do remain. Most of these are planning needs required to keep pace with the expanding population and economy with their attendant waste production. As the basin becomes more complex pollution control agencies must institute systematic methods to control pollution and expand control to encompass all forms of pollution.

Future Waste Treatment

Waste treatment requirements will maintain a constant pressure on facilities into the foreseeable future. Continued construction and expansion of treatment facilities at rates equal to or exceeding those of the last decade will be required in the future, even after the present treatment needs have been met. Additional plants will have to be built as a result of three kinds of processes—municipal and industrial growth, plant obsolescence, and higher treatment level requirements.

Growth of population and industry will involve a steady rise in the level of waste production. The oxygen demand of municipal and industrial wastes is anticipated to rise threefold during the period from 1960 to 2020 in spite of a considerable increase in manufacturing efficiency that should lead to a noticeable decline in the waste-to-product ratio for almost every significant class of product.

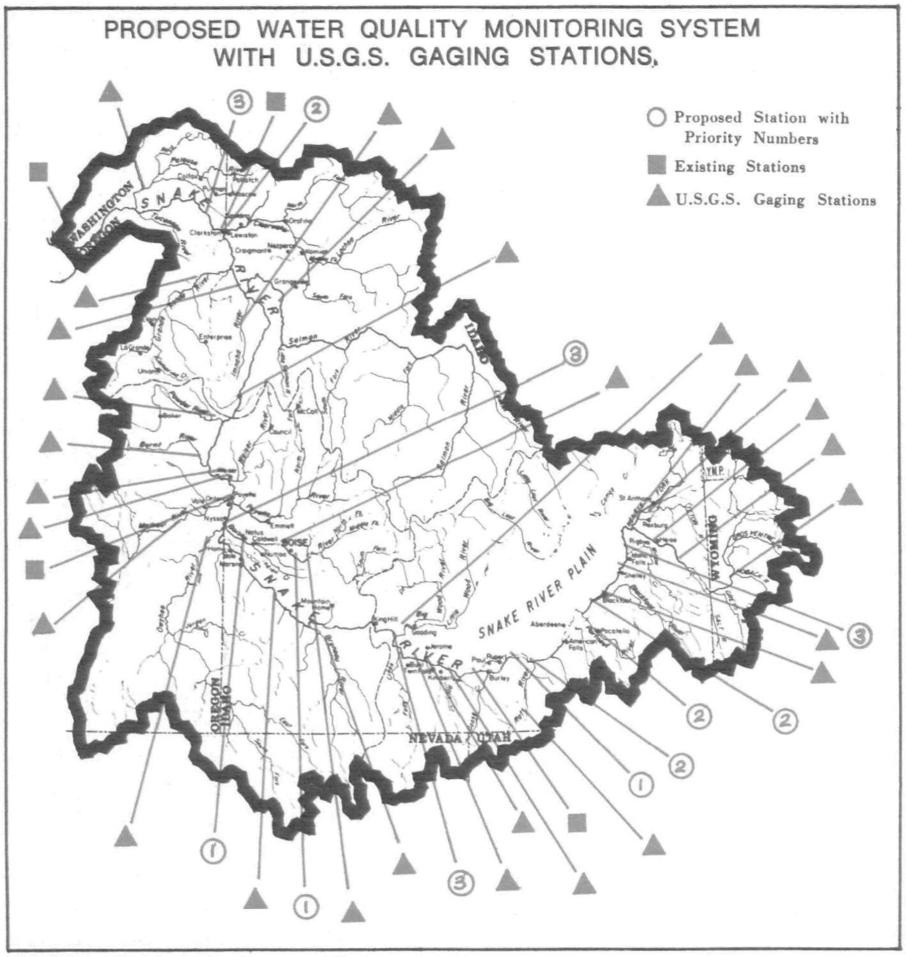
Replacement of plant and equipment will become an increasingly significant element in assessing waste treatment requirements after 1980. Average plant life for conventional plants is about twenty-five years; well-maintained waste stabilization ponds, a treatment method prevalent in the basin, may be expected to operate efficiently for a somewhat longer period. Thus extensive plant construction that occurred in the late nineteen-fifties and early nineteen-sixties indicates the need for extensive replacement by the nineteen-eighties.

The need for treatment beyond the level of secondary depends almost entirely on the availability of streamflow to assimilate residual wastes. If dependable base flows can be established and maintained, the cost of advanced waste treatment may be foregone. On the other hand, if flows are allowed to diminish when reservoirs are filling and when irrigation water is being diverted, tertiary treatment of municipal and industrial wastes being discharged to the Boise River and to Milner Pool may be necessary. There will also be a rapidly developing need for some form of advanced waste treatment in a portion of the Palouse River watershed. The growth in population of the cities of Moscow and Pullman will almost inescapably involve the two cities in expanded waste control investments. Availability of water to augment streamflow is slight and extremely expensive. In addition to the advanced waste treatment mentioned above, other needs may arise in locations where flows are depleted. New industries locating in the Snake Basin will have to face the high cost of advanced treatment if base streamflows are not established.

CREATION OF POLLUTION CONTROL DISTRICTS. Pollution of water courses tends to occur at specific points and the conditions which result in pollution tend to be associated with concentrations of waste sources. The traditional method of dealing with the problem has been to require that every polluter remove his own pollutants. Thus every municipality and every industry is in the position of negotiating with the regulatory authorities with respect to its own waste handling responsibilities. The obvious alternative is the banding together of a group of waste producers in a metropolitan area or watershed pollution control organization to achieve a higher degree of joint financial, operational, and political competence in dealing with their waste handling problems. Ideally, such an organization should be based upon the physical boundaries of a drainage area and should include both municipalities and the industries in that area.

