WATER CONTROL MANUAL REVISIONS
FOR LOWER MONUMENTAL LOCK AND DAM

The following revisions are provided for the updating of this Water Control Manual. This Manual will be reviewed anually and updated if necessary. Major revisions pertaining to format and content in accordance with references ET'. 110-2-251 and ER 1110-2-240 will be accomplished as time and manpower becomes available.

FEBRUARY 2011 revisions include:

1. Emergency Regulation Assistance Procedures (Pink Sheet, Page iv)
2. Personnel and Telephone Numbers (Pages 6-9 and 6-10)
3. EXHIBIT 8-1 (Page 7 of 7)

DECEMBER 1988 revisions include:

1. Emergency Regulation Assistance Procedures (Pink Sheet, Page iv)
2. Personnel and Telephone Numbers (Pages 6-9 and 6-10)
3. SECTION IX - EFFECT OF WATER CONTROL PLAN (Pages 9-3 and 9-4)
4. PLATE 9-2, Annual Peak Discharge Frequency - Columbia River at The Dalles.

JUNE AND DECEMBER 1987 revisions include:

1. TITLE PAGE (Green Sheet)
2. PHOTOGRAPH (Insert existing project photo for page ii)
3. NOTICE TO USERS (page iii)
4. EMERGENCY REGULATION ASSISTANCE PROCEDURES (Pink Sheet, Pages
5. TABLE OF CONTENTS (Yellow Sheet, Pages a-d)
6. PERTINENT DATA (Blue Sheet, Pages A-D)
7. SECTION - Introduction (Pages 1-1 to 1-2)
8. SECTION VI- Water Control Management (Pages 6-1 to 6-10)
9. SECTION VII - Streamflow Forecasts (Page 7-1)
10. SECTION VIII - Water Control Plan (Pages 8-1 to 8-11)
11. SECTION IX - Effects of Water Control Plan (Pages 9-1 to 9-4)
12. TABLE 6 - Summary of Runoff and Discharge Data Snake River near Clarkston, Wash.
13. TABLE 6A - Summary of Runoff and Discharge Data - Lower Granite Reservoir Computed Regulated Inflows
14. TABLE 13 - Ice Harbor Mean Unit Performance
15. CHART 3 - Power Unit Discharge Rating
16. CHART 12- Regulation of Large Historical Snake River Floods
17. PLATE 2 - Reservoir Map (2 Sheets)
18. PLATE 8 - Daily Discharge Hydrographs - Snake River near Clarkston, Wash. (1948-1966)
19. PLATE 8A - Daily Discharge Hydrographs - Snake River near Clarkston, Wash.(1967-1972)
20. PLATE 8B - Daily Discharge Hydrographs - Lower Granite Reservoir Computed Regulated Inflows (1976-1986)
21. PLATE 9 - Summary Hydrographs - Snake River near Clarkston, Washington
22. PLATE 9-1 - Annual Peak Discharge Frequencies - Snake River at Lower Granite
23. PLATE 9-2 - Annual Peak Discharge Frequencies Columbia River at The Dalles

1985 WATER CONTROL MANUAL STATUS SHEET
LOWER MONUMENTAL LOCK and DAM, WASHINGOTN

CHAPTER NUMBER	ITEM*	PRIORITY	STATUS	PLANNED ACTION
I	INTRODUCTION	3	3	
II	DESCRIPTION	3	3	ALL MANUAL ITEMS WILL BE REVIEWED PERIODICALLY.
III	HISTORY	3	3	
IV	WATERSHED CHARACTERISTICS	3	3	
V	DATA COLLECTION	2	3	
VI	HYDROLOGIC FORECASTS	2	NA	
VII	WATER CONTROL PLAN	1	1	
VIII	EFFECT OF WATER CONTROL PLAN	2	6	
IX	WATER CONTROL MGT.	2	3	
SUPPORTING INFORMATION:				
PROJECT PHOTO		3	1	
PERTINENT DATA		2	3	

* Includes charts & tables associated with each chapter

STATUS CODES

APPROVED MANUALS:

1. TECHNICAL ASPECTS ADEQUATE AND APPROVED; FINISHED FORM (up-to-date).
2. TECHNICAL ASPECTS ADEQUATE AND APPROVED; DRAFT FORM (preliminary).
3. APPROVED, BUT SOME ASPECTS INCOMPLETE OR NEED REVISION.

MANUALS NOT APPROVED:

4. DRAFT FORM; NOT ALL ASPECTS APPROVED.
5. PORTIONS INCOMPLETE AND/OR OUTDATED.
6. INCOMPLETE CHAPTER (report published prior to ETL 1110-2-251, "Engineering and Design - Preparation of Water Control Manuals," dated 14 March 1980).

NA - Not applicable

WATER CONTROL MANUAL INDORSEMENTS

CENPW-PL-H (CENPW-PL-H/11 Jun 87) (1110-2-1150a) 2nd End Mr. Kim/jm/434-6608
SUBJECT: Lower Monumental Lock and Dam, Water Control Manual Revisions

DA, Commander, Walla Walla District, Corps of Engineers, Walla Walla, WA 99362-9265 28 December 1987

FOR: Commander, North Pacific Division, ATTN: CENPD-EN-WM

1. Enclosed for your approval are five sets of revisions for Section VIII - Water Control Plan and other pertinent sections in the subject Water Control Manual which was published in May 1970 and approved on 15 July 1970. Review comments by your office and NPW Planning, Operations, Engineering Divisions, and Ice Harbor - Lower Monumental Project Office on the set of June 1987 revisions have been incorporated into the following set of revisions to the subject Water Control Manual.

2. The items revised within the subject Manual include:

1. TITLE PAGE (Green sheet)
2. PHOTOGRAPH (Insert existing project photo for Page ii)
3. NOTICE TO USERS OF MANUAL (Page iii)
4. EMERGENCY REGULATION ASSISTANCE PROCEDURES (Pages iv-v, pink sheet)
5. TABLE OF CONTENTS (Pages a-d, yellow sheet)
6. PERTINENT DATA (Pages A-D, blue sheet)
7. I - INTRODUCTION (Pages 1-1 to 1-2)
8. VI - WATER CONTROL MANAGEMENT (Pages 6-1 to 6-10)
9. VII - STREAMFLOW FORECASTS (Page 7-1)
10. VIII - WATER CONTROL PLAN (Pages 8-1 to 8-11)
11. IX - EFFECTS OF WATER CONTROL PLAN (Pages 9-1 to 9-4)
12. EXHIBIT 1-1 Design Memorandums
13. EXHIBIT 8-1 Part 207 - Navigation Regulations
12. TABLE 6 Summary of Runoff and Discharge Data - Snake River near Clarkston, Washington
13. TABLE 6A Summary of Runoff and Discharge Data - Lower Granite Reservoir Computed Regulated Inflows

14. CHART 11 Regulation of Large Snake River Floods

15. PLATE 8A Daily Discharge Hydrographs - Snake River near Clarkston, Washington (1967-1972)

16. PLATE 8B Daily Discharge Hydrographs - Lower Granite Reservoir Computed Regulated Inflows (1976-1986)

17. PLATE 9 Summary Hydrographs - Snake River near Clarkston, Washington

18. PLATE 9-1 Annual Peak Discharge Frequencies - Snake River at Lower Granite

19. PLATE 9-2 Annual Peak Discharge Frequencies - Columbia River at The Dalles

20. PLATE 10 Summary Hydrographs - Clearwater River at Spalding, Idaho (Regulated Discharge)

3. We would appreciate your response by 15 January 1988. We plan to forward copies of the above set of revisions to other interested parties after approval is received from your office.

4. Questions concerning these revisions to the subject manual should be directed to Ed Kim, extension 6608.

FOR THE COMMANDER:

KIM/kl

RICKEL/PL-H

5 Encls

RONALD G. BARRETT, P.E.
Acting Chief, Planning Division

BARRETT/PL

IM-SM

EN

CENPD-EN-WM (CENPW-PL-H/11 Jun 87)(1110-2-1150a) Mr. Holmes/FTS 423-3761/dll
SUBJECT: Lower Monumental Lock and Dam, Water Control Manual Revisions

DA, North Pacific Division, Corps of Engineers, P. O. Box 2870, Portland, Oregon 97208-2870 27 July 1987

FOR: Commander, Walla Walla District, ATTN: CENPW-PL-H

One set of revisions which has been marked with our comments is enclosed. Exhibit 5-1 should also incorporate changes shown in the enclosed CFR.

FOR THE COMMANDER:

5 Encls
w/d 4 Encls
added 1 Encl

HERBERT H. KENNON, P.E.
Chief, Engineering Division

DEPARTMENT OF THE ARMY
WALLA WALLA DISTRICT, CORPS OF ENGINEERS
BUILDING 602, CITY-COUNTY AIRPORT
WALLA WALLA, WASHINGTON 99362

REPLY TO
ATTENTION OF:

CENPW-PL-H (1110-2-1150a) 11 June 1987

MEMORANDUM FOR: Commander, North Pacific Division, ATTN: CENPD-EN-WM

SUBJECT: Lower Monumental Lock and Dam, Water Control Manual Revisions

1. Enclosed for your review and comment are five sets of revisions for Section VIII - Water Control Plan and other pertinent sections in the subject Manual, which was published in May, 1970. We are requesting concurrent review of these revisions by CENPW Planning Division; Operations, Construction, and Readiness Division; Engineering Division; and Lower Monumental Project Engineer.

2. The items revised within the subject Manual include:

a. TITLE PAGE (Page i)

b. PHOTOGRAPH (Insert existing project photo for Page ii)

c. NOTICE TO USERS OF MANUAL (Page iii, pink sheet)

d. EMERGENCY REGULATION ASSISTANCE PROCEDURES (Pgs iv-v, pink sheet)

e. TABLE OF CONTENTS (Pgs a-d, yellow sheet)

f. PERTINENT DATA (Pgs A-D, blue sheet)

g. I - INTRODUCTION (Pgs 1-1 to 1-2)

h. VI - WATER CONTROL ~~PLAN~~ MANAGEMENT (Pgs ~~8-1 to 8-11~~ 6-1 to 6-10)

i. VII - STREAMFLOW FORECASTS (Page 7-1)

j. VIII - WATER CONTROL PLAN (Pgs 8-1 to 8-11)

k. IX - EFFECT OF WATER CONTROL PLAN (Pgs 9-1 to 9-4)

l. PLATE 9-1 Maximum Annual Flood Frequency Curve
Snake River at Lower Granite

m. PLATE 9-2 Maximum Annual Flood Frequency Curve
Columbia River at the Dalles

n. EXHIBIT 1-1 Design Memorandums

o. EXHIBIT 8-1 Part 207 - Navigation Regulations

CENPW-PL-H
SUBJECT: Lower Monumental Lock and Dam, Water Control Manual Revisions

3. We would appreciate receiving any editorial comments your office may have by 15 July 1987. Review comments will be incorporated into the Water Control Manual, and final revisions to the Manual will be distributed to interested parties.

4. Questions concerning revisions to the subject manual should be directed to Ed Kim, Extension 6608.

FOR THE COMMANDER:

5 Encls

for L. V. ARMACOST, P.E.
Chief, Planning Division

NPDEN-WC (26 Jun 70) 1st Ind
SUBJECT: Reservoir Regulation Manual, Lower Monumental Project

DA, North Pacific Division, Corps of Engineers, 210 Custom House, Portland, Oregon 15 July 1970

TO: District Engineer, Walla Walla, ATTN: NPWEN-PL

1. ER 1110-2-240 dated 22 April 1970 indicates that Division Engineers of divisions with Reservoir Control Centers have the responsibility of reviewing and approving reservoir regulation plans and manuals and related activities specified in ER 1110-2-1400, issued in April 1970.

2. The subject manual is approved with the exception of paragraph 1-01 which should be updated to agree with the instructions in ER 1110-2-240.

3. Two copies of the manual have been forwarded to OCE for their files, with paragraph 1-01 corrected by hand.

4. With regard to paragraph 2 of your transmittal letter, copies of manuals and reports should not be forwarded to other agencies until approval is received.

FOR THE DIVISION ENGINEER:

1 Incl
wd all cys

fr John W Daugherty
GORDON H. FERNALD, JR.
Chief, Engineering Division

DEPARTMENT OF THE ARMY
WALLA WALLA DISTRICT, CORPS OF ENGINEERS
BLDG. 602, CITY-COUNTY AIRPORT
WALLA WALLA, WASHINGTON 99362

NPWEN-PL

26 June 1970

SUBJECT: Reservoir Regulation Manual, Lower Monumental Project

Division Engineer
U.S. Army Engineer Division, North Pacific

1. Inclosed are four copies of the Lower Monumental Reservoir Regulation Manual. Additional copies can be provided if desired.

2. We are providing Bonneville Power Administration with three copies of the manual for their use.

FOR THE DISTRICT ENGINEER:

HAROLD L. MATTHIAS
Major, CE
Deputy District Engineer

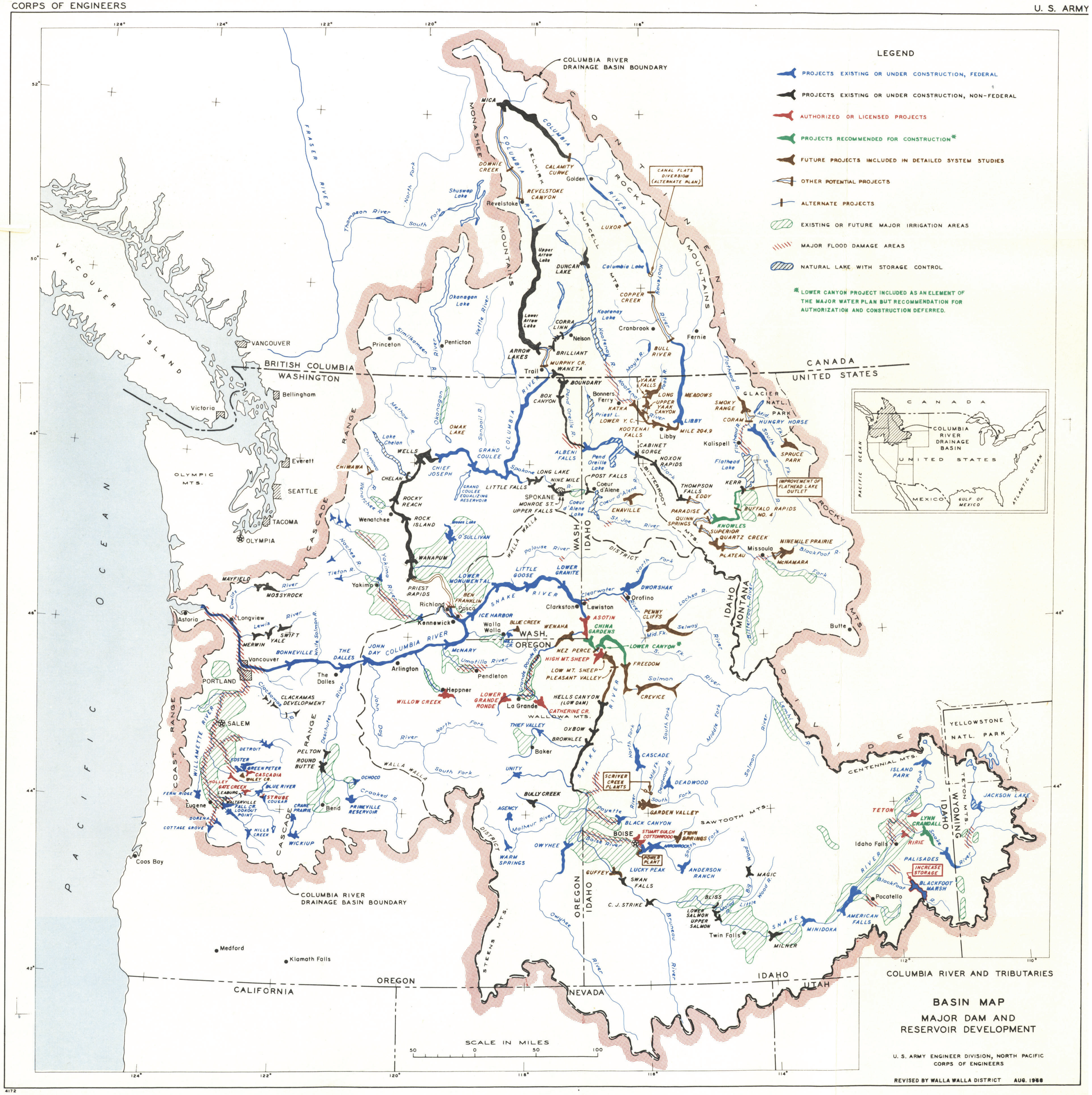
1 Incl
Manual - Cy 2-5

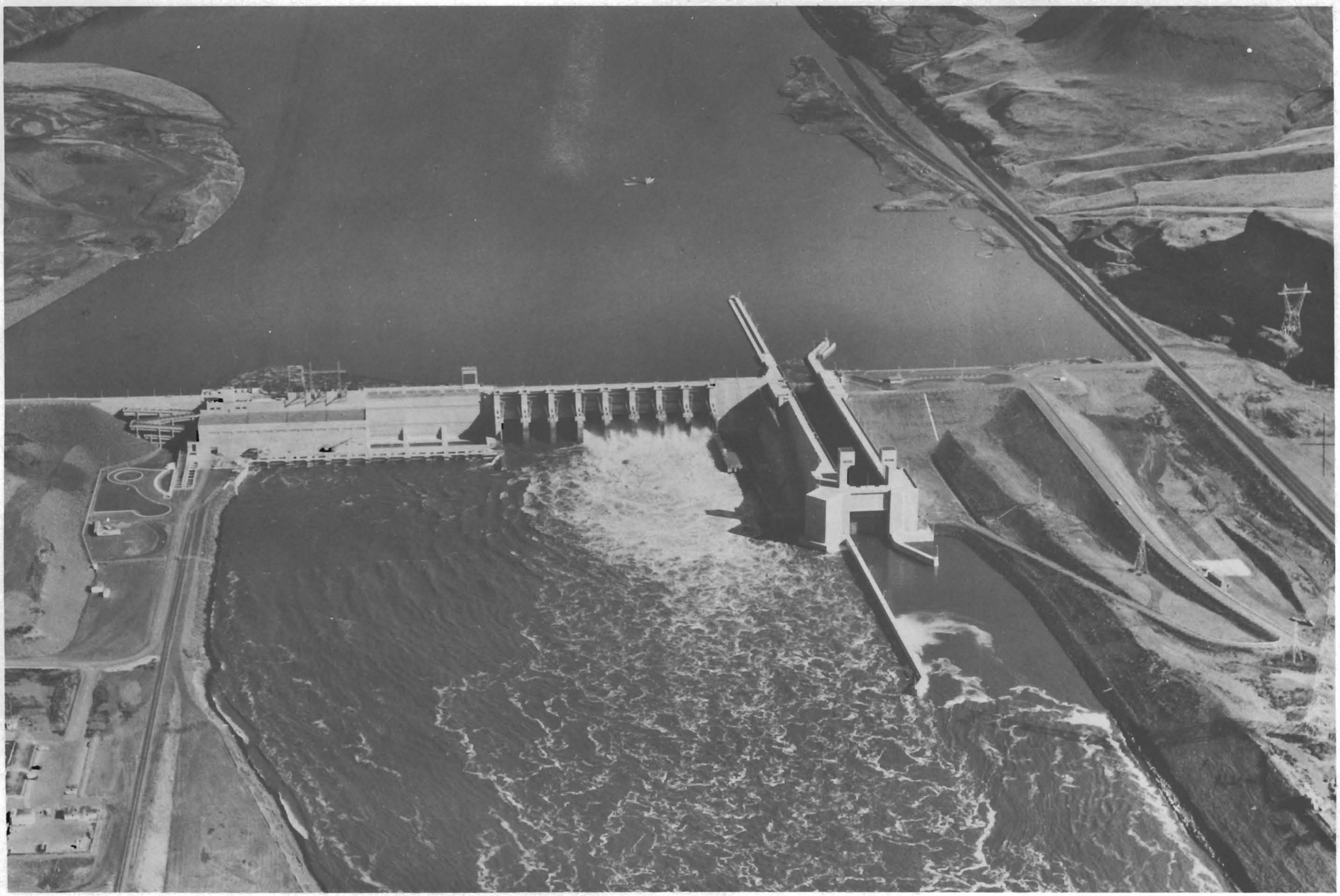
WATER CONTROL MANUAL
FOR
LOWER MONUMENTAL LOCK AND DAM
SNAKE RIVER, WASHINGTON

U.S. ARMY CORPS OF ENGINEERS
WALLA WALLA DISTRICT

MAY 1970

CORPS OF ENGINEERS U. S. ARMY



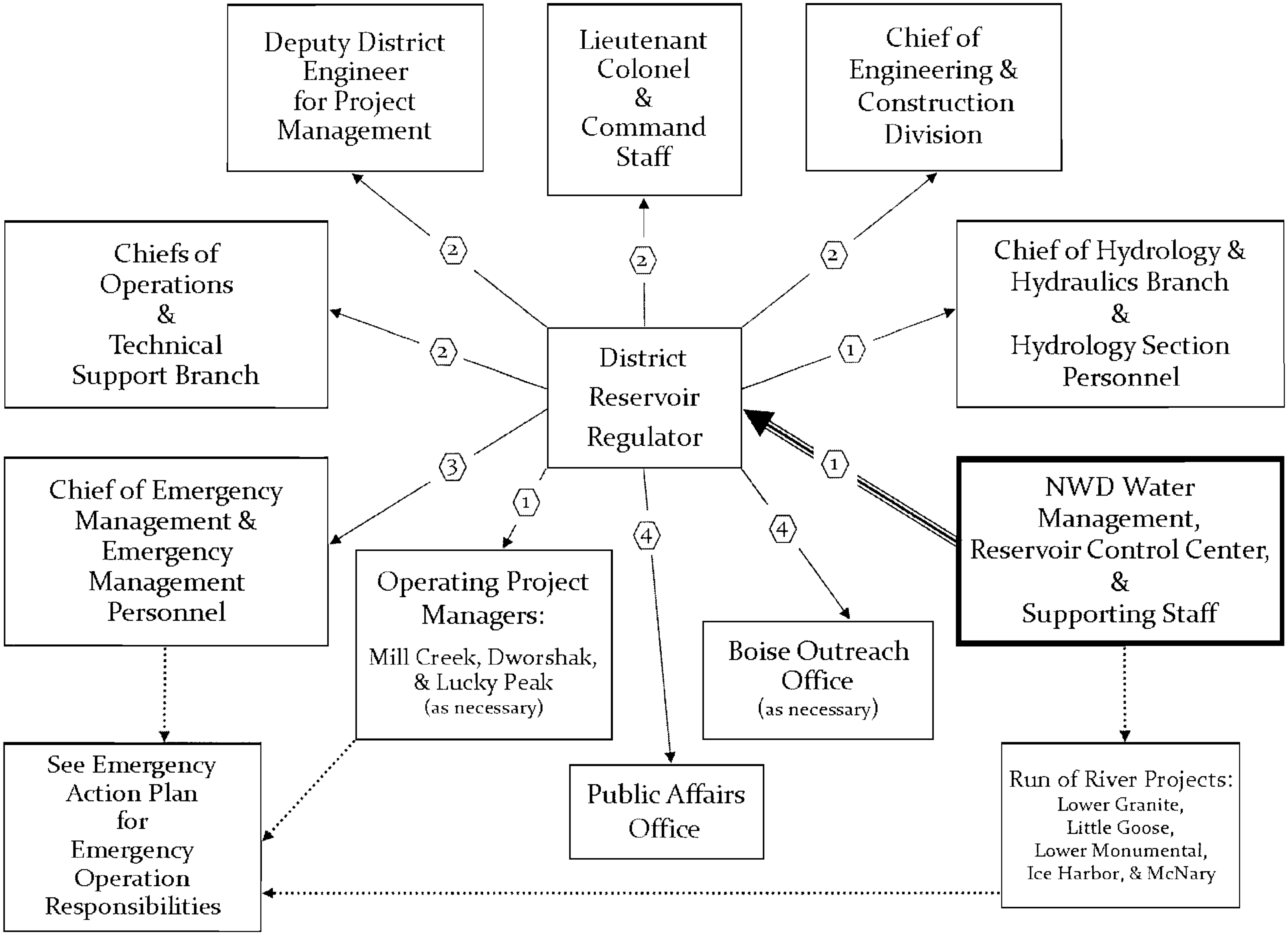


LOWER MONUMENTAL DAM

19 February 1970. Spillway discharge 48,900 cfs, powerhouse discharge 43,400 cfs, fish facilities discharge 300 cfs.

COMMUNICATION RESPONSIBILITIES for Flood Emergencies

Run of River Projects



NOTE: Numbers on the arrows indicate priority of contact. The highest priority contacts are denoted with 1 and the lowest priority contacts are denoted with 4.

NOTE: NWD Water Management initiates communication with the District Reservoir Regulator (large arrow) when the concern is with the Run of the River Projects.
District Reservoir Regulator sends the information to the interested parties (Solid Lines)
Communications that occur between the respective sources shown with Dashed lines

NOTICE TO USERS OF THIS MANUAL

Regulations specify that this Water Control Manual be published in loose-leaf form, and only those sections, or parts thereof, requiring changes will be revised and printed. Therefore, this copy should be preserved in good condition so that inserts can be made to keep the manual current.

As a continuing program it will be necessary to revise portions of this manual annually in order to keep it up to date. Revisions to this manual will be made by the Walla Walla District's Planning Division - Hydrology Branch. Whenever revisions are necessitated, new pages containing the revised material will be printed with the date of revision and issued to each person having a copy of the manual so that substitution may be made.

Emergency procedures are used if physical and/or structural failures occur at the Lower Monumental project and emergency coordination and action may be necessary to prevent loss of life or property. Emergency coordination and action required will be dependent upon the nature and severity of the emergency. Possible emergencies have been divided into the following categories: (1) catastrophic failures, (2) equipment failures, (3) project function emergencies (power generation and navigation), and (4) national type emergencies. The following paragraphs provide guidance on action required by operators and engineers dealing with these four categories of emergency conditions.

Catastrophic failures include:

1. Flooding resulting from failures at Lower Monumental Dams.
2. Flooding resulting from failures at upstream dams.
3. Assumed spillway design floods.
4. Flooding and damage caused by earthquakes, sabotage, cracking, equipment malfunction, leakage, and foundation failures.

Catastrophic failures should be coordinated according to existing criteria within the Flood Emergency Subplans - Lower Monumental Lock and Dam - Snake River, Washington, U.S. Army Engineer District, Walla Walla, August 1982.

Equipment failures that would prevent the controlled discharge of water passing through the project powerhouse or spillway would be an emergency and should be coordinated according to "Call-Out Procedures for Lower Monumental Emergencies", which is in the Lower Monumental Project Standing Orders.

Project function emergencies affecting power generation and/or navigation, are the responsibility of the Ice Harbor - Lower Monumental Project Engineer or his representative. Emergencies affecting power generation should be coordinated according to "Call-Out Procedures for Lower Monumental Emergencies", which is in the Lower Monumental Standing Orders. If the nature of the emergency is such as to require immediate action, the Project Engineer may take necessary action and report to Walla Walla District's Chief of Operations Division as soon as possible. The Bonneville Power Administration (BPA) dispatcher will also be notified of any emergency which may affect power production. Table B-1 in Exhibit 8-1 of this Manual shows a notification list for unscheduled lock closures or other navigation matters.

National type emergencies should be coordinated according to Annex K, Appendix 3 of the Walla Walla District Continuity of Operations Plan, which describes actions to be taken at Lower Monumental Project under various types of national emergencies (terrorist attack, sabotage, nuclear war, etc.).

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

Tables

* DELETED BY REVISION
** ADDED BY REVISION

Charts

Plates

Exhibits

* DELETED BY REVISION
** ADDED BY REVISION

LOWER MONUMENTAL LOCK AND DAM

SNAKE RIVER, WASHINGTON

PERTINENT DATA

GENERAL	
Stream miles from mouth of Snake River	41.6
River miles upstream from Ice Harbor Dam	31.9
Drainage Area, square miles	108,500
Length of dam at crest, feet	3,791
Height upper lake level to tailwater, feet	100
Discharge in cubic feet per second:	
Minimum of record, natural	9,000
Mean annual flow	48,950
Average annual peak flow	187,000
Maximum of record, June 1894	409,000
Maximum of record, June 1894, controlled by existing projects	295,000
Standard project flood, controlled by existing projects and Dworshak	420,000
Spillway design flood	850,000
Project Cost, October 1980	$236,417,061
RESERVOIR	
Elevations:	
Maximum, at dam, for spillway design flood	548.3
Normal operating range	540-537
Length, miles	28.7
Area at El. 540 (flat), acres	6,590
Reservoir capacity below El. 540, (low flow - flat pool) acre-feet	376,000
Reservoir capacity below El. 537, (low flow - flat pool) acre-feet	356,000
Relocations, miles:	
Northern Pacific Railway (abandoned)	
Union Pacific Railroad	14.0
Railroad Branch Lines	15.0
State Highway	5.0
County Roads	4.2
Access Roads	5.0
Length of Shoreline, miles	78
SPILLWAY	
Number of bays	8

Bay width, feet	50
Pier width, feet	14
Overall width, feet	498
Overall length, feet	335
Crest elevation	483
Gate size, width by height above crest	50 x 59
Stilling basin length, feet	193
Deck elevation	553
Deck width, clear, feet	20
POWERHOUSE	
Length overall, feet	656
Width overall, (transverse section), feet	243
Intake deck elevation	553
Tailrace deck elevation	460
Maximum height, (draft tube invert to intake deck), feet	226
Spacing - feet:	
Units 1 through 5	90
Unit 6	96
Erection Bay	110
Turbines:	
Type	Kaplan, 6-blade
Runner diameter, inches	288
Revolutions per minute	90
Rating, horsepower	190,360
Generators:	
Rating, (nameplate), kilowatts	135,000
Power Factor	0.95
Kilo-volt ampere rating	142,105
Overload capacity	155,000
Total number of units	6
Ultimate plant capacity, nameplate rating, (kw)	810,000
Ultimate plant capacity, overload capability (kw)	930,000
NAVIGATION LOCK AND CHANNELS	
Net clear length of lock, feet	650
Net clear width of lock, feet	86
Minimum water depth over sills	15
Maximum upper water surface elevation in chamber	540
Minimum water surface elevation in chamber	437
Top of lock walls, elevation	548
Upstream sill block elevation	522

Downstream sill block elevation	422
Upstream gate:	
Type	Submergible lift
Height, effective, feet	21
Downstream gate:	
Type	lift
Height, effective, feet	84
Maximum possible lift, feet	103
Lift with standard project flood, feet	87
Length of guard walls, feet	700
Downstream channel:	
Width, feet	250
Bottom elevation	421
<u>CONCRETE NONOVERFLOW SECTIONS</u>	
Clear deck width, feet:	
Right abutment	24
Between spillway and lock	41
Deck elevation	553
<u>ABUTMENT EMBANKMENTS</u>	
Embankment elevation	558
Embankment top width, feet	32
Material	Rock and gravel fill with impervious core
Slopes, upstream and downstream	1V on 2H
<u>FISH FACILITIES</u>	
Maximum design riverflow, cfs	225,000
Slope	1V on 10H
Ladder clear width, feet	16
Regulation for lake fluctuation	Orifice flow
Weir height, feet	6
Normal ladder flow, cfs	70
Diffusion chambers:	
Number in North Ladder	8
Number in South Ladder	7
Velocity through gratings, fps:	
Gross Area	0.25
Net Area	0.50

Powerhouse collection channel:	
Optimum transportation velocity, fps	2
Entrances, number:	
Submerged orifices	12
Overflow Weirs	3
Velocities, fps:	
Through orifices	8
Over weirs	8
Diffusion chambers, number	12
Auxiliary water requirements, cfs, north shore, maximum design tailwater (Elev. 448)	1,709

THIS PAGE INTENTIONALLY LEFT BLANK

I – INTRODUCTION

1-01. Authorization. This Water Control Manual has been prepared according to authority contained in Section 7 of ER 1110-2-240, "Engineering and Design - Water Control Management," dated 8 Oct. 1982. The format and content of this manual are in accordance with criteria set forth in EM 1110-2-3600, dated 25 May 1959, and ETL 1110-2-25], "Engineering and Design - Preparation of Water Control Manuals," dated 14 March 1980.

