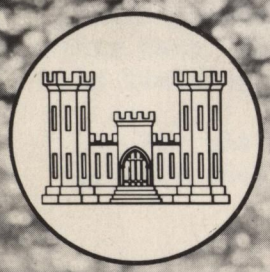
WATER RESOURCE DEVELOPMENT

COLUMBIA RIVER BASIN



U. S. ARMY ENGINEER DIVISION

NORTH PACIFIC

JUNE, 1958

REPORT BROCHURE

Portland, Oregon:	Division Engineer, U.S. Army Engineer Division North Pacific, 210 Custom House
	District Engineer, U.S. Army Engineer District, Portland, 628 Pittock Block
Seattle, Washington:	District Engineer, U.S. Army Engineer District, Seattle, 1519 South Alaskan Way
Walla Walla, Washington:	District Engineer, U.S. Army Engineer District, Walla Walla, Building 602, County-City Airport
Spokane, Washington:	Area Engineer, U. S. Bureau of Reclamation, W. 1323 Ide Avenue
Boise, Idaho:	Regional Director, U. S. Bureau of Reclamation, Fairgrounds
Missoula, Montana:	Library, Montana State University

Copies of the report may be purchased from the Division Engineer at the following prices:

Volume I	- Main Report	$10.00
Volume II	- Appendix A - Flood Control, Appendix B - Navigation, Appendix C - Power (Parts 1-4)	$ 7.50
Volume III	- Appendix C - Power (Parts 5-6)	$ 7.50
Volume IV	- Appendix D - Reports of Other Agencies	$ 7.50
Volume V	- Appendix E - Project Details	$ 7.50

I would appreciate your communicating the foregoing information to any persons known by you to be interested in the plan of improvement, and who may not have received a copy of this public notice.

Allen F. Clark, Jr.

1 Incl
Report Brochure

ALLEN F. CLARK, JR.
Colonel, Corps of Engineers
Division Engineer

U. S. ARMY ENGINEER DIVISION, NORTH PACIFIC
CORPS OF ENGINEERS
210 Custom House
Portland 9, Oregon

11 December 1958

PUBLIC NOTICE

TO WHOM IT MAY CONCERN:

The report on Water Resource Development of the Columbia River Basin has been completed by the Division Engineer and a summary of the findings and recommendations for further development in the interest of flood control, navigation, power, recreation and other water uses is contained in the attached report brochure.

This review investigation was authorized by resolution adopted 28 July 1955 by the Committee on Public Works of the United States Senate and other Congressional resolutions. Public hearings were held during the summer of 1956 and fall of 1957.

In accordance with law, the report has been referred to the Board of Engineers for Rivers and Harbors in Washington, D. C., for review. Parties desiring to comment on the recommendations of the Division Engineer may submit their views to the Board in writing. Statements prepared for consideration of the Board should not include material of a general nature or duplicate substantiating data already considered in the report of the Division Engineer. Those desiring an oral hearing should inform the Board whether they are proponents or opponents to the recommended improvements. In order for parties not in agreement with conclusions and recommendations of the Division Engineer to substantiate their request for a hearing, they should present a statement to the Board outlining the additional data they plan to present. Written communications should be addressed to the Board of Engineers for Rivers and Harbors, Washington 25, D.C., and should be mailed to be in the possession of the Board on or before 15 January 1959. If the factual data and information interested parties desire to submit to the Board in writing cannot be prepared for proper presentation by the above date, the Board should be informed of this fact without delay and a request should be made for an extension of the limiting date for submitting the written information.

For the convenience of the public, copies of the report are available for reference at the following places:

THE COLUMBIA RIVER BASIN

CORPS OF ENGINEERS

U. S. ARMY

BASIN MAP
MAJOR DAM AND RESERVOIR DEVELOPMENT

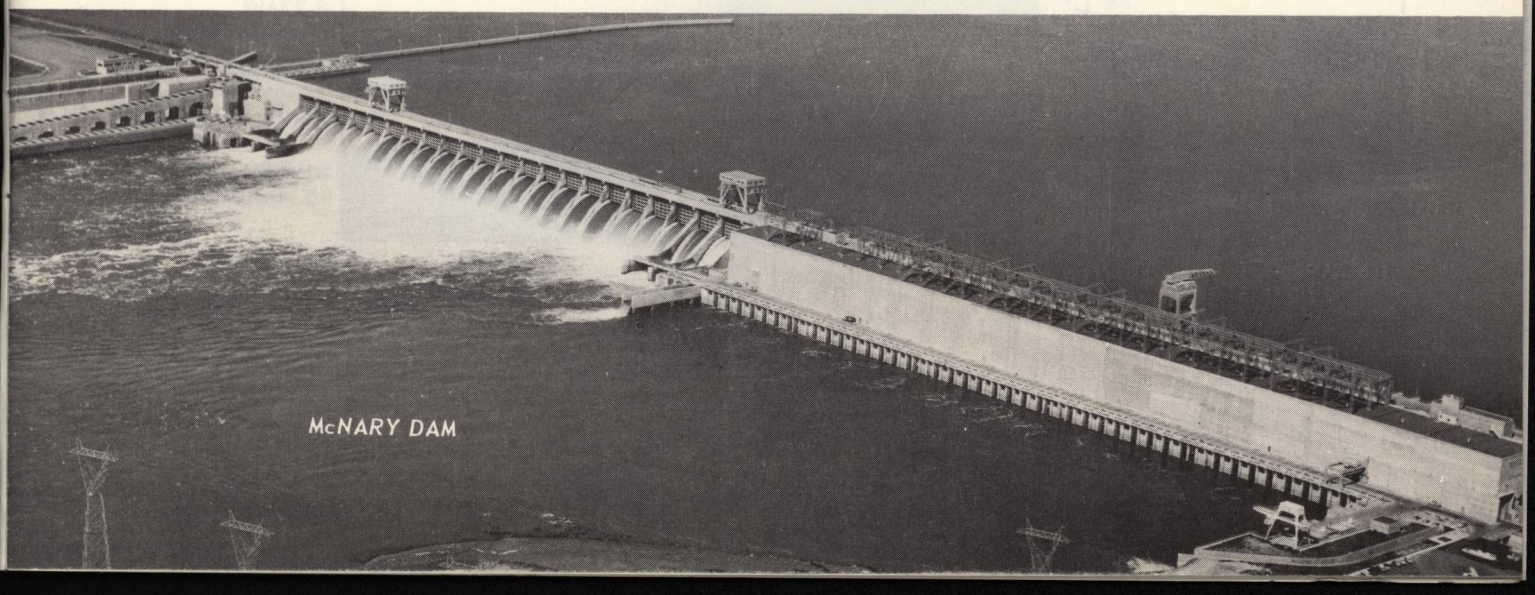
U. S. ARMY ENGINEER DIVISION, NORTH PACIFIC
CORPS OF ENGINEERS
1 JUNE 1958

Review of H.D. 531, 81st Congress, 2nd Session

WATER RESOURCE DEVELOPMENT of the COLUMBIA RIVER BASIN

REPORT BROCHURE

THE PURPOSE OF THIS BROCHURE IS TO ACQUAINT INTERESTED PERSONS WITH THE CONCLUSIONS AND RECOMMENDATIONS OF THE FIELD REPORT BY THE CORPS OF ENGINEERS ON "WATER RESOURCE DEVELOPMENT, COLUMBIA RIVER BASIN" DATED JUNE 1958 WHICH WAS PREPARED BY THE DIVISION ENGINEER, NORTH PACIFIC DIVISION WITH THE ASSISTANCE OF THE DISTRICT ENGINEERS AND OF THE FEDERAL AND STATE AGENCIES AND OTHER INTERESTS CONCERNED WITH DEVELOPMENT OF THE BASIN RESOURCES.



McNARY DAM

SUMMARY OF NEEDS

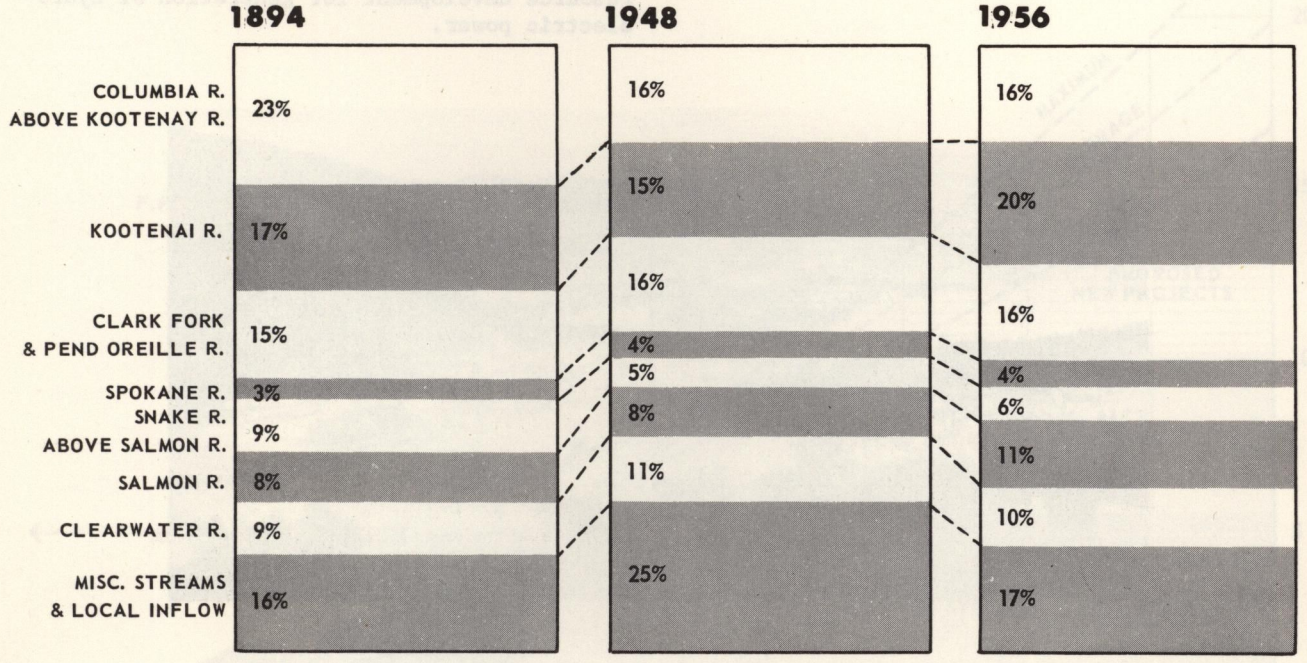
Flood Control

Major floods on Columbia River are the result of rapid spring melting of the winter snow pack in the main interior basin, occasionally augmented by rain. The distribution of flood runoff between tributaries is reasonably constant from year to year as illustrated by the following diagram (Figure 2 of the report) which shows the distribution of runoff for the 1894, 1948 and 1956 floods.