The most obvious advantage in the creation of such pollution control districts is that it spreads the financial burden of providing sewerage and waste treatment requirements over a broad base. Substantial economies of scale are available in both construction and operation of waste treatment plants and a larger population and financial base permits the maintenance of a managerial and technical competence that is often beyond the means of single communities or industries. The district approach allows orderly programming of capital investment and accommodates itself to an optimal disposition of waste handling requirements that rise with urban and industrial growth.

The desirability of consolidating waste handling requirements of a group of communities and industries has been recognized by the Congress, which has provided several substantial financial incentives for such programs. If water quality standards



29. This riverside feedlot near Ontario, Oregon is typical of many in the Snake River Basin. Wastes of farm animals are considered to be the principal source of the high bacterial counts found in much of the Snake River.

are in effect for the stream into which the project would discharge, and if the project is part of a regional plan, the Federal government will provide 55 percent of the cost of treatment works construction when the state provides 25 percent or more of the cost.

TRAINING AND MANDATORY CERTIFICATION FOR TREATMENT PLANT OPERATORS. A highly desirable and inexpensive management measure that could be extended immediately is a program to upgrade the skills of both municipal and industrial waste treatment plant operators. There are wide differences in the levels of efficiency achieved among similar groups of treatment plants and a major element in the disparity is differences in skill and interest among operators. Improved pay scales, certification and pay for achievement of recognized levels of skill (presently existing in the States of Washington, Oregon, and Idaho) and frequent short courses and advisory inspection all serve a useful purpose in developing a higher level of competence among operators. Mandatory certification of treatment plant operators — both municipal and industrial — would greatly improve the efficiency of waste treatment plants.

Pollution Surveillance

A major need in controlling water pollution in the Snake is expanded water quality data and waste loading information. These are the basic inputs required to manage and maintain water quality.

MONITORING. Water quality monitoring is the joint responsibility of the states, the FWPCA, and the USGS in the Snake Basin. Each agency has its own area of responsibility, and a coordinated program of surveillance is presently being explored.

Water quality monitoring should include periodic sampling at points which are critical in terms of their potential for pollution or for their value in interpreting behavior of streams. Surveillance stations, placed to measure changing water quality through the passage of the Snake River and situated so their data can be correlated with U. S. Geological Survey flow gaging stations, are necessary to provide the constant overview needed to operate the quality management program. Stations should be installed in a fashion that recognizes the significance of particular stream points and the parameters measured designed for those points. The adjacent map shows existing and desirable sites for such a system to provide a basic information framework for the Snake Basin.

WASTE DISCHARGE PERMIT SYSTEMS. A waste discharge permit system is a useful tool necessary for the operation of a water quality management program in the Snake River Basin. The advantages of the permit as a source of control and enforcement are obvious. Through the inventory of allowable discharges, the water quality management agency has at all times a knowledge of the types and characteristics, including volume, of wastes being discharged to streams. It is able, then, to calculate waste treatment requirements and to review the performance of waste sources relative to what is allowed under the terms of the permit. Enforcement is simplified because evidence of the breach of the conditions of the permit constitutes evidence of non-compliance with the laws of the issuing state and the regulations of the issuing authority. While Oregon and Washington already have permit systems, Idaho has yet to establish such a system.

Other Control Needs

Some of the more serious water pollution problems of the Snake are beyond the reach of conventional procedures of waste control. These include animal wastes, erosion, aquatic growths, and commercial toxins. Remedies for these pollutants are not as clearcut but are just as important in maintaining water quality.

CONTROL OF ANIMAL WASTES. The concentration of large numbers of animals into limited space provides opportunities for brief, intense point waste loadings that have high pollutional capabilities. There are perhaps a dozen feedlots in the watershed that hold two thousand or more animals at a time, at least twice that many which can accommodate five hundred animals or more. Assuming that the cattle-to-human waste ratio of 6.4:1 holds true, a feedlot with 2,000 animals provides the oxygen-demanding waste equivalent of a city of about 13,000 people.

Fences should be interposed between watercourses and feedlots, dairies improved pastures, and other locations where large numbers of animals are gathered relative to a given amount of land. Simple retaining structures between such animal habitats and watercourses should also be provided in order to limit direct surface drainage and allow wastes to decompose through soil processes. At some places it may be preferable to collect runoff from cattle holding facilities in order to provide waste treatment or to collect the concentrated materials for use as manure.

EROSION CONTROL. Erosion stands high among factors that seriously lessen water quality in large portions of the Snake River Basin. It constitutes the principal kind of pollution of the Palouse watershed and is demonstrated in greater or lesser degree through much of the agricultural area of the Snake River Basin. Desert soils without vegetative cover are among the most difficult to manage as sources of erosion and consequent sedimentation of streams. Bureau of Land Management programs to provide suitable forms of vegetation and install appropriate use possibilities for such lands are unquestionably of great utility in regard to erosion control. Soil stabilization practices also have a high priority in management of lands administered by the U. S. Forest Service. The success of its effort has been of high importance in limiting erosion in forested portions of the watershed.

Erosion from agricultural lands presents a far more difficult prolem. The institutional framework does not exist to effect changes in the practices of thousands of individual farmers. To devise incentives for soil conservation procedures is beyond the scope of this report, but it is appropriate to point out that the Soil Conservation Service has an active incentive program to encourage good land management practice. Very meaningful control of erosion and sedimenta-

30., 31. Development of control methods to rid the Snake River of aquatic growths that flourish throughout its length is the major research need in the watershed.

tion is possible by resorting to simple techniques such as avoiding excess application and surface runoff of irrigation waters, deep-chisel plowing, and well-considered crop rotations.

Control of erosion from construction activities may be instituted through State standards for construction practices that would require use of such techniques as mulching, terracing, limiting area of surface scarring, and use of sedimentation ponds. Standards can be expressed in quantitative terms and performance gaged by inspection. Even in the absence of state controls, it is possible to incorporate such requirements in all construction contracts let by Federal agencies or performed on Federally administered land.