1-02. Purpose and Scope. The purpose of this manual is to present information pertinent to the regulation of Lower Monumental Project and to provide a reference source for higher authority and personnel responsible for the regulation of the project. Items discussed within this manual are as follows:

a. Basin Description.

b. Climatology and Hydrology.

c. Project History.

d. Description of project.

e. Water control management.

f. Streamflow forecasts.

g. Water control plan.

h. Effect of water control plan.

Section VIII, Water Control Plan, contains information necessary for understanding the objectives of the project and instructions to implement the regulation of the reservoir. Section VI, Water Control Management, outlines responsibilities of the Corps of Engineers, Bonneville Power Administration, and other agencies involved indirectly with the regulation of the Lower Monumental Project, The Master Water Control Manual for the Columbia River Basin, dated Dec. 1984, contains policies and procedures for system regulation and coordination of major water control projects in the basin.

1-03. Related Manuals and Reports. A List of published design memorandums is provided in Exhibit 1-1 of this Manual. The following list outlines manuals and reports which contain information and data pertinent to the Lower Monumental Project, Snake River, Washington.

a. Design Memorandum No. 1 - General Design Memorandum (5 volumes), 5 October 1959.

b. Design Memorandum No. 7B Master Plan for Development of Lower Monumental Lock and Dam, 6 May 1966.

c. Lower Monumental Lock and Dam, Operation and Maintenance Manual (3 Volumes, Except Chapter 3, Powerhouse and Equipment), 1974.

d. Final Environmental Impact Statement, February 1976.

e. Lower Monumental Master - A Master Plan For Management of All Natural and Manmade Resources of Lower Monumental Lock and Dam, May 1975.

f. Lower Monumental Master Plan, Recreational/Resource Management Appendices, June 1979.

g. North Pacific Division - Fish Facilities Manual, U.S. Army Corps of Engineers, March 1981.

h. Flood Emergency Subplans, identification, Operation, Repair, Notification, and Inundation Maps - Lower Monumental Lock and Dam, Snake River, Washington, August 1982.

i. Lower Monumental Lock and Dam. Operation and Maintenance Manual (2 Volumes, Units 1 - 6, Chapter 3, Powerhouse and Equipment), 1983.

j. Columbia River Basin - Master Water Control Manual, Dec. 1984.

k. Juvenile Fish Passage Plan For Corps of Engineers Projects, published annually by CENPD-EN-WM.

1-04. Project Owner and Operator. The Federal government owns the Lower Monumental project. The Walla Walla District Corps of Engineers is responsible for the operation and maintenance of the Dam and its facilities.

1-05. Regulating Agencies. Functional day-to-day water regulation at Lower Monumental is the responsibility of the U.S. Army Corps of Engineers, North Pacific Division, Reservoir Control Center (RCC). RCC coordinates the regulation of existing projects with other agencies in order to provide maximum benefits to the public. The Walla Walla District Corps of Engineers is responsible for reviewing and updating the Water Control Plan for the regulation of Lower Monumental and upon request from RCC aids in its regulation by providing technical advice. The Bonneville Power Administration is authorized to market electrical energy generated at Lower Monumental and other Federal projects within the Columbia Basin system. Section VI, Water Control Management, outlines the responsibilities of the key agencies connected with the management of Lower Monumental and other Corps of Engineers, North Pacific Division Projects.

LOWER MONUMENTAL RESERVOIR REGULATION MANUAL
SECTION I - INTRODUCTION

1-01. AUTHORITY

Authority for this manual is contained in paragraph 5 of ER 1110-2-240, dated 25 March 1963, which states impart that reservoir regulation manuals for Corps of Engineers projects will be prepared by District Engineers and submitted through the appropriate Division Engineers for approval of the Chief of Engineers in accordance with instructions in EM 1110-2-3600. Chapter 6 of EM 1110-2-3600, Reservoir Regulation, dated 25 May 1959, outlines the material which should be included in a reservoir regulation manual.

1-02. PURPOSE AND SCOPE

The purposes of this manual are to document the plan of reservoir regulation and to provide a ready reference source for higher authority and for personnel responsible for the regulation of Lower Monumental project. Material presented in this manual includes a brief description of the Snake River basin, climatology and hydrology, history and description of the project, and the plan of operation. It contains information necessary for understanding the objectives of the project and instructions to implement the regulation of the reservoir. The Master Reservoir Regulation Manual for the Columbia River basin will contain policies and procedures for system regulation and coordination of major water control projects in the basin.

1-03. REVISIONS TO MANUAL

Changes and revisions to this manual, as required from time to time to keep up-to-date, will be made by the Engineering Division of the Walla Walla District.

Whenever revisions are necessitated, new pages containing the revised material will be printed and issued to each person or office having a copy of the manual so that substitution may be made. Revised pages will show the date of revision.

SECTION II - BASIN DESCRIPTION

2-01. PROJECT LOCATION

Lower Monumental Dam is located in southeastern Washington on Snake River, 41.6 miles above its confluence with Columbia River. The dam is 365.9 river miles above the mouth of Columbia River and about 270 airline miles east of the Pacific Ocean. The frontispiece map shows the geographical location of Lower Monumental project in relation to the overall Columbia River system and to other major dam and reservoir development. Plate 1 gives further detail on the plan of development of lower Snake River.

2-02. DRAINAGE BASIN

Lower Monumental Dam has a tributary area of 108,500 square miles, comprising very nearly the entire Snake River basin. Although some 500 square miles less than Ice Harbor, no significant runoff occurs below Lower Monumental Dam. Most of Idaho, with lesser parts of Oregon, Washington, Wyoming, Nevada, and Utah, are within the Snake River watershed. The greatest overall dimensions of the basin are about 450 miles in both the north-south and east-west directions. The Master Reservoir Regulation Manual will describe the basin in greater detail.

2-03. STREAM SYSTEM

Snake River is 1,078 miles long and is the largest tributary of Columbia River. It originates in the high Yellowstone National Park area of western Wyoming and traverses the southern part of Idaho in a broad arc running from east to west. It then flows almost due north, forming part of the boundary between Idaho, Oregon, and Washington. Near

Lewiston, Idaho, it turns westerly and joins Columbia River near Pasco, Washington. Total fall of Snake River from its source near Two Ocean Plateau, Wyoming, to Lower Monumental Dam is about 8,000 feet. The principal tributary streams are given in the following tabulation:

Stream	Drainage Area Sq. Mi	Snake River Mile
Henrys Fork	3,010	837
Blackfoot	1,300	751
Portneuf	1,380	737
Big Wood	3,000	571
Bruneau	3,300	493
Owyhee	11,300	392
Boise	4,100	391
Malheur	4,800	369
Payette	3,240	368
Weiser	1,660	352
Powder	1,660	296
Salmon	14,100	188
Grand Ronde	4,070	169
Clearwater	9,640	139
Palouse	2,900	60

2-04. RESERVOIRS AND LAKES

The numerous artificial reservoirs and partially controlled lakes in the Snake River basin have a substantial effect on the flow of lower Snake River. Total useable storage in the 50 largest reservoirs and lakes amounts to about 9,600,000 acre-feet. American Falls Reservoir has the greatest useable capacity, 1,700,000 acre-feet, followed by Palisades Reservoir with 1,202,000 acre-feet and Brownlee Reservoir with 980,000 acre-feet. Useable capacity of the under-construction Dworshak Reservoir will be 2,000,000 acre-feet initially.

2-05. TOPOGRAPHY

Several complex systems of mountain ranges, with intervening valleys and plains, lie within the Snake River basin. Much of the southern part of the basin is included within the Columbia Plateau, a semiarid expanse formed by successive flows of basaltic lava. To the north of this plateau is a rugged area of mountain ridges and troughs, with deeply incised stream channels. Overall extremes of elevation are 13,766 feet, at Grande Teton Mountain in Wyoming, to 11O feet, which is normal Ice Harbor pool elevation, at Lower Monumental Dam. The basin mean elevation is about 5,300 feet.

2-06. POPULATION

Overall, the Snake River basin is sparsely populated, with two-thirds of the people living on farms or in small towns. The 1960 census indicates a basin population of 643,000, which is equivalent to an average density of less than six persons per square mile. The largest cities are Boise and Idaho Falls, each with a metropolitan area population of approximately 50,000. Both rural and urban populations are concentrated along Snake River and major tributaries where the principal towns and agricultural areas are located.

2-07. INDUSTRY

Agriculture and associated processing and service industries constitute the primary economic base of the Snake River basin. Other important industries are based on forestry and wood products, mineral deposits, and the recreational resources of the region. More than 3.3 million acres of land in the Snake River basin are under irrigation, and it is expected that the acreage will increase substantially in the future. The effect of present and future irrigation water demands on the flow of Snake River at Lower Monumental Dam is discussed in the following section of this manual. House Document 403, 87th Congress, contains additional information on development of the agricultural and other resources.

2-08. NAVIGATION

In the early days of regional development, the Snake River served as the major transportation artery to east-central Washington and west-central Idaho. Sternwheelers with cargo capacities up to 250 and 300 tons navigated Snake River to Lewiston, Idaho, and played a most important part in the growth of the area. Following completion of water-grade railroads, the need for water transport over a hazardous, unimproved river route was eliminated and commercial navigation operations on Snake River were soon suspended. Completion of Lower Monumental Lock and Dam will permit reestablishment of navigation to meet the existing demand for water transport of grain, petroleum, and other bulk commodities to terminals along the reservoir. Completion of Little Goose and Lower Granite Dams will permit resumption of navigation to Lewiston, Idaho.

SECTION III - CLIMATOLOGY AND HYDROLOGY

3-01. GENERAL CLIMATE

Basically, the climate of the Snake River basin is transitional between the maritime regimen west of the Cascade Range and the continental type climate of the northern Great Plains. Both maritime and continental air masses affect the basin, but since it is located in the zone of prevailing westerly flow the maritime air masses predominate, The Rocky Mountains to the north and east provide some protection against outbreaks of cold arctic air from Canada, but such incursions do occur occasionally in the winter season, particularly over the eastern part of the basin. Because of the irregular topography and large differences in elevation and exposure, there are pronounced differences of local climate.

3-02. TEMPERATURE

Air temperatures within the Snake River basin are controlled by elevation and distance from the Pacific Ocean, as well as by air mass and season of the year. An important aspect of basin temperature to the. regulation of Lower Monumental project lies in the effect of temperature and solar radiation on snowmelt. The shape, timing, and peak discharge of the spring snowmelt runoff of lower Snake River are determined to considerable degree by the sequence of spring season basin temperatures. In addition, temperatures in the region have a pronounced effect on electric power demand and therefore on generation at Lower Monumental project and other hydroelectric projects which serve the area.

Normal summer maximum temperatures for most climatological stations are between 80 and 90 degrees Fahrenheit and normal winter minimums between zero and

20 degrees Fahrenheit. Extreme recorded temperatures are minus 66 degrees Fahrenheit at West Yellowstone, Montana, barely outside the upper Snake River basin boundary, and 118 degrees Fahrenheit at Ice Harbor Dam and at Orofino, Idaho. Average frost-free periods in agricultural areas vary with location from about 50 to 200 days, and some small high-elevation areas experience frost in every month of the year.

3-03. PRECIPITATION

The normal annual precipitation over the Snake River basin ranges from less than 8 inches in the vicinity of Ice Harbor Dam and in portions of the plains of southern Idaho to an estimated maximum of 70 inches in the Bitterroot Mountains. The normal annual precipitation averaged over the entire basin is estimated to be 20 inches. Much of the winter precipitation is in the form of snow, a factor of great hydrologic importance.

The climate of the immediate Lower Monumental project area is semiarid, sometimes classified as middle-latitude steppe climate. The climatological record for Lower Monumental Dam is too short to be considered representative. Table 1 shows climatological data for other longer-period stations in the area which are considered reasonably representative of Lower Monumental Dam. Table 2 is a climatological summary for selected stations located throughout the Snake River basin, and Table 3 is a summary of representative snow course data for selected snow courses.

3-04. KEY STREAM GAGING STATION

A stream gaging station on Snake River 7 miles downstream from Clarkston, Washington, is of primary importance to Lower Monumental project. Runoff from 103,200 square miles of the 108,500 square miles above Lower Monumental Dam is gaged by this station. The contribution of the intervening area is relatively very small because of its generally semiarid climate and the absence of major tributaries, so runoff volumes at the dam are only slightly more than at the gage. Records for this station, which will be inundated when Lower Granite Reservoir is raised, are published by the U. S. Geological Survey, and are rated as excellent by that agency. Table 4 is a discharge rating for the station.

3-05. RUNOFF CHARACTERISTICS

The normal pattern of stream flow for Snake River consists of low flows from August through February and high flows from March through July. At Lower Monumental Dam the peak usually occurs in May or June and is primarily the result of snowmelt, sometimes augmented by rainfall. Discharge hydrographs on Plates 6, 7, and 8 illustrate the characteristic runoff pattern and the year-to-year variations. Plate 9 shows mean monthly discharges, summary hydrographs, discharge-duration curves, maximum annual mean daily discharges, and annual runoffs for the Clarkston station. Plate 10 shows similar data for Clearwater River, a major contributor to lower Snake River which enters Snake River near Clarkston. Table 6 summarizes the annual runoff volumes and extremes of discharge, by years, for Snake River near Clarkston and Table 7 presents similar data for Clearwater River at Spalding.

The observed mean annual runoff of Snake River at the gaging station near Clarkston for the period 1910-62 is 36,080,000 acre-feet. Annual runoff volumes ranged from a low of 20,600,000 acre-feet in the 1931 water year to 49,800,000 acre-feet in the 1921 water year. In average depths of water over the drainage area of 103,200 square miles above the Clarkston gage the mean, low, and high annual runoffs are 6.5 inches, 3.7 inches and 9.0 inches, respectively. The mean annual discharge is 49,800 cfs.

Annual peak flows average about 199,000 cfs, and the maximum historical flood peak was 409,000 cfs on 5 June 1894. The extreme low flow, caused by emergency regulation of the upstream Brownlee Reservoir, was 6,660 cfs on 2 September 1958. Annual minimum flows have averaged 15,220 cfs but, as discussed in paragraph 3-09, the average low-water flow will probably be somewhat greater in the future.

The relation of the runoff of lower Snake River to the contribution of major sub-basins and also to runoff of Columbia River is shown in Table 8. During the period 1928-57 Snake River at Lower Monumental Dam derived 35 percent of its runoff volume from Snake River above Weiser, 22 percent from Salmon River, 30 percent from Clearwater River, and 13 percent from other lesser streams between Weiser and Lower Monumental Dam. Snake River contributes about 27 percent of the runoff of Columbia River at The Dallas. Columbia River above Snake River contributes about 66 percent, and miscellaneous streams below Snake River contribute about 7 percent.

3-06. FLOODS

Floods in lower Snake River are of two types: (a) annual spring floods caused primarily by snowmelt but sometimes augmented by rainstorms, and (b) occasional winter or early spring floods resulting from rainstorms, low elevation snowmelt, or a combination of the two factors. The spring floods usually begin in March, culminate with the peak discharge for the year usually between late April and early June amid a succession of high fluctuating flows, and end with recession to low flows in late June and July as snow disappears from the principal contributing areas.

The average date of spring flood peaks at the stream gaging station near Clarkston is 24 May. Some 59 percent of the annual peaks of a 5O-year period have occurred in May, 25 percent were in June, 11 percent were in April, 3 percent were in December and one peak or 2 percent occurred in March. The winter or early spring floods are of shorter duration, seldom exceeding a week or 10 days, and usually consist of one peak preceded and followed by rapidly rising and receding flows. They normally occur with much lower base flows than exist between indi- vidual peaks of the spring snowmelt runoff season. Unregulated and regulated hydrographs of the 1894, 1948, and 1956 floods are shown on Chart 11.

Frequencies of annual flood peaks, analyzed in accordance with procedures in OCE publication 'Statistical Methods in Hydrology,' are shown in Chart 1. Natural peaks were computed by adjusting the observed peaks for storage changes in the larger upstream reservoirs and estimates of depletions for irrigation. Statistics for the natural peak frequencies were adjusted to the long-term record of peak flows of Columbia River near The Dalles. '.chart 1 also shows the effects of regulation by existing projects and the additional effects of the under-construction Dworshak Reservoir.

3-07. STANDARD PROJECT FLOOD

The 1894 flood reduced for upstream storage was provisionally adopted as the standard project flood for design studies on Lower Monumental Dam and Reservoir. It was by far the largest flood in both peak and volume on lower Columbia River and the largest known historical flood on lower Snake River. The 1894 flood had a peak dis-charge of 409,000 cfs and a 60-day runoff volume of about 27,000,000 acre-feet or 4.9 inches over the drainage area above the Clarkston gage. The peak discharge was 48 percent of the probable maximum peak discharge and 11 percent larger than that of any other recorded flood. The volume of runoff during the 60-days of highest flow of the

1894 flood is 45 percent of that applicable to a comparable period for the probable maximum flood, and 20 percent larger than that for any other recorded flood. The 1894 hydrograph, as reduced by projects existing in 1963 (standard project flood) is shown on Chart 11. The reduced peak is 340,000 cfs.

3-08. SPILLWAY DESIGN FLOOD

The computed probable maximum flood has a peak discharge of 850,000 cfs and a 7-month runoff volume of 81,000,000 acre-feet. It was adopted without modification as the spillway design flood for Lower Monumental Dam. Derivation of the probable maximum flood, which was developed in cooperative studies with the Office, Chief of Engineers, was presented in the report on Selection of Sites, Lower Snake River, dated 14 March 1947.

3-09. WATER SUPPLIES

Stream flows of lower Snake River have been. undergoing progressive modification during the entire period of recorded flows because of upstream irrigation and storage developments. The depletions above Lower Monumental Dam now amount to approximately 6,000,000 acre-feet per year. Modified streamflows for future conditions with anticipated irrigation and upstream irrigation reservoir developments as of the years 1960 and 2010 have been determined for the 20-year period July 1928 - June 1948, a period of subnormal flow. From these data, system studies were made as of the year 1985 (average of conditions for years 1960 and 2010) to show the effects of system regulation of reservoir projects on main streams for power, navigation, basic elements of flood control, and water conservation. Several systems were studied, each of which gave slightly different water supply conditions at Lower Monumental Dam.

Results of Sequence IV-H studies for 1985 conditions, shown in the report entitled, 'Water Resource Development Columbia River Basin," (Review of House Document 531, 81st Congress, 2nd Session) dated June 1958 are considered representative of regulated flow conditions for illustration of the regimen and changes in flows expected to occur. The following tabulation briefly summarizes the flows determined in these studies for Snake River at Lower Monumental Dam:

SUMMARY OF MEAN MONTHLY FLOWS, 1928-1948
1,000 cfs

	Average			Maximum			Minimum		
Mo.	Act[1/]	Mod[2/]	Reg[3/]	Act[1/]	Mod[2/]	Reg[3/]	Act[1/]	Mod[2/]	Reg[3/]
Oct	21.4	21.7	31.4	30.6	29.2	38.3	16.6	17.5	27.2
Nov	25.6	25.4	37.3	36.2	35.0	45.4	17.6	18.5	24.7
Dec	29.2	27.8	46.6	52.4	57.6	74.6	16.9	17.6	34.2
Jan	27.8	26.8	50.3	55.5	54.7	75.0	14.9	14.9	29.3
Feb	29.5	28.1	52.7	46.7	43.5	81.2	19.1	17.5	27.0
Mar	43.8	42.4	61.2	63.9	65.1	93.5	28.0	27.7	39.5
Apr	79.6	73.6	47.6	158.4	158.3	86.5	48.8	43.4	19.8
May	108.4	100.2	44.8	179.1	172.6	99.7	69.0	66.0	17.7
Jun	93.1	85.2	50.3	191.6	183.2	123.2	33.9	32.0	15.1
Jul	33.9	32.0	30.1	85.0	75.7	75.1	15.3	16.6	13.6
Aug	18.8	18.8	21.7	28.5	26.9	26.8	11.1	13.0	18.0
Sep	18.4	19.6	26.0	24.5	25.4	32.1	12.7	14.9	21.4
W									
Ave	44.1	41.8	41.6	79.4	77.3	71.0	25.3	25.0	24.0
Max	108.4	100.2	61.2	191.6	183.2	123.3	69.0	66.0	39.5
Min	18.4	18.8	21.7	24.5	25.4	26.8	11.1	13.0	13.6

[1/] Actual historical.
[2/] Discharges modified by irrigation, 1985 conditions.
[3/] Discharges regulated by at-site and upstream power storage, Sequence IV-H, 1985 conditions.

Although emergency closure of Brownlee Dam caused Snake River at the Clarkston gage to drop to 6,660 cfs on 2 September 1958, the discharge otherwise has fallen only as low as 10,600 cfs for the minimum mean daily flow and 11,000 cfs for the minimum mean monthly flow. With increasing development upstream from Lower Monumental project it is not likely that minimum flows will be as low in the future as in the past. As regulation of the flows increases, the effect will be to raise the magnitude of the low base flow and to lengthen the duration of the moderately low-flow period. From the foregoing compilation of data on modified and regulated flow 1985 conditions, the dependable minimum mean monthly flows would be about 13,000 cfs without regulation by upstream projects. With regulation by these main stream projects, the corresponding discharge would be about 13,600 cfs.

3-10. SEDIMENTATION

Analysis of sediment in lower Snake River indicates that the average annual sediment load will be about 5,700 acre-feet per year. This figure is based on suspended sediment sampling on Snake River at Central Ferry, Snake River mile 83, for a 3-year period, theoretical adjustment of quantities measured to a value for an average year, and the assumption that the volume of bedload in the stream would be equal to 20 percent of the suspended sediment. It is also estimated that a reservoir on lower Snake River would trap 65 percent of the total sediment load entering that reservoir; hence the average yearly accumulation of sediment in' Lower Monumental Reservoir, with no additional upstream reservoirs is estimated to be roughly 3,700 acre-feet. Because of the short-period record used as a basis for the estimates, assumptions regarding the amount of bedload and trap efficiencies, and uncertainty as to major origins of sediment, it is not practical at this time to modify the estimate for effect of future upstream reservoirs, but the reduction probably will be considerable.

Both the above data and experience with run-of-river reservoirs on Columbia River suggest that sedimentation of Lower Monumental Reservoir will not be a major problem. It is expected that some silting may occur at the mouths of minor watercourses or draws entering the pool, but this would not result in significant loss of storage in the main reservoir.

3-11. ICING

Lower Monumental Reservoir may be expected to freeze over occasionally. A number of instances of extensive ice formation on reservoirs in the region have been noted, but relatively little difficulty has been experienced with ice at Columbia River dams that have been in operation during the last several years. Because of the low velocities ice that forms on the reservoirs melts with little or no tendency to jam, even during periods of relatively severe cold weather.

The most marked ice effects have occurred at the head of backwater or in the backwater reaches of tributary streams that enter the reservoirs where ice jams have a tendency to form, causing a considerable rise in the water surface. At the head of McNary backwater in Snake River, ice raised the river levels 13 to 14 feet at Ice Harbor Dam site during February 1956, and in February 1957 ice accumulated in the river for a period of 12 days and raised the water surface approximately. 8 feet. Records show that there has been ice in Snake River at Lewiston an average of 8 days per year. Individual years show wide variations in durations of floating ice, with none shown for 16 years in a 36-year period and a maximum single duration of 48 days in 1937.

SECTION IV - PROJECT HISTORY

4-01. AUTHORIZATION AND PURPOSE

Lower Monumental Project was authorized by Public Law 14, 79th Congress, 1st Session, approved 2 March 1945. The applicable portion of the act reads as follows:

“. . .Snake River, Oregon, Washington, and Idaho: The construction of such *dams as* are necessary, and open channel improvement for the purposes of providing slackwater navigation and irrigation in accordance with the plan submitted in House Document Numbered 704, Seventy-fifth Congress, with such modifications as do not change the requirement to provide slackwater navigation as the Secretary of War may find advisable after consultation with the Secretary of the Interior and such other agencies as may be concerned: Provided, that surplus electric energy generated at the dams authorized in this item shall be delivered to the Secretary of the Interior for disposition in accordance with existing laws relating to the disposition of power at Bonneville Dam: Provided further, that nothing in this paragraph shall be construed as conferring the power of condemnation of transmission lines;. . .”

The primary purposes of the project are inland navigation and hydroelectric power generation. In addition, it will provide irrigation and recreation benefits. Flood control is not a designated or planned project function.

4-02. EARLY HISTORY

Prior to the authorization of slackwater development of the lower Snake River in 1945, an existing project provided for open river improvements to obtain a 5-foot depth in the existing channel to Riparia (mile 68) and from that point a channel of the same depth and generally 60 feet wide to Lewiston, Idaho. Beyond that point removal of boulders and rock points was contemplated.

House Document 704, 75th Congress, 3rd Session, upon which authorization of the Lower Snake River Project was based, proposed an ultimate slackwater development between Pasco, Washington and Lewiston, Idaho, by 10 locks and dams, with such power facilities as were feasible to develop at the time the work was undertaken. Subsequent to authorization, additional studies of the number of dams required for the project were made and reported in 'Special Report on Selection of Sites, Lower Snake River, Oregon, Washington, and Idaho,¯ dated 14 March 1947. This report recommended that development be accomplished by four dams with the downstream unit at Snake River mile 10.2. The report was approved and additional planning work on the entire four-dam development was authorized, including preparation of a letter report summarizing costs and benefits and of a definite project report on relocations and flowage. Locations of the other three dams, Ice Harbor, Little Goose, and Lower Granite are shown on the lower Snake River map, Plate 1.

Detailed studies on Lower Monumental Project as a separate unit of the Lower Snake River Project were initiated in 1958. With more complete data on the proposed site locations, the final site location at river mile 41.6 was selected on the basis of geology and navigation channel excavation requirements.

4-03. SIGNIFICANT CONSTRUCTION DATES

Construction work on Lower Monumental Dam was initiated on 16 June 1961 with notice to proceed on Contract No. DA-45-164-CIVENG-61-29. Closure of the dam at the downstream leg of the north shore second-step cofferdam and diversion of water through the low spillway bays was accomplished on 8 August 1964. Raising of the reservoir was started at 2230 hours on 6 January 1969 by closing the powerhouse gates in the three skeleton units. This closure was more than a month early due to the rise on the Snake River which threatened to exceed the design capacity of the three skeleton units. The water surface was raised rapidly to the spillway crest elevation 483.0 feet by 0600 hours on 7 January. The pool reached a maximum elevation of

503.1 feet on 8 January with seven spillway gates on free flow. As Snake River flows receded the forebay lowered to near 497 feet and was then held near this elevation until about 21 February to facilitate emergency levee construction at Marmes Rock Shelter. No fish passage facilities were operable while the pool was at this elevation. It was deemed essential that the fish passage facilities be in operation by 28 February.

The filling to elevation 520 feet was started at 0800 on 21 February but due to excessive leakage at the Marmes Rock Shelter levee, the pool filling was stopped and the pool returned to approximately elevation 500. On Monday, 24 February, it was decided the leakage at Marmes could not be reduced sufficiently and the area inside the levee was prepared for flooding.

The Lower Monumental pool reached minimum operating pool, elevation 537.0 feet at noon on 26 February 1969 and full pool, elevation 540.0, at 1980 hours the same day.

Power on the line was achieved at 1711 hours on 28 May and the second generator was placed in service at 1331 hours on 8 September.

SECTION V - PROJECT DESCRIPTION

5-01. GENERAL

Main structures of the dam consist of a powerhouse, concrete spillway and stilling basin, navigation lock, concrete nonoverflow sections, rockfill embankments on both shores, and fish passage and appurtenant facilities. The dam is 3,791+ feet in length, including embankments. Concrete sections have a maximum height of 256.7 feet, from a low elevation of 296.3 feet in the erection bay to top of deck, elevation 553. Plate 3 and the frontispiece photograph show the relative location of the principal components of the dam. Data on various features are summarized in the Pertinent Data, page i, and more detailed descriptions of the equipment are contained in the Operation and Maintenance Manual.

5-02. POWERHOUSE

The powerhouse consists of three complete generator bays, an erection bay, control room, and project office space. It contains skeleton provision for three future units. The powerhouse general plan is shown on Plate 11 and a transverse section of the generator bays is shown on Plate 12. The overall powerhouse length, including the abutment piers, is 656 feet. Generator and skeleton bays are approximately 243 feet in width. The three completed generator bays and skeleton bays Nos. 4 and 5 are 90 feet in length. Skeleton bay No. 6 is 96 feet in length and the erection bay is 110 feet in length. Powerplant generation equipment is serviced by a 625-ton bridge crane.

5-03. GENERATORS

The three generators were supplied by General Electric Company. These generators are suitable for operation under varying load conditions and can be operated continuously at 115 percent of rated capacity. The following performance and operating data are guaranteed by the contract:

Rated capacity, kVA	142,105
Power factor	0.95
Frequency, cycles	60
Number of phases	3
Voltage between phases, rated	13,800
Speed, rpm	90
Stator winding connection	Star, suitable both for grounded or ungrounded operation
Excitation voltage, nominal	375
Direction of rotation	Clockwise
Maximum runaway speed, not less than, rpm	180

The maximum temperature rise of both stator and field windings is designed not to exceed 60 degrees Centigrade, and stator core 55 degrees Centigrade, when delivering rated output continuously at rated voltage, power factor, and frequency, and with cooling air entering the generator at no more than 40 degrees Centigrade.