Although flood damages occur at many localities throughout the Columbia River Basin, the area of major damages lies along the 140-mile reach of the main stem Columbia River below Bonneville Dam. About 60 percent of the flood plain in this reach of river is protected to some degree by levees. A minimum acceptable flood control plan for lower Columbia River consists of improving and extending the

SOURCE OF MAJOR FLOODS

PERCENTAGE OF TOTAL VOLUME OF THE COLUMBIA & TRIBUTARIES DURING FLOOD CONTROL OPERATIONS



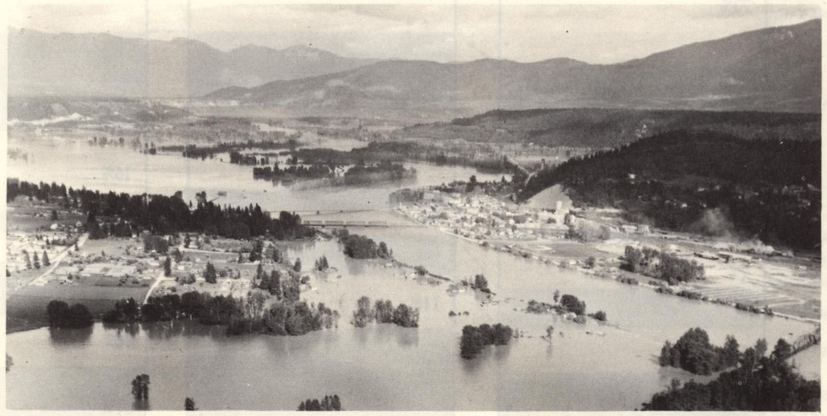
Oregonian Photo

Vanport after the destructive flood of 1948

existing levee system, as presently authorized, to provide dependable protection against a flow of 800,000 cfs at The Dalles and provision of a system of upstream storage reservoirs to effect reduction in peak discharges to 800,000 cfs or less.

A total of 18 to 19 million acre-feet of usable storage would be required to control to a maximum flow of 800,000 cfs at The Dalles a flood similar to that which occurred in 1894, the maximum flood of record on the Columbia River and most of its tributaries. A total of 10½ million acre-feet of storage, sufficient to control major floods to a flow of 1,030,000 cfs, is presently available at projects existing or under construction. An additional 7½ to 8½ million acre-feet must be obtained to achieve the minimum flood control goal, including additional storage of from 4 to 5 million acre-feet upstream from Grand Coulee Dam. This storage above Grand Coulee, together with modification of the outlet works at that project would permit full use of Franklin D. Roosevelt Lake for flood control.

Sufficient storage to afford control of major floods to 600,000 cfs at The Dalles (32 to 33 million acre-feet) is a desirable future goal and has been found obtainable within the limits of economic and needed water resource development for generation of hydroelectric power.

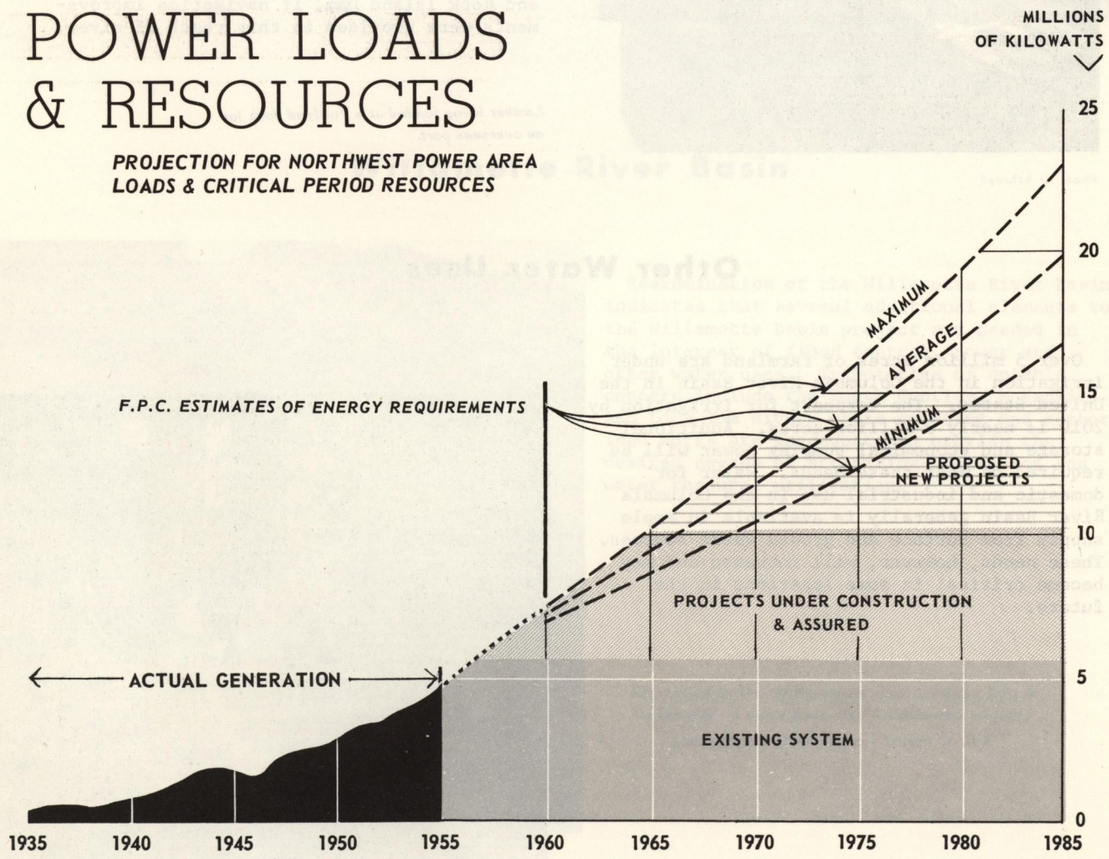


Flooding along Kootenai River at Bonner's Ferry, Idaho, during 1954 flood.