CONTROL OF AQUATIC VEGETATION. The most chronic problem of the Snake River Basin is the prolific aquatic growths which characterize the entire system. Limited knowledge of the ecology of the stream system imposes severe restrictions on controls procedures. Research must be depended upon to provide any long range answers to control. However, several means of partial control might be explored.

The natural level of phosphates in the river is extremely high and, because nutrient control is extremely expensive, it would not seem logical to institute phosphate controlling additions to waste treatment facilities until a thorough study of stream ecology indicates that such procedures would help the problem.

Direct control of aquatic biota can be approached in several fashions. The most obvious is harvesting of the materials where they are concentrated in ponds, irrigation returns and slow-moving stream reaches. The procedure would have the effect of both removing the aquatic growths themselves and preventing the production of additional phosphorus that occurs if growths are allowed to decay in the water.

A more likely solution is to attempt to control aquatic weeds through introduction of forage fish. *Tilapia mossambica*, a small weed forager of African origin, has been found to be spectacularly effective in controlling growths in Texas ponds. The fish is resistant to wide swings in temperature, so is well suited to the climatic environment. Moreover, it might constitute a very desirable addition to the ecological system of the southern sweep of the Snake River. By functioning as a link in the food chain for larger fish, the forager would have the effect of allowing the water mass to support a larger population of game fish and perhaps contribute to the size and growth rate of such fish.

CONTROL OF COMMERCIAL TOXICANTS. Eliminating the entry of commercial poisons—pesticides and herbicides—to watercourses is another high priority pollution control requirement that can only be met through application procedures. Careful selection of types of poisons that are applied, determination of optimum application levels, and sanctions against applications that occur within the immediate surface drainage of a watercourse are all desirable. In view of the demonstrated deficiencies of the process of educating individual farm operators to accept procedures that do not result in an immediate personal profit, it would appear that the most likely avenue of approach in instituting such procedures would be through food processors. These consumers of agricultural products customarily issue extremely tight grower contracts, covering production conditions and quality specifications for a crop which they agree to purchase. Control of pesticide applications could be included among the conditions of such contracts, with a probable immediate impact on procedures. Certainly negotiations and persuasion directed to a few dozen processors would be easier to undertake than approaches to tens of thousands of farm operators.

32. The FWPCA's Pacific Northwest Laboratory at Corvallis, Oregon is engaged in research relative to the water quality problems of the Snake.

Thermal Pollution

High water temperatures in the lower Snake River have already been cited as detrimental to migration of anadromous fish. These and other high temperatures in the Snake system are caused by the many impoundments and the spreading of large quantities of irrigation water over the fields, thus exposing huge surface areas to solar radiation.

With the projected need for electrical power and with the limited head remaining for hydropower development in the Snake, future power needs will almost certainly be met by nuclear reactor generation of electricity. Nuclear energy means waste heat to be dissipated—more heat than a coal burning plant of comparable size must dissipate. And nuclear energy means the risk, small though it may be, of releasing one of the deadliest forms of pollution on earth—radioactive wastes.

Actions are already underway to protect the environment from waste heat and radioactivity. State water resource agencies and state pollution control agencies are involved in determining the location and control measures required for nuclear thermal plants. Federal agencies, including the FWPCA, are studying the impact of such development on the air and water environment.

These actions must be expanded and strengthened to protect the high quality waters of the Snake and to eliminate any further burden to the lower Snake temperature regimen. Specific cooling facilities must be prescribed prior to the installation of any thermal nuclear plant in the basin.

Research

Requirements for research that is definitely aimed at the problems of the Snake River watershed are fairly well defined. While many of the water quality difficulties of the area are common to much of the Nation and should benefit from the application of principles derived from research in other areas, several types of investigation directed to specific Snake River conditions should be instituted.

The most obvious area for research, and one which should have top priority, is that of investigation of the sources of nutrients for, and methods to control the production of, aquatic biota. Some very limited suggestions as to methods of control have been provided in this report. But the most chronic water quality problem of the watershed remains a matter beyond existing control capabilities. Research capabilities of universities, private firms and state and Federal agencies should be directed toward this investigation. The FWPCA can offer valuable assistance through its National Eutrophication Research Program.

In the event that water diversion plans are considered for the Columbia River, examinations of the water quality effects should also be conducted, considering Snake River diversion points in conjunction with other Columbia River System sources of water. All Federal and state agencies concerned with the multiple use of the Snake Basin would participate in such a study.

A more limited but locally significant requirement exists to investigate the effect of induced recharge on quality of groundwater. At least two areas of extensive ground-water recharge are proposed in connection with projects of the Bureau of Reclamation. One would require diversion of flood waters of the Henrys Fork for storage in the aquifer of the Snake Plain. The other would occur through the operation of the Southwestern Idaho Water Development Plan as a result of the introduction of great volumes of irrigation water to previously arid lands in the area of Mountain Home and on the south bank of the Snake. While such operations will probably be beneficial, only their quantitative aspects have been considered at this time. Effects on ground-water quality should be diligently considered and forecast, most logically by the U. S. Geological Survey.