5-04. TURBINES

a. Design Characteristics. The three turbines were built under contract by the Baldwin-Lima-Hamilton Corporation. These turbines are Kaplan type with six adjustable blades. Synchronous speed is 90 rpm and runner throat diameter 311-5/8 inches. The centerline of the turbine distributor is at elevation 403.0 feet msl, and the elevation of the water surface in the tailrace will vary from 437 to 471 feet msl. Each turbine is guaranteed to develop 212,400 horsepower at rated net head of 93.5 feet and 192,000 horsepower at net head of 87 feet. The turbines are designed to have good efficiencies throughout a wide load range and for heads varying from 87 to 103 feet. Design is based on the following reservoir and plant operating conditions:

Elevations, feet, msl	
Maximum pool (850,000 cfs)	548.0
Top of power pool	540.0
Normal full pool	540.0
Minimum power pool	537.0
Maximum tailwater (850,000 cfs)	471.0
Normal maximum tailwater (340,000 cfs)	453.0
Tailwater at rated condition (139,000 cfs)	443.5
Normal tailwater (30,000 cfs or less)	441.0
Minimum tailwater (zero flow)	437.0
Heads, feet	
Extreme maximum (zero flow)	103.0
Normal maximum	100.0
Average operating	99.0
Rated	93.5
Minimum for power	87.0

b. Operating Characteristics. Table 11 and charts 2 and 3 show power-discharge relationships as developed from turbine model test Index No. B195-N-6-11.25-12-783A with step-up in efficiency of two-thirds of the correction obtained by using the Moody formula. Generator efficiency is based on the Ice Harbor installation. These charts should only be used as a guide, as they are preliminary and will be revised by index test results, current meter ratings, and as other information becomes available. No turbine limits are shown on these charts other than the full gate limit. Maximum and minimum operating limits are imposed by the contract guarantee. Since these limits can be exceeded under various combinations of flow, head and pool elevations, it is not practical to show the limits on the charts. The operating limits as quoted from the contract are as follows:

"(e) The turbine runner is guaranteed against excessive pitting caused by cavitation for a period of one year from date it is placed in service, but not to exceed three years after completion of delivery, provided the turbine is not operated:"

"(1) More than 10 percent of the operating time during the guarantee period at less than the minimum horsepowers specified below, or

(2) More than 50 hours during the guarantee period at outputs greater than the maximum horsepowers specified below:

Output Horsepower Maximum	Output Horsepower Minimum	Net Head Feet	Minimum Tailwater Elevation – ft. msl	Plant Sigma
192,000	64,500	87.0	453.0	1.059
212,400	69,000	93.5	443.5	0.882
212,400	73,500	100.0	437.0	0.761
212,400	76,000	103.0	437.0	0.739

It should also be noted that heads referenced on the charts and in the guarantee are net heads and no accounting has been made for trash rack and other hydraulic losses.

5-05. MAIN UNIT TRANSFORMERS

The main unit transformers were manufactured by Westinghouse Electric Corporation. Each transformer is three-winding (two separate, identical, low-voltage windings), oil-immersed, self-cooled/forced-air-cooled, Class 0A/FA, type suitable for outdoor operation. Each transformer is rated 164/218 MVA, 13.2-13.2-500 Grd. Y/289 KV, single-phase. Originally, three generators will serve the three-transformer bank, with 500 KV output. Each transformer has an external manually-operated tap changer for changing connections to the taps in the high-voltage windings when the transformer is de-energized.

5-06. STATION SERVICE POWER

Station service power is provided by one 2700 KVA 13.8-4.16 Y/2.4 KV, 3-phase transformer, manufactured by Westinghouse Electric Corporation. It is two-winding, oil-immersed, water-cooled, Class OW, sealed tank type, with load ratio: control equipment for changing taps under load, both manually and automatically. It also has an external manually-operated tap changer for changing connections to the taps in the high voltage windings when the transformer is de-energized. Standby station service power is provided by a 4160 volt, 3-phase, 1000 KVA connection from the local utility company (Franklin County PUD of Pasco, Washington).

5-07. SPILLWAY

The spillway has a total length of 498 feet, including 7 intermediate piers, and consists of 8 gate-controlled bays, each 50 feet wide. Piers 14 feet wide separate the bays. Elevation of the spillway crest is 483 feet. The spillway has a maximum height, foundation to deck, of 143 feet, with a 20-foot wide roadway on top at elevation 553. Spillway discharges are controlled by 8 tainter gates each 50 feet wide by 60.56 feet high. The gates are operated by electric hoist units mounted above the gates, with one motor and two hoist units per gate. Operation of the gates may be by manual control through push button stations located near each hoist, but normally gates are remotely controlled from the powerhouse control room. One spare hoist motor is provided for maintenance and emergency use, and all spillway gates can be operated with emergency power supplied by a diesel generator set. The gate sill is downstream of the spillway crest *axis* at elevation 481.44. Side seal plates and sill beams of the four center gate bays are heated to prevent formation of ice at the gate seals. Heating is accomplished by electrically heated oil circulated through embedded tubing behind the seal plates and sill beam.

The design capacity of the spillway is 850,000 cfs, with a corresponding maximum pool of 548.3 feet. At normal pool elevation 540, the spillway will pass a maximum of 676,000 cfs. Table 9 and Chart 9 show the discharge for an individual bay at various gate openings and pool elevations.

Energy of the water discharging through the spillway is dissipated by a hydraulic jump in a horizontal apron type stilling basin with a sloping end sill. The stilling basin has been designed to contain the jump for all discharges up to 850,000 cfs.

5-08. NAVIGATION LOCK

The single-lift navigation lock is located on the south side of the river. It has a clear inside width of 86 feet and a length of 666 feet. The maximum lift with Ice Harbor Reservoir at elevation 437, Lower Monumental pool-elevation 540, and zero Lower Monumental outflow is 103 feet. Other dimensions are given in the pertinent data tabulation.

The downstream lift gate is operated by hydraulic hoists which are automatically controlled to keep the gate level during travel. Provision is made for a floating bulkhead to be installed in the upstream and downstream ends of the lock for maintenance and emergency use. However, it would be difficult to install the bulkhead in flowing water. Also, slots are provided for stoplogs downstream of the downstream gage. The slots are designed to accommodate McNary's stoplogs. Guidewalls extend 750 feet downstream and 778 feet upstream of the gate to protect the 250-foot wide approach channel. The upstream guidewall opens into deep water but downstream a 2,000-foot long approach channel was excavated to elevation 421 along the left bank beyond the end of the guidewall to provide 16 feet of depth with Ice Harbor pool at elevation 437.

Lock-control facilities are located in sheltered control stands adjacent to each gate on the river wall of the lock. Partial control stations for the downstream gate are located in each tower for maintenance and emergency operation. Air bubblers installed in the sill, guide slots, and bridge, keep floating ice and debris away from the lift gates during freezing weather and any gate operation. The seal plates are also heated where required to prevent icing. The medium is electrically heated oil circulated through embedded tubing.

5-09. FISH FACILITIES

The fish passing facilities at Lower Monumental Dam consist of north and south shore fish ladders, powerhouse collection system and transportation channel, auxiliary water supply system, fingerling bypass system, and a fish counting station on each ladder. Both ladders have the same width, slope, weir design, pool size, and receive auxiliary attraction water from the three turbine pumps located in the erection bay of the powerhouse. Neither ladder extends upstream of the dam; fluctuations in the forebay elevation are accommodated by the orifice control section located below the dam at the upper end of the ladder. This section is designed to regulate the flow from the forebay to 74 cfs for transportation water or a total of 148 cfs from the forebay for both ladders. In addition, 65 cfs per pump is required from the forebay to drive each turbine pump or a total of 195 cfs with the three pumps running.

The ladders are 16 feet wide with a slope of one on ten. Each pool is 10 feet long, except at the turns, with a 1-foot head on the weir. The weirs are designed with a 6-foot nonoverflow center section and two 5-foot wide overflow sections, one at each end. Depth of water over the weir crest is 12 inches. In addition, the weir has two 18x18-inch orifices through the bottom of the weir. The center of each orifice is 3 feet in from the side of the ladder. The crest of the weir is 6 feet above the floor of the pool below it and 2 feet below the top of the nonoverflow section and side of the ladder. The weir is designed to maintain a minimum velocity in the ladder of 2 feet per second with one foot of head on the weir crest.

A total of six diffusers in the lower portion of the south shore fish ladder and five in the north shore supply auxiliary water to the fishway through floor gratings. The auxiliary water is required to maintain adequate velocities in that portion of the ladder that is submerged by tail-water. Flow from the fish entrance will vary from 584 cfs at minimum tailwater of 437 feet to 844 cfs at a maximum design tailwater of 448 feet and a river flow of 225,000 cfs. The three turbine fishway pumps located in the powerhouse have an individual capacity of 835 cfs. The auxiliary water is delivered through conduits to each ladder and is controlled by an automatic system which will maintain a pre-set 4-foot head differential between the supply conduit water and tailwater.

The south shore fish ladder is between the spillway and the navigation lock. The fish counting station is located in the navigation lock wall structure at. elevation 534.0, just upstream of weir 533 where operation of the orifice-control section and diffuser 7 provides a constant water surface elevation. Thus, the counting station does not have to move up and down.

The north shore fish ladder is north of the powerhouse and includes the powerhouse collection and transportation system. The fish counting station is in the Visitors' Center which is located at the north end of the powerhouse. Visitors may view the fish through windows in the side of the ladder just downstream of the counting station.

The powerhouse collection and transportation system consists of a 17.5-foot wide channel across the length of the powerhouse with 10 submerged orifices through which water is released to the powerhouse tailrace. Weired openings are provided at unit 6 and the stilling basin. Automatic operation of the weirs maintains the water level in the channel one foot above tailwater. The powerhouse collection and transportation system join in the north shore fish ladder near the north end of the powerhouse.

A fingerling bypass has been provided at Lower Monumental using the gate wells as a collection basin patterned after the system developed for John Day, which was a first on the Columbia River. To attract the fingerlings out of the gate wells, a 6-inch diameter collector pipe is provided in each intake bulkhead slot in the powerhouse.. The intakes to the collector pipes are controlled by 14-inch diameter sluice gates with centerlines at elevation 535.5. The sluice gates will be operated either full open or closed. When a gate is open, the normal attraction flow is 0.8 cfs or 4 fps in the 6-inch diameter collector pipes which discharge into the transportation pipe.

The transportation pipe carries the fingerling across the powerhouse to the spillway right end pier monolith. To maintain a relatively constant transportation velocity of 2 fps as additional collector pipes discharge into transportation pipe, it transitions across the powerhouse from a 12-inch to a 36-inch diameter. The top of the pipe is held at elevation 534.5 throughout the length of the powerhouse. A 24-inch diameter sluice gate, located in the spillway right end pier monolith, automatically controls the discharge of the transportation pipe to maintain a head differential between the pool and the pressure in the pipe. This head is approximately l.6 feet to obtain a normal Q of 14.4 cfs with 6 powerhouse units operating or 7.2 cfs with 3 units.

A 24-inch diameter exit pipe extends from the regulating gate, centerline elevation 532.5, to the pipe exit at, the downstream end of the pier monolith where the pipe centerline is elevation 456.0 and discharges the fingerlings into the tailrace.

5-10. NONOVERFLOW SECTIONS

Lower Monumental Dam has three concrete gravity nonoverflow sections and two earth abutments. One concrete section extends 143 feet from the lock to the spillway and contains the south shore fish ladder exit structure, stoplog storage, and appurtenances. A second section, 37 feet long, is between the spillway and the powerhouse and contains the fingerling bypass exit facilities. The third concrete section between the powerhouse and north shore abutment is 228 feet long and contains the north shore fish ladder exit structure.

The south shore earth abutment extends from the navigation lock approximately 1,075 feet to the left bank. On the north shore the earth abutment extends from the concrete nonoverflow section approximately 968 feet to the right bank. The maximum earth fill height is in the north shore abutment where the deepest excavation was to elevation 403.2 feet or 154.8 feet below the abutment crest elevation 558 feet. Lowest point on the south shore abutment was elevation 448.0. The embankment consists of a central impervious core flanked on both sides by substantial rockfill shells. Sand and gravel filter zones are provided for transition between the impervious core and rockfill sections. Within the zone of wave action the upstream slope is protected by riprap. The upstream and downstream slopes are 1 on 2.

5-11. RESERVOIR

Lower Monumental Reservoir is 28.7 miles long from Lower Monumental Dam to Little Goose Dam. It has an average width of about l,900 feet and a maximum depth of about 130 feet near the mouth of Palouse River. The flat reservoir has a surface area of 6,590 acres at normal pool, elevation 540. -Plate 2 shows a detailed reservoir and land use map, and Plate 3 shows the general shape and configuration of the reservoir on a small scale map.

Reservoir regulation at Lower Monumental project for power generation will normally be confined to the use of storage between elevations 537 and 540, measured at the dam. That storage amounts to about 20,000 acre-feet at low flows and about 19,000 acre-feet at a discharge of 300,000 cfs. For flows up to 30,000 cfs the pool is nearly level, but at higher flows the slope of the pool increases, particularly at the upper end. Plate 4 shows water surface profiles for various significant river discharges With elevations 537 and 540 at Lower Monumental Dam. Plate 5 shows the river bottom profile and natural water surface profiles. Table 10 and Chart 4 show the storage-discharge relationship for a wide range of river flows.

5-12. REAL ESTATE ACQUISITION

Real estate acquisition for Lower Monumental was based on a preliminary taking line 300 feet horizontally landward of a flat 540 pool elevation. This guideline was then modified as dictated by sound real estate practices, additional project and public use requirements, and relocation considerations. This original guideline was further modified as necessary to assure a 5-foot freeboard above the standard project flood, 340,000 cfs, backwater profile. All lands between the natural normal high water

(165,000 cfs) profile and the final taking line were purchased in fee. Relocation and protection of railroads and roadways is based on the 1894 flood (409,000 cfs), regulated by existing upstream storage (360,000 cfs), backwater profile plus 7.5 feet of freeboard. Where this relocation construction prevents water from reaching lands behind it, the preliminary taking line was modified to include only as much land as was needed for the relocation right-of-way.

5-13. WATER SURFACE ELEVATION GAGES

Lower Monumental Reservoir elevation is recorded only at the powerhouse forebay gage. This gage is a servomanometer sensor with a bubbler system. The sensors are located near construction stationing 63+28 and 63+35 on the forebay face of the erection bay at elevation 520.00. The gage reading is telemetered to a two-pen recorder in the control room where it is recorded in combination with the tailwater gage.

Lower Monumental tailwater elevations are determined by the same type gages located in the piers of bays 3 and 6. Elevations from bay 3 are telemetered to the recorder in the control room and the bay 6 location will be used for tests or as an alternate gage location.

In addition to the recording water-surface elevation gages, a number of non-recording gages are installed at various locations at the project. Four staff gages are located in the landward wall of the navigation lock:

(1) Downstream of downstream lock gate at station 42+39.73 extending from elevation 436.9 to 452.0 feet msl.

(2) Upstream of downstream lock gate at station 43+33.00 extending from elevation 436.9 to 546.0 feet msl.

(3) Downstream of upstream lock gate at station 49+77.00 extending from elevation 436.9 to 546.0 feet msl.

(4) Upstream of upstream lock gate at station 50+29.23 extending from elevation 531.9 to 546.0 feet msl.

VI - WATER CONTROL MANAGEMENT

6-01. Responsibilities and Organization. The complex system of reservoirs in the Columbia River Basin and their diverse ownership requires a high degree of cooperation and coordination between Federal, state, municipal, and other public and private organizations which have interests in the reservoir regulation activities of the Columbia River system. Lower Monumental is a part of this system. Functional water regulation at Lower Monumental Project is the responsibility of the Engineering Division of the North Pacific Division. Physical operation and maintenance are the responsibility of the Operations Division of the Walla Walla District. Details of organization and responsibilities, liaison with other agencies coordinated regulation of reservoirs on a system basis, and related matters are described in the Master Regulation Manual for the overall Columbia River basin.

a. Corps of Engineers. In general, the NPD Reservoir Control Center (RCC) plans and directs the regulation of NPD reservoirs and certain non-Corps reservoirs that have space allocated for flood control. The RCC coordinates the regulation of NPD, non-Corps, and Canadian reservoirs in the Columbia River Basin in order to increase the effectiveness of the system operation under routine and critical conditions.

The real-time daily regulation of Lower Monumental is the direct responsibility of the RCC. For special reservoir operations, the RCC collaborates with the Hydrology Branch of the Walla Walla District. The Hydrology Branch provides assistance and support to the RCC by participating in reservoir regulation studies, supplying hydrometeorological data, and providing reservoir regulation manuals for District projects. Final regulation plans are approved and administered by the RCC. Physical operation and maintenance of the Lower Monumental project is the responsibility of the project engineer who is under the supervision of the Operations Division, Walla Walla District, Pages 6-7 through 6-10 show organizational charts, corresponding personnel names and telephone numbers pertinent to the operation of Lower Monumental for the Corps of Engineers and Bonneville Power Administration.

b. Portland River Forecast Center (RFC). The Portland RFC is authorized to issue coordinated runoff volume forecasts, peak flow forecasts, and flood stage forecasts for key gaging stations within the Columbia River Basin. See Section VII of this manual for details on hydrologic forecasts. A formal agreement in 1963 between the Corps of Engineers and the National Weather Service formed the Cooperative Columbia River Forecasting Service. In 1971, this agreement was amended to include Bonneville Power Administration. A three-member technical committee provides technical advice and guidance to the Columbia River Forecasting Service. The three committee members are as follows:

Chief, Hydrologic Engineering Section, NPD
Hydrologist in Charge, National Weather Service, Portland RFC
Chief, Hydrometeorology Branch, Bonneville Power Administration

c. Bonneville Power Administration (BPA). The BPA is the marketing agency for electric power produced at Federal hydroelectric projects throughout the Columbia River Basin system. This group of Federal hydroelectric plants along with BPA's transmission facilities is known as the Federal Columbia River Power System. Lower Monumental is a unit of this system. The Chief of the RCC coordinates with the BPA Chief of Division of Power Supply and Chief of Power Scheduling Branch on significant regulation decisions that affect power generation. Routine power scheduling is accomplished by NPD/RCC in coordination with BPA's Power Scheduling Branch. BPA dispatchers coordinate power production from the Federal projects on a real-time basis.

A Memorandum of Understanding, entered into on 8 October 1956 and revised on 16 November 1970, between the NPD and the BPA documents the policies and procedures to he followed in the operation of the Corps of Engineers projects. The objective of this Memorandum of Understanding is to maximize power generation by coordinated operations within the normal and special operating limits of NPD projects.

c. Other Agencies. Other entities with which the RCC coordinates and exchanges information in the process of carrying out reservoir regulation activities include the Bureau of Reclamation, U.S. Geological Survey, Soil Conservation Service, Federal Energy Regulatory Commission, Northwest Power Power Planning Council, the Fish Passage Center representing Federal and state fish and wildlife agencies and the Indian tribes, Federal and state water quality agencies, non-Federal public utilities, private power utilities, and navigation interests. Details on coordination of reservoir regulation activities with other agencies on a system basis are provided in the RCC Guidance Memorandum dated January 1972 and the Master Water Control Manual for the Columbia River Basin dated December 1984.

6-02. Coordination Committees and Agreements. The principal organizations which have been formed to coordinate the planning and operation of the Columbia River system projects are the Northwest Power Pool, the Pacific Northwest Coordination Contract Committee, the Columbia River Treaty Operating Committee, and the Columbia River Water Management Group.

a. Northwest Power Pool. The Northwest Power Pool is a voluntary organization whose primary function is to coordinate the operation and maintenance of the power systems of the Pacific Northwest. It also serves as a coordinating group for the solution of a variety of system operating problems.

The membership of the Northwest Power Pool Operating Committee includes 20 utilities and agencies as follows:

1. Bonneville Power Administration
2. Bureau of Reclamation
3. British Columbia Hydro and Power Authority
4. Chelan County PUD
5. Corps of Engineers

6. Douglas County PUD
7. Eugene Water and Electric Board
8. Grant County PUD
9. Idaho Power Company
10. Montana Power Company
11. Pacific Power and Light Company
12. Portland General Electric Company
13. Puget Sound Power and Light Company
14. Seattle City Light
15. Sierra Pacific Company
16. Tacoma City Light
17. Transalta Utilities Corporation
18. Utah Power and Light Company
19. Washington Water Power
20. West Kootenay Power and Light Company

The functions of the pool are carried out by means of an Operating Committee and a Coordinating Group:

(1) Operating Committee. The Operating Committee consists of one member from each participating system through whom all pool matters are handled. Implementation of any pool action requires unanimous approval by the Operating Committee. The Operating Committee has three continuous subcommittees: Relaying, Communications, and Maintenance.

(2) Coordinating Group. The Coordinating Group, headquartered in Portland, Oregon, consists of five full-time professionals. It acts as a staff for the Operating Committee and the Coordination Contract Committee of the Pacific Northwest Coordination Agreement and provides a clearinghouse for all pool utilities. The group initiates telephone conference calls, chairs Operating Committee meetings, prepares numerous load-resource analyses, takes a lead in coordinating operation with the pool and with adjacent areas, and makes other operating studies and reports. A considerable amount of time is spent on making load-resource analyses for both the Coordinated System of the Pacific Northwest Coordination Agreement and the Northwest Power Pool. Utilizing digital computers, these analyses are made from load and resource data supplied by the utilities. The Northwest Power Pool does not maintain a centralized group to schedule and dispatch the combined resources of the members of the pool. Rather, each member system remains autonomous, scheduling and dispatching its own resources to serve its own load. The Northwest Power Pool is a member of the North American Power Systems Interconnection Committee (NAPSIC) which coordinates energy interchange between 10 regional systems.

b. Pacific Northwest Coordination Agreement. The utilities of the Pacific Northwest have long recognized the need for coordinated operation. Through the years the Northwest Power Pool and other inter-utilities arrangements have accomplished much toward this end. These efforts culminated in the Pacific Northwest Coordination

Agreement, a formal contract for coordinating the seasonal operation of the generating resources of the member systems for the best utilization of their collective reservoir storage. Finalized in mid-August 1964, the agreement (Contract No. 14-02-4822) became effective on 4 January 1965 and terminates on 30 June 2003. The following 18 agencies and utilities have ratified the agreement:

1. Bonneville Power Administration
2. Bureau of Reclamation
3. Corps of Engineers
4. Chelan County PUP
5. Colockum Transmission Company
6. Cowlitz County PUD
7. Douglas County SPUD R. Eugene Water and Electric Board
8. Grant County PUD
9. Montana Power Company 11, Pacific Power and Light Company
10. Pend Oreille PUB
11. Portland General Electric Company
12. Puget Sound Power and Light Company
13. Seattle City Light
14. Snohomish County PUP
15. Tacoma City Light
16. Washington Water Power Company

A fundamental concept of the Coordination Agreement is "Firm Load Carrying Capability," commonly abbreviated as FLCC. For the coordinated system of all 18 parties, the FLCC is the aggregate firm load that the system could carry under coordinated operation with critical period streamflow conditions and with the use of all reservoir storage.

In order to accomplish such coordinated operation, the combined power facilities of the parties are operated to produce optimum firm load-carrying ability.

Each party is entitled to a Firm Energy Load Carrying Capability (FELCC) equal to its capability in the critical streamflow period with full upstream storage release, except for reimbursement of Canadian Treaty benefits and restoration of capability to parties which suffer loss in critical period energy capability as a result of the Canadian Treaty storage. FELCC's are sustained by exchange of energy between parties.

Prior to the start of a contract year, a reservoir operating and storage schedule is developed to provide the optimum FELCC of the coordinated system. This schedule is melded with a schedule that provides adequate assurance of reservoir refill. The resulting schedule, called an Energy Content Curve (ECC), is used in the operation of the system to determine system energy generation capability. Generation in excess of FELCC resulting from draft to ECC can be used to serve secondary load. If draft below ECC is required to carry FELCC, then secondary load may not be served.

The above discussion refers primarily to the procedures followed to insure meeting FELCC during periods of critical streamflow. However, the same basic procedures are used to insure optimum utilization of reservoir storage during years of plentiful streamflow as well.

If, as may frequently happen, the best operation for the coordinated system requires a utility to cut back on releases and to hold storage for later use thereby reducing its present generation below its FELCC and perhaps below its load requirements, it has the right to call for and receive interchange energy from a party with excess capability. Later, when the first party's storage is scheduled for release, it will be able to return the energy. Provision is made to pay for any imbalances in such interchange energy exchange accounts that may remain at the end of a contract year.

The agreement provides that, upon request, a utility is entitled to the energy that it could generate at its plants if upstream reservoirs released all water above their FCC's. The upstream party can either release the water or, if it has surplus energy and wishes to conserve its storage for later use, it may deliver energy "in lieu" of the water. The upstream party is not required to spill water to satisfy demands of a downstream utility. Representatives of the participants in the agreement are members of the Coordination Contract Committee. This committee makes studies and analyses and rules on any actions concerning the agreement. Most of its work is delegated to the Northwest Power Pool Coordinating Group. However, some of the work is delegated to one or more of the participants.

Other provisions of the agreement include the following: Each party shall accept for storage in available reservoir space energy surplus to other parties' needs. Equitable compensation shall be made for the benefits from reservoir storage. The obligation to reimburse treaty power to Canada shall be shared by the projects which benefit from treaty storage in proportion to their benefits. Interconnecting transmission facilities shall be made available for coordination use subject to the owners' prior requirements. Equitable charges shall he made for capacity, energy, transmission, storage and other services. Nothing in the agreement is intended to conflict with project constraints for other functions such as flood control, recreation, fish, irrigation, etc.

c. Columbia River Treaty. In 1964 the Columbia River Treaty for the international development of the Columbia River was ratified by the governments of Canada and the United States. The treaty provided for Canada to build and operate three reservoirs presently known as Duncan Lake, Arrow Lake, and Kinbasket Lake. These three reservoirs have a combined usable storage of 20.5 million acre-feet. Under the treaty, Canada operates these reservoirs in a manner which increases downstream power generation and reduces flood damage in the united States. In return for the benefits received, the United States gives Canada half of the dependable capacity and half the energy gain in the United States as a result of Canadian storage and pay Canada an amount equal to half the value of flood damages prevented.

In carrying out the functions required under the Columbia River Treaty, each country has set up a working organization. The treaty working organization is comprised of a permanent engineering board, U. S. and Canadian entities, U. S. coordinators, Manager - Canadian Entity Service, and two international committees., The RCC Guidance Memorandum dated January 1972 provides details on functions and responsibilities of these working organizations.

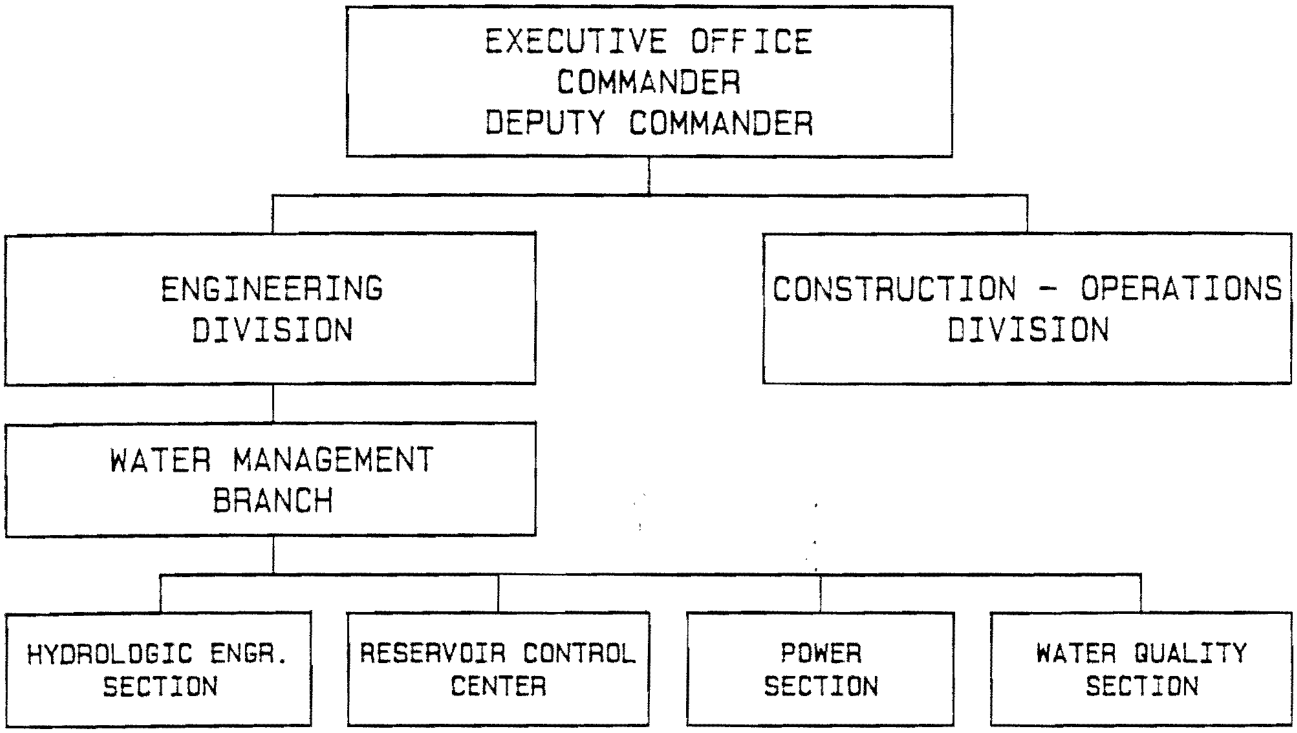
d. Columbia River Water Management Group. The Columbia River Water Management Group acts as a committee to consider problems relating to operation and management of water control facilities in the Columbia River Basin. Upon review and discussion of the problems, the group makes tentative recommendations for consideration of the individual agencies having primary responsibilities in these areas. The basic function of the group is coordination of river systems operations including the efficient operation of the hydrometeorological system required for each operation. The Water Management Group prepares an annual report which summarizes hydrometeorological, reservoir regulation activities, and activities and accomplishments of member agencies as related to the Columbia River and tributaries.

The membership of the Columbia River Management Group is composed of representatives from the following state and Federal agencies:

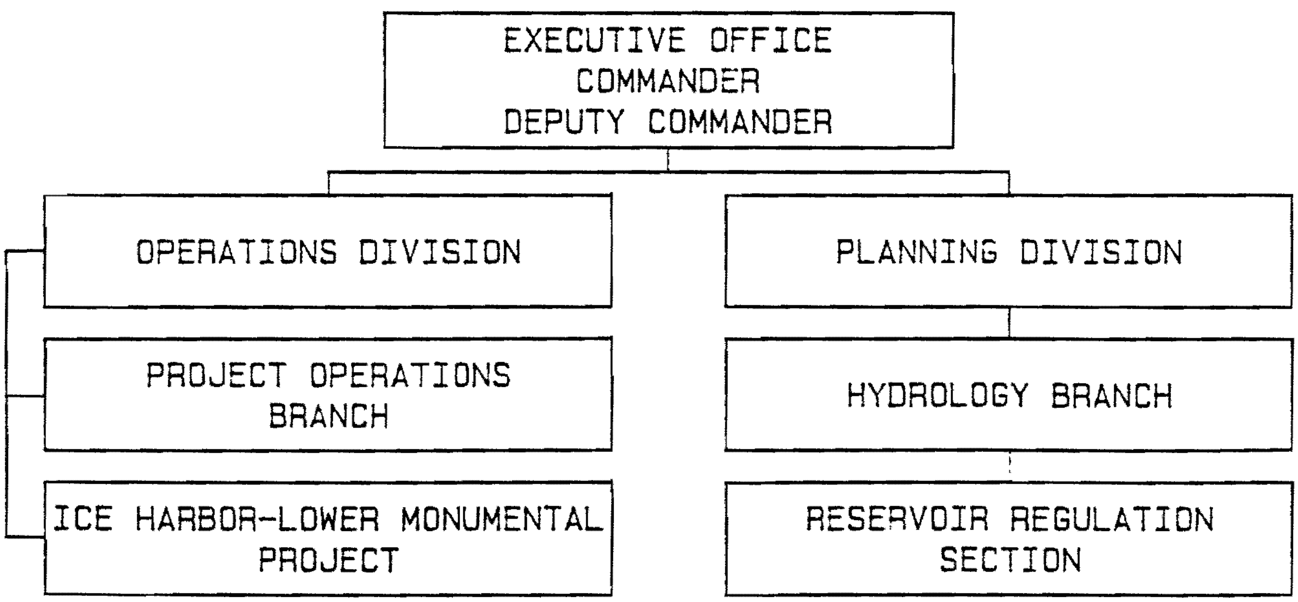
1. Bureau of Reclamation
2. Bonneville Power Administration
3. Corps of Engineers
4. National Weather Service
5. United States Geological Survey
6. Environmental Protection Agency - Water Quality Office
7. U.S. Forest Service
8. Soil Conservation Service
9. Bureau of Land Management
10. Federal Energy Regulatory Commission
11. Fish and Wildlife Service
12. National Marine Fisheries Service
13. Oregon Water Resources Department
14. Washington Department of Ecology
15. Idaho Department of Ecology
16. Nevada State Engineer
17. Department of Natural Resources and Conservation (Montana)
18. Wyoming State Engineer

6-03. Regulation Decisions and Records. The Reservoir Control Center (RCC) is responsible for making regulation decisions which affect project discharge rates and storage. The goal of the RCC is to effectively and efficiently schedule project operations in order to maximize benefits for project purposes. A daily log noting pertinent conversations and discussions leading to regulation decisions will he kept current both at the project and the RCC. Regulation decisions and instructions are discussed with appropriate project personnel and confirmed both on the CET and the CROHMS (Report Number 42 - Project Regulation Messages). Details and completeness of the daily log will be as necessary for after-the-fact review and analysis of regulation plans.