The requirements for power in the Northwest Power Region have increased rapidly in the past and large additions in generating capacity will be required to meet future loads. The 1957 regional power load amounted to approximately 5,400,000 kw of average generation. Based on the maximum load growth forecast shown on the figure below, it is estimated that this average load will be increased to more than 16,000,000 kw by 1975, to about 23,000,000 kw by 1985 and to about 56,000,000 kw by 2010. This represents an additional generating requirement of about 600,000 kw per year in the early decades increasing to over 1,300,000 kw per year by the end of the century, far beyond the amounts that can be supplied from the hydro resources alone. The plan for water resource development, therefore, should provide for early optimum utilization of available hydro-electric resources, with full recognition given to the need for compatible operation in a future regional power system which will be preponderantly thermal-electric in character.

POWER LOADS & RESOURCES

PROJECTION FOR NORTHWEST POWER AREA LOADS & CRITICAL PERIOD RESOURCES



Navigation

Photo by Ackroyd

Navigation use of Columbia River has increased with the growth of the region and improvement of the river. Annual traffic through Bonneville Locks, placed in operation in 1938, now approximate 1½ million tons. Upon completion of slack water to Pasco, Washington, and Lewiston, Idaho, as currently authorized, navigation tonnage is expected to increase more rapidly. It is estimated that over a 50-year period following provision of slack water to Lime Point, Idaho, annual barge commerce on the Columbia-Snake navigation system will average about 9 million tons. It is also estimated that annual barge commerce of 1.8 million tons will develop by 1990 on Columbia River between the head of McNary pool and Rock Island Dam, if navigation improvements were provided in this reach of river.

Lumber being loaded at a Portland dock for an overseas port.

Other Water Uses

Over 5 million acres of farmland are under irrigation in the Columbia River Basin in the United States. The forecast for irrigation by 2010 is nearly 9 million acres. Additional storage and economical pumping power will be required to meet these needs. Water for domestic and industrial use in the Columbia River Basin generally is available in ample supply from surface and ground water sources. These needs, however, will increase and may become critical in some locations in the future.

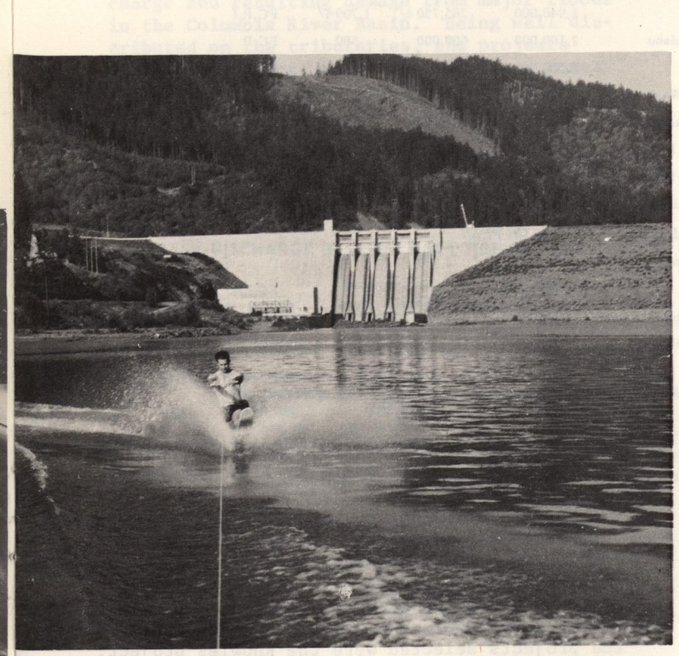
A U. S. Forest Service family camping unit.

U.S.F.S. Photo

Other water uses include the needs for recreation, fish and wildlife and pollution abatement. Increased population and leisure time and more ready access are placing much heavier demands on public recreational facilities. Although water-based recreational opportunities are relatively plentiful in the Columbia River Basin, the immediate utilization of each new development demonstrates the intensity of interest in additional opportunities. Preservation and improvement of fish and wildlife habitat is an essential requirement of satisfactory recreational use. Pollution in streams of the Columbia River Basin, while not widespread, is critical in some areas and will become of greater general concern as population and industry continue to grow. Increasing the uniformity of flow in the rivers through upstream regulatory facilities will be of much value in helping to maintain the purity of the water.

Trout fishing on Row River above Dorena Reservoir

Willamette River Basin



Reexamination of the Willamette River Basin indicates that several additional elements to the Willamette Basin project are needed in the interest of flood control, power and other water uses. Tributaries of notable concern include the South Santiam, McKenzie, and Long Tom Rivers where existing and authorized works are inadequate to provide the desired degree of streamflow regulation and water resource utilization.

Recreation on Dexter Reservoir. Lookout Point Dam in background - a major power and flood control project.

SELECTION OF MAJOR WATER PLAN

The report formulates a plan, identified as the Major Water Plan for the Columbia River Basin, consisting of a group of proposed projects selected from a number of alternatives, which together with the projects completed, under construction and reasonably assured, will provide for optimum utilization of the resources of the Columbia River Basin available within the United States. The projects selected for inclusion in the Major Water Plan, together with a summary of pertinent data, are listed in Table 1. The attached map, Plate 1 of the report, shows all projects of the Major Water Plan as well as alternatives considered and possible future additions to the Plan.