APPENDIX

WATER RESOURCE DEVELOPMENT SUMMARY

	Upper Basin	Central Basin	Lower Basin	Total
Number of Storage Structures				
Existing	35	30	6	71
Under Construction	1	1	4	6
Authorized	1	1	1	3
Total Structures	37	32	11	80
Active Storage, Acre-Feet				
Existing	5,173,000	4,448,200	42,800	9,664,000
Under Construction	315,000	100,000	1,433,000	1,848,000
Authorized	100,000	7,200	—	107,200
Total Storage	5,588,000	4,555,400	1,475,800	11,619,200
Generating Capacity, Kilowatts				
Existing	390,700	579,600	924,000	1,894,300
Under Construction	22,000	—	1,455,000	1,477,000
Authorized	30,000	—	288,000	318,000
Total Power Capacity	442,700	579,600	2,667,000	3,689,300
Purposes, Number of Structures				
Irrigation	17	19	—	36
Power	13	3	4	20
Multi-Purpose*	7	10	3	20
Other Multi-purpose	—	—	4	4

* Including Irrigation

POTENTIAL RESERVOIR DEVELOPMENT

Potential Development	Storage (1000 AF) Total	Active	Stream	River Mile	Data Source
1. Granite Creek	470	430	Hoback R.	S.944.3-H.12.4	USBR Recon.- Jackson Lk Replacement, April 1967
2. Alpine	1,078	878	Snake R.	S.922.4	Same as No. 1
3. Crow Creek	27	24.5	Crow Ck. (Salt R. Basin)	S.917.2-Salt R. 40.0-C.Ck.11.0	USBR Feas.-Upper Star Valley, June 1965
4. Lynn Crandall	1,620	1,620	Snake R.	S.872.5	Same as No. 1
5. Warm River	140	75	Henrys Fork	S.837.4-H.F.56.9	USBR-USACE Joint Report Upper Snake River Basin 1961
6. Ashton Enlargement	49	40	Henrys Fork	S.837.4-H.F.44.0	Same as No. 5
7. Teton Creek	7	6	Teton Ck	S.837.4-H.F.20.4-T.64.1-T.Ck.13.2	USBR Recon-Alta Project March 1964
8. Driggs	50	35	Teton R.	S.837.4-H.F.20.4-T.58.7	Same as No. 5
9. Blackfoot Enlargement	38	38	Blackfoot R.	S.751.2-B.78.0	USACE Design Memo No. 2 Blackfoot Res. Modification, Sept. 1966
10. Marsh Creek	40	40	Marsh Ck. (Portneuf Basin)	S.736.0-P.32.7-M.Ck.5±	Current USACE Investigation
11. Jordan Creek	100	100	Jordon Ck. (Owyhee Basin)	S.392.3-O.117.5 J.Ck.57	USBR Recon-Upper Owyhee Project, June 1965
12. Twin Springs	600	490	Boise R.	S.391.3-B.103.0	Same as No. 5-USACE Investigation in 1966
13. Gold Fork	102	80	Gold Fk. R. (Payette Basin)	S.365.6-P.72.7-N.F.P.51.3-G.F.9.0	USBR Feas.-Southwest Idaho Water Dev. Project June 1966
14. Garden Valley	2,400	2,400	Payette	S.365.6-P.75.9	Same as No. 13
15. Lost Valley Enlargement	20	20	Lost Creek (W. Fk. Weiser)	S.351.8-W.76.2-W.F.W.12.0-L.C.	Same as No. 13
16. Monday Gulch	35	35	Little Weiser R. off-stream site	S.351.8-W.45.0-L.W.15.4-M.G.1.2	Same as No. 13
17. Hardman	14	12	So. Fk. Burnt R.	S.327.7-B.64.0-S.F.B. 8±	USBR Investigations
18. Dark Canyon	12	10	Burnt R.	S.327.7-B.36.9	Same as No. 17
19. Appaloosa	2,413	1,500	Snake R.	S.197.6	Current U.S. Dept. of the Interior Investigation
20. High Mountain Sheep	3,600	2,700	Snake R.	S.189.1	Same as No. 19 - Alternate site
21. Challis	10.6	10.6	Challis Ck. (Salmon Basin)	S.188.2-S.317.4-C.Ck.7	USBR Feas. - Challis Ck. Division, August 1963
22. Lower Grande Ronde	220	220	Grande Ronde R.	S.168.7-G.R.174±	USACE Investigations
23. Catherine Creek	83	83	Catherine Ck. (Grande Ronde Basin)	S.168.7-G.R.143.9-C.Ck.28.4	Same as No. 22
24. Potlatch	160	160	Palouse R.	S.59.5-P.135	USACE & USBR Investigations