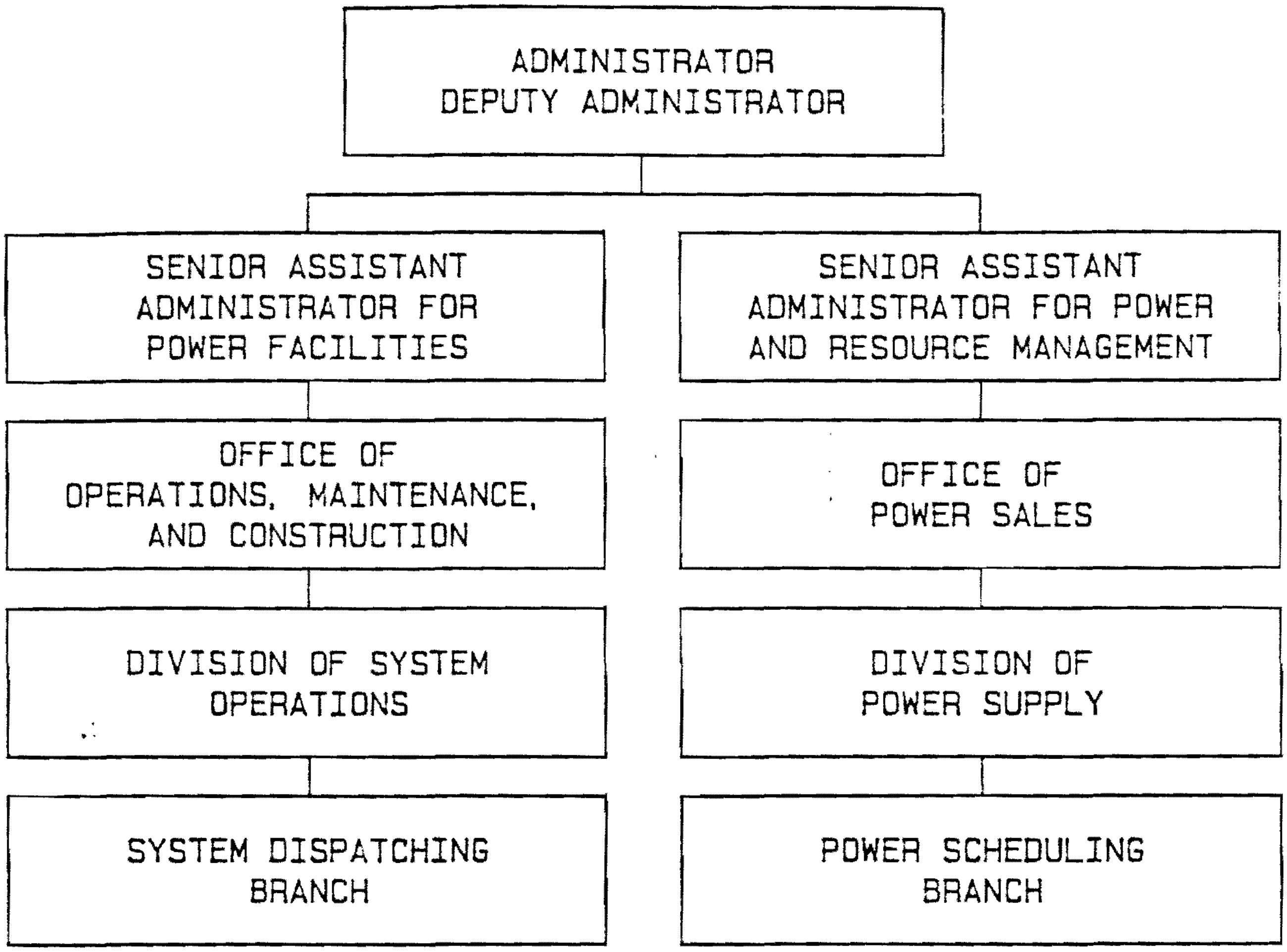
ORGANIZATION CHART
CORPS OF ENGINEERS - NORTH PACIFIC DIVISION



ORGANIZATION CHART
CORPS OF ENGINEERS - WALLA WALLA DISTRICT



ORGANIZATION CHART
BONNEVILLE POWER ADMINISTRATION



VII - STREAMFLOW FORECASTS

7-01. a. General. The development of reservoir regulation plans for the Lower Monumental project is based primarily on power operations and daily streamflow forecasts. The North Pacific Division Corps of Engineers Reservoir Control Center (RCC) is directly responsible for coordination of operational planning and regulation of Corps of Engineers reservoirs. The Northwest River Forecast Center of the National Weather Service is responsible for issuing coordinated water supply forecasts for the Columbia River Basin system based on forecasts from B. C. Hydro, Bonneville Power Administration, Bureau of Reclamation, Corps of Engineers, Soil Conservation Service (SCS), and the Northwest River Forecast Center (RFC). RFC also makes peak discharge estimates for key gaging stations in the Columbia River Basin based on 1 April runoff volume forecasts. These peak flow forecasts are based on statistical relationships between peak flow and runoff volume.

For real-time short-range daily regulation, the BCC uses the Streamflow Synthesis and Reservoir Regulation (SSARR) model. The SSARR model utilizes routing procedures, snowmen, and precipitation data to simulate streamflows. The storage effects of lakes and reservoirs can also be evaluated with specified streamflow and reservoir conditions. The RFC and the RCC develop SSARR forecasts cooperatively and use results to carry out their public service and operational responsibilities. Refer to the Master Water Control Manual dated December 1984 for more information on use of the SSARR model.

b. SSARR Forecasts. The SSARR model is comprised of three basic components:

(1) A generalized watershed model for synthesizing runoff from snowmelt, rainfall, or a combination of the two as drainage basin outflows.

(2) A river system model for routing streamflows from upstream points to downstream points through channel and lake storage. Streamflows may be routed as a function of multivariable relationships involving backwater effects from tides or reservoirs.

(3) A reservoir regulation model whereby reservoir outflow and contents may be analyzed in accordance with predetermined or synthesized inflow and free flow or any of several modes of operation.

SSARR forecasts normally begin about 1 April and continue until the flood potential becomes minimal, which is usually sometime in July. During the early part of the spring flood season, the frequency of these forecasts is 3 days per week on Monday, Wednesday, and Friday. The Monday and Friday forecasts are short-range forecasts for 10 days in advance. The Wednesday forecast is a long-range forecast which covers the period from the initial forecast date through July. During the peak flow and recession flow period, long-term extended forecasts are made every day.

These extended forecasts continue until the danger of flooding is past and the reservoirs are filled. Since weather forecasts are usually reliable only for 3 to 5 days in advance, the hydrometeorological factors affecting runoff must be extended during the forecast period on the basis of average and extreme snowmelt conditions in order to compare probable flows with the most severe flows likely to occur.

VIII - WATER CONTROL PLAN

8-01. General Objectives. The objectives of this water control plan are to define regulation practices and procedures to maximize benefits from authorized project uses of providing water transportation lockages past the dam, slackwater navigation in the reservoir, and producing hydroelectric power. Regulation to optimize these authorized uses will also provide suitable conditions for secondary uses of recreation and fish and wildlife. Flood control is not an authorized or planned project function since the amount of reservoir storage is small compared to river flows.

8-02. Major Constraints.

a. Lake Elevation Limitations. Lower Monumental Reservoir will normally be operated between elevations 537.0 and 540.0. A tolerance of up to 0.5 foot above or below those limits is permissible to allow for forecast error or other unanticipated events, but the 0.5-foot tolerance will not be utilized on a planned basis. The 536.5-540.5 elevation range will not be violated without prior District Office approval except in event of an emergency. District Office approval will be coordinated through the Chief of the Operations, Construction and Readiness Division. In the event of possible artificial flooding due to rupture of an upstream dam, the increased flows will be passed through the spillway with the pool in the normal operating range, elevation 537 to 540 insofar as possible. When fully open the 8 spillway gates will pass 676,000 cfs at pool elevation 540.0. Should the river flow exceed 676,000 cfs, elevation 540.0 will be exceeded even with all spillway gates fully open. Except in event of a definite emergency, elevation 540.5 will not be exceeded unless the pool is forced above that elevation by involuntary surcharge with exceptionally high river discharge.

b. Minimum Discharge. Minimum project discharge limits ensure the safe passage of anadromous fish during their migration to spawning grounds. From December through February, "zero" minimum project discharge is permitted on a limited basis. Under an agreement between the Corps of Engineers and the fishery agencies zero river flow is allowed for water storage during low power demand periods (at night and on weekends) when there are few if any actively migrating anadromous fish present in the Snake River. From March through November, the minimum project discharge is 11,500 cfs for power generation and fishery ,purposes. This minimum discharge is the approximate design discharge of one power unit operated at the continuous minimum generation limit of 80 MW. Special conditions may develop which make "zero" minimum project discharge desirable for a limited time during the March to November period. The Reservoir Control Center (RCC) will be responsible for coordinating such "zero" flow requests with the fishery agencies for approval. Water Stored under "zero" river flow conditions may maximize power production from the Columbia River Basin system, but "zero" river flow operations are not recommended at Lower Monumental when fish are actively migrating in the Snake River.

c. Rate of Change of Discharge. The maximum rate of change per hour for project discharge will normally be limited to 70,000 cfs, which is based on a 1.5 feet per hour rate of change for tailwater elevation. Chart 10 shows tailwater discharge rating curves.

d. Spillway Operation. The spillway is operated to pass the desired discharge with the best practical hydraulic conditions in the area adjacent, to the stilling basin, particularly at the fish ladder entrances. All spillway gate positions are remotely indicated and each gate is equipped for remote operation from the powerhouse control room and through SAT3 from the McNary powerhouse. The spillway hays and gates are numbered I to 8 from left to right looking downstream. Spillway gates are operated in accordance with criteria contained in the Walla Walla District - Fish Facility Operation and Maintenance Plan, Appendix C - Operating Standards for Adult Fish Passage Facilities. Table 8-1 on pages 8-3 to 0-4 shows the spill pattern based on current criteria for spillway gate operation during the adult fish passage season from 1 March through 31 December. The variation in gate opening normally will not exceed one stop. This criteria for spillway pattern is a guide and may be modified with additional experience and tests. Table 9 is the discharge rating for one spillway gate and Chart 9 shows similar data in graphical form.

8-03. Flood Control Plan. Flood control is not a planned project function because Lower Monumental is operated as a run-of-river project with a small amount of usable storage. However, with extremely high forecasted inflow conditions at Lower Granite, the NPD Reservoir Control Center may consider drawing down Little Goose, Lower Monumental and Ice Harbor reservoirs in advance of increased discharges from Lower Granite in order to provide some space in the Lower Snake River system if such a system regulation plan provides benefits for flood control and power generation at downstream locations on the Snake and the Columbia Rivers.

A flood period on the Lower Snake River system is defined as a period when Lower Granite inflows will reach 120,000 cfs and when these flows have the potential to increase substantially and remain above 120,000 cfs for at least 24 hours because of past or forecasted meteorological events. The intent of the flood control plan is to allow the Reservoir Control Center some flexibility and judgment in the operation of the Lower Snake River system.

TABLE 8-1
LOWER MONUMENTAL SPILL PATTERN
(I March - 31 December)

Gate Numbers 1	2	3	4	5	6	7	8	Total Stops	Spill (kcfs)[1/]
Gate Stops									
1	0	0	0	0	0	0	0	1	1.1
1	0	0	0	0	0	0	1	2	2.2
1	1	0	0	0	0	0	1	3	3.3
1	1	0	0	0	0	1	1	4	4.4
2	1	0	0	0	0	1	1	5	6.1
2	1	0	0	0	0	1	2	6	7.8
2	1	1	0	0	0	1	2	7	8.9
2	1	1	0	0	1	1	2	8	10.0
2	1	1	1	0	1	1	2	9	11.1
2	1	1	1	1	1	1	2	10	12.2
2	1	2	1	1	1	1	2	11	13.9
2	1	2	1	1	2	1	2	12	15.6
2	1	2	2	1	2	1	2	13	17.3
2	1	2	2	2	2	1	2	14	19.0
3	1	2	2	2	2	1	2	15	20.8
3	2	2	2	2	2	1	2	16	22.5
3	2	2	2	2	2	1	3	17	24.3
3	2	2	2	2	2	2	3	18	26.0
4	2	2	2	2	2	2	3	19	27.7
4	2	2	2	3	2	2	3	20	29.5
4	2	2	2	3	2	2	4	21	31.2
4	2	2	2	3	2	3	4	22	33.0
4	2	3	2	3	2	3	4	23	34.8
4	3	3	2	3	2	3	4	24	36.6
4	3	3	3	3	2	3	4	25	38.4
4	3	3	3	3	3	3	4	26	40.2
4	3	3	4	3	3	3	4	27	41.9
4	3	3	4	4	3	3	4	28	43.6
5	3	3	4	4	3	3	4	29	45.3
5	4	3	4	4	3	3	4	30	47.0
5	4	3	4	4	3	3	5	31	48.7
5	4	3	4	4	3	4	5	32	50.4
5	4	4	4	4	3	4	5	33	52.1
5	4	4	4	4	4	4	5	34	53.8
5	4	4	5	4	4	4	5	35	55.5
5	4	4	5	4	5	4	5	36	57.2
6	4	4	5	4	5	4	5	37	58.9

6	5	4	5	4	5	4	5	38	60.6
6	5	4	5	4	5	4	6	39	62.3
6	5	4	5	4	5	5	6	40	64.0
6	5	5	5	4	5	5	6	41	65.7
6	5	5	5	5	5	5	6	42	67.4
6	5	5	6	5	5	5	6	43	69.1
6	5	5	6	5	6	5	6	44	70.8
7	5	5	6	5	6	5	6	44	72.5
7	6	5	6	5	6	5	6	46	74.2
7	6	5	6	5	6	5	7	47	75.9
7	6	5	6	5	6	6	7	48	77.6
7	6	6	6	5	6	6	7	49	79.3
7	6	6	6	6	6	6	7	50	81.0
7	6	6	7	6	6	6	7	51	82.7
7	6	6	7	6	7	6	7	52	84.4
8	6	6	7	6	7	6	7	53	86.3
8	7	6	7	6	7	6	7	54	88.0
8	7	6	7	6	7	6	8	55	89.9
8	7	6	7	6	7	7	8	56	91.6
8	7	7	7	6	7	7	8	57	93.3
8	7	7	7	7	7	7	8	58	95.0
8	7	7	8	7	7	7	8	59	96.9
8	7	7	8	7	8	7	8	60	98.8
9	7	7	8	7	8	7	8	61	100.4
9	8	7	8	7	8	7	8	62	102.3
9	8	7	8	7	8	7	9	63	103.9
9	8	7	8	7	8	8	9	64	105.8
9	8	8	8	7	8	8	9	65	107.7
9	8	8	8	8	8	8	9	66	109.6
9	8	8	9	8	8	8	9	67	111.2
9	8	8	9	8	9	8	9	68	112.8
10	8	8	9	8	9	8	9	69	114.6
10	9	8	9	8	9	8	9	70	116.2
10	9	8	9	8	9	8	10	71	118.0
10	9	8	9	8	9	9	10	72	119.6
10	9	9	9	8	9	9	10	73	121.2
10	9	9	9	9	9	9	10	74	122.8
10	9	9	10	9	9	9	10	75	124.6
10	9	9	10	9	10	9	10	76	126.4
11	9	9	10	9	10	9	10	77	128.1
11	10	9	10	9	10	9	10	78	129.9
11	10	9	10	9	10	9	11	79	131.6
11	10	9	10	9	10	10	11	80	133.4
11	10	10	10	9	10	10	11	81	135.2
11	10	10	10	10	10	10	11	82	137.0
11	10	10	11	10	10	10	11	83	138.7

11	10	10	11	10	11	10	11	84	140.4
12	10	10	11	10	11	10	11	85	142.2
12	11	10	11	10	11	10	11	86	143.9
12	11	10	11	10	11	10	12	87	145.7
12	11	10	11	10	11	11	12	88	147.4
12	11	11	11	10	11	11	12	89	149.7
12	11	11	11	11	11	11	12	90	150.8

[1/] Forebay elevation 539.0 (M.S.L.)

Source: Walla Walla District - Fish Facility O & M Plan, Appendix C - Operating Standards for Adult Fish Passage Facilities.

8-04. Fish and Wildlife Plan.

a. Background. Every spring juvenile salmon and steelhead smolts leave spawning grounds and hatcheries on the Columbia and Snake Rivers and begin their downstream migration to the Pacific Ocean. These young fish depend on river currents to carry them downstream. The many hydroelectric dams constructed on these rivers have resulted in adverse survival conditions for these smolts due to: (1) increased travel times to the ocean caused by slower flows in reservoirs, and (2) restricted downstream fish movement past the dams.

The spring runoff of 1973, which was one of the lowest droughts of record, brought about a heightened awareness of the problems facing juvenile fish during their migration past Columbia an Snake River dams. During the 1973 spring runoff period, migrating juvenile fish suffered heavy mortalities as a result of (1) the extended transit time through the system and (2) the passage of most fish through the turbine units of the dams. A Committee on Fishery Operations (COFO) was established in 1975 to coordinate the effort to provide for the protection of juvenile fish within a balance of reduced firm power and adverse impacts on other uses of the water resource. Definitive steps were taken to assist juvenile fish passage during the 1977 drought which was more severe than the one in 1973. The COFO continued to coordinate the annual juvenile fish passage program through 1982.

In November 1982, the Northwest Power Planning Council, under guidelines of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Regional Act, Public Law 96-501), developed the first regional fish and wildlife program for the Columbia River and its tributaries. The fish and wildlife program , amended in October 1984, proposes development of an interim regional plan to coordinate, refine, and develop operations and facilities for protecting these migrating fish and improving migration conditions. The NPD Corps of Engineers is responsible for developing and implementing the juvenile fish passage plan for Coups of Engineers projects.

b. Lower Snake River Fish and Wildlife Program.

(1) Lower Granite Water Budget. The Lower Granite Water Budget is a recommended amount of water specifically reserved for the enhancement of flows at Lower Granite Dam to aid in the spring migration of smolts through the Lower Snake River reservoir system. This Water Budget may be used during the 15 April-15 June period when the major smolt migration is occurring at Lower Granite Dam, hence the water budget approach rather than a minimum flow requirement to enhance spring migration conditions. A total Water Budget of 20 Kcfs-months (1.19 MAF) has been recommended for shaping spring flows under the Columbia River Basin Fish and Wildlife Program developed by the Pacific Northwest Power Planning Council in 1982 and amended in 1984 and 1987.

In most years, the Water Budget flows will be the result of runoff from uncontrolled drainage basins above Lower Granite because of the limited amount of water available from storage in Dworshak and Brownlee reservoirs with which to control the Lower Snake River flows. If the Snake River flows at Lower Granite Dam are not adequate (less than 85 Kcfs) to move fish quickly through the reservoir, additional water may be released from upstream reservoirs (Dworshak and Brownlee), if available.

Under the Lower Granite Water Budget Implementation Procedure developed by the Engineering Division of the NPD Corps of Engineers, a sliding scale, based on the Lower Granite April-July runoff volume forecast, is used to determine the volume of water to be allocated from upstream reservoirs (Dworshak and Brownlee) for the Lower Granite Water Budget. Idaho Power Company's participation, use of Brownlee storage, in the Lower Granite Water Budget is still under negotiation with the Bonneville Power Administration.

Water Budget flows at Lower Granite will be an operational consideration whenever requested during the 15 April to 15 June period. Requests for Water Budget flows will originate from fish and wildlife agencies and tribes through two Fish Passage Managers. These managers will he the primary points of contact between the power system operators and the fish and wildlife agencies and tribes on matters concerning the Water Budget and fish passage. The flow requests must be greater than average weekly firm power flows and less than 140 Kcfs. For Water Budget accounting purposes, the Power Planning Council has used firm power flows for Lower Granite Dam as follows:

Period	Average Weekly Firm Power Flows (Kcfs)
15-30 April	50
1-31 May	65
1-15 June	60

(2) Fishery Regulation. Since Lower Granite, Little Goose, Lower Monumental, and Ice Harbor are operated as run-of-river projects, The Water Budget flows provided at Lower Granite from the use of Dworshak and Brownlee storage will be passed through the Lower Snake River reservoir system and into the Lower Columbia River.

(a) Water Budget Regulation. During a year when the Lower Granite runoff volume inflow forecast for April-July is 23.0 MAF or less, the use of upstream reservoir storage for providing Water Budget flows will be coordinated by the CENPD RCC. The RCC and Fish Passage Managers will jointly monitor the runoff and juvenile migration and may, by mutual agreement, modify the minimum level of flow at Lower Granite if necessary. The RCC will be responsible for coordinating releases from upstream storage to the extent that water is available for shaping fish flows at Lower Granite. The regulation objectives will be to provide well-timed flows from upstream reservoirs in addition to the uncontrolled spring runoff to aid and enhance migration. Total water available for Water Budget requests above uncontrolled runoff is provided from Dworshak and Brownlee storage under the following conditions:

1 Brownlee storage may be available to meet Lower Granite Water Budget requests if such releases are agreeable to Idaho Power Company.

2 Water from Dworshak for shaping Water Budget flows at Lower Granite may be used to maintain average weekly flows of at least 85 Kcfs at Lower Granite. Additional water may be available from Dworshak to provide extended flows up to 140 Kcfs if Dworshak refill is not jeopardized and the Corps is not collecting and transporting juvenile fish at Lower Granite or Little Goose.

3 A Water Budget request may not be implemented if it conflicts with other nonpower constraints at Dworshak. The severity of the conflict will be analyzed by the CENPD-RCC and appropriate action taken, with documentation of the basis of the decision forwarded to the Fish Passage Managers.

(b) Nonwater Budget Regulation. During a year when the Lower Granite runoff volume inflow forecast for April-July is greater than 23.0 MAF and the reservation of water for the Water Budget is not required at Dworshak, the RCC would still coordinate the regulation of releases from Dworshak and Brownlee to the extent that water is available for flow augmentation at Lower Granite.

c. Spill Program for Juvenile Fish Passage.

(1) General. Lower Monumental's existing gatewell juvenile bypass system is a very minimal facility. As a result, the Corps of Engineers has implemented a "juvenile fish spill program", which specifically helps salmonids pass Lower Monumental Dam during their downstream migration to the Pacific Ocean. This spill program is separate from the Water Budget, which is river flow intended to assist fish movement through the reservoirs. The facilities at Lower Granite and Little Goose dams are used mostly for collection, with bypass capability being used only when flow conditions warrant bypass as requested by agencies and tribes or fish numbers make transportation unfeasible, so the number of fish bypassed at Lower Monumental is small in comparison to the total fish numbers. The spill program at Lower Monumental is considered a temporary measure until the installation of adequate permanent bypass facilities.

(2) Objective. The goal of the "juvenile fish spill program", at Lower Monumental is to achieve a 90 % survival rate for juvenile salmonids passing the project. An 85 % survival rate is used for turbine passage in "FISHPASS", the CENPD-EN-WM computer model of fish passage for the Columbia-Snake River system. Lower Monumental's total project survival rate is raised to 90 % by passing approximately 40 % of the juveniles through the spillway.

(3) Spill Criteria for Juvenile Passage. Criteria for spill patterns from 1 April to the end of the juvenile fish passage season are summarized as follows:

(a) Involuntary Spill Operation. Involuntary spill occurs when the powerplant's hydraulic capacity has been exceeded or low system power demands require part of the river flow to be spilled. The spill pattern for an involuntary spill operation will be in accordance with criteria contained in the Walla Walla District - Fish Facility Maintenance Plans, Appendix C - Operating Standards for Adult Fish Passage (Refer to Table 8-1 on pages 8-3 to 8-4 of this Manual).

(b) Voluntary Spill Operation. Voluntary spill is the amount of spill required to achieve Lower Monumental's 90 survival rate for juvenile fish passage. Operation for voluntary spill during the juvenile fish passage season (1 April to 15 August) may be required to minimize turbine mortality. Turbine mortality is defined as the percent of juveniles killed in passage through the turbines. Voluntary spill regulation will he coordinated by the Walla Walla District's Natural Resources Management Branch (CENPW-OP-RM) with the North Pacific Division's Reservoir Control Center (RCC) and in accordance with the annual Juvenile Fish Passage Plan For Corps of Engineers Projects, which is published by the North Pacific Division's Water Management Branch (CENPD-EN-WM). In-season modification of spill criteria will be coordinated between the Corps' RCC, CENPW-OP-RM, and the Fish Passage Center.

Voluntary spill at Lower Monumental is based on a specified minimum daily fish count or trigger number at Little Goose. When the trigger number is reached, spill will begin each night and continue for a specified minimum time period with additional hours of spill dependent on the numbers of fish passing the project and through the spillway. Hourly in-season night spill may be terminated when fish numbers either drop below the minimum hourly passage number required for continuing the spill or a specified hour is reached. Directions for initiating spill will come over the Columbia Basin Telecommunications (CBT) network from the RCC. Guidelines for continuing hourly night spill will be provided by CENPW-OP-RM and updated as required as the season progresses. Spill will be terminated at the end of the fish passage season when the daily fish count drops below the specified trigger number and will not be provided beyond the date specified in the annual Juvenile Fish Passage Plan For Corps of Engineers Projects.

(c) Project Responsibilities. The information on juvenile fish passage is utilized by CENPW-OP-RM, CENPD-EN-WM, and fishery agencies during the fish passage season. Therefore, when there are on-site monitoring programs, control room operators should telefax the Daily Fish Passage Report to CENPW-OP-RM by 0730 hours, if possible. If operators have questions on the "juvenile fish spill program", they should contact CENPW-OP-RM.

(d) Special Spill. Special spill will be considered during the summer when the Lyons Ferry Hatchery fish are released. The Reservoir Control Center will be responsible for evaluating special spill regulation schedules and will either approve or deny implementation of special spill schedules based on real-time conditions.

8-05. Power Plan. Lower Monumental Dam is operated for power within the foregoing bondage and release limitations and in accordance with a working agreement between the Corps of Engineers and Bonneville Power Administration, the marketing agency for Federally generated power in the Pacific Northwest. Power scheduling for Lower Monumental is accomplished by Bonneville Power Administration in coordination with the North Pacific Division of the Corps of Engineers. To implement scheduling and maintain optimum operating conditions, close coordination between the Lower Monumental and McNary powerplant operators and the Bonneville Power Administration dispatchers is essential. Routine power operations are remotely controlled from McNary through the system optimizer controller, which can also remotely control Ice Harbor, Little Goose, and Lower Granite projects. Discussion of overall coordinated operation of the Northwest Federal Power System is presented in the Master Water Control Manual.

Load factoring may be accomplished by making use of the 20,000 acre-feet of storage between elevations 537 and 540 when the reservoir inflow is less than powerplant hydraulic capacity. The discharge capacity of the six power units is about 130,000 cfs in the range of normal operating head.

Generally, the power units will be operated to provide greatest overall powerplant efficiency. This will be in the interest of smooth and efficient turbine operation and also will provide more satisfactory conditions for any downstream migrating juvenile fish which pass through the turbines. All operations will be within the safe limitations of the equipment as set forth in the Operations and Maintenance Manual.

The Bonneville Power Administration dispatcher will be notified of any emergency which may affect power production and the estimated time to restore conditions to normal.

In the event of a transmission system break-up which would leave Lower Monumental Project the only major generating facility on an isolated segment of the Bonneville Power Administration system, a maximum effort will be made to carry the load. Under such conditions, it may be justified on a short-time basis to load the generators above the normal 15 percent overload, and to utilize somewhat more than the normal 3-foot reservoir operating range. If at all possible, at least one generator will be kept in operation throughout an emergency which has isolated or threatens to isolate the project from other power sources. If no other power is available, the spillway gates may be operated with emergency power supplied by a diesel-generator set.

8-06. Navigation Plan. Operation for navigation, a major project function, consists essentially of making the necessary lockages. Normally, navigation requirements are met with regulation of streamflows and pool levels for other project purposes. Occasionally, however, special requirements are met by special regulation of pool levels, but these do not significantly alter the Columbia River system regulation as a whole. The lock facilities are operable at the full range of normally experienced river flows, but should the discharge reach 300,000 cfs, it may be necessary to close the lock to some vessels because of restricted clearance under the downstream lift gate. In the raised position, the bottom of the gate is at elevation 505, the same as the bottom of the bridge. Tailwater elevation with a 300,000 cfs discharge is 450 feet msl, providing 55 feet of clearance. The navigation regulations and procedures are set forth in Exhibit 8-1.

The locks at the dams may be closed for brief periods every year for maintenance. Closures are scheduled far enough in advance and given sufficient publicity to provide minimum interference with navigation. A callout list for use in case of emergency closure of the lock facilities or other navigation emergencies is given in table B-1, Exhibit 8-1.

Water which is passed through the dam by lockages is accounted for and reported. A lockage requires approximately 15 to 30 minutes, varying somewhat with head and other factors. The following tabulation shows the relationship between head and volume in a lockage expressed in acre-feet and equivalent cfs averaged over a one-hour period.

Head	Lockage Volume	
Ft.	Acre-Feet	Cfs-Hr
103	142	1722
100	138	1672
96	133	1605
92	127	1538
88	122	1472
84	116	1405
80	111	1338

8-07. Recreation Plan. The plan of operation of Lower Monumental project does not specifically provide for special regulation of the reservoir in the interest of recreation. The recreation facilities are constructed to accommodate the three-foot reservoir fluctuations between elevations 537 and 540 measured at the dam. Under special conditions and when clearly not detrimental to other interests it may be permissible to regulate the reservoir in the specconsideredst of recreation for short periods.