TABLE 1

SUMMARY PROJECT DATA

Project	Location	Usable Storage (Acre-Feet)	Power Installation (Initial-KW)	Gross Head (Feet)	Primary Purposes 1/
PROJECTS SELECTED FOR INCLUSION IN MAJOR WATER PLAN					
Libby 2/	Kootenai River, Montana	5,010,000	344,000	344	FC,P
Long Meadows	Yaak River, Montana	400,000	9,000	192	FC,P
Ninemile Prairie 3/	Blackfoot River, Montana	885,000	60,000	285	FC,P
Flathead Lake Outlet Improvement	Flathead River, Montana	1,220,000	–	–	FC
Knowles	Clark Fork, Montana	3,080,000	256,000	230	FC,P
Enaville	Coeur d'Alene River, Idaho	700,000	30,000	272	FC,P
Garden Valley Division 3/	Payette River, Idaho	1,940,000	285,750 4/	1,700 4/	FC,P,I
High Mountain Sheep	Snake River, Oregon-Idaho	2,100,000	600,000	580	FC,P
Lower Canyon 5/	Salmon River, Idaho	2,500,000	640,000	665	FC,P
Wenaha	Grande Ronde River, Wash.-Ore.	900,000	134,000	520	FC,P
Asotin	Snake River, Idaho-Washington	Pondage	288,000	107.5	N,P
Penny Cliffs	MF Clearwater River, Idaho	2,300,000	292,000	592	FC,P,N
Bruces Eddy	NF Clearwater River, Idaho	1,433,000	240,000	566	FC,P,N
Navigation Extension to Rock Island	Columbia River, Washington	–	–	–	N
ADDITIONS TO THE WILLAMETTE RIVER BASIN PLAN					
Strube Reregulating Reservoir	SF McKenzie River, Oregon	Pondage	4,500	63	P
Gate Creek	Gate Creek, Oregon	45,000	–	–	FC,I,N
Fern Ridge Modification	Long Tom River, Oregon	15,000	–	–	FC
Cascadia	South Santiam River, Oregon	145,000	–	–	FC,I,N

1/ FC-Flood Control, P-Power, I-Irrigation, N-Navigation

2/ Libby project reconfirmed as a desirable element of the Major Water Plan. Development is contingent upon agreement with Canada.

3/ As developed and proposed by the Bureau of Reclamation.

4/ Totals for all elements of proposed Garden Valley Division, including Scriver Creek plants.

5/ Selected for Major Water Plan but not recommended for authorization pending solution of fish passage problem.

In the selection of the above projects, studies were made of available alternatives. Complete alternative plans were developed on the Clark Fork and in the Middle Snake for comparative analysis prior to selection of the Major Water Plan projects.

In the Clark Fork Basin, three alternative plans were studied, consisting basically of: (1) the Paradise project, (2) the Knowles project, and (3) a group of several smaller reservoirs. Following comparative analyses, the projects selected were the Knowles project, the Ninemile Prairie project, as proposed by the Bureau of Reclamation; and improvement of the outlet channel for Flathead Lake to permit the use of the lake storage between the present operating limits for flood control purposes.

In the Middle Snake River Basin six alternative plans were studied. The essential elements of these plans were: (1) Nez Perce on the Snake River below the Salmon River; (2) Low Mountain Sheep and Low Pleasant Valley on the Snake River and Lower Canyon on the Salmon River just above its mouth; (3) High Mountain Sheep on Snake River just above the mouth of Salmon River but below the mouth of Imnaha River, and Lower Canyon on Salmon River; (4) High Mountain Sheep with diversion from the Salmon River; (5) High Pleasant Valley on the Snake River, as contemplated by the Bureau of Reclamation, and Lower Canyon on the Salmon River; and (6) High Pleasant Valley with diversion from the Salmon River. The report recommends adoption of Plan 3. This plan affords a maximum development in the area and can be constructed in two stages with deferment in authorization and construction of the Lower Canyon project on Salmon River until adequate means for the safe passage of downstream migrants over high dams have been developed and satisfactorily tested.

ACCOMPLISHMENTS OF MAJOR WATER PLAN

Flood Control

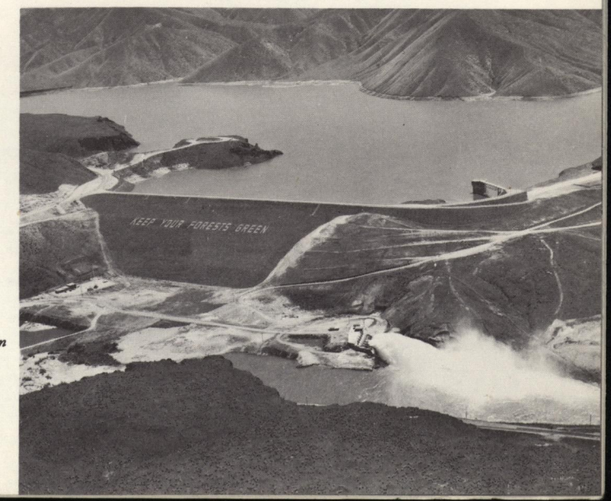
Projects of the Major Water Plan would effect a very large reduction in the discharge and resulting damage from major floods in the Columbia River Basin. Being well distributed on the tributaries, the projects would also protect many upstream flood zones as well as the major damage area along the lower river. Usable flood control storage of the Major Water Plan reservoirs totals 32,400,000 acre-feet, an amount that would reduce peak flows at The Dalles for three major floods of record as follows:

PEAK DISCHARGE IN CUBIC FEET PER SECOND

Flood	Unregulated	Regulated by Present Storage	Regulated by the Major Water Plan
1894	1,240,000	1,030,000	590,000
1948	1,010,000	860,000	500,000
1956	920,000	720,000	450,000

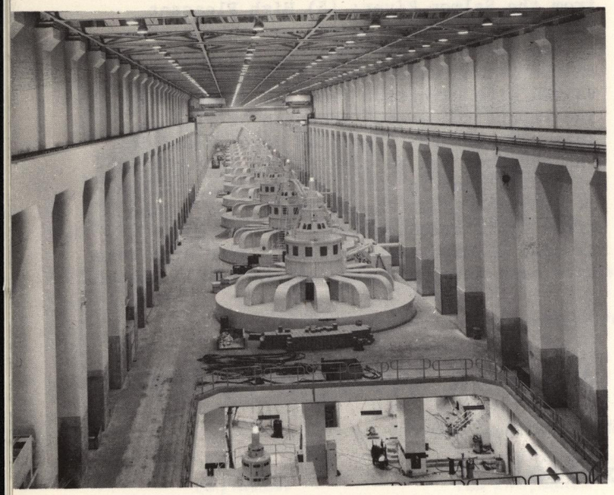
Thus it is seen that completion of the Major Water Plan will permit flow reduction for a flood similar to that of 1894 to far beyond the minimum objective of 800,000 cfs at The Dalles. The report shows that this minimum objective can be achieved with partial completion of the Plan, by projects having total usable flood control storage of 18,030,000 acre-feet.