REPRESENTATIVE SUMMARY OF WATER

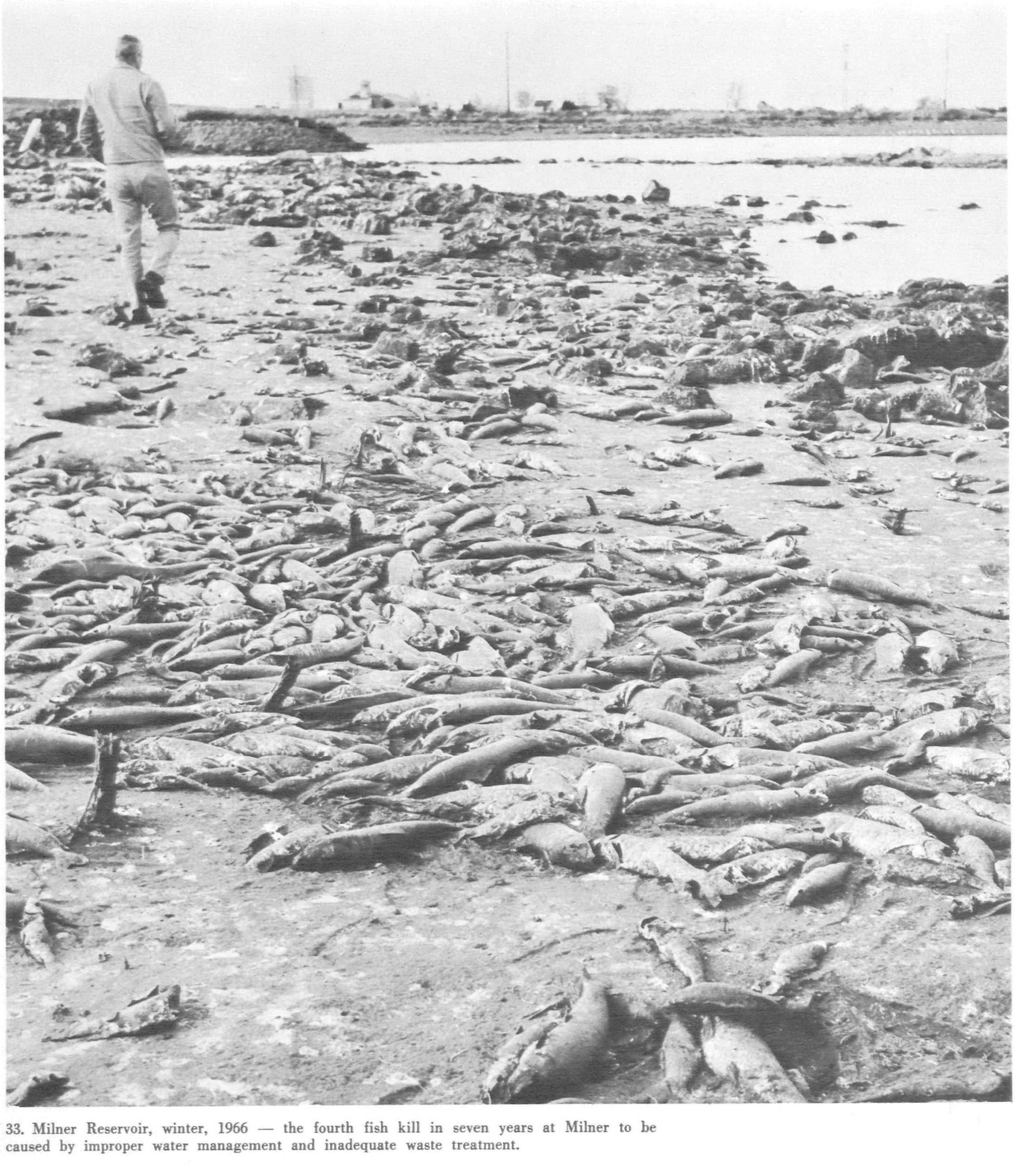
SPECIFIC CRITERIA

Interstate Receiving Water	Dissolved Oxygen D.O.	Organisms of the Coliform Group Where Associated with Fecal Sources (Total Coliform)	pH (Negative Logarithm of the Hydrogen-Ion Conc.)	Temperature	Turbidity (Certain short-term activities specifically authorized by the pollution control agency may be permitted)
- Snake River -					
Within Wyoming: (proposed) South boundary of Yellowstone National Park to the Wyoming-Idaho State line.	Not less than 6 ppm at any time.	Coliform counts shall not exceed 1000 per 100 ml (Most Probable Number) as an arithmetical average of the last five consecutive samples; nor exceed this number in more than 20 percent of the samples; nor exceed 2,400 per 100 ml in any one sample. Organisms of the fecal coliform group shall not exceed 200 per 100 ml, as an arithmetic average of the last five consecutive samples, nor exceed this number in more than 20 percent of the samples, nor exceed 480 per 100 ml in any one sample.	Maintained within the range of 6.5 to 8.5.	No increase of more than 4° F. of the monthly average water temperature as determined from measurements of monthly averages. In no case will heat be discharged in amounts which will result in water temperatures deleterious to the propagation and sustenance of indigenous aquatic life.	Not more than a 15 turbidity unit increase when the receiving water is 150 units or less, or more than a 10 percent increase when water turbidity is over 150 turbidity units.
Within Idaho: Wyoming-Idaho State line (R.M. 918) to the Oregon-Idaho State line (R.M. 407).	Not less than 75 percent of saturation at seasonal low or less than 100 percent of saturation in spawning areas during spawning, hatching, and fry stages of salmonid fishes. (Exception: five ppm at Milner Dam based on a minimum stream flow of 600 cfs at this point).	Average concentrations of coliform bacteria (MPN or equivalent MF) shall not exceed 1000 per 100 milliliters, with 20 percent of samples not to exceed 2,400 per 100 milliliters.	pH values shall not fall outside the range of 7.0 to 9.0, induced variation shall not be more than 0.5 pH unit.	No measurable increase when stream temperatures are 68° F. or above, or more than 2° F. increase when stream temperatures are 66° F. or less.	No objectionable turbidity which can be traced to a point source.
Adjacent to Idaho: Oregon-Idaho border (R.M. 407) to Hells Canyon Dam (R.M. 247).	Same as above.	Same as above.	Same as above.	No measurable increase when stream temperatures are 70° F. or above, or more than 2° F. increase when river temperatures are 68° F. or less.	Same as above.
Hells Canyon Dam (R.M. 247) to the Washington-Idaho State line (R.M. 139).	Same as above.	Same as above with the following exception: Average concentration of coliform bacteria shall not exceed 240 per 100 milliliters for the lower Snake River (R.M. 170-139).	Same as above.	No measurable increase when stream temperatures are 68° F. or above or more than 2° F. increase when river temperatures are 66° F. or less.	Same as above.
In and adjacent to Oregon:	Not less than 75 percent of saturation at seasonal low or less than 95 percent of saturation in spawning areas during spawning, hatching, and fry stages of salmonid fishes.	Average concentrations of coliform bacteria (MPN or equivalent MF using a representative number of samples) shall not exceed 1000 per 100 ml, with 20 percent of samples not to exceed 2400 per 100 ml.	pH values shall not fall outside the range of 7.0 to 9.0.	No measurable increase when river temperatures are 70° F. or above, or more than 2° F. increase when river temperatures are 68° F. or less.	Turbidity shall not exceed 5 JTU above natural background values.
Within Washington: Mouth to Washington-Idaho-Oregon State line.	Shall exceed 8.0 mg/l.	Total coliform organisms shall not exceed median values 240 per 100 ml with less than 20 percent of samples exceeding 1000 per 100 ml.	pH shall be within the range of 6.5 to 8.5 with an induced variation of less than 0.25 units.	No measurable increase shall be permitted which results in water temperatures exceeding 68° F. nor shall the cumulative total of all increases be permitted in excess of $t = \frac{110}{T-15}$ (t=permissive increase) (T=resulting water temperature).	Turbidity shall not exceed 5 JTU over natural conditions.