8-08. Special Operations. Special reservoir regulation activities, which are not &onsidered normal reservoir regulation activities, will be required from time to time. Such reservoir regulation plans for special activities would be developed within the normal operating limits and constraints of the project, which are explained in paragraph 8-02, Major Constraints. Requests for special operations that are not within the normal operating criteria of the project will be evaluated and approved or denied by Reservoir Control Center in consideration of real-time or current conditions.

8-09. Public Notices. Public notices will be issued only when there is a pronounced departure from normal operating procedure or an unusual development which will require scheduled special reservoir operations that will be of concern to public activities. Public notices will not be issued for conditions which are of little significance to the public or navigation interests. Public notices pertaining to Lower Monumental project will be issued by the Operations Division of the Walla Walla District. Public information releases to newspapers, radio stations, and television stations will normally be issued by the Public Affairs Officer of the Walla Walla District and/or Ice Harbor - Lower Monumental Project engineer.

8-10. Standing Instructions. The following is a list of standing instructions for reservoir regulation under normal conditions, emergency conditions and communication outage.

a. Normal Conditions. Lower Monumental will be regulated according to criteria and procedures in this Water Control Manual. The following tabulation lists key paragraphs in this Water Control Plan Section for normal operation.

*** Instructions and procedures for lockage of vessels are contained in Exhibit 8-1, Navigation Regulations. Exhibit 8-1 shows a list of personnel and companies to notify in the event of unscheduled navigation matters.

b. Emergency Conditions. Emergency conditions are unforeseen and cannot be completely provided for in this Water Control Manual. General instructions are summarized as follows:

- Refer to pages iv and v (pink sheets in the front of this Manual) for telephone numbers and guidelines on emergency conditions.

- If the nature of the emergency requires immediate action to prevent loss of life and property, the Project Engineer will take the necessary action and report all circumstances to the Walla Walla District's Chief of Operations Division as soon as possible.

c. Communications Outage. In the event of normal telephone and CET systems outage, communication between the project and the Reservoir Control Center will be established via the Walla Walla District radio system.

An elaborate radio, microwave radio, and telephone system connects all District projects except Lucky Peak, McNary Dam is the control center for this system. Radio communication to commercial floating craft and the U.S. Coast Guard utilizes assigned Marine channel 14, for working traffic, and Marine channel 16, for contacting and emergencies. Radio communication between mobile and portable units and the District office or a project control room will be on the Corps' operating frequency 163.4125 megahertz. Relay stations, one near Pomeroy in the Blue Mountains and one near Kennewick, are provided to increase mobile and portable radio coverage. Microwave radio channels link the project control rooms and the District Office.

When the operator at Lower Monumental leaves the control room, McNary can switch the microwave radio system so that it is rebroadcast over the mobile or portable frequency, 163.4125 megahertz, and reach the operator anywhere on the project. The operator can monitor and answer the navigation radio on Marine Channel 14 by activating the rebroadcasting feature when he leaves the control room. Be must return to the control room to conduct any radio traffic on Marine Channel 16.

A microwave telephone system provides an additional link between the District Office and the projects. With the microwave radio and telephone system available, it is possible to communicate between a mobile radio and any project or District telephone extension via McNary control room.

IX - EFFECT OF WATER CONTROL PLAN

9-01. General. The various water control plans are intended as a means of outlining project regulation and/or management practices that maximize benefits derived from project functions. These water control plans provide for safe operation, power generation, recreation, fish and wildlife, and navigation. Overall benefits and effects from the project include:

1. Production of hydroelectric power.

2. Water oriented recreational opportunities for the public.

3. Enhancement of economic productivity in the region with slack water navigation to Lewiston.

4. Impact upon fish and wildlife habitat by altering 37.2 miles of free-flowing river and associated canyon bottom lands.

The benefits and effects of the various water control plans will be discussed in the following paragraphs.

9-02. Flood Control. Lower Monumental is operated as a run of river project and as a result, river flow passing the dam would not be significantly reduced by reservoir routing. However, the cumulative effect of drawing down Lower Monumental and downstream reservoirs in advance of flood peaks would have some moderating effect on the flood peak at downstream locations on the Snake and Columbia Rivers.

9-03. Fish and Wildlife.

a. Fish Passage. The two major fish migration events in the life cycle of anadromous fish include the downstream juvenile migration to the ocean and years later, the upstream adult migration to spawning grounds. Lower Monumental dam is a major physical barrier that anadromous fish must move past when migrating both up and down the Snake River. As a result, fish facilities were provided at the project to aid migrating adults and juveniles. Two fish ladders at the project are effective in providing passage past the dam for upstream migrating fish. A gatewell juvenile bypass system and juvenile fish spill program helps move juveniles rapidly past the dam during their downstream migration. The juveniles that do not go through the bypass system' will either pass over the spillway if water is being spilled or be drawn through the turbines. Lower Monumental's total project survival rate objective is 90% for juvenile salmonids passing the project. Physical transport by truck or barge from facilities at Lower Granite and Little Goose dams is another method of helping juveniles downstream and survival rates have been found to be higher for transported fish. Juvenile survival rates will increase with improvements to the fish bypass/collection facilities and physical transport methods.

b. Flow Augmentation at Lower Granite for Downstream Migrants. In addition to fish passage facilities and physical transport, well-timed and increased flows through Lower Monumental reservoir will also contribute to greater survival rates for downstream migrating fish. The effects of the slow-moving current through the reservoir on juveniles include increased migration time which reduces the smolts ability to adapt to salt water, favorable conditions for predators, and warmer water conditions. Flow augmentation at Lower Granite by water budget releases from upstream storage reservoirs will help to shape the flow pattern on the Lower Snake River during the critical migration period (15 April to 15 June) in order to move juveniles quickly and safely downstream.

The Corps does not plan to augment flows at Lower Granite for implementation of the Water Budget where it would cause spill at Lower Granite and Little Goose in excess of the rated hydraulic capacity of the power plant. Hydraulic capacity of each power plant at Lower Granite and Little Goose is approximately 130,000 cfs. However, at Lower Monumental voluntary spill specifically separate from the water budget flow may be required to aid juveniles in passing the dam. The volume of water required for water budget flow will be drawn from storage in Dworshak and Brownlee if necessary. The effect on Dworshak and Brownlee is a reduction of the firm energy load carrying capability (FELCC), which will also affect the FELCC of the entire Federal Columbia River Power System.

9-04. Hydroelectric Power. Power produced by Lower Monumental goes into the Northwest Power Pool where it is used to meet system needs. This power generation helps to meet the power needs of the Pacific Northwest at a cost considerably lower than would be possible using fossil fuels. The addition of Lower Monumental to the system also produces more dependability in the power system, since it can help meet power demands in the event that the generating ability of another facility is impaired.

9-05. Navigation. The regulation of the Snake River for navigation has a considerable effect on the economy of the region and of the Lewiston - Clarkston area. Prior to the building of the Lower Snake River navigation system, it was possible though difficult to. navigate the river as far up as Lewiston. In the last few years before the system was finished, water traffic had almost ceased, since it was more economical to ship commodities by railway or truck. However, completion of the system made it possible to easily and economically transport commodities from interior areas of the basin by water. Major shipping facilities in Lewiston and Clarkston and along the reservoir handle bulk commodities such as grain and fertilizer, which are considerably cheaper to transport by barge.

9-06. Recreation. The Lower Monumental project has greatly improved the recreation opportunities of the region. The relatively stable pool levels provided by operation between elevations 537 and 540 for primary project functions of power generation and navigation provide excellent conditions for reservoir recreation activities. Project recreation activities include boating, water skiing, swimming, picnicking, and camping. These opportunities enhance the quality of life for people in the region.

9-07. Water Quality. The regulation of Lower Monumental reservoir to provide optimum conditions for primary project functions of power generation and navigation, while providing the best possible conditions for other project purposes of fish and wildlife and recreation has not resulted in prolonged adverse effects on the water quality of the reservoir to date. The growth of algae in Lower Granite reservoir has somewhat alleviated this problem in downstream reservoirs, by decreasing the nutrient levels passing the dam. Lower Granite also traps much of the sediment carried by the river, and thus improves water quality in Lower Monumental. Water contact activities such as water skiing, swimming, and fishing have not been seriously affected as a result of the water quality in the reservoir.

9-08. Flood Frequencies.

a. Snake River at Lower Granite. Plate 9-1 shows frequency curves for natural peak discharges and regulated peak discharges for the Snake River at Lower Granite Dam, which is immediately upstream of Little Goose. Since runoff between these points is insignificant, runoff at Little Goose is essentially identical. These frequencies were computed by CENPD-EN-WM-HES in May 1978. The frequency curve for natural discharges is based on the station record form 1894-1975 (81 years) which is adjusted for irrigation depletion and storage and extended by correlation with 1858-1975 (117 years) Columbia River at The Dalles station record. The frequency curve for regulated discharge is based on the 1975 level of storage development and 1985 level of irrigation depletions. Regulated discharges are from regulation studies for 1894, 1929 through 1958, and in addition the high runoff years of 1972 and 1974. Data from Plate 9-1, Snake River at Lower Granite Frequency curves, are summarized in the following tabulation:

MAXIMUM ANNUAL PEAK DISCHARGE FREQUENCIES

Exceedence Probability (Percent)	Average Recurrence Interval (years)	Unregulated Discharge (cfs)	Regulated Discharge (cfs)
Standard Project Flood		575,000	420,000
1	100	426,000	319,000
2	50	403,000	300,000
5	20	367,000	270,000
10	10	334,000	244,000
20	05	298,000	214,000
50	02	231,000	163,000

b. Columbia River at the Dalles. Plate 9-2 shows frequency curves for natural and regulated peak discharges for the Columbia River at the Dalles. These curves were computed by CENPD-EN-WM-HES in June 1987. The frequency curve for natural discharges is based on the 1858-1985 period (127 years). Observed flows have been adjusted for irrigation depletion and storage. The frequency curve for regulated discharges is based on 1985 level of storage development and 1985 level of irrigation depletions. Data from Plate 9-2, Columbia River at the Dalles, frequency curves are summarized in the following tabulation:

MAXIMUM ANNUAL PEAK DISCHARGE FREQUENCIES

Exceedence Probability (Percent)	Average Recurrence Interval (years)	Unregulated Discharge (cfs)	Regulated Discharge (cfs)
Standard Project Flood		1,550,000	840,000
1	100	1,000,000	670,000
2	50	950,000	620,000
5	20	880,000	550,000
10	10	810,000	500,000
20	05	730,000	450,000
50	02	580,000	365,000

Tables

* DELETED BY REVISION
** ADDED BY REVISION

TABLE 1
SUMMARY OF CLIMATOLOGICAL DATA
REPRESENTATIVE FOR LOWER MONUMENTAL DAMSITE
Record Through 1968

	Unit	Years of Record	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug	Sep.	Oct	Nov.	Dec.	Annual
Precipitation data for Kahlotus 1/, Washington															
Average	Inch	48	1.21	1.03	.88	.74	.81	.89	.17	.24	.49	.91	1.38	1.49	10.24
Average as percent	%	48	12	10	9	7	8	9	2	2	5	9	13	14	100
Maximum monthly	Inch	48	3.80	4.66	3.12	1.82	3.49	2.76	1.28	1.50	2.88	3.53	3.16	3.12	---
Year of maximum 2/	--	48	1953	1940	1916	1920	1948	1923	1966	1960	1927	1947	1926	1964	---
Minimum monthly	Inch	48	.03	.02	.06	T	.03	T	.00	.00	.00	T	.05	.28	---
Year of minimum 2/	--	48	1949	1920	1965	1918	1931	1919	1905	1905	1950	1917	1929	1965	---
Maximum year (1948)	Inch	48	1.68	1.72	.15	1.66	3.49	1.98	.84	.16	.16	.67	1.05	1.96	15.52
Minimum year (1935)	Inch	48	.49	0.88	.51	.65	.14	.21	.16	.03	.04	.40	.64	1.42	5.57
Average snowfall	Inch	42	4.6		.2	.1	0	0	0	0	0	0	1.3	2.8	11.9
Precipitation data for Pleasant View 3/, Washington															
Average	Inch	32	1.45	1.26	1.17	.89	1.08	1.01	.23	.31	.62	1.17	1.57	1.69	12.45
Average as percent	%	32	12	10	9	7	9	8	2	2	5	9	13	14	100
Maximum monthly	Inch	32	4.64	4.92	2.64	2.17	3.16	3.15	1.10	.90	2.20	4.01	3.33	4.00	---
Year of maximum 2/	--	32	1953	1940	1957	1958	1942	1942	1948	1964	1947	1947	1942	1964	---
Minimum monthly	Inch	32	.24	.34	.08	.03	.19	.10	.00	.00	.00	.00	0.01	.41	---
Year of minimum 2/	--	32	1943	1955	1965	1956	1964	1940	1938	1936	1942	1936	1936	1946	---
Maximum year (1948)	Inch	32	1.90	1.98	.37	2.12	2.91	1.69	1.10	.24	.54	.73	1.21	2.40	17.19
Minimum year (1939)	Inch	32	1.01	.85	1.43	.45	.21	.35	.12	.00	.20	.44	.06	2.73	7.85
Precipitation data for Kennewick 4/, Washington															
Average maximum	°F	69	39.5	47.2	58.3	68.4	76.4	83.5	91.9	89.1	79.3	66.5	50.7	41.7	66.0
Average minimum	°F	70	25.0	29.6	34.7	39.9	47.6	53.6	59.1	57.1	49.3	41.0	33.2	28.2	41.5
Mean	°F	69	32.2	38.4	46.5	54.2	62.0	68.6	75.5	73.1	64.3	53.8	42	35.0	53.8
Extreme maximum	°F	69	74	74	88	95	105	108	115	115	102	89	78	71	115
Extreme minimum	°F	70	-27	-23	10	18	26	37	38	37	21	14	-12	-29	-29
Precipitation data for Lewiston 5/, Washington															
Average maximum	°F	38	38.4	45.0	52.7	62.4	71.1	78.1	89.6	87.8	78.2	63.6	47.8	41.3	63.0
Average minimum	°F	38	24.5	28.5	32.8	38.7	45.5	52.1	58.0	56.1	49.1	40.6	32.4	28.3	40.6
Mean	°F	38	31.4	36.8	42.8	50.6	58.3	65.1	73.8	72.0	63.6	52.1	40.1	34.8	51.8
Extreme maximum	°F	22	66	66	76	87	96	102	110	115	103	85	71	63	115
Extreme minimum	°F	22	-22	-15	2	20	23	34	41	42	28	21	-3	-11	-22
Ave. No. days with minimum 32 or lower	Day	22	23	18	15	4	*	0	0	0	*	3	13	20	96
Ave. No. days with minimum 0 or lower	Day	22	2	*	0	0	0	0	0	0	0	0	*	*	3

NOTES: * Less that one half.

1/ Kahlotus, Washington elevation 1370 feet, located about 6 miles north of damsite
2/ First year of occurrence.
3/ Pleasant View, Washington, elevation 1650 feet, located about 10 miles southeast of damsite.
4/ Kennewick, Washington, Elevation 510 feet, located about 40 miles southwest of damsite.
5/ Lewiston, Idaho, elevation 720 feet, located about 72 miles east of damsite.

LOWER MONUMENTAL RESERVOIR REGULATION MANUAL

TABLE 2 - CLIMATOLOGICAL DATA

Snake River Basin above Lower Monumental Dam

Record through 1960

Sta. No.	Station	Basin	Elevation	TEMPERATURE Length of record	Annual mean	Extremes Max.	Extremes Min.	PRECIPITATION Length of record	Average	Wettest year 1/	Amount	Driest year 1/	Amount	SNOWFALL Length of record	Average depth
			Feet m.s.l.	years	°F	°F	°F	Years	Inches		Inches 1/		Inches 1/	Years	Inches
	WASHINGTON														
1	Anatone	Snake	3,750					41	22.78	1940	30.98	1935	12.78	33	87.10
2	Dayton	Columbia	1,610	63	50.8	109	-22	69	20.39	1948	26.78	1944	12.07	59	23.00
3	Kahlotus	Columbia	1,350	--	----	---	---	47	10.23	1940	15.49	1935	5.57	41	11.90
4	La Crosse 3 ESE	Snake	1,546	53	49.6	110	-30	70	14.43	1940	20.45	1944	8.58	52	19.30
5	Pomeroy	Snake	1,890	61	50.5	112	-24	63	17.07	1941	22.37	1952	9.33	44	23.20
6	Pullman	Palouse	2,545	--	----	---	---	69	20.67	1958	29.85	1944	11.81	65	44.20
7	Walla Walla	Columbia	949	75	53.8	113	-29	75	16.14	1942	21.60	1935	10.12	75	21.60
	IDAHO														
8	Big Creek	Salmon	5,686	18	37.9	102	-43	20	25.54	1955	36.05	1952	16.34	11	165.60
9	Boise	Boise	2,842	93	51.1	112	-28	94	12.72	1938	16.40	1949	7.43	30	22.40
10	Burley	Snake	4,180	44	49.1	106	-35	43	9.09	1936	12.59	1939	3.51	18	21.40
11	Challis	Salmon	5,171	48	43.7	102	-33	49	7.21	1941	10.33	1935	2.62	--	----
12	Council	Snake	2,935	47	47.9	109	-27	49	25.97	1940	39.65	1935	16.77	--	----
13	Deadwood Dam	Payette	5,375	29	38.4	100	-48	30	32.14	1940	44.71	1935	19.42	29	191.10
14	Dubois FAA-AP	Lost	5,122	21	42.9	101	-23	23	10.08	1944	13.75	1956	6.28	20	37.80
15	Gooding FAA-AP	Snake	3,696	16	49.0	105	-18	18	8.93	1951	11.24	1949	5.91	--	----
16	Grangeville	Clearwater	3,355	39	46.3	108	-24	42	23.82	1959	27.55	1934	15.16	--	----
17	Hailey RS	Snake	5,328	57	43.2	109	-36	55	14.78	1941	22.01	1947	6.76	51	85.20
18	Idaho City	Boise	3,965	30	44.8	109	-38	54	22.29	1951	31.34	1935	12.54	44	93.90
19	Idaho Falls FAA-AP	Snake	4,730	29	44.6	104	-37	30	8.68	1940	14.24	1952	5.53	27	34.50
20	Kooskia	Clearwater	1,261	50	50.5	116	-30	52	24.25	1948	35.54	1936	15.75	--	----
21	Lewiston WBAP	Snake	1,413	55	52.9	109	-22	55	13.38	1940	21.33	1935	8.40	55	14.40
22	Obsidian	Snake	6,870	45	35.1	95	-46	49	15.12	1946	19.79	1952	7.14	43	84.90
23	Payette	Payette	2,110	63	50.7	113	-33	67	10.79	1940	18.62	1949	5.27	61	23.20
24	Pierce RS	Clearwater	3,175	24	43.6	107	-44	42	40.92	1948	59.17	1935	27.70	19	114.30
25	Pocatello WBAP	Snake	4,444	61	47.6	103	-31	61	12.35	1938	16.50	1939	6.43	56	41.80
26	Riggins RS	Salmon	1,801	35	52.9	111	-13	44	15.39	1941	22.40	1936	9.77	29	11.50
27	St. Anthony	Snake	4,968	19	42.6	98	-33	21	13.92	1951	17.89	1946	9.86	--	----
28	Salmon	Salmon	3,949	52	43.7	106	-37	52	8.95	1946	14.36	1935	3.63	--	----
	OREGON														
29	Baker KBKR	Snake	3,444	70	45.9	104	-25	70	11.12	1940	15.75	1939	5.79	61	39.40
30	Harper	Malheur	2,518	--	----	---	---	32	8.20	1941	12.47	1935	4.22	--	---
31	Huntington	Snake	2,150	47	52.9	113	-17	50	11.71	1940	18.90	1949	5.38	42	35.20
32	La Grande	Grande Ronde	2,805	72	49.1	108	-34	72	19.70	1953	29.11	1935	13.68	__	----
33	Owyhee Dam	Owyhee	2,400	25	52.4	111	-17	26	8.64	1940	13.72	1939	4.80	24	12.60
34	Wallowa	Grande Ronde	2,923	51	45.2	108	-38	55	17.56	1958	24.94	1939	9.66	48	53.70
35	Warm Sprgs Res.	Malheur	3,332	28	49.2	109	-36	30	8.33	1940	13.11	1939	3.33	25	16.70
	WYOMING														
36	Moran	Snake	6,798	49	34.4	92	-63	50	21.49	1955	27.66	1952	13.51	48	152.80
	NEVADA														
37	Owyhee	Owyhee	5,396	30	45.9	108	-35	31	13.38	1945	19.39	1933	5.67	--	----

NOTE: 1/ From record of period 1931 - 1960 only

LOWER MONUMENTAL RESERVOIR REGULATION MANUAL

TABLE 3 - REPRESENTATAIVE SNOW COURSE DATA THROUGH 1967

Snake River Basin

Course	River Basin	Elevation in M.S.L.	Years of 1/ Record	Observed Snow Water Equivalent Depth in Inches: Average Jan. 1	Average Feb. 1	Average Mar. 1	Average Apr. 1	Average May 1	Maximim Recorded	Date	Minimum April 1	Year
Arizona, Wyo. 2/	Snake	6850	19	7.5	12.3	16.5	19.5	----	26.1	Mar. 1956	10.3	1963
Aster Creek, Wyo. 2/	Snake	7700	16	13.2	20.8	27.3	33.5	----	50.8	Apr. 1943	12.0	1931
Snake River Station, Wyo. 2/	Snake	6780	19	8.2	13.5	18.1	21.6	----	30.0	Mar. 1956	14.2	1960
Blackrock, Wyo.	Snake	8600	32	---	13.9	18.5	22.0	----	34.6	Mar. 1943	14.1	1940
Afton Ranger Station, Wyo.	Snake	6200	28	2.3	3.6	4.5	1.9	0.0	10.2	Mar. 1936	0.0	1938
West Yellowstone, Mont.	Snake	6700	30	4.6	7.5	10.0	11.2	4.5	19.0	Apr. 1952	6.1	1966
Magic Mountain, Idaho	Snake	6700	25	7.4	12.4	16.4	18.8	14.4	28.6	Apr. 1952	8.2	1963
White Knob, Idaho	Big Lost	7700	31	2.9	5.2	7.8	9.6	7.8	22.9	Apr. 1938	3.9	1939
Graham Ranch, Idaho	Big Wood	6200	32	5.4	9.0	12.0	13.8	9.0	23.2	Apr. 1938	5.9	1939
Mascot Mine, Idaho	Big Wood	7900	32	3.7	8.0	13.0	15.2	----	24.7	Mar. 1943	6.4	1961
Bogus Basin, Idaho	Boise	6120	25	9.0	14.8	19.5	23.6	23.0	40.2	Apr. 1952	8.4	1963
Couch Summit, Idaho	Boise	6950	21	7.3	13.2	16.8	19.3	13.4	30.9	Apr. 1952	10.6	1963
South Mountain No. 2, Ida.	Owyhee	6340	27	4.2	7.6	10.4	11.0	----	23.8	Mar. 1952	0.7	1963
Crawford Ranger Station, Ida.	Payette	4800	30	2.6	5.6	7.1	6.3	0.0	14.3	Apr. 1936	0.0	Several
Deadwood River Dam, Idaho	Payette	5500	31	7.2	11.4	15.3	16.6	12.4	25.7	Apr. 1952	4.7	1963
Blue Mountain Springs, Ore.	Malheur	5900	38	5.8	10.1	14.4	15.2	7.2	23.1	Apr. 1952	4.1	1930
Rock Spring, Oregon	Malheur	5100	32	2.0	4.2	5.8	4.6	0.3	10.4	Mar. 1936	0.0	Several
Boulder Creek, Idaho	Weiser	5500	30	8.7	13.6	20.5	23.6	16.9	36.4	Apr. 1952	11.1	1963
Blue Mountain Summit, Ore.	Burnt	5100	33	3.4	5.7	8.3	7.7	1.7	13.8	Mar. 1949	1.0	1940
Williams Creek Summit, Idaho	Salmon	7800	31	---	---	10.9	13.4	10.6	22.4	Apr. 1965	6.8	1941
Mill Creek Summit, Idaho	Salmon	8870	30	9.5	18.2	19.4	21.7	21.7	37.2	Apr. 1965	11.8	1941
Eilertson Meadows, Ore.	Powder	5400	30	4.3	7.8	10.6	11.6	4.5	17.0	Apr. 1952	0.8	1963
Schneider Meadows, Ore.	Pine Creek	5400	30	---	19.8	27.3	29.9	22.2	45.4	Apr. 1952	16.3	1963
Aneroid Lake No. 1, Ore.	Imnaha	7480	33	---	22.2	31.3	36.7	37.8	57.0	Apr. 1956	20.5	1960
Moss Spring, Oregon	Grande Ronde	5850	30	9.3	15.0	20.2	24.5	20.1	34.6	Apr. 1943	8.7	1963
Nez Perce Pass, Idaho	Clearwater	6575	31	---	10.9	14.4	17.1	12.1	27.3	Mar. 1943	6.4	1941

1/ For 1 April surveys, January, February and May usually shorter records.

2/ Longer record for midmonth available.

DELETED

TABLE 4
DISCHARGE RATING TABLE – SNAKE RIVER NEAR CLARKSTON, WASHINGTON

DELETED

TABLE 5
DISCHARGE RATING TABLE – PALOUSE RIVER AT HOOPER, WASHINGTON

TABLE 6
SUMMARY OF RUNOFF AND DISCHARGE DATA
Snake River near Clarkston, Washington

Water Year	Station Name	Annual KAF	Runoff Inches	Mean Daily Discharge Maximum c.f.s.	Date	Minimum c.f.s.	Date
1894	RIPARIA 2/	----	----	409,000	1/ 5 JUN	----	----
1910	BURBANK 3/	49,000	8.43	252,000	23 MAR	11,800	26 AUG
1911	BURBANK	42,200	7.26	242,000	15 JUN	15,600	2 SEP
1912	BURBANK	49,100	8.45	289,000	10 JUN	15,000	6 JAN
1913	BURBANK	46,400	7.98	298,000	29 MAY	15,500	4 SEP
1914	BURBANK	36,300	6.24	175,000	25 MAY	13,000	4 SEP
1915	BURBANK	26,000	4.47	122,000	20 MAY	13,000	1 SEP
1916	RIPARIA	46,500	8.38	230,000	20 JUN	15,200	1 OCT
1917	RIPARIA	46,300	8.35	256,000	30 MAY	16,200	3 SEP
1918	RIPARIA	42,600	7.68	216,000	14 JUN	15,000	8 SEP
1919	RIPARIA	28,900	5.21	167,000	30 MAY	10,900	28 AUG
1920	RIPARIA	30,800	5.55	148,000	17 JUN	12,300	1 OCT
1921	RIPARIA	49,800	8.98	270,000	20 MAY	16,700	31 AUG
1922	RIPARIA	39,400	7.10	233,000	7 JUN	14,500	24 SEP
1923	4/	32,800	5.91	179,000	13 JUN	15,200	13 SEP
1924		24,100	4.34	136,000	14 MAY	9,800	29 AUG
1925		38,800	7.00	219,000	22 MAY	15,200	11 AUG
1926		25,400	4.58	91,000	20 APR	11,300	3 AUG
1927		41,500	7.48	245,000	9 JUN	16,800	29 AUG
1928		45,600	8.22	271,000	27 MAY	16,100	3 SEP
1929	RIPARIA	27,000	4.87	155,000	25 MAY	13,100	9 SEP
1930	RIPARIA	25,000	4.51	95,600	26 APR	13,100	2 SEP
1931	RIPARIA	20,600	3.71	107,000	2 APR	10,600	14 AUG
1932	RIPARIA	34,800	6.27	219,000	23 MAY	14,400	6 OCT
1933	RIPARIA	32,700	5.90	245,000	11 JUN	----	----
1934	RIPARIA	29,400	5.30	149,000	23 DEC	12,200	19 AUG
1935	RIPARIA	25,020	4.51	130,000	25 MAY	13,100	28 AUG
1936	CLARKSTON 5/	31,460	5.72	219,000	16 MAY	12,200	20 DEC
1937	CLARKSTON	22,310	4.06	114,000	19 MAY	10,800	10 JAN
1938	CLARKSTON	37,540	6.82	219,000	29 MAY	15,200	1 OCT
1939	CLARKSTON	27,320	4.96	149,000	4 MAY	14,000	21 AUG
1940	CLARKSTON	28,810	5.23	126,000	12 MAY	13,000	24 AUG
1941	CLARKSTON	26,290	4.78	102,000	14 MAY	15,500	16 DEC
1942	CLARKSTON	34,490	6.27	162,000	27 MAY	16,800	26 AUG
1943	CLARKSTON	49,030	8.91	209,000	20 APR	17,900	11 OCT
1944	CLARKSTON	25,500	4.63	109,600	16 MAY	16,400	13 SEP
1945	CLARKSTON	30,800	5.60	149,000	7 JUN	16,100	14 DEC
1946	CLARKSTON	37,860	6.88	169,000	20 APR	17,800	20 AUG
1947	CLARKSTON	40,410	7.34	239,000	10 MAY	19,000	21 AUG
1948	CLARKSTON	46,390	8.43	369,000	29 MAY	20,200	16 SEP
1949	CLARKSTON	48,390	6.97	248,000	16 MAY	17,200	3 SEP
1950	CLARKSTON	42,730	7.76	212,000	17 JUN	19,200	5 JAN
1951	CLARKSTON	43,060	7.82	182,000	25 MAY	19,200	16 SEP
1952	CLARKSTON	46,590	8.46	250,000	28 APR	20,700	27 AUG
1953	CLARKSTON	37,710	6.85	232,000	14 JUN	15,600	30 NOV
1954	CLARKSTON	35,320	6.42	210,000	21 MAY	20,500	10 SEP
1955	CLARKSTON	30,890	5.61	204,000	13 JUN	17,500	10 SEP
1956	CLARKSTON	48,460	8.80	292,100	24 MAY	20,400	5 OCT
1957	CLARKSTON	42,700	7.76	322,900	20 MAY	18,300	31 JAN
1958	CLARKSTON	37,470	6.81	247,600	22 MAY	9,320	3 SEP
1959	CLARKSTON	36,760	6.68	171,400	6 JUN	13,400	8 OCT
1960	CLARKSTON	35,180	6.39	163,500	4 JUN	15,900	22 AUG
1961	CLARKSTON	30,000	5.45	174,500	27 MAY	13,000	15 AUG
1962	CLARKSTON	32,680	5.94	138,900	26 MAY	17,500	10 SEP
1963	CLARKSTON	34,940	6.35	150,400	25 MAY	18,100	2 SEP
1964	CLARKSTON	37,720	6.86	240,300	9 JUN	17,900	7 OCT
1965	CLARKSTON	53,130	9.66	227,000	21 APR	20,820	22 AUG
1966	CLARKSTON	27,110	4.93	111,000	8 MAY	14,400	22 AUG

TABLE 6 (continued)
SUMMARY OF RUNOFF AND DISCHARGE DATA
Snake River near Clarkston, Washington

1967	CLARKSTON	33,790	6.14	205,000	24 MAY	15,500	22 AUG
1968	CLARKSTON	31,100	5.65	134,000	4 JUN	15,200	11 OCT
1969	CLARKSTON	42,010	7.63	189,000	20 MAY	16,500	2 SEP
1970	CLARKSTON	38,180	6.94	233,000	7 JUN	17,900	31 AUG
1971	CLARKSTON	54,340	9.87	258,000	30 MAY	16,700	27 AUG
1972	CLARKSTON	50,660	9.20	240,000	2 JUN	19,300	11 SEP
1973	6/	25,750	4.68	96,000	19 MAY	14,850	26 AUG
1974		57,410	10.43	332,000	18 JUN	20,750	9 SEP
Average 8/		37,000	6.65	200,000		16,000	
Maximum		57,410	10.43	409,000	1894	24,100	1975
Minimum		20,600	3.71	91,000	1926	9,320 7/	1958

1/ Computed by the U.S. Geological Survey from high water marks.
2/ Drainage area at Riparia is 104,000 square miles.
3/ Drainage area at Burbank is 109,000 square miles.
4/ Estimated from discharge records of Snake River at Oxbow, Salmon River at Whitebird, and Clearwater River at Kamiah, and from stage records at Lewiston for 1923-1928.
5/ Drainage area for Snake River near Clarkston is about 103,200 square miles.
6/ Estimated from Snake River at Anatone and Clearwater River at Spalding for 1973-1974 mean daily discharges.
7/ Minimum extreme discharge is 6,660 cfs on 2 September 1958.
8/ Average for period 1910-1974.