Levees along lower Columbia River, together with authorized improvements and extensions thereto will afford flood protection having an annual value of $14,300,000. A reservoir system having sufficient capacity to meet the minimum goal of control, 800,000 cfs at The Dalles, would provide protection having an additional annual value of $20,630,000. This value would increase to $22,022,000 with operation of the full Major Water Plan. In addition, storage projects of the full Plan would effect flood damage reductions on the tributaries amounting to $5,736,000 annually. Flood control benefits attributable to the new storage projects of the Major Water Plan would total $11,012,000.



Reservoir storage at Lucky Peak Dam, a Corps of Engineers project providing flood control and supplementary irrigation water in the Boise River Basin

Power



Powerhouse at McNary Dam.

Operating under load conditions forecast for 1985, the hydro-electric projects contemplated for the region would have an installed capacity of nearly 25,000,000 kw and would be capable of generating about 14,400,000 kw of average continuous (prime) power. The total salable annual generation would be about 143 billion kwh. Power data for the projects proposed in the report are summarized in Table 2 which shows installed capacities and the added prime power (at site and downstream) which they would provide when operated in the Major Water Plan under load conditions forecast for 1985. These projects collectively added to the regional resource would increase the average annual energy production by about 28 billion kwh and represent nearly 14 percent of the 1985 estimated total regional energy load of 203 billion kwh.

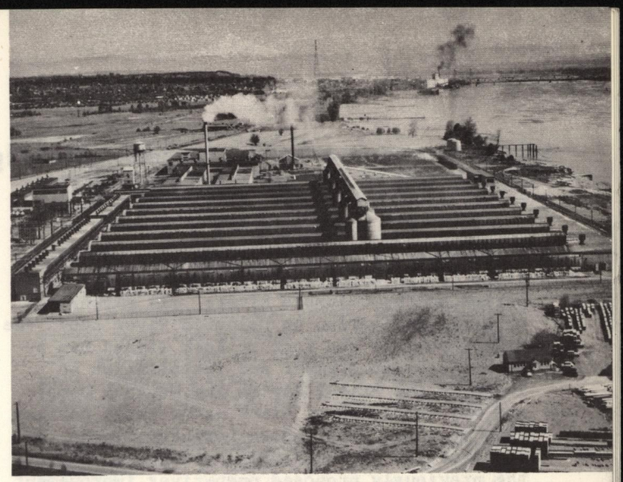
TABLE 2

ADDITIONAL POWER, MAJOR WATER PLAN

Project	Initial Installed Capacity (kw)	Prime Power Credit (kw)
Libby	344,000	956,000
Long Meadows	9,000	54,500
Ninemile Prairie	60,000	130,000
Knowles	256,000	697,000
Enaville	30,000	143,000
Garden Valley	286,000	(271,400) 1/
High Mountain Sheep	600,000	637,000
Lower Canyon	640,000	477,000
Asotin	288,000	168,000
Wenaha	133,000	135,000
Penny Cliffs	292,000	342,000
Bruces Eddy	240,000	236,000
Total	3,178,000	3,975,500 2/

1/ Benefits for Garden Valley development evaluated on the basis of dependable capacity.

2/ Not including Garden Valley. Total prime in excess of 4,100,000 kw during period Garden Valley storage operated for downstream power.



Aluminum Company of America plant, bordering the Columbia River at Vancouver, Washington.

The figure on Page 3 shows the present and future phases of the Major Water Plan, including the independent resources, and their relation to the forecasted regional load. The following tabulation summarizes this comparison, based on the maximum and minimum load forecasts for the Northwest Load Area for 1985:

LOAD-RESOURCE COMPARISON IN 1000 KILOWATTS

	MAXIMUM FORECAST			MINIMUM FORECAST		
	Hydro Resource	Load Forecast	Thermal Reqmt.	Hydro Resource	Load Forecast	Thermal Reqmt.
Existing and reasonably assured projects	10,400	22,800	12,400	10,400	16,500	6,100
Full Major Water Plan incl. proposed new projs	14,400	22,800	8,400	14,400	16,500	2,100

The net savings to the region resulting from these new projects, in lieu of alternative thermal generation, would be about $60 million annually.

Within foreseeable practical limits of development, the potential power in the United States' portion of the Columbia River Basin above and including Bonneville is nearly 17,000,000 kw of average annual generation. Of this total, nearly 10,000,000 kw would be developed with the projects completed, under construction, authorized, and licensed. Completion of the Major Water Plan would increase the development to about 13,200,000 kw or 78 percent of the practical potential in the U. S. portion of the basin. Other future projects discussed in the report would permit eventual development of better than 98 percent of this practical objective.

General view of The Dalles Dam – the city of The Dalles and Mt. Hood in the background.