QUALITY CRITERIA MAINSTEM SNAKE RIVER

GENERAL CRITERIA

Toxic Materials	Tastes and Odors	Radioactivity	Aesthetic Values	Other
No toxic, corrosive, or other deleterious substances of other than natural origin in concentrations or combinations which are toxic to human, animal, plant, or aquatic life.	Essentially free from substances of other than natural origin which produce taste, odor, or color that would: (a) Import an unpalatable or off-flavor in fish flesh. (b) Visibly alter the natural color of the water, or import color to skin, clothing, vessels or structures. (c) Produce detectable odor at the site of use. (d). Directly or through interaction with chemicals used in treatment import undesirable taste or odor to the finished water.	Radioactive material of other than natural origin shall not be present in any amount which reflects failure in any case to apply all controls which are physically and economically feasible. In no case shall such materials exceed the limits established in the 1962 PHS Drinking Water Standards or 1/30 (168 hour value) of the values for radioactive substances specified in the "National Bureau of Standards Handbook 69."	Essentially free from substances of other than natural origin that will settle to form sludge, bank or bottom deposits. Free from floating debris, oil, grease, scum, and other floating materials of other than natural origin in amounts sufficient to be unsightly.	
No toxic chemicals of other than natural origin in concentrations found to be of public health significance or adversely affect the use indicated.	No deleterious substances of other than natural origin in concentrations that cause tainting of edible species or tastes and odors to be imported to drinking water supplies.	Radioactive materials of other than natural origin shall not be present in any amount which reflects failure in any case to apply all controls which are physically and economically feasible. In no case shall such materials exceed the limits established in the 1962 PHS Drinking Water Standards.	No floating or submerged matter not attributable to natural causes. Excess nutrients of other than natural origin that cause visible slime growths or other nuisance aquatic growths.	
Same as above.	Same as above.	Same as above.	Same as above.	
Same as above.	Same as above.	Same as above.	Same as above.	
No wastes shall be discharged or activities conducted which cause the creation of toxic or other conditions that ar deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish.	No wastes shall be discharged or activities conducted which cause the creation of tastes or odors that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish.	No wastes shall be discharged or activities conducted which cause radio-isotope concentrations to exceed maximum permissible concentrations in drinking water, edible fishes or shellfishes, wildlife, irrigated crops, livestock and dairy products or pose an external radiation hazard.	No wastes shall be discharged or activities conducted which cause the formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation or industry; or which cause objectionable discoloration, turbidity, scum, oil slick or floating solids, or coat the aquatic life with oil films; or which cause aesthetic conditions offensive to the human senses of sight, taste, smell or touch.	The Oregon standards establish a list of guide concentrations of dissolved chemical substances which shall not be exceeded. (See the Oregon Standards for this list).
Shall be below those of public health significance, or which may cause acute or chronic toxic conditions to the aquatic biota, or which may adversely affect any water use.	Aesthetic values shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch or taste.	Radioactive concentrations shall be below those of public health significance, or which may cause acute or chronic toxic conditions to the aquatic biota, or which may adversely affect any water use.	Aesthetic values shall not be impaired by the presence of materials or their effects excluding those of natural origin, which offend the senses of sight, smell, touch or taste.	



33. Milner Reservoir, winter, 1966 — the fourth fish kill in seven years at Milner to be caused by improper water management and inadequate waste treatment.

FISH KILLS

Date	Place	Source of Pollution	Specific Cause	Type Fish Killed % Game	Trash	Number Killed	Extent of Effects	Duration	Comments
Dec. 9, 1960	Milner Res.	Domestic Industrial	—	1	99	250,000	3 miles	26 days	
Dec 20, 1960	Murtaugh Lk.	Domestic Industrial	—	25	75	3,000	650 acres	20 days	—
Nov. 8-9, 1961	Milner Res.	Potato Processing Plants	D.O. 1ppm	2 6 forage	92	100,000	12 miles	19 days	Repeat of 1960 kill
Mar. 19, 1962	Hagerman State Fish Hatchery Riley Creek	FWS Hatchery at Hagerman	Copper Sulfate	100	—	235,900	1½ miles	6 hrs.	Treatment at FWS hatchery responsible for kill at downstream state hatchery
Feb. 5, 1963	Milner Res.	Food Processing	—	—	100	20,000	2 miles	30 days	
June 11, 1964	Boise R. Irrigation Ditch	Industrial	Lube oil	2	98	1,500	—	2 days	
June 25, 1964	Snake R. Strike Res.	Poison Toxaphene	—	1	99	2,500	5 miles	1 day	
June 20, 1964	Boise R. Caldwell	Food Processing	Low D.O.	2	98	700	5 miles	—	
April 27, 1965	Bowen Creek Teton R.	Food Processing	—	100	—	1,250	1 mile	4 hrs.	
May 6, 20, 27, 1966	Portneuf R.	Fertilizer Plant	High Temp. pH 3	1	99	30,000	4 miles	4 days	
June 7, 1966	S. Fk. Teton R.	Food Processing	Low D.O.	4.5	95.5	35,000	2 miles	—	
Nov. 20-25, 1966	Milner Res.	Food Processing	D.O. 0.5	—	100	500,000	7 miles	5 days	
April 1, 1967	Boise R. Drain Ditch	Glue Waste	Poison	100	—	400	—	½ hr.	
April 4, 1967	Snake R.	Food Processing	Low D.O.	6	94	500	10 miles	10 days	
Mar. 28-Apr. 10, 1967	Billingsley Cr. Snake R.	Sheep Spraying	Poison	100	—	32,000	—	14 days	
Aug. 1967	American Falls Res.	Decaying Algae	Low D.O.	10	90	20,000	—	—	
Apr. 3, 1968	Boise R.	Dismantled Refrigeration Unit	Ammonia	2	98	250,000	14.4 miles	—	