Notes:
1. Data source U.S. Army Corps of Engineers, Walla Walla District, Hydrology Branch.
2. Gage discountinued December 1972.

TABLE6A
SUMMARY OF RUNOFF AND DISCHARGE DATA
(Lower Granite Reservoir Computed Regulated Inflows) 1/

Water Year	Annual KAF	Runoff Inches 3/	Mean Daily Discharge Maximum c.f.s.	Date	Minimum c.f.s.	Date
1975 2/			177,300	7 JUN	24,100	15 AUG
1976	50,780	9.20	192,800	11 MAY	22,000	5 SEP
1977	20,430	3.70	62,200	3 MAY	10,900	21 AUG
1978	40,370	7.31	148,800	9 JUN	18,700	3 SEP
1979	30,970	5.60	141,200	25 MAY	13,700	13 AUG
1980	32,810	5.94	133,200	13 JUN	16,100	1 SEP
1981	33,920	6.15	176,100	10 JUN	15,700	24 AUG
1982	51,000	9.24	205,600	18 JUN	17,400	25 OCT
1983	48,400	8.77	194,300	29 MAY	22,800	31 AUG
1984	54,750	9.92	244,800	31 MAY	19,400	2 OCT
1985	35,280	6.39	124,400	8 JUN	28,600	6 AUG
1986	44,320	8.03	211,000	1 JUN	23,800	30 AUG
Average	40,270	7.30	168,000		19,000	
Maximum	54,750	9.92	244,800	1984	28,600	1985
Minimum	20,430	3.70	62,200	1977	10,900	1977

1/ Inflows computed at Lower Granite Dam due to abandonment of Clarkston site in 1972 because of Lower Granite Dam construction.
2/ Water year 1975 data based on March-September 1975 period of record.
3/ 1.0 basin inches = 5,520 KAF for a drainage area of 103,500 sq. mi. above Lower Granite Dam.

Note: Data source U.S. Army Corps of Engineers, Walla Walla District, Hydrology Branch.

LOWER MONUMENTAL RESERVOIR REGULATION MANUAL
TABLE 7 - SUMMARY OF RUNOFF AND DISCHARGE DATA
Clearwater River at Spalding, Idaho

Water	Annual Runoff		Extremes			
			Momentary maximum		Minimum Day	
Year	1,000 ac. ft.	Inches	C.f.s.	Date	cfs	Date 1/
1927	14,500	28.42	109,000	9 Jun	3,670	24 Aug
1928	17,600	34.47	107,000	26 May	2,450	5 Jan
1929	7,460	14.62	77,100	24 May	1,000	9 Feb
1930	7,430	14.56	52,600	25 Apr	950	15 Jan
1931	6,910	13.52	71,500	1 Apr	1,510	6 Sep
1932	12,100	23.70	121,000	14 May	1,570	24 Nov
1933	11,900	23.31	136,000	10 Jun	1,900	9 Feb
1934	13,880	27.19	172,000	23 Dec	1,660	8 Sep
1935	8,709	17.07	72,400	24 May	1,500	21 Jan
1936	10,260	20.12	107,000	15 May	1,000	20 Dec
1937	6,566	12.86	54,400	19 May	500	9 Jan
1938	10,110	19.81	134,000	19 Apr	1,790	14 Oct
1939	8,289	16.26	77,500	4 May	1,710	28 Sep
1940	8,166	16.00	56,200	12 May	1,500	3 Sep
1941	6,569	12.86	39,700	13 May	1,660	16 Dec
1942	9,280	18.18	53,500	26 May	2,040	30 Sep
1943	14,060	27.53	87,200	28 May	2,020	10 Oct
1944	6,212	12.13	50,900	16 May	1,680	30 Jan
1945	8,886	17.40	79,600	6 May	1,540	13 Dec
1946	10,740	21.05	65,600	6 May	2,380	16 Oct
1947	13,360	26.17	114,000	8 May	2,560	7 Sep
1948	16,290	31.93	177,000	29 May	2,840	17 Sep
1949	12,450	24.39	123,000	16 May	2,150	5 Sep
1950	14,290	28.01	100,700	17 Jun	2,400	5 Jan
1951	12,680	24.84	73,800	12 May	2,140	22 Sep
1952	11,250	22.05	89,900	28 Apr	1,980	28 Sep
1953	9,902	19.40	81,800	13 Jun	500	1 Dec
1954	11,320	22.19	104,000	20 May	1,960	16 Oct
1955	10,470	20.51	101,000	12 Jun	1,850	20 Dec
1956	14,850	29.10	121,000	24 May	2,630	20 Sep
1957	11,990	23.47	143,000	20 May	1,600	18 Jan
1958	9,910	19.41	91,200	22 May	2,190	1 Oct
1959	14,440	28.29	84,000	6 Jun	2,420	7 Oct
1960	12,750	24.98	79,000	13 May	2,200	22 Sep
1961	10,980	21.52	91,900	27 May	1,750	8 Dec
1962	10,740	21.03	75,800	7 Apr	1,530	18 Nov
1963	10,120	19.83	56,100	25 May	2,200	13 Sep
1964	12,050	23.60	117,000	9 Jun	1,800	12 Dec
1965	15,030	29.43	109,000	21 Apr	3,330	11 Sep
1966	8,180	16.03	63,600	7 May	1,980	18 Dec
1967	10,760	21.08	92,000	23 May	1,890	29 Sep
Average	11,061	21.67	95,439		1,901	
Maximum	17,600	34.47	177,000	1948	3,670	1927
Minimum	6,212	12.13	39,700	1941	500	1937

1/ First date of occurrence. Same values recorded on additional days in some years.

LOWER MONUMENTAL RESERVOIR REGULATION MANUAL
TABLE 8 - SUMMARY OF RUNOFF AND DISCHARGE DATA
Representative Stream Caging Stations in Snake and Columbia River Basins

Station	Drainage Area Sq. Mi.	Period Years	Recorded Annual Runoffs: Mean 1,000 A.F.	Mean Inches	Maximum 1,000 A.F.	Maximum Year	Minimum 1,000 A.F.	Minimum Year	1928-1957 Mean 2/ 1,000 A.F.	Historical Maximum Flood Peak c.f.s.	Date	Recorded Minimum Flow c.f.s
Upstream Stations showing distribution of origin of flows												
Snake River at Weiser, Idaho	69,200	1911-1967	12,790	3.47	19,750	1952	7,880	1931	12,370	125,000	Jun 1984	5,100
Salmon River at Whitebird, Idaho	13,550	1911-1967 3/	7,971	11.04	12,470	1965	4,200	1931	7,784	120,000	Jun 1984	1,580
Grande Ronde River at Troy, Oregon	3,275	1945-1962	2,252	13.60	3,213	1948	1,630	1963	-	42,200	23 Dec 1964	434
Clearwater River at Spalding, Idaho	9,570	1927-1967	11,061	21.67	17,600	1928	6,212	1944	10,800	177,000	29 May 1948	500
Station representative of Lower Monumental reach												
Snake River near Clarkston, Washington	103,200	1910-1967 4/	36,187	6.52	53,130	1965	20,600	1931	34,800	409,000	5 June 1894	6,660 6/
Stations on Columbia River showing distribution of flows as related to Lower Monumental Pool												
Columbia River below Priest Rapids Dam, Washington	95,500	1917-1967 5/	86,880	17.07	113,000	1928	56,650	1944	85,860	740,000	7 Jun 1894	4,120
Columbia River near The Dalles, Oregon	237,000	1879-1967	140,800	11.15	227,000	1894	85,500	1926	130,350	1,240,000	6 Jun 1894	35,000

2/ Shown for period of recent years in order to afford comparisons of runoffs for various locations including effects of irrigation.
3/ Intermittent records in early years.
4/ Combination of records 1910-1915 at Burbank near Pasco, 1916-1922, and 1929-1933 at Riparia, 1923-1928 from W.B. stages at Lewiston and 1934-1967 at present site near Clarkston.
5/ Combination of records 1917-1930 at Vernita near Priest Rapids, 1931-1959 at gage at Trinidad, 1959-1965 as below Priest Rapids Dam.
6/ Minimum discharge (6,660 cfs on 2 Sep 1958) caused by construction closure at Brownlee Dam. Natural minimum about 10,600 cfs in August, September 1931.

Table 9

LOWER MONUMENTAL DAM
GATED SPILLWAY RATING TABLE

Increment stops	Nominal gate opening, ft.*	Revolution counter reading	POOL ELEVATION - M.S.L.										
			536.0	536.5	537.0	537.5	538.0	538.5	539.0	539.5	540.0	540.5	541.0
			Flow under one gate in 1000 cfs										
1	0.59	9.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
2	1.50	19.5	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.9	2.9	2.9	2.9
3	2.45	30.0	4.5	4.5	4.5	4.5	4.6	4.6	4.6	4.6	4.6	4.7	4.7
4	3.37	40.6	6.1	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.4	6.4
5	4.30	51.1	7.8	7.8	7.9	7.9	7.9	8.0	8.0	8.0	8.1	8.1	8.1
6	5.25	61.6	9.5	9.5	9.6	9.6	9.6	9.7	9.7	9.8	9.8	9.9	9.9
7	6.20	72.3	11.1	11.2	11.2	11.3	11.3	11.4	11.4	11.5	11.6	11.6	11.7
8	7.20	82.8	12.9	12.9	13.0	13.1	13.1	13.2	13.3	13.3	13.4	13.4	13.5
9	8.15	93.4	14.5	14.6	14.6	14.7	14.8	14.9	14.9	15.0	15.1	15.1	15.2
10	9.15	104.0	16.2	16.3	16.4	16.5	16.5	16.6	16.7	16.8	16.9	16.9	17.0
11	10.13	114.6	17.9	18.0	18.1	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8
12	11.12	125.1	19.6	19.7	19.8	19.9	20.0	20.1	20.2	20.3	20.4	20.5	20.5
13	12.12	135.6	21.3	21.4	21.5	21.6	21.7	21.8	21.9	22.0	22.1	22.2	22.3
14	13.12	146.2	23.0	23.1	23.2	23.3	23.4	23.6	23.7	23.8	23.9	24.0	24.1
15	14.14	155.9	24.7	24.8	25.0	25.1	25.2	25.3	25.4	25.6	25.7	25.8	25.9
16	15.16	167.3	26.4	26.5	26.7	26.8	26.9	27.1	27.2	27.3	27.5	27.6	27.8
17	16.19	177.8	28.1	28.3	28.4	28.5	28.7	28.8	29.0	29.1	29.3	29.4	29.6
18	17.22	188.4	29.8	30.0	30.1	30.3	30.5	30.7	30.8	31.0	31.1	31.3	31.4
19	18.26	199.0	31.6	31.8	31.9	32.1	32.3	32.4	32.6	32.8	32.9	33.1	33.3
20	19.31	209.4	33.4	33.5	33.7	33.9	34.1	34.3	34.5	34.6	34.8	35.0	35.1
21	20.35	220.1	35.1	35.3	35.5	35.7	35.9	36.1	36.3	36.4	36.6	36.8	37.0
22	21.40	230.7	36.8	37.0	37.2	37.4	37.6	37.8	38.1	38.3	38.5	38.7	38.9
23	22.45	241.1	38.6	38.8	39.0	39.2	39.5	39.7	39.9	40.1	40.3	40.5	40.7
24	23.50	251.7	40.4	40.6	40.8	41.0	41.3	41.5	41.7	42.0	42.2	42.4	42.6
25	24.56	262.2	42.1	42.4	42.6	42.8	43.1	43.3	43.6	43.8	44.1	44.3	44.5
26	25.64	272.8	43.9	44.2	44.4	44.7	44.9	45.2	45.4	45.7	45.9	46.2	46.4

*Vertical distance, gate seal to gate; average of 8 bays. Tolerance, 100 cfs $\pm$.

TABLE 10
LOWER MONUMENTAL RESERVOIR REGULATION MANUAL
RESERVOIR CAPACITY IN ACRE-FEET

Res. Inflow	30,000 cfs or less		100,000 cfs		200,000 cfs	
Pool Elev.	Volume	Diff.	Volume	Diff.	Volume	Diff.
536.0	350,000	580	350,800	580	352,700	580
0.1	350,580	590	351,380	590	353,280	590
0.2	351,170	600	351,970	600	353,870	600
0.3	351,770	610	352,570	610	354,47o	610
0.4	352,380	620	353,180	620	355,080	620
0.5	353,000	620	353,800	620	355,700	630
0.6	353,620	630	354,420	630	356,330	630
0.7	354,250	640	355,050	640	356,960	640
0.8	354,890	650	355,690	650	357,60o	650
0.9	555,540	660	356,34o	660	358,250	650
537.0	356,200	670	357,000	670	358,90o	650
0.1	356,87o		357,670		359,550	
0.2	357,540		358,340		360,200	
0.3	358,210		359,010		360,850	
0.4	358,880		350,080		361,500	
0.5	359,550		360,350		362,150	
0.6	360,220		361,020		362,80o	
0.7	360,890		361,690		363,450	
0.8	361,560		362,360		364,100	
0.9	362,230		363,030		364,750	
538.0	362,900	670	363,70o	670	365,400	660
0.1	363,570		364,370		366,060	
0.2	364,240		365,040		366,720	
0.3	364,910		365,710		367,380	
0.4	365,580		366,380		368,040	
0.5	366,250		367,05o		368,700	
0.6	366,920		367,720		369,360	
0.7	367,590		368,390		370,020	
0.8	368,260		369,06o		370,680	
0.9	368,930		369,730		371,340	
539.0	369,600	670	370,400	670	372,000	670
0.1	370,270		371,070		372,670	
0.2	370,940		371,740		373,340	
0.3	371,610		372,410		374,010	
0.4	372,280		373,08o		374,080	
0.5	372,950		373,750		375,350	
0.6	373,620		374,420		376,020	
0.7	374,290		375,090		376,690	
0.8	374,96o		375,76o		377,360	
0.9	375,630		376,430		378,030	
540.0	376,300	670	377,10o	670	378,700	670
0.1	377,070		377,770		379,370	
0.2	377,740		378,440		380,040	
0.3	378,410		379,110		380,710	
0.4	379,180		379,780		381,380	
0.5	379,850		380,450		382,050	

Note: Use Chart 6 for inflows over 200,000 cfs.

LOWER MONUMENTAL MEAN UNIT PERFORMANCE

POWER OUTPUT (MW)	GROSS HEAD IN FEET 82	83	84	85	86	87	88	89	90	91	92	93	GROSS HEAD IN FEET 94	95	96	97	98	99	100	101	102	103	104	POWER OUTPUT (MW)
	DISCHARGE IN CFS												DISCHARGE IN CFS											
24	7756	7714	7672	7628	7584	7554	7524	7498	7471	7447	7423	7396	7370	7345	7319	7300	7282	7261	7240	7225	7209	7207	7205	24
25	7812	7769	7726	7682	7638	7607	7577	7550	7523	7500	7476	7448	7420	7394	7369	7349	7330	7310	7290	7273	7257	7254	7251	25
26	7869	7824	7779	7736	7692	7661	7630	7603	7576	7552	7529	7499	7470	7444	7418	7398	7378	7359	7340	7322	7304	7300	7297	26
27	7926	7879	7833	7790	7747	7714	7682	7655	7628	7605	7582	7551	7520	7494	7468	7447	7427	7409	7390	7371	7351	7347	7343	27
28	7984	7936	7888	7845	7802	7769	7736	7708	7680	7657	7635	7602	7570	7544	7518	7497	7475	7458	7440	7419	7399	7394	7389	28
29	8044	7996	7948	7905	7862	7828	7794	7766	7738	7714	7690	7656	7623	7596	7569	7548	7526	7508	7490	7469	7447	7442	7436	29
30	8104	8056	8008	7965	7922	7887	7852	7824	7796	7770	7745	7711	7677	7650	7622	7600	7577	7559	7540	7518	7497	7490	7484	30
31	8164	8116	8068	8025	7982	7946	7909	7882	7854	7827	7800	7766	7731	7703	7675	7652	7629	7609	7590	7568	7547	7539	7531	31
32	8224	8176	8128	8085	8042	8005	7967	7939	7912	7883	7856	7820	7785	7756	7727	7704	7680	7660	7640	7618	7596	7588	7579	32
33	8284	8236	8188	8145	8102	8064	8025	7997	7969	7940	7911	7875	7839	7809	7780	7756	7731	7711	7690	7668	7646	7636	7627	33
34	8344	8296	8248	8205	8162	8122	8083	8055	8027	7997	7966	7929	7893	7863	7833	7808	7782	7761	7740	7718	7696	7685	7675	34
35	8404	8356	8308	8265	8222	8181	8141	8113	8085	8053	8021	7984	7947	7916	7885	7860	7834	7812	7790	7768	7745	7734	7723	35
36	8477	8427	8377	8333	8290	8247	8204	8175	8146	8112	8079	8040	8002	7970	7938	7912	7886	7863	7840	7818	7795	7783	7770	36
37	8551	8499	8448	8405	8361	8316	8272	8241	8210	8175	8140	8100	8060	8027	7995	7968	7941	7918	7894	7871	7847	7833	7819	37
38	8625	8572	8519	8476	8432	8386	8339	8307	8275	8238	8202	8160	8118	8085	8051	8024	7997	7973	7948	7924	7900	7884	7869	38
39	8699	8645	8591	8547	8503	8455	8407	8373	8339	8301	8263	8220	8177	8142	8107	8080	8053	8027	8002	7977	7952	7935	7918	39
40	8773	8717	8662	8618	8575	8525	8475	8439	8403	8364	8325	8280	8235	8199	8163	8136	8109	8082	8056	8030	8005	7986	7967	40
41	8849	8790	8733	8689	8646	8594	8543	8505	8468	8427	8387	8340	8293	8256	8219	8192	8164	8137	8110	8084	8057	8036	8016	41
42	8934	8872	8810	8765	8719	8667	8615	8575	8535	8492	8450	8402	8353	8315	8276	8248	8220	8192	8165	8137	8110	8087	8065	42
43	9020	8954	8888	8841	8793	8742	8691	8648	8605	8560	8516	8468	8419	8380	8340	8310	8280	8250	8221	8192	8164	8140	8116	43
44	9106	9035	8966	8917	8867	8817	8766	8720	8675	8628	8582	8534	8485	8445	8404	8372	8340	8309	8278	8248	8219	8193	8168	44
45	9191	9117	9044	8993	8941	8892	8842	8793	8745	8696	8648	8600	8551	8510	8468	8434	8400	8367	8335	8304	8274	8247	8220	45
46	9277	9199	9122	9069	9015	8966	8917	8866	8815	8764	8714	8666	8617	8575	8532	8496	8460	8426	8392	8360	8329	8300	8272	46
47	9364	9286	9208	9152	9095	9044	8994	8940	8887	8834	8781	8732	8683	8640	8597	8558	8520	8484	8449	8416	8384	8354	8324	47
48	9451	9373	9295	9236	9177	9124	9071	9015	8961	8906	8851	8801	8751	8707	8663	8624	8584	8547	8510	8476	8443	8411	8379	48
49	9539	9460	9382	9321	9259	9203	9147	9091	9034	8978	8921	8870	8818	8773	8729	8689	8649	8610	8572	8538	8504	8470	8436	49
50	9626	9547	9469	9405	9341	9282	9224	9166	9108	9050	8992	8938	8885	8840	8795	8754	8713	8673	8634	8599	8565	8529	8493	50
51	9713	9635	9556	9489	9423	9362	9301	9241	9182	9121	9062	9007	8952	8907	8861	8819	8778	8737	8696	8661	8626	8588	8549	51
52	9813	9730	9648	9578	9508	9443	9379	9316	9255	9193	9132	9076	9020	8973	8927	8885	8842	8800	8758	8722	8687	8646	8606	52
53	9917	9830	9744	9672	9601	9532	9464	9399	9335	9271	9207	9149	9091	9042	8994	8951	8907	8863	8820	8784	8748	8705	8663	53
54	10021	9930	9841	9767	9693	9621	9549	9483	9417	9351	9286	9227	9168	9117	9066	9021	8976	8931	8886	8848	8810	8768	8726	54
55	10125	10030	9937	9861	9786	9710	9635	9567	9499	9431	9364	9305	9245	9191	9138	9091	9045	8998	8952	8912	8873	8833	8792	55
56	10228	10130	10033	9956	9879	9799	9720	9650	9581	9512	9443	9383	9322	9266	9210	9162	9114	9066	9018	8977	8936	8897	8858	56
57	10338	10235	10132	10050	9971	9888	9806	9734	9663	9592	9521	9460	9400	9341	9282	9232	9183	9133	9084	9041	8998	8962	8925	57
58	10450	10348	10245	10160	10076	9987	9900	9824	9749	9674	9600	9538	9477	9415	9354	9303	9252	9201	9151	9106	9061	9026	8991	58
59	10563	10460	10357	10270	10183	10091	10000	9923	9846	9769	9693	9627	9562	9497	9432	9378	9324	9271	9218	9170	9124	9090	9057	59
60	10676	10573	10470	10379	10290	10194	10100	10021	9942	9864	9787	9718	9650	9583	9516	9461	9406	9352	9298	9247	9197	9161	9125	60
61	10789	10685	10582	10489	10397	10298	10200	10119	10039	9959	9880	9809	9739	9669	9600	9543	9487	9432	9377	9324	9271	9232	9194	61
62	10902	10798	10695	10599	10504	10401	10300	10218	10136	10054	9974	9900	9828	9756	9684	9626	9568	9512	9457	9401	9345	9304	9262	62
63	11026	10919	10812	10712	10613	10505	10400	10316	10232	10149	10067	9991	9916	9842	9769	9709	9649	9593	9537	9478	9420	9375	9331	63
64	11151	11041	10933	10831	10730	10621	10511	10422	10333	10246	10161	10082	10005	9928	9853	9791	9731	9673	9616	9555	9494	9446	9400	64
65	11275	11163	11053	10949	10846	10737	10628	10535	10444	10356	10268	10185	10103	10021	9940	9875	9812	9754	9696	9632	9568	9518	9468	65
66	11399	11286	11173	11067	10962	10853	10744	10649	10555	10466	10377	10292	10208	10124	10040	9974	9908	9846	9784	9714	9646	9592	9538	66
67	11523	11408	11294	11186	11079	10970	10861	10763	10666	10576	10486	10399	10314	10226	10140	10073	10007	9941	9876	9803	9732	9678	9623	67
68	11655	11534	11415	11304	11195	11086	10977	10876	10777	10686	10595	10507	10419	10329	10240	10172	10105	10036	9967	9892	9819	9763	9708	68
69	11791	11665	11541	11428	11316	11204	11094	10990	10888	10796	10704	10614	10524	10432	10340	10271	10203	10130	10059	9981	9905	9849	9793	69
70	11926	11795	11667	11552	11438	11325	11212	11107	11002	10906	10813	10721	10629	10534	10440	10371	10301	10225	10150	10070	9992	9934	9877	70
71	12062	11926	11793	11676	11561	11445	11331	11224	11117	11018	10921	10827	10734	10637	10541	10470	10399	10320	10242	10159	10078	10020	9962	71
72	12198	12057	11919	11800	11683	11566	11450	11340	11232	11130	11029	10934	10839	10741	10642	10569	10496	10416	10336	10251	10167	10107	10048	72
73	12336	12187	12044	11924	11805	11686	11568	11457	11347	11241	11137	11040	10944	10844	10744	10668	10593	10512	10431	10345	10259	10197	10135	73
74	12496	12338	12182	12052	11928	11807	11687	11574	11462	11353	11246	11147	11049	10947	10846	10767	10690	10608	10527	10438	10351	10287	10223	74
75	12655	12494	12335	12201	12069	11938	11810	11691	11577	11465	11354	11254	11154	11050	10947	10867	10787	10704	10622	10532	10443	10376	10311	75
76	12815	12651	12489	12349	12212	12076	11943	11821	11700	11582	11465	11361	11259	11154	11049	10966	10883	10800	10717	10626	10535	10466	10398	76
77	12974	12808	12643	12498	12356	12215	12077	11950	11826	11704	11583	11477	11371	11262	11154	11066	10980	10896	10812	10719	10627	10556	10486	77
78	13134	12964	12797	12647	12499	12353	12210	12080	11951	11825	11701	11593	11486	11376	11266	11175	11085	10998	10912	10816	10720	10646	10574	78
79	13301	13127	12953	12795	12643	12491	12343	12209	12077	11947	11819	11709	11600	11489	11379	11284	11190	11102	11015	10917	10820	10742	10665	79
80	13470	13293	13118	12955	12795	12634	12477	12338	12202	12068	11937	11825	11714	11603	11491	11392	11295	11207	11119	11019	10920	10838	10758	80
81	13638	13459	13282	13117	12953	12789	12628	12480	12334	12190	12055	11941	11829	11716	11604	11501	11401	11311	11222	11121	11020	10935	10851	81
82	13806	13626	13447	13278	13111	12945	12781	12630	12481	12335	12191	12067	11947	11829	11716	11610	11506	11416	11326	11222	11120	11032	10944	82
83	13974	13792	13611	13439	13270	13101	12934	12780	12628	12481	12334	12206	12081	11958	11838	11725	11614	11520	11429	11324	11220	11128	11038	83
84	14143	13959	13776	13601	13428	13256	13086	12930	12776	12626	12478	12345	12214	12088	11965	11848	11733	11636	11541	11432	11323	11226	11131	84
85	14312	14125	13941	13762	13586	13412	13239	13080	12923	12772	12622	12483	12348	12218	12091	11971	11852	11753	11655	11544	11434	11334	11234	85
86	14481	14293	14106	13924	13744	13567	13392	13230	13070	12917	12765	12622	12482	12348	12217	12093	11972	11869	11769	11657	11546	11442	11339	86
87	14650	14460	14271	14086	13904	13724	13546	13380	13217	13062	12909	12760	12616	12478	12344	12216	12091	11986	11882	11769	11657	11550	11444	87
88	14820	14628	14437	14249	14063	13882	13702	13533	13366	13208	13053	12899	12749	12608	12470	12339	12210	12102	11996	11882	11768	11657	11549	88
89	14989	14795	14603	14412	14223	14040	13859	13688	13519	13358	13199	13039	12883	12738	12596	12462	12329	12219	12110	11994	11879	11765	11654	89