Navigation

The Major Water Plan provides for two extensions to the authorized improvements for navigation on the Columbia River: (1) extension of barge navigation on Columbia River above the McNary pool to the foot of Rock Island Dam by open-river improvement and installation of locks in the Priest Rapids and Wanapum Dams; and (2) extension of slack water barge navigation on Snake River above Lewiston, Idaho, by construction of the Asotin project in lieu of the previously proposed open-river improvement. The Columbia River extension would bring an additional tributary area into reach for economical transportation of many of its products and requirements. On the Snake River, the proposed modification in the navigation plan would provide access by slack water navigation to the extensive limestone deposits above Lewiston.

These navigation extensions will result in an estimated average annual saving to the region in transportation costs of about $5,400,000 after a short period for development of commerce following completion of the entire navigation system.

Since all locks from The Dalles to Lewiston, Idaho, will have minimum over-sill depths of 15 feet and depths of 14 feet or greater can be obtained in all reservoir reaches at a negligible cost over and above the basic lock and dam costs, it is considered desirable that project dimensions of 14 feet by 250 feet be formally authorized for the Columbia-Snake River slack water navigation project above The Dalles.

Entrance to Bonneville Lock.

Other Water Uses

One of the fish ladders at Bonneville Dam for passing upstream migratory fish.

The proposed reservoirs of the Major Water Plan will have 330 square miles of water area and will provide excellent and much needed opportunities for such activities as fishing, boating, swimming, picnicking, and camping. The recreational value of all proposed projects has been appraised by the National Park Service and the U. S. Forest Service. Adequate facilities are proposed in each case, either by the construction agency in collaboration with local governmental bodies, or by the Forest Service where the reservoirs are in national forest land. Summarizing estimates prepared by the National Park Service, the aggregate attendance for all new projects of the Major Water Plan totals 375,000 visitor-days annually, producing yearly recreational benefits of $600,000, of which $343,400 would accrue to facilities to be provided in connection with the projects on lands outside the national forests.

Relative evaluation among the tributaries of the present and future utility for fish and wildlife has been a constant and important consideration in weighing project selections. Preliminary appraisals were made by the Fish and Wildlife Service of nearly all the projects studied. In accordance with these studies, three of the Major Water Plan projects, Long Meadows, Ninemile Prairie, and Garden Valley, would increase the value of the local fishery resource. The sum of the estimated annual benefits resulting from this improvement at Long Meadows and Ninemile Prairie is $535,000. The benefits at Garden Valley have not been specifically evaluated. The cost estimates for all projects contain funds for detailed examination, planning and construction of facilities for maintaining, and wherever reasonably possible, improving the fish and wildlife resource. Total funds included for this purpose in cost estimates for new Major Water Plan projects are over $58,000,000.

With completion of the Major Water Plan, the average low water flows will be approximately 138,000 cfs or more than a 50 percent increase over natural conditions. Such regulation, storing the surplus high flows and releasing this water to maintain increased low water discharges, will provide many benefits, other than to navigation and power, which will increase with the passage of time. Most important among these are domestic water supply uses, benefits from pollution abatement, and benefits to the fish and wildlife resource.

The Garden Valley project, as proposed by the Bureau of Reclamation, will eventually provide material direct irrigation benefits to the Payette Basin. Other storages also will be beneficial to future irrigation in providing direct water service in the area and in augmenting water supplies to downstream areas for diversion or direct pumping from the river channels.

Comparative cost and benefit data for each of the new projects are presented in Table 3.

TABLE 3

COST AND BENEFIT DATA, NEW MAJOR WATER PLAN PROJECTS

Project	Stream	Construction Cost 1/	Annual Costs	Annual Benefits	Benefit-Cost Ratio
Libby (authorized project)	Kootenai River	$ 307,900,000	$14,732,000	$ 29,428,000	1.70
Long Meadows	Yaak River	25,709,000	1,218,400	2,009,000	1.65
Ninemile Prairie 2/	Blackfoot River	54,893,000	2,703,900	4,546,400	1.68
Flathead Lake Outlet Improvement	Flathead River	6,142,000	236,000	656,000	2.78
Knowles	Flathead River	234,910,000	11,213,000	18,738,000	1.67
Enaville	Coeur D'Alene R.	78,036,000	3,562,200	4,448,000	1.25
Garden Valley Division 2/	Payette River	146,100,000	6,559,000 3/	9,906,000 3/	1.51
High Mountain Sheep	Snake River	226,333,000	12,902,400	28,373,000	2.20
Lower Canyon (recommendation for authorization deferred)	Salmon River	194,520,000	10,993,200	22,155,000	1.73
Wenaha	Grande Ronde R.	94,574,000	4,411,000	5,931,000	1.34
Asotin	Snake River	125,851,000 4/	6,444,000	10,748,000	1.67
Penny Cliffs	M.F. Clearwater	210,036,000	9,635,000	15,442,000	1.60
Bruces Eddy	N.F. Clearwater	127,166,000	6,165,000	11,363,000	1.84
Subtotal		$1,832,170,000	$90,775,100	$150,831,400 5/	1.66
Navigation Extension to Rock Island	Columbia River	64,973,000 6/	2,951,000	3,271,000	1.11
Total		$1,897,143,000	$93,726,100	$154,102,400 5/	1.64

1/ Excludes preauthorization study costs.

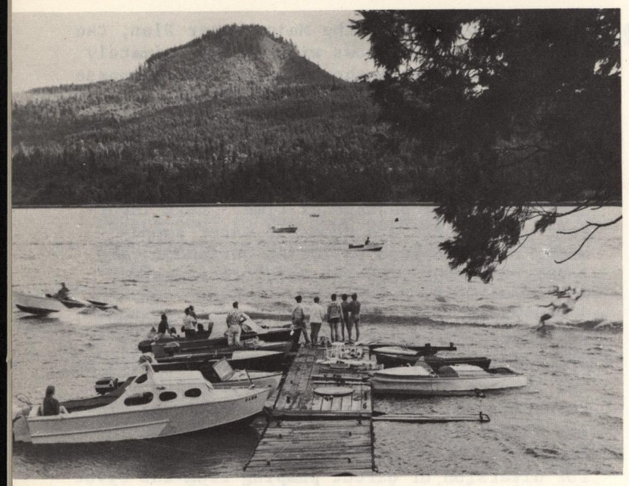
2/ As planned and proposed by U. S. Bureau of Reclamation.