MAJOR WASTE LOADING AREAS 1967

Service Area	Raw Waste	Discharged Waste	Treatment Efficiency	Percent of Basin Waste Discharge	Percent of Area Waste Discharge
Rexburg	88,600	37,800	57	1.4	
Rogers Bros. Food Prod.		(27,000)			72
St. Anthony Starch Co.		(9,000)			24
Rigby	53,800	37,500	30	1.4	99
Idaho Fresh Pak - Lewisville		(37,000)			
Idaho Falls	1,300,000	442,400	66	16.8	
Rogers Bros. Co.		(110,000)			25
Utah Idaho Sugar Co.		(120,000)			27
R. T. French Co. - Shelley		(85,000)			19
Blackfoot	192,000	82,000	57	3.1	
American Potato Corp.		(72,000)			88
Pocatello	49,500	27,700	44	1.1	
Pocatello		(27,000)			98
FMC	Inorganic				
J. R. Simplot Co.	Inorganic				
American Falls	291,000	68,400	77	2.6	
Idaho Potato Growers		(24,000)			35
Lamb & Weston		(25,000)			37
Burley	1,359,000	647,000	52	24.6	
Ore-Ida Foods Corp.		(106,000)			16
J. R. Simplot Co.		(493,000)			76
Twin Falls	795,000	342,000	57	13.0	
Amalgamated Sugar Co.		(200,000)			58
Twin Falls		(70,000)			20
Boise	831,000	167,500	80	6.4	
Boise B		(10,000)			6
Nampa		(30,000)			18
J. R. Simplot - Caldwell		(100,000)			60
Emmett	31,000	1,000	97	0.04	
Ontario	742,000	197,000	74	7.5	
Amalgamated Sugar Co. - Nyssa		(41,000)			21
Ore-Ida Foods - Ontario		(145,000)			74
Baker	12,400	500	96	0.02	
La Grande	13,000	1,300	90	0.05	
Lewiston	545,000	522,000	4.2	20	
Potlatch Forest Industries		(432,000)			83
Pullman	28,000	3,600	87	0.14	
Service Area Total	6,301,000	2,578,000	59	98.1	
BASIN TOTAL	6,430,000	2,633,000	59	—	—

TIME SCHEDULE FOR CURRENT WASTE TREATMENT NEEDS TO MEET ESTABLISHED WATER QUALITY STANDARDS

City or Industry	Primary	Secondary
WYOMING		
City of Jackson		(Unscheduled)*
IDAHO		
Roger Brothers - Rexburg		1970
Idaho Fresh Pak - Lewisville		1970
City of Idaho Falls		1971
U & I Sugar Company - Idaho Falls		1969
Roger Brothers - Idaho Falls	1968	1971
Idaho Potato Growers - Idaho Falls	1968	1971
Idaho Potato Foods - Idaho Falls		1972
RT French - Shelley	1968	1972
Idaho Supreme - Firth	1968	1972
American Potato Company - Blackfoot	1968	1972
City of Blackfoot		1972
Idaho Potato Starch Company - Blackfoot		1972
St. Anthony Starch Company - St. Anthony		1972
City of Pocatello		1973
City of Aberdeen		1969
Idaho Potato Growers - Aberdeen		1969
Idaho Potato Starch Co. - Aberdeen		1969
Kraft Foods Co. - Aberdeen		1969
City of Rupert		1968
Kraft Foods Co. - Rupert		1968
Magic Valley Foods - Rupert		1968
City of Paul		1969
City of Heyburn		1970
J. R. Simplot Co. - Heyburn		1970
Ore-Ida Co. - Burley		1970
A & P Co. - Burley		1970
Amalgamated Sugar Co. - Twin Falls	1969	
Independent Meat Co. - Twin Falls		1968
Magic Valley Co. - Twin Falls		1973
City of Twin Falls		1973
Bertie's Poultry - Twin Falls		1973
Swift & Co. - Twin Falls		1973
Young's Dairy - Twin Falls		1973
Idaho Frozen Foods - Twin Falls		1973
City of Jerome		1969
Ida-Gem Dairy - Jerome		1969
King of Spuds - Jerome		1969
City of Glenns Ferry		1968
IDAHO—Cont'd.		
City of Wilder		1969
Northwest Boise Sewer District		1969
Swift & Co. - Boise		1968
Star Sewer District		1969
J. R. Simplot - Caldwell		1970
City of Notus		1969
City of McCall		1968
City of Donnelly		1969
City of Cascade		1968
Gem Canning - Emmett		1968*
City of Payette		1973
City of Cambridge		1968
Wells and Davies - Payette		1973
City of Weiser		1973
City of Salmon		1968
City of Craigmont		1970
City of Orofino		1972
City of Lewiston		1970
Lewiston Orchards - Lewiston		1970
Seabrook Farms, Inc. - Lewiston		1970
Smith Foods, Inc. - Lewiston		1970
Potlatch Forests, Inc. - Lewiston	1968	
Wallowa		1969
OREGON		
Adrian School and Adrian Homes		(Unscheduled)
City of Nyssa		1970
Pioneer Meat - Ontario		(Unscheduled)*
Ore-Ida Foods, Inc. - Ontario		
WASHINGTON		
Meats, Inc. - Clarkston		1970
City of Clarkston		1970
Bristol Packing Co. - Clarkston		1970
Town of Asotin		1970**
City of Colfax 1/		1968*
City of Palouse		1969*