TABLE 11

LOWER MONUMENTAL MEAN-UNIT-PERFORMANCE

GROSS HEAD IN FEET — DISCHARGE IN CFS

POWER OUTPUT (MW)	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	POWER OUTPUT (MW)
90	15158	14963	14768	14574	14383	14198	14015	13843	13672	13508	13346	13185	13026	12874	12724	12584	12448	12335	12224	12106	11990	11873	11758	90
91	15329	15130	14934	14737	14542	14356	14171	13998	13826	13659	13494	13331	13170	13016	12864	12719	12575	12453	12337	12219	12101	11981	11863	91
92	15502	15290	15099	14899	14702	14514	14328	14153	13979	13809	13641	13477	13314	13158	13003	12858	12713	12587	12464	12339	12215	12089	11968	92
93	15675	15468	15264	15062	14862	14673	14484	14308	14132	13959	13789	13623	13459	13300	13143	12997	12851	12721	12593	12467	12342	12212	12084	93
94	15848	15637	15429	15224	15022	14831	14642	14463	14285	14110	13937	13769	13603	13442	13283	13136	12990	12855	12723	12595	12468	12337	12207	94
95	16021	15806	15594	15387	15182	14990	14799	14618	14439	14262	14085	13915	13748	13584	13422	13275	13128	12989	12853	12723	12595	12462	12330	95
96	16194	15974	15759	15549	15342	15148	14956	14773	14592	14414	14237	14065	13894	13727	13562	13414	13266	13123	12982	12852	12722	12587	12453	96
97	16367	16143	15924	15712	15502	15307	15113	14929	14746	14566	14388	14215	14042	13874	13706	13554	13404	13257	13112	12980	12848	12712	12576	97
98	16540	16312	16088	15874	15662	15466	15271	15084	14899	14719	14539	14364	14191	14020	13851	13698	13546	13395	13245	13109	12975	12836	12699	98
99	16713	16481	16253	16036	15822	15624	15428	15239	15052	14871	14690	14514	14339	14167	13996	13841	13687	13534	13383	13244	13107	12965	12823	99
100	16886	16650	16418	16199	15982	15783	15585	15395	15206	15023	14842	14664	14487	14314	14141	13984	13829	13674	13520	13380	13241	13098	12956	100
101	17059	16819	16583	16361	16142	15942	15742	15550	15359	15176	14993	14814	14636	14460	14286	14128	13970	13813	13658	13516	13376	13231	13088	101
102	17235	16988	16748	16524	16302	16100	15900	15705	15512	15328	15144	14964	14784	14607	14431	14271	14111	13953	13795	13652	13510	13365	13220	102
103	17419	17165	16915	16686	16462	16259	16057	15861	15666	15480	15295	15113	14932	14754	14577	14414	14253	14092	13933	13788	13644	13498	13352	103
104	17602	17345	17093	16855	16623	16417	16214	16016	15819	15633	15447	15263	15081	14901	14722	14557	14394	14232	14071	13924	13778	13631	13485	104
105	17785	17526	17270	17028	16791	16581	16373	16171	15973	15785	15598	15413	15229	15047	14867	14701	14536	14371	14208	14060	13912	13764	13617	105
106	17969	17706	17447	17200	16958	16746	16535	16330	16127	15937	15749	15563	15377	15194	15012	14844	14677	14511	14346	14195	14046	13897	13749	106
107	18152	17886	17624	17372	17125	16911	16698	16491	16285	16092	15901	15713	15526	15341	15157	14987	14819	14650	14483	14331	14180	14031	13881	107
108	18336	18066	17801	17544	17292	17076	16861	16651	16443	16248	16055	15864	15675	15487	15302	15130	14960	14790	14621	14467	14314	14164	14014	108
109	18519	18247	17978	17716	17460	17241	17024	16812	16601	16404	16208	16015	15824	15636	15449	15274	15102	14929	14759	14603	14449	14297	14146	109
110	18703	18427	18155	17888	17627	17406	17187	16972	16759	16559	16362	16167	15974	15785	15596	15421	15246	15070	14896	14739	14583	14430	14278	110
111	18886	18607	18332	18060	17794	17571	17350	17132	16917	16715	16515	16319	16124	15933	15744	15568	15392	15213	15037	14876	14717	14563	14411	111
112	19070	18788	18509	18232	17961	17736	17513	17293	17075	16871	16669	16470	16273	16082	15892	15714	15537	15357	15178	15015	14854	14698	14543	112
113	19253	18968	18687	18404	18128	17901	17676	17453	17233	17026	16822	16622	16423	16231	16040	15861	15683	15500	15319	15154	14991	14833	14677	113
114	19446	19149	18864	18576	18296	18066	17839	17614	17391	17182	16976	16773	16573	16379	16187	16007	15829	15643	15461	15293	15127	14968	14810	114
115	19640	19339	19044	18748	18463	18231	18002	17774	17549	17338	17129	16925	16722	16528	16335	16154	15974	15787	15602	15432	15264	15103	14943	115
116	19835	19529	19229	18927	18630	18396	18165	17934	17707	17494	17283	17076	16872	16677	16483	16301	16120	15930	15743	15571	15401	15238	15077	116
117	20030	19719	19415	19109	18808	18564	18327	18095	17865	17649	17436	17228	17021	16825	16630	16447	16265	16073	15884	15710	15537	15373	15210	117
118	20224	19909	19600	19291	18987	18738	18495	18256	18023	17805	17590	17379	17171	16974	16778	16594	16411	16217	16025	15849	15674	15508	15343	118
119	20419	20098	19785	19473	19165	18911	18663	18422	18184	17961	17743	17531	17321	17123	16926	16740	16556	16360	16166	15988	15811	15643	15477	119
120	20613	20288	19970	19654	19343	19084	18831	18588	18347	18120	17897	17682	17470	17271	17074	16887	16702	16503	16308	16127	15948	15778	15610	120
121	20808	20478	20156	19836	19522	19258	19000	18753	18510	18279	18052	17836	17621	17420	17221	17034	16847	16647	16449	16265	16084	15913	15743	121
122	21003	20668	20341	20018	19700	19431	19168	18919	18673	18438	18207	17990	17774	17571	17370	17180	16993	16790	16590	16404	16221	16048	15877	122
123	21202	20858	20526	20200	19878	19604	19337	19085	18836	18597	18362	18144	17927	17722	17519	17328	17139	16933	16731	16543	16358	16183	16010	123
124	21407	21054	20711	20381	20057	19778	19505	19250	18999	18755	18517	18298	18080	17874	17669	17476	17285	17078	16873	16682	16494	16318	16143	124
125	21612	21253	20904	20564	20235	19951	19673	19416	19162	18914	18672	18452	18233	18025	17818	17624	17432	17223	17016	16823	16632	16453	16277	125
126	21817	21452	21096	20757	20418	20124	19842	19582	19325	19073	18827	18606	18386	18176	17968	17772	17578	17368	17160	16965	16772	16591	16411	126
127	22028	21651	21289	20950	20611	20307	20010	19747	19488	19232	18982	18760	18539	18327	18117	17920	17725	17513	17303	17107	16912	16730	16550	127
128	22256	21859	21482	21143	20804	20494	20191	19916	19651	19391	19137	18914	18692	18478	18267	18069	17872	17658	17446	17248	17052	16869	16688	128
129	22483	22076	21685	21336	20996	20681	20373	20091	19818	19550	19292	19068	18845	18630	18416	18217	18018	17803	17589	17390	17192	17008	16826	129
130	22711	22293	21892	21531	21188	20868	20554	20266	19987	19717	19450	19222	18998	18781	18566	18365	18165	17948	17733	17531	17332	17147	16964	130
131	22946	22510	22099	21726	21373	21054	20736	20441	20156	19885	19616	19382	19152	18932	18715	18513	18311	18093	17876	17673	17472	17286	17102	131
132	23201	22737	22306	21922	21557	21238	20919	20616	20325	20052	19782	19545	19312	19086	18865	18661	18458	18238	18019	17815	17612	17426	17240	132
133	23455	22980	22526	22117	21742	21423	21104	20798	20496	20220	19947	19708	19472	19241	19015	18809	18605	18383	18162	17956	17752	17565	17378	133
134	23709	23223	22759	22325	21926	21607	21288	20980	20676	20391	20113	19871	19632	19396	19165	18957	18751	18528	18306	18098	17892	17704	17516	134
135	23985	23466	22991	22544	22123	21792	21472	21163	20856	20566	20283	20035	19792	19551	19315	19106	18898	18674	18450	18240	18032	17843	17654	135
136		23735	23224	22763	22328	21987	21658	21345	21036	20741	20452	20200	19953	19706	19465	19254	19045	18819	18595	18382	18172	17982	17792	136
137		24010	23485	22981	22534	22183	21845	21527	21216	20915	20622	20366	20115	19865	19618	19403	19192	18965	18740	18525	18313	18121	17931	137
138			23754	23225	22739	22379	22033	21708	21393	21090	20791	20531	20277	20024	19774	19554	19339	19111	18884	18668	18453	18261	18069	138
139			24023	23475	22966	22575	22220	21890	21569	21263	20961	20697	20438	20183	19931	19706	19486	19257	19029	18810	18594	18400	18207	139
140				23725	23198	22791	22410	22071	21744	21437	21133	20865	20600	20342	20087	19857	19633	19403	19174	18954	18734	18539	18346	140
141				23998	23431	23006	22610	22256	21920	21610	21304	21034	20767	20502	20243	20009	19780	19549	19319	19099	18879	18680	18484	141
142					23693	23222	22810	22447	22099	21784	21476	21203	20933	20664	20401	20161	19927	19694	19464	19244	19024	18823	18624	142
143					23999	23469	23010	22637	22280	21962	21648	21372	21100	20827	20559	20316	20077	19840	19609	19389	19169	18965	18764	143
144					24305	23747	23241	22827	22461	22140	21823	21542	21267	20989	20717	20472	20230	19989	19754	19534	19314	19108	18904	144
145						24025	23492	23046	22642	22318	21999	21714	21434	21151	20875	20628	20384	20139	19899	19679	19459	19250	19044	145
146						24316	23744	23274	22845	22499	22175	21885	21602	21315	21034	20784	20537	20288	20045	19825	19605	19392	19184	146
147							24014	23502	23051	22690	22351	22057	21769	21478	21193	20940	20691	20438	20190	19970	19750	19534	19322	147
148							24327	23751	23257	22882	22529	22229	21937	21642	21353	21097	20845	20589	20335	20115	19895	19676	19461	148
149								24038	23485	23073	22707	22401	22103	21806	21512	21254	20999	20742	20486	20262	20041	19818	19600	149
150								24325	23747	23288	22884	22574	22270	21971	21674	21411	21153	20894	20638	20409	20185	19961	19738	150
151									24010	23518	23080	22748	22437	22135	21837	21572	21309	21047	20789	20556	20328	20103	19879	151
152									24317	23754	23280	22935	22607	22300	22000	21732	21467	21203	20941	20703	20471	20246	20022	152
153										24041	23494	23122	22781	22473	22165	21893	21626	21358	21094	20854	20615	20389	20164	153
154										24329	23763	23334	22955	22646	22338	22057	21784	21514	21247	21005	20765	20534	20306	154
155											24032	23571	23157	22823	22511	22223	21944	21671	21400	21157	20915	20682	20451	155
156											24320	23808	23366	23013	22680	22390	22104	21830	21557	21308	21064	20830	20597	156

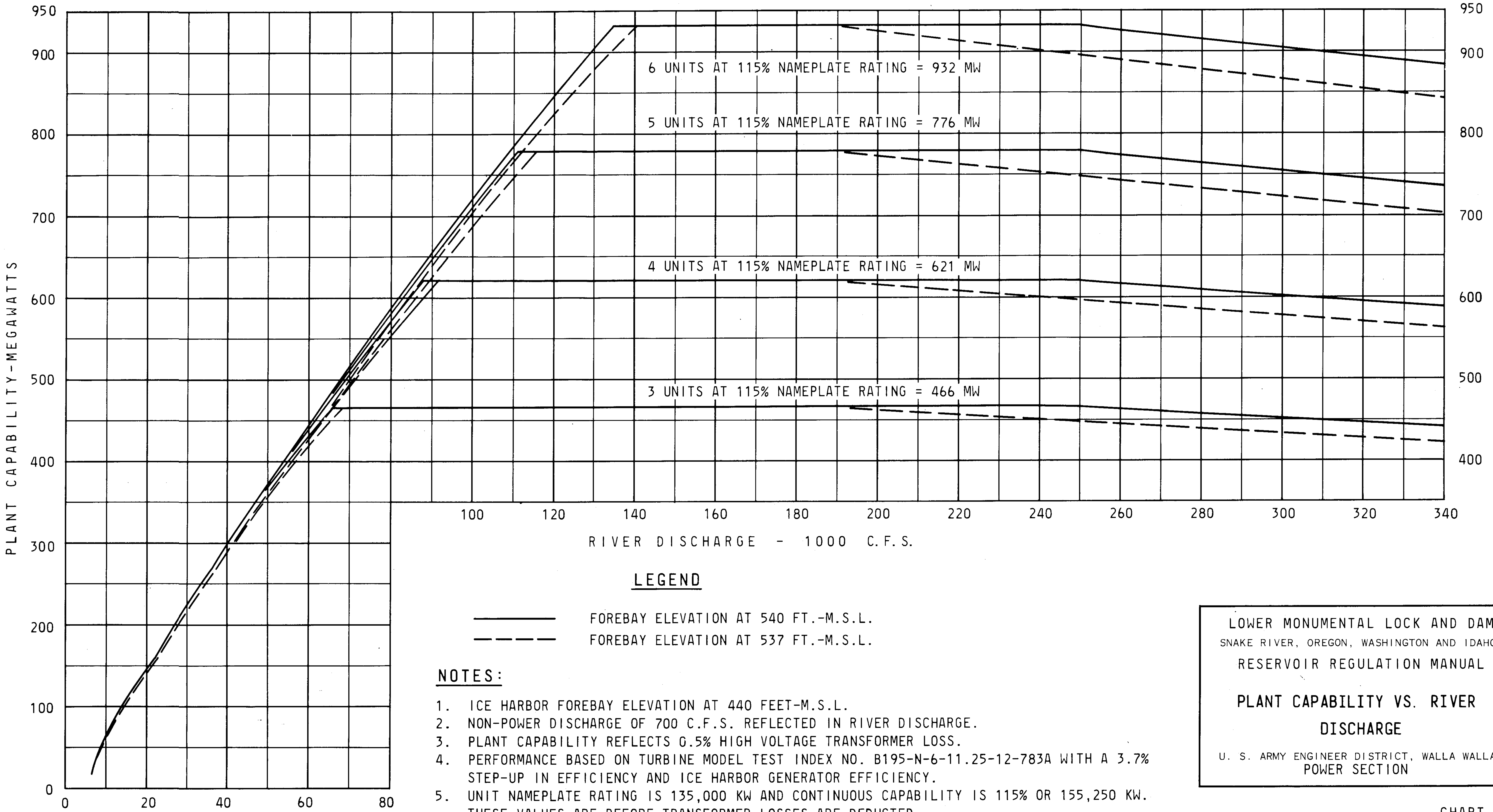
Charts

* DELETED BY REVISION

DELETED

CHART 1

ANNUAL FLOOD PEAK FREQUENCIES- SNAKE RIVER NEAR CLARKSTON, WASHINGTON



LEGEND

—— FOREBAY ELEVATION AT 540 FT.-M.S.L.

– – – FOREBAY ELEVATION AT 537 FT.-M.S.L.

NOTES:

1. ICE HARBOR FOREBAY ELEVATION AT 440 FEET-M.S.L.
2. NON-POWER DISCHARGE OF 700 C.F.S. REFLECTED IN RIVER DISCHARGE.
3. PLANT CAPABILITY REFLECTS 0.5% HIGH VOLTAGE TRANSFORMER LOSS.
4. PERFORMANCE BASED ON TURBINE MODEL TEST INDEX NO. B195-N-6-11.25-12-783A WITH A 3.7% STEP-UP IN EFFICIENCY AND ICE HARBOR GENERATOR EFFICIENCY.
5. UNIT NAMEPLATE RATING IS 135,000 KW AND CONTINUOUS CAPABILITY IS 115% OR 155,250 KW. THESE VALUES ARE BEFORE TRANSFORMER LOSSES ARE DEDUCTED.

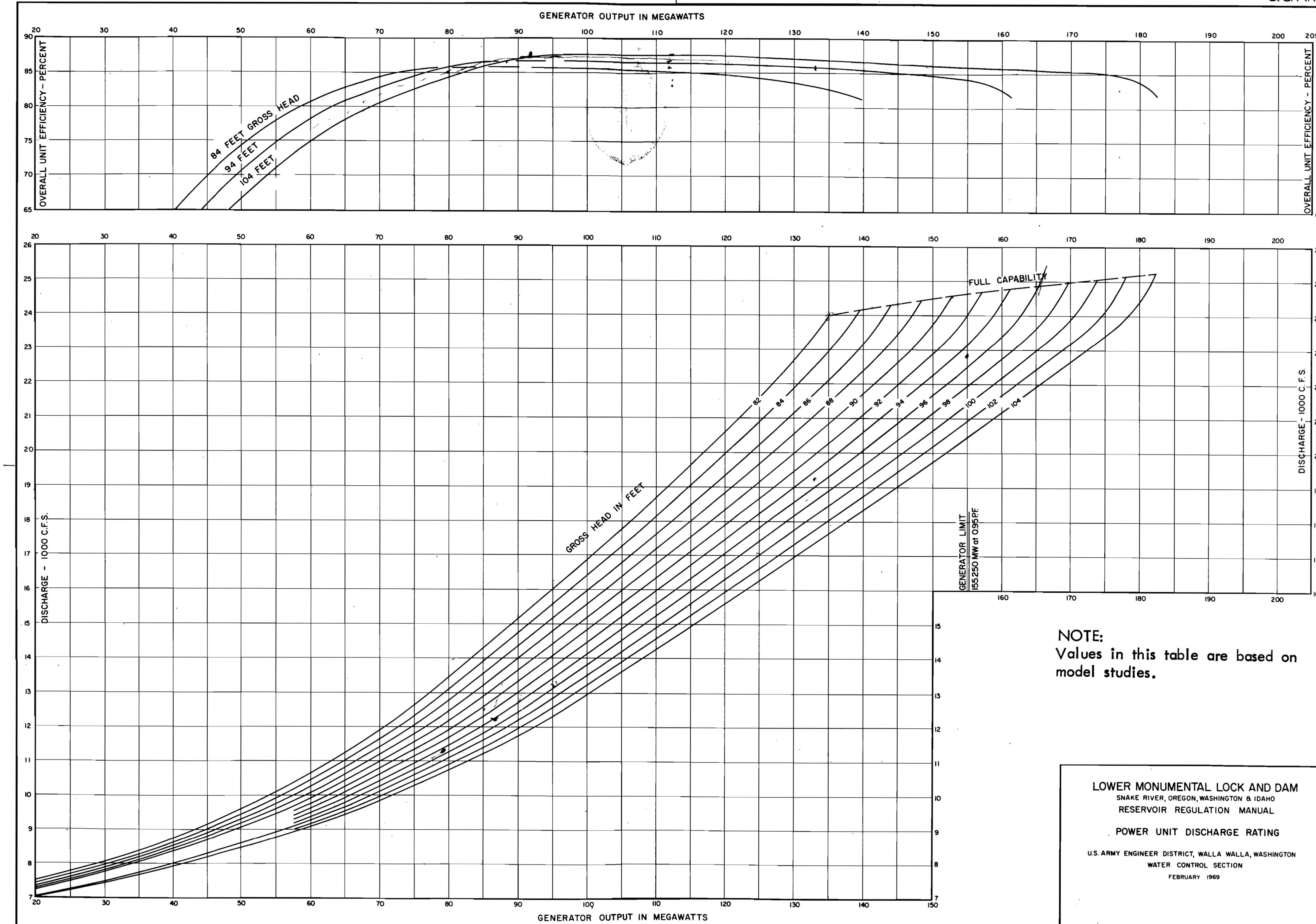
LOWER MONUMENTAL LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
RESERVOIR REGULATION MANUAL

PLANT CAPABILITY VS. RIVER DISCHARGE

U. S. ARMY ENGINEER DISTRICT, WALLA WALLA
POWER SECTION

CHART 2

1% range
generally
12.3 - 16.5



NOTE:
Values in this table are based on model studies.

LOWER MONUMENTAL LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON & IDAHO
RESERVOIR REGULATION MANUAL

POWER UNIT DISCHARGE RATING

U.S. ARMY ENGINEER DISTRICT, WALLA WALLA, WASHINGTON
WATER CONTROL SECTION
FEBRUARY 1969

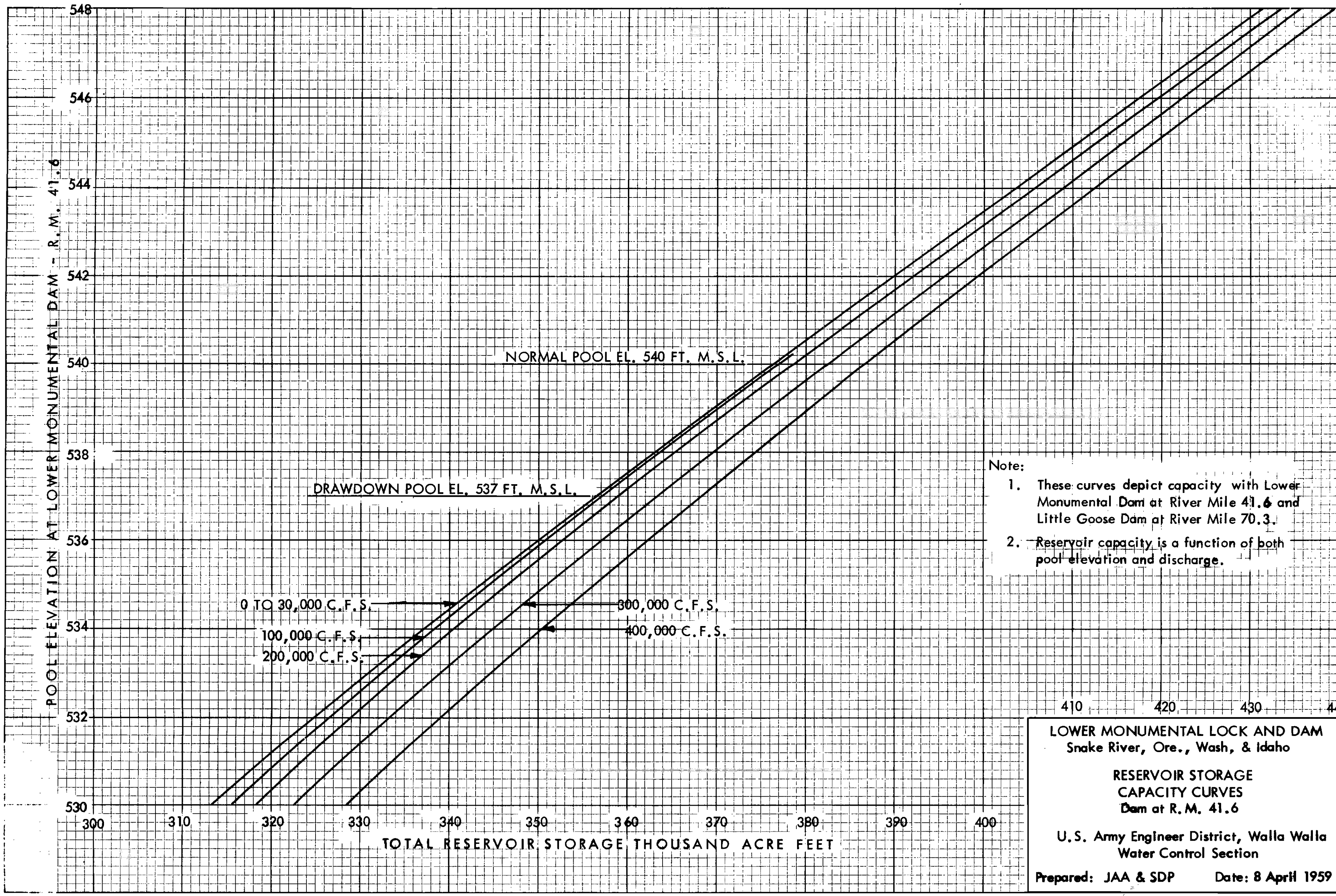


CHART 7

CHART 4

DELETED

CHART 5
ORGANIZATION FOR RESERVOIR REGULATION, WALLA WALLA DISTRICT

DELETED

CHART 6
FUNCTIONAL ORGANIZATION CHART

DELETED

CHART 7
NORTH PACIFIC DIVISION ORGANIZATION CHART

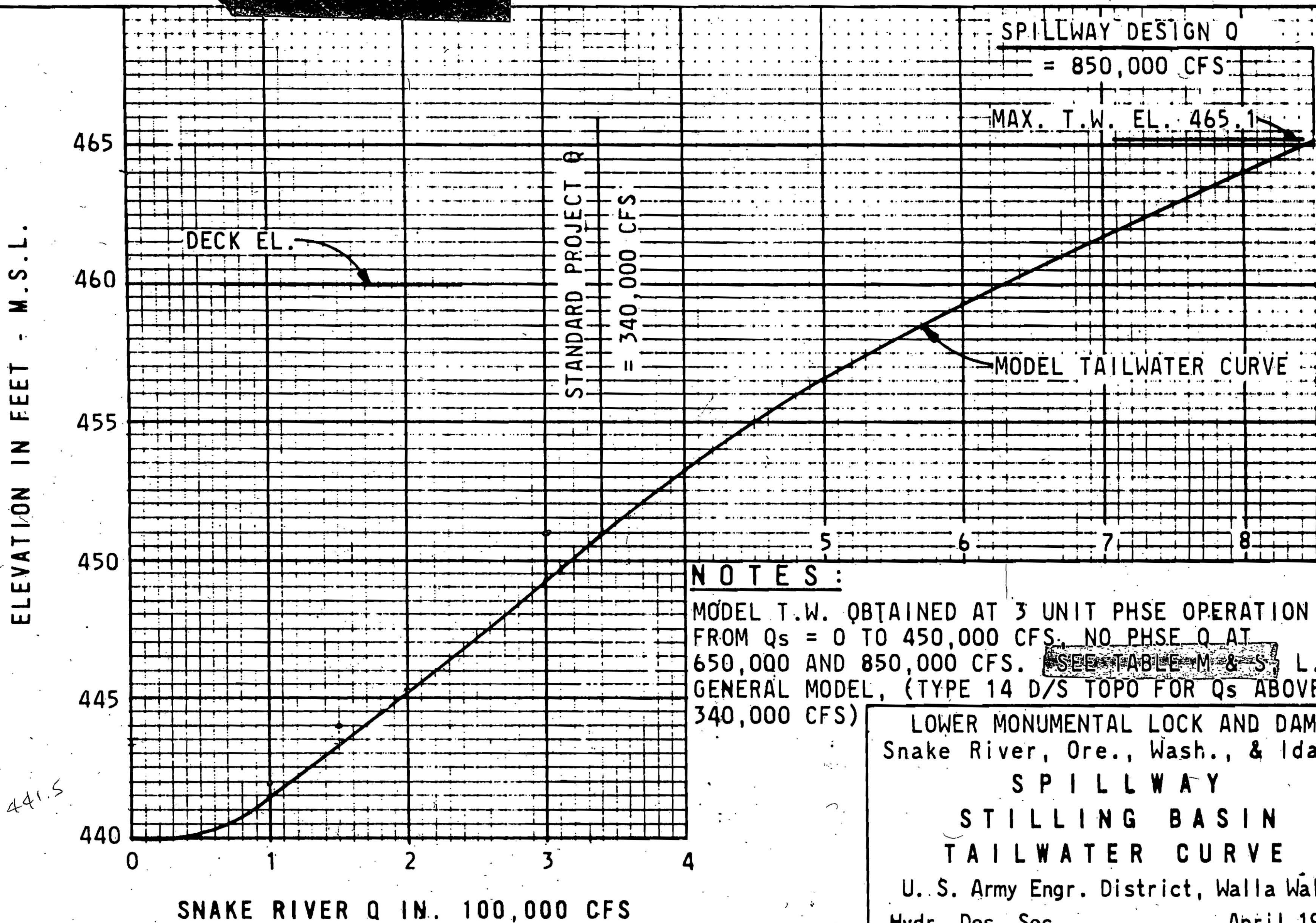
DELETED

CHART 8
BONNEVILLE POWER ADMINISTRATION ORGANIZATION CHART

This plate was added by J. Card 31 Mar 95

x 471

From Operational Manual Part II, Vol. 2 of 3 (Ed Kim's Office)



NOTES:

MODEL T.W. OBTAINED AT 3 UNIT PHSE OPERATION FROM Qs = 0 TO 450,000 CFS. NO PHSE Q AT 650,000 AND 850,000 CFS. SEE TABLE M & S, L.M. GENERAL MODEL, (TYPE 14 D/S TOPO FOR Qs ABOVE 340,000 CFS)

LOWER MONUMENTAL LOCK AND DAM
Snake River, Ore., Wash., & Idaho

SPILLWAY
STILLING BASIN
TAILWATER CURVE

U. S. Army Engr. District, Walla Walla
Hydr. Des. Sec. April 1962

These tables are not given in T.R. 102-1 dated May 1974

PLATE 28.03-1.2

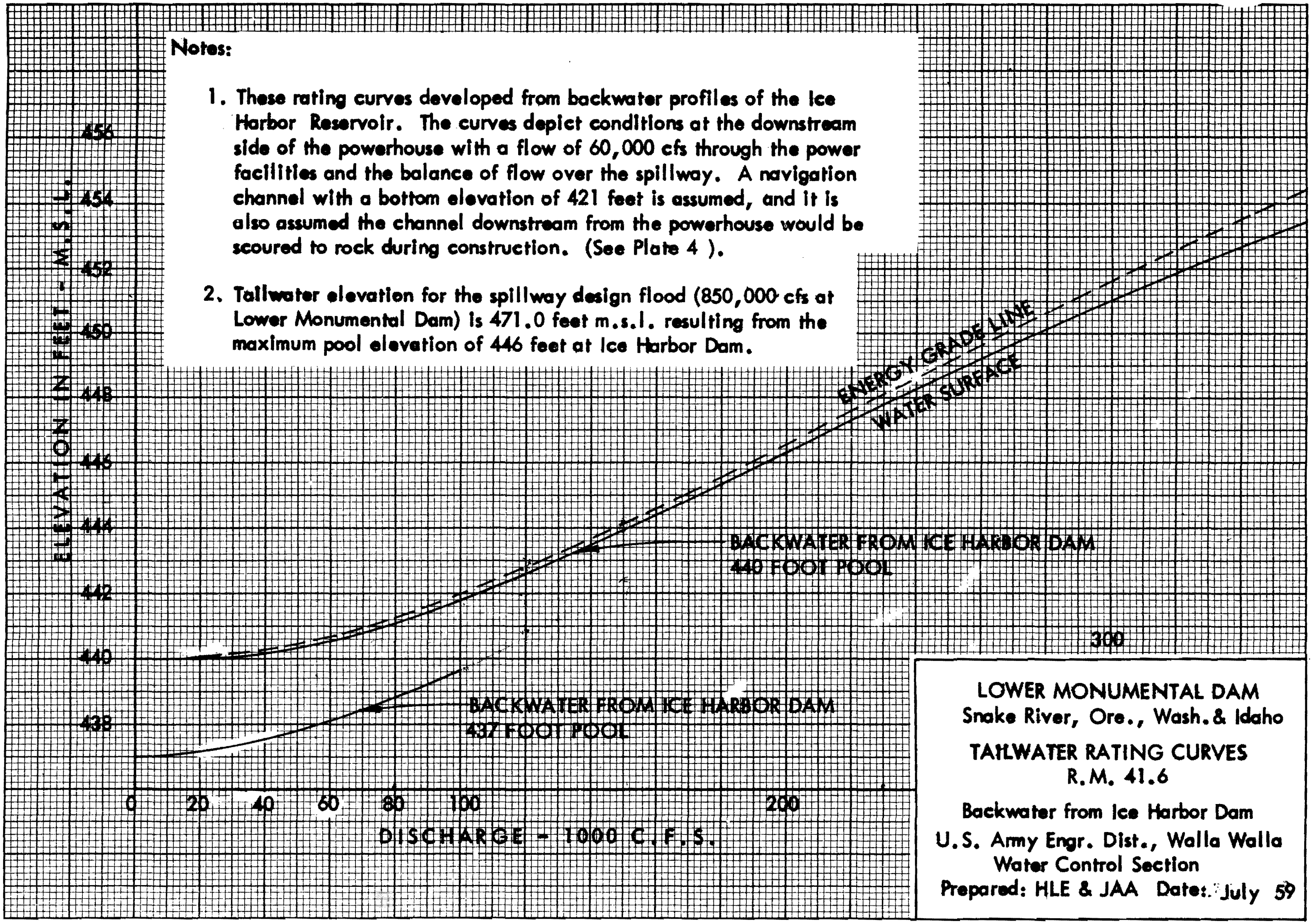
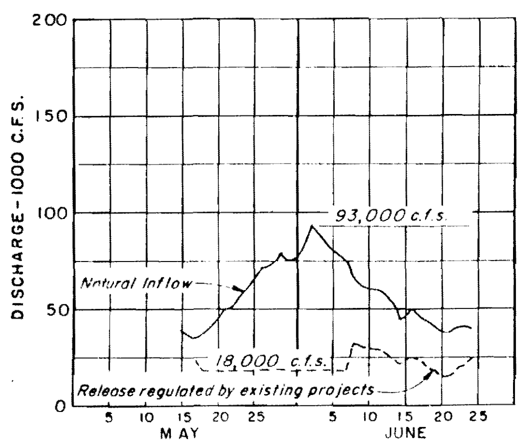
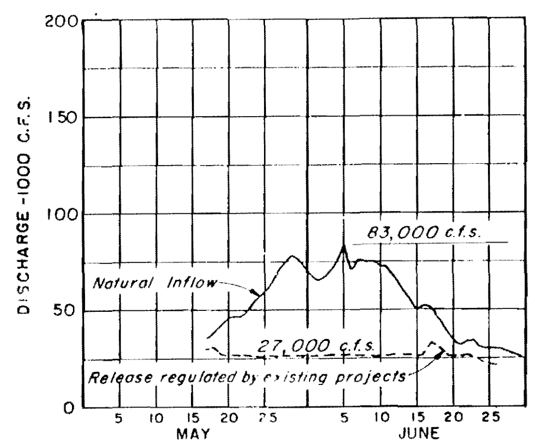