3/ Not including taxes.

4/ Includes $171,000 for navigation aids.

5/ This total, which reflects the total system flood control benefits for control to 600,000 cfs at The Dalles, is $12,912,000 less than the sum of the individual project benefits above which assume each project participating in the base system for control to 800,000 cfs at The Dalles. Those projects constructed after the basic flood control goal has been achieved, actually would be credited with a lesser flood control benefit than included above.

6/ Includes $105,000 for navigation aids. Excludes $225,000 for initial provisions by nonfederal interests for future navigation lock at Priest Rapids.



Boating on Dexter Pool.

The total evaluated annual benefits credited in the report to the group of new projects of the Major Water Plan (Table 3) amount to $154,102,400 broken down as follows:

Flood Control	$ 11,012,000
Navigation	6,234,000
Power	135,978,000
Recreation	343,400 1/
Fish and Wildlife	535,000
Total	$154,102,400

1/ Does not include benefits resulting from facilities to be provided by the U. S. Forest Service.

Annual costs of the new projects of the Major Water Plan are estimated to be $93,726,100, which, when compared with the above total benefits, result in an over-all benefit-cost ratio of 1.64.

ADDITIONS TO WILLAMETTE RIVER BASIN PLAN

Three projects to provide additional storage in the Willamette River Basin have been found to be needed and economically justified based on conditions foreseeable at this time. These are Gate Creek and Cascadia Reservoirs and modification of the existing Fern Ridge Dam to provide 15,000 acre-feet of additional flood control storage in Fern Ridge Reservoir.

Studies also show that provision of a reregulating dam and reservoir at the Strube site to permit low load factor operation of the Cougar project, currently under construction, is desirable and economically justified. Descriptive data on these projects are contained in Table 1. Cost and benefit data are presented in the following tabulation:

COST AND BENEFIT DATA, NEW WILLAMETTE BASIN PROJECTS

Project	Stream	Construction Cost 1/	Annual Costs	Annual Benefits	Benefit-Cost Ratio
Strube	S.F. McKenzie River	$ 6,685,000	$ 582,700 2/	$ 647,000 2/	1.11
Gate Creek	Gate Creek	15,920,000	677,500	887,400	1.31
Fern Ridge (modification)	Long Tom River	140,000	5,000	13,800	2.76
Cascadia	South Santiam	28,270,000	1,171,700	1,532,800	1.31
		$51,015,000	$2,436,900	$3,081,000	

1/ Excludes preauthorization study costs.

2/ Annual costs and benefits are total incremental amounts associated with Strube and peaking installation at Cougar compared to initial high load factor installation at Cougar.

In addition to the above projects recommended in this report, recommendation has been made by the field officers in a separate report for authorization of the Foster project on South Santiam River below Green Peter, with 30,000 acre-feet of usable storage, in lieu of the presently authorized White Bridge Reregulating Reservoir.

SUMMARY OF RECOMMENDATIONS

The Division Engineer recommends that the following projects of the Major Water Plan for development of the water resource of the Columbia River Basin be authorized for construction:

Long Meadows project, Yaak River, Montana, at an estimated construction cost of $25,709,000.

Ninemile Prairie project, Blackfoot River, Montana, at an estimated construction cost of $54,893,000 as planned and proposed by the Bureau of Reclamation.

Flathead Lake Outlet Improvement, Flathead River, Montana, at an estimated construction cost of $6,142,000.

Knowles project, Flathead River, Montana, at an estimated construction cost of $234,910,000.

Enaville project, Coeur d'Alene River, Idaho, at an estimated construction cost of $78,036,000.

Garden Valley Division, Payette River, Idaho, at an estimated construction cost of $146,100,000 as planned and proposed by the Bureau of Reclamation.

High Mountain Sheep project, Snake River, Idaho and Oregon, at an estimated construction cost of $226,333,000.

Wenaha project, Grande Ronde River, Washington and Oregon, at an estimated construction cost of $94,574,000.

Asotin project, Snake River, Idaho and Washington, at an estimated construction cost of $125,680,000, not including the cost of navigation aids.

Penny Cliffs project, Middle Fork Clearwater River, Idaho, at an estimated construction cost of $210,036,000.

Bruces Eddy project, North Fork Clearwater River, Idaho, at an estimated construction cost of $127,166,000.

Navigation Extension to Rock Island Dam, Columbia River, Washington, at an estimated construction cost of $64,868,000, not including the cost of navigation aids.

The Division Engineer also recommends that the following projects be authorized as additions to the Willamette Basin Plan:

Strube Reregulating Reservoir project, South Fork McKenzie River, Oregon, at an estimated construction cost of $6,685,000.

Gate Creek project, Gate Creek, Oregon, at an estimated construction cost of $15,920,000.

Modification of Fern Ridge project, Long Tom River, Oregon, at an estimated construction cost of $140,000.

Cascadia project, South Santiam River, Oregon, at an estimated construction cost of $28,270,000.

It is further recommended that the channel of the authorized Columbia-Snake barge navigation project be designated as 14 feet by 250 feet at minimum regulated flows.

WATER RESOURCE DEVELOPMENT

COLUMBIA RIVER BASIN

U. S. ARMY ENGINEER DIVISION

NORTH PACIFIC

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REPORT BROCHURE