* Plant expansion or modification

** New plant or modification

1/ Under construction

TREATMENT REQUIREMENTS IN ADDITION TO INTERSTATE IMPLEMENTATION PLANS

	Existing Treatment	Waste Raw PE	Waste Discharge PE	Receiving Stream	Recommended Action
	IDAHO				
MUNICIPAL					
Community					
Hailey	No system	1200	1200	Big Wood River	Collection & Secondary
Ketchum	No system	6000	6000	Big Wood River	Collection & Secondary
INDUSTRIAL					
Company					
Armour Meat Co. (Buhl)	Septic tank	4000	3000	Deep Creek	Secondary
B & L Meat Packers (Buhl)	Septic tank	1000	700	Deep Creek	Secondary
Bryants Packing Co. (Burley)	Septic tank	500	300	Snake River	Secondary
Custom Packing Co. (Rupert)	Septic tank	250	200	Main Drain	Secondary
Farrer Meat Co. (Rexburg)	Septic tank	500	400	Snake River	Secondary
Gabriel Packing Co. (Gooding)	Lagoon	7500	5000	Little Wood River	Improved efficiency
Gibson Bros. Meat Co. (Burley)	Septic tank	500	300		Secondary
Grimes Custom Slaughter House (Nampa)	Septic tank	200	100	Indian Creek	Secondary
H. H. Keim Packing Co. (Nampa)	Septic tank	3200	2400	Indian Creek	Secondary
Hillcrest Packing Co. (Nampa)	X	300	150	Indian Creek	Secondary
Hopkins Packing Co. (Blackfoot)	Lagoon	750	500		Improved efficiency
Idaho Falls Animal Prod. (Idaho Falls)	Septic tank	1000	500	Snake River	To city sewer
Idaho Falls Meat Co. (Idaho Falls)	Septic tank	1250	1000	Snake River	To city sewer
Idaho Hide & Tallow Co. (Twin Falls)	Septic tank	2000	1000	Rock Creek	Secondary
Johnson Bros. Meat Packing (Nampa)	X	400	300	Indian Creek	Secondary
Kraft Cheese Co. (Ririe)	No system	1000	1000	Snake River	Secondary
Kraft Food Co. (Carey)	No system	1000	1000	Little Wood R.	Secondary
Liberty Packing Co. Boise)	No system	800	800	Eagle Drain	Secondary
Mickelsens Packing Co. (Blackfoot)	Lagoon	750	500		Improved efficiency
Nampa Animal Products (Nampa)	Septic tank	500	400	Indian Creek	Secondary
Nampa Packing Co. (Nampa)	Septic tank	300	200	Indian Creek	Secondary
	Septic tank	250	150	Indian Creek	Secondary
Nankafell Slaughter House (Nampa)	Secondary (munic.)				Eliminate deep well injection
National Reactor Test Station	Special processes (radioactive)	Radioactive			
Owyhee Meat Packers (Homedale)	Septic tank	500	400	Snake River	Secondary
Peoples Meat Packing Co. (Rupert)	Septic tank	500	300	Main Drain	Secondary
Seddon Meat Processing (Filer)	Septic tank	500	300	Drainage Ditch	Secondary
Stockmans Meat Packing Co. (Gooding)	Lagoon	10000	6000	Little Wood R.	Improved efficiency
Tiffany Slaughter House (Nampa)	Septic tank	200	100	Indian Creek	Secondary
Vans Packing Plant (Boise)	Septic tank	1500	900	Boise River	Secondary
Wattenbarger Meat Prod. (Shelley)	None	500	500	Snake River	Secondary

FEDERAL INSTALLATIONS

Installation	Agency	Need
Redfish Lake Recreation Area	USFS	Collection system & trmt
Island Park Recreation Area	USFS	Collection system & trmt
Alturas Lake Recreation Area	USFS	Collection system & trmt
Elk City Ranger Station	USFS	Connect to city
Powell Ranger Station	USFS	Lagoon
Bungalow Ranger Station	USFS	Treatment plant
Musselshell Work Camp	USFS	Treatment plant
Slate Creek Ranger Station	USFS	Chlorination
Mountain Home Air Force Base	USAF	Industrial trmt plant
Anderson Ranch Dam	USBR	Drainfield
Black Canyon Dam	USBR	Drainfield
Black Canyon Dam Power Plant	USBR	Septic tank & drainfield
Cascade Dam	USBR	Drainfield
Deadwood Dam	USBR	Drainfield
Boise River Diversion Dam	USBR	Drainfield
Lucky Peak Dam	USACE	Drainfield
Minidoka Dam & Headworks	USBR	Septic tank & drainfield
Ice Harbor Dam	USACE	Septic tank & drainfield

PAGE NOT

AVAILABLE

DIGITALLY

PHOTO CREDITS

PHOTO NO.	AGENCY
1	IDCD
2	OSHC
3, 4	FWPCA
5	FWPCA
6	USBR
7	FWPCA
8	OSHC
9	USFS
10	IDCD
11	IPC
12	IDCD
13	OSHC
14	IFGD
15	IFGD
16	USBR
17	FWPCA
18	AEC
19	OSHC
20	FWPCA
21	USBR
22	USFS
23	FWPCA
24	IFGD
25	IFGD
26	SCS
27	SCS
28	IDCD
29	FWPCA
30	FWPCA
31	FWPCA
32	FWPCA
33	BLM

AGENCY ABBREVIATIONS

IDCD — Idaho Department of Commerce and Development
OSHC — Oregon State Highway Commission
FWPCA — Federal Water Pollution Control Administration
AEC — Atomic Energy Commission
USBR — U. S. Bureau of Reclamation
IPC — Idaho Power Company
IFGD — Idaho Fish and Game Department
SCS — Soil Conservation Service
BLM — Bureau of Land Management
USFS — U. S. Forest Service