ELEVATION IN FEET - M.S.L.
456
454
452
450
448
446
444
442
440
438
0
20
40
60
80
100
200
300
DISCHARGE - 1000 C.F.S.
ENERGY GRADE LINE
WATER SURFACE
BACKWATER FROM ICE HARBOR DAM
440 FOOT POOL
BACKWATER FROM ICE HARBOR DAM
437 FOOT POOL
Notes:
1. These rating curves developed from backwater profiles of the Ice Harbor Reservoir. The curves depict conditions at the downstream side of the powerhouse with a flow of 60,000 cfs through the power facilities and the balance of flow over the spillway. A navigation channel with a bottom elevation of 421 feet is assumed, and it is also assumed the channel downstream from the powerhouse would be scoured to rock during construction. (See Plate 4).
2. Tailwater elevation for the spillway design flood (850,000 cfs at Lower Monumental Dam) is 471.0 feet m.s.l. resulting from the maximum pool elevation of 446 feet at Ice Harbor Dam.
LOWER MONUMENTAL DAM
Snake River, Ore., Wash. & Idaho
TAILWATER RATING CURVES
R.M. 41.6
Backwater from Ice Harbor Dam
U.S. Army Engr. Dist., Walla Walla
Water Control Section
Prepared: HLE & JAA Date: July 59

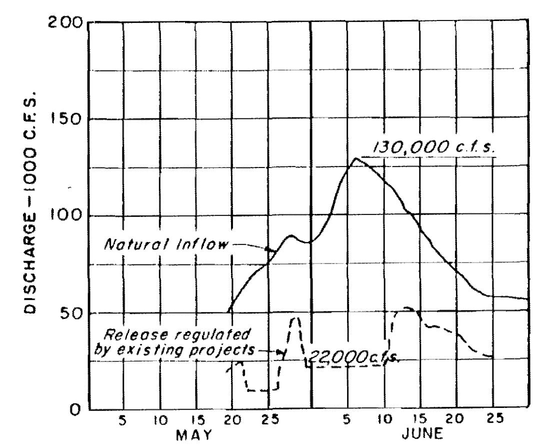
CHART 10



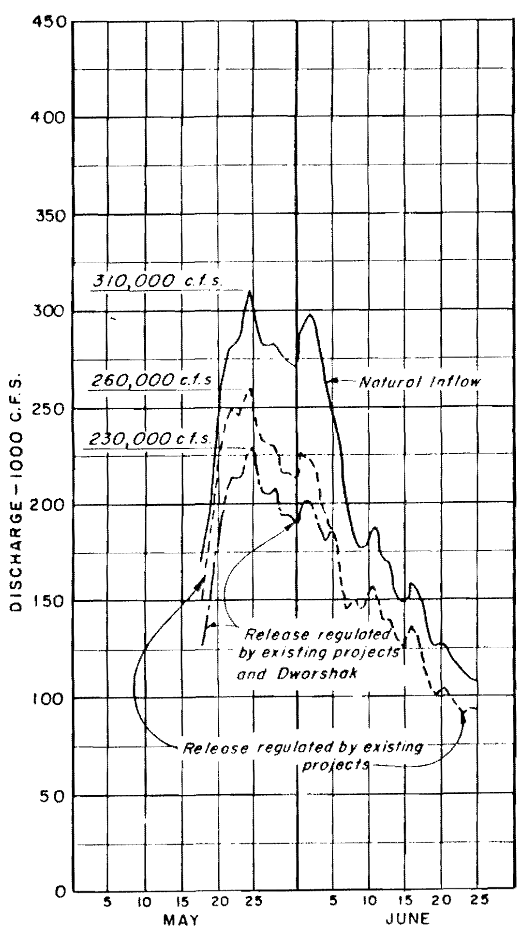
SNAKE RIVER AT BROWNLEE-1956



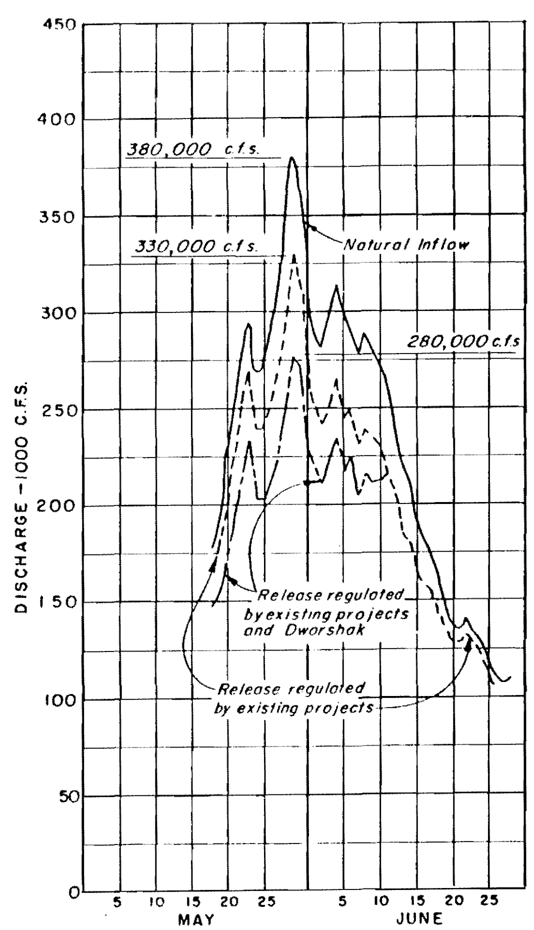
SNAKE RIVER AT BROWNLEE-1948



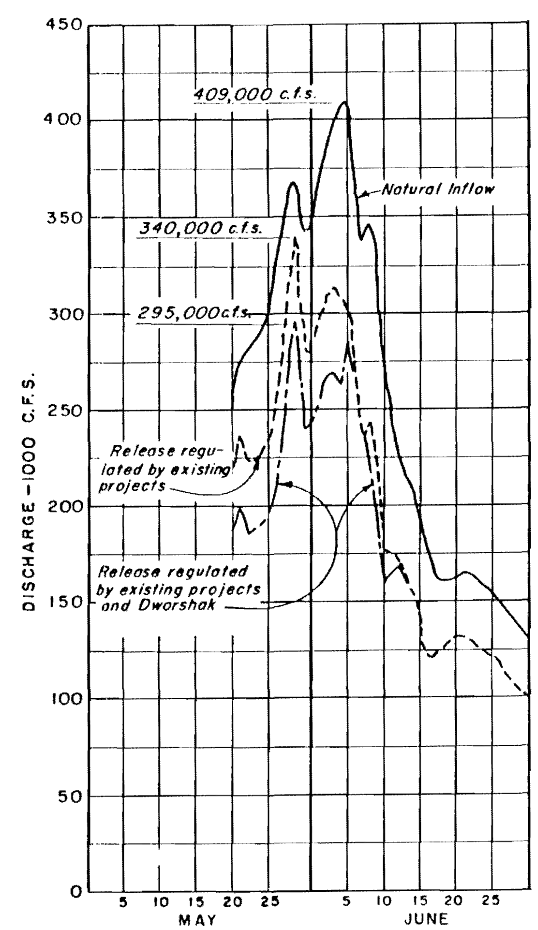
SNAKE RIVER AT BROWNLEE-1894



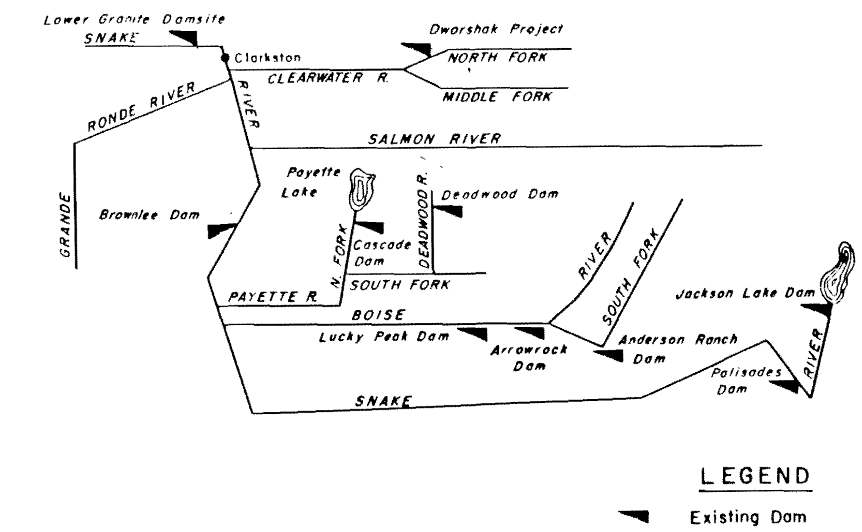
SNAKE RIVER AT CLARKSTON-1956



SNAKE RIVER AT CLARKSTON-1948



SNAKE RIVER AT CLARKSTON-1894



SCHEMATIC DIAGRAM OF MAJOR PROJECTS WITH FLOOD CONTROL STORAGE

MAJOR PROJECTS AND FLOOD CONTROL STORAGE

EXISTING PROJECTS		GROSS USABLE ACRE-FEET
UPPER SNAKE RIVER		
JACKSON LAKE AND PALISADES		1,400,000
BOISE RIVER		
ANDERSON RANCH		418,000
ARROWROCK		286,000
LUCKY PEAK		279,000
PAYETTE RIVER		
CASCADE		653,000
DEADWOOD		160,000
MIDDLE SNAKE RIVER		
BROWNLEE		980,000
	TOTAL	4,176,000
NORTH FORK CLEARWATER		
DWORSHAK		2,000,000
TOTAL EXISTING AND DWORSHAK		6,176,000

NOTES:

1. REGULATION BY EXISTING PROJECTS IS BASED ON REGULATION PROCEDURES USED IN "JUNE 1958 REVIEW REPORT OF HOUSE DOCUMENT 531."
2. DWORSHAK REGULATION PROCEDURES ARE OUTLINED IN APPENDIX A OF THE 15 SEPTEMBER 1961 "BRUCES EDDY DAM AND RESERVOIR GENERAL DESIGN MEMORANDUM."

REVISION	DATE	DESCRIPTION	BY

U. S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

DESIGNED Y. Armacost — DRAWN R. L. B. — CHECKED R. Conway

LOWER MONUMENTAL LOCK & DAM
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO

REGULATION OF LARGE SNAKE RIVER FLOODS

PREPARED: [signature]
SUBMITTED: Glenn H. Von Gunten, CHIEF PROJECT PLANNING BRANCH
RECOMMENDED: E. C. [signature], CHIEF ENGINEERING DIVISION
APPROVED: [signature], COL. C. E. DISTRICT ENGINEER — DATE 22 Nov 1963
SCALE AS SHOWN — INV. NO. ENG.
FILE NO. GD-05-3/18

DELETED

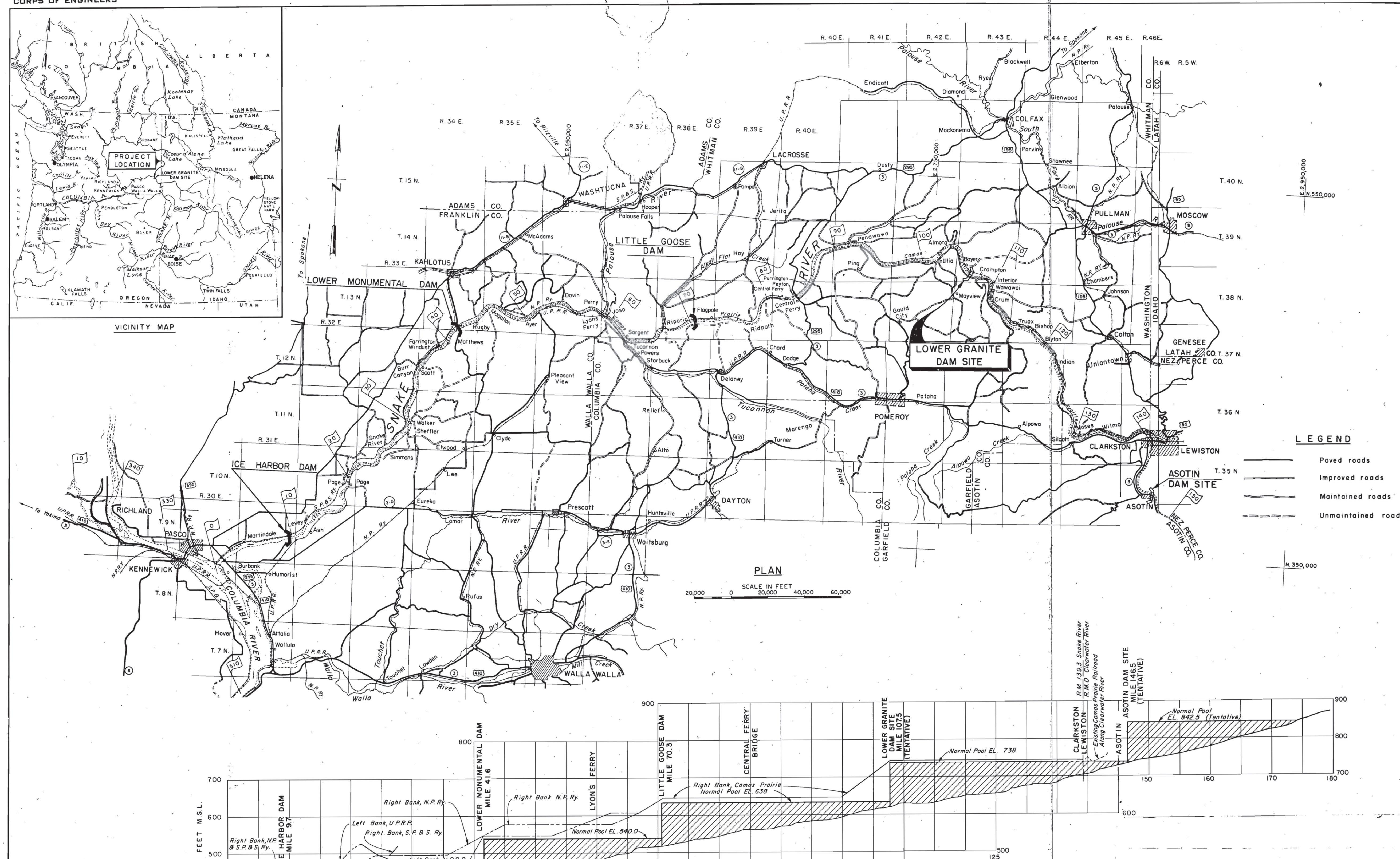
CHART 12
TYPICAL WINTER DAILY POWER OPERATION

Plates

** ADDED BY REVISION

CORPS OF ENGINEERS

U. S. ARMY



LOWER MONUMENTAL LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON & IDAHO
RESERVOIR REGULATION MANUAL

PLAN AND PROFILE

LOWER SNAKE RIVER DEVELOPMENT

U.S. ARMY ENGINEER DISTRICT, WALLA WALLA, WASH.

PLATE 1

Lower Monumental
LAND USE · MASTER PLAN

---- PROJECT BOUNDARY

—— ROADS

+++ RAILROADS

NORMAL POOL
540 feet m.s.l.

60 * RIVER MILE

Project Operations

PROJECT STRUCTURES

PUBLIC PORT TERMINAL

INDUSTRIAL USE and ACCESS

Operations · Recreation

INTENSIVE USE · INITIAL

INTENSIVE USE · FUTURE

LOW DENSITY USE

RECREATION LANDS

Operations · Fish and Wildlife

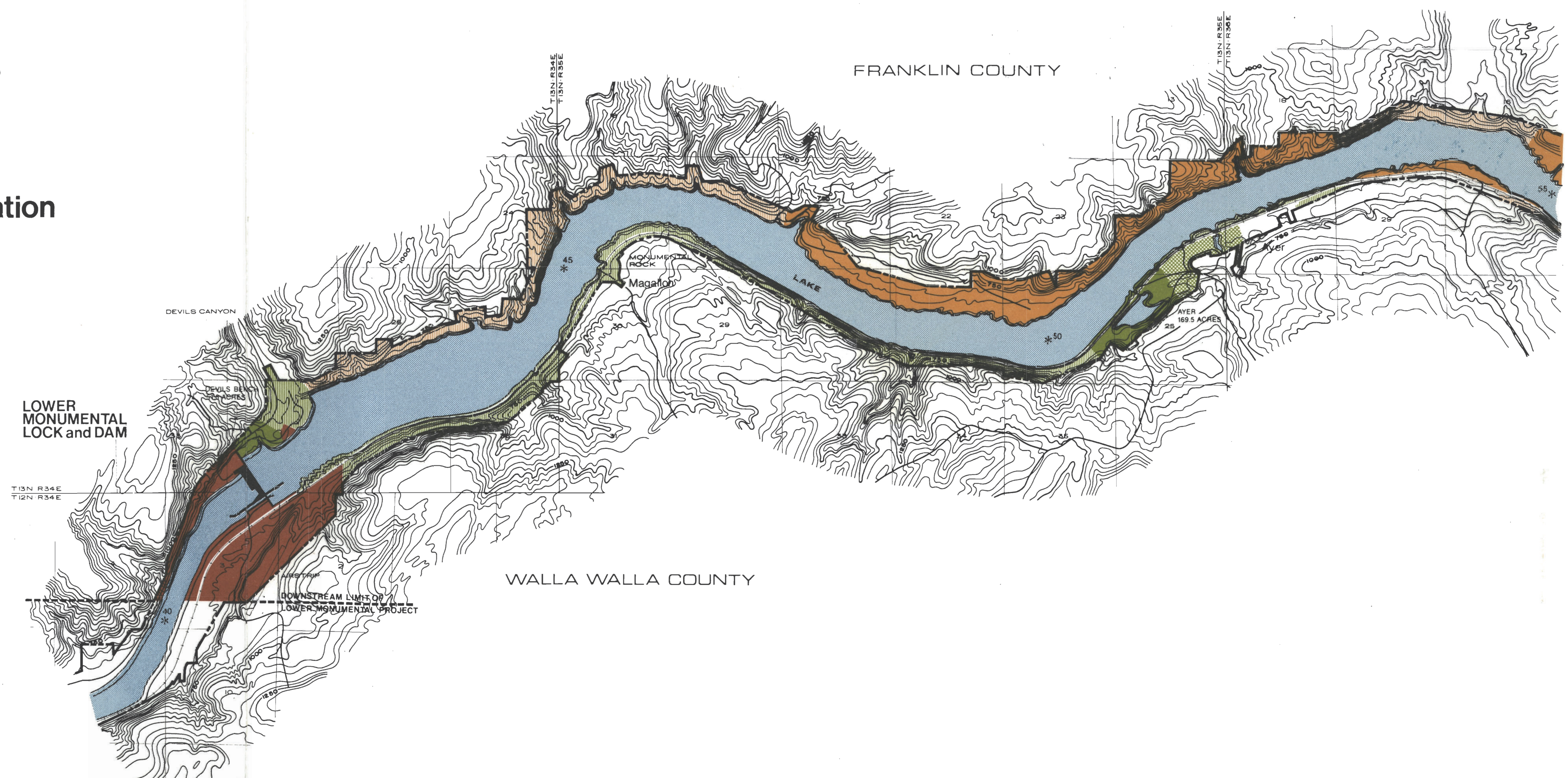
INTENSIVE MANAGEMENT

MODERATE MANAGEMENT

Other

NATURAL AREA

uncolored areas within the project boundary are either railroads or highway rights-of-way



0 1 2 4 feet 8000

5 SHEET 1 OF 2

APRIL 1978

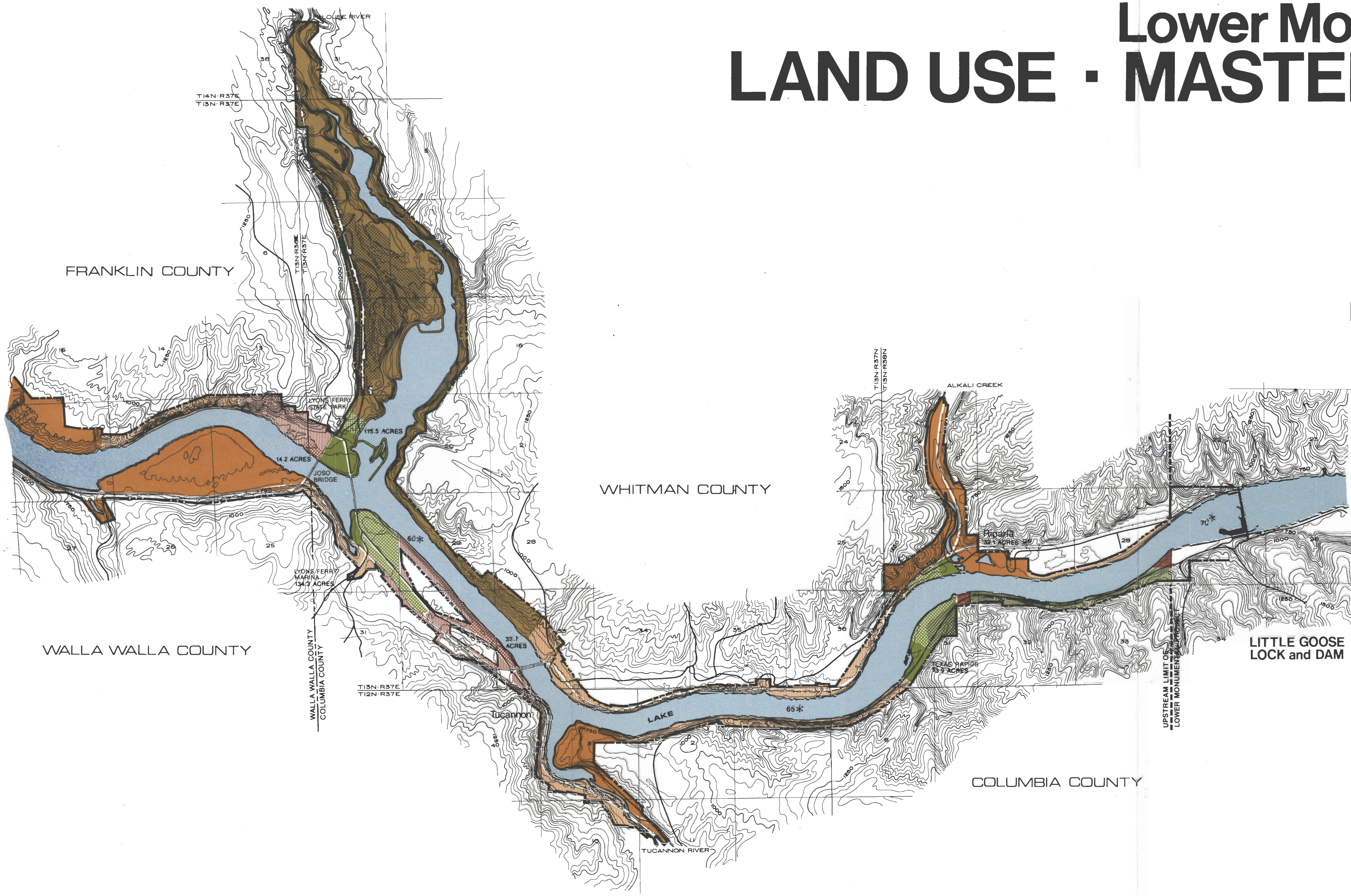
LOWER SNAKE RIVER PROJECT

U.S. ARMY ENGINEER DISTRICT
Walla Walla, Washington

WATER CONTROL MANUAL

PLATE 2

Lower Monumental
LAND USE · MASTER PLAN



PROJECT BOUNDARY

ROADS

RAILROADS

NORMAL POOL
540 feet m.s.l.

RIVER MILE *60

Project Operations

PROJECT STRUCTURES

PUBLIC PORT TERMINAL

INDUSTRIAL USE and ACCESS

Operations · Recreation

INTENSIVE USE · INITIAL

INTENSIVE USE · FUTURE

LOW DENSITY USE

RECREATION LANDS

Operations · Fish and Wildlife

INTENSIVE MANAGEMENT

MODERATE MANAGEMENT

Other

NATURAL AREA

uncolored areas within the project boundary are either railroads or highway rights-of-way

0 1 2 4 feet 8000

SHEET 2 OF 2 **5**

APRIL 1978

U.S. ARMY ENGINEER DISTRICT
Walla Walla, Washington

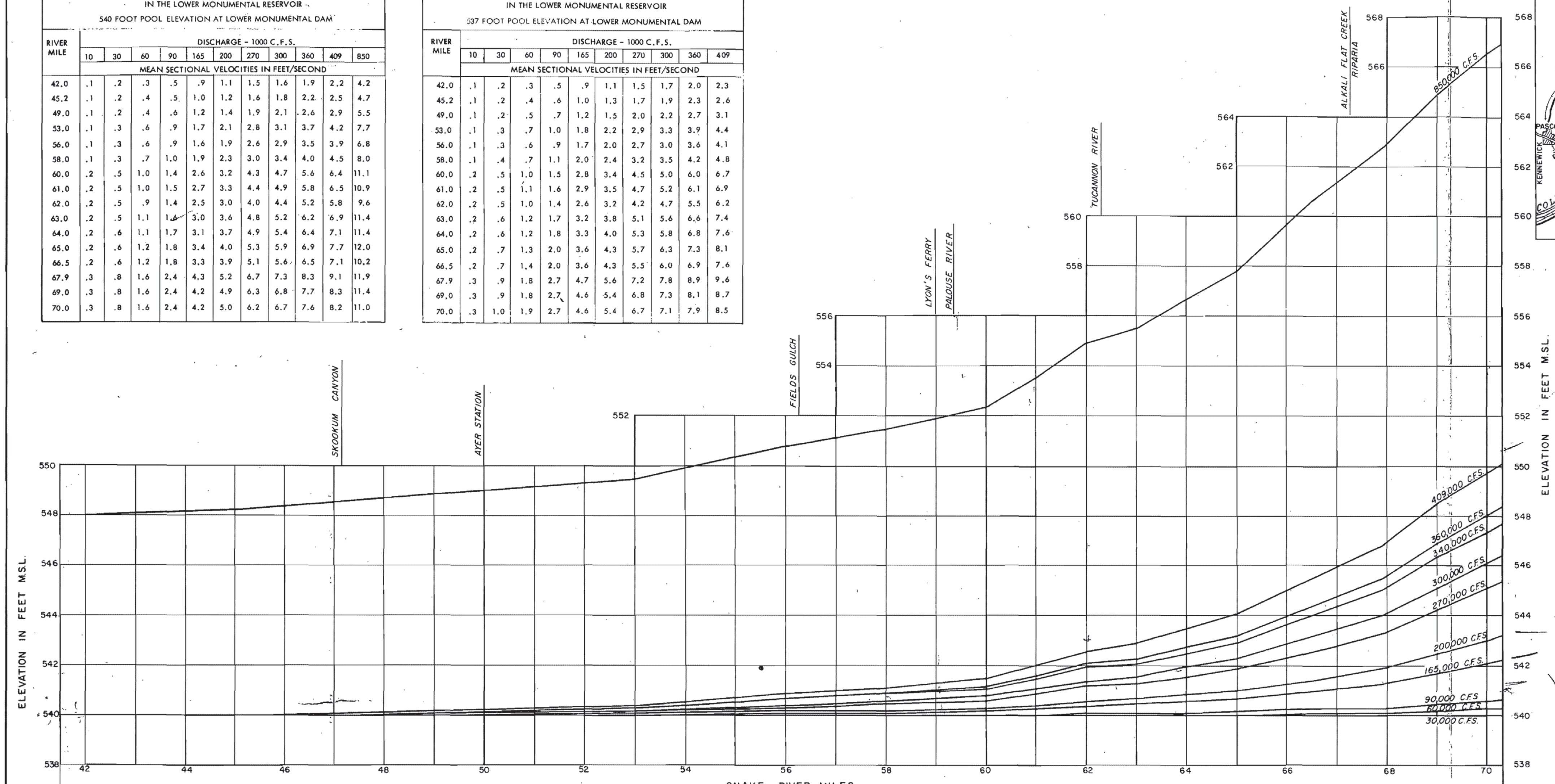
LOWER SNAKE RIVER PROJECT

RIVER MILE	DISCHARGE - 1000 C.F.S. 10	30	60	90	165	200	270	300	360	409	850
	MEAN SECTIONAL VELOCITIES IN FEET/SECOND										
42.0	.1	.2	.3	.5	.9	1.1	1.5	1.6	1.9	2.2	4.2
45.2	.1	.2	.4	.5	1.0	1.2	1.6	1.8	2.2	2.5	4.7
49.0	.1	.2	.4	.6	1.2	1.4	1.9	2.1	2.6	2.9	5.5
53.0	.1	.3	.6	.9	1.7	2.1	2.8	3.1	3.7	4.2	7.7
56.0	.1	.3	.6	.9	1.6	1.9	2.6	2.9	3.5	3.9	6.8
58.0	.1	.3	.7	1.0	1.9	2.3	3.0	3.4	4.0	4.5	8.0
60.0	.2	.5	1.0	1.4	2.6	3.2	4.3	4.7	5.6	6.4	11.1
61.0	.2	.5	1.0	1.5	2.7	3.3	4.4	4.9	5.8	6.5	10.9
62.0	.2	.5	.9	1.4	2.5	3.0	4.0	4.4	5.2	5.8	9.6
63.0	.2	.5	1.1	1.6	3.0	3.6	4.8	5.2	6.2	6.9	11.4
64.0	.2	.6	1.1	1.7	3.1	3.7	4.9	5.4	6.4	7.1	11.4
65.0	.2	.6	1.2	1.8	3.4	4.0	5.3	5.9	6.9	7.7	12.0
66.5	.2	.6	1.2	1.8	3.3	3.9	5.1	5.6	6.5	7.1	10.2
67.9	.3	.8	1.6	2.4	4.3	5.2	6.7	7.3	8.3	9.1	11.9
69.0	.3	.8	1.6	2.4	4.2	4.9	6.3	6.8	7.7	8.3	11.4
70.0	.3	.8	1.6	2.4	4.2	5.0	6.2	6.7	7.6	8.2	11.0

MEAN SECTIONAL VELOCITIES AT SELECTED LOCATIONS IN THE LOWER MONUMENTAL RESERVOIR 540 FOOT POOL ELEVATION AT LOWER MONUMENTAL DAM

RIVER MILE	DISCHARGE - 1000 C.F.S. 10	30	60	90	165	200	270	300	360	409
	MEAN SECTIONAL VELOCITIES IN FEET/SECOND									
42.0	.1	.2	.3	.5	.9	1.1	1.5	1.7	2.0	2.3
45.2	.1	.2	.4	.6	1.0	1.3	1.7	1.9	2.3	2.6
49.0	.1	.2	.5	.7	1.2	1.5	2.0	2.2	2.7	3.1
53.0	.1	.3	.7	1.0	1.8	2.2	2.9	3.3	3.9	4.4
56.0	.1	.3	.6	.9	1.7	2.0	2.7	3.0	3.6	4.1
58.0	.1	.4	.7	1.1	2.0	2.4	3.2	3.5	4.2	4.8
60.0	.2	.5	1.0	1.5	2.8	3.4	4.5	5.0	6.0	6.7
61.0	.2	.5	1.1	1.6	2.9	3.5	4.7	5.2	6.1	6.9
62.0	.2	.5	1.0	1.4	2.6	3.2	4.2	4.7	5.5	6.2
63.0	.2	.6	1.2	1.7	3.2	3.8	5.1	5.6	6.6	7.4
64.0	.2	.6	1.2	1.8	3.3	4.0	5.3	5.8	6.8	7.6
65.0	.2	.7	1.3	2.0	3.6	4.3	5.7	6.3	7.3	8.1
66.5	.2	.7	1.4	2.0	3.6	4.3	5.5	6.0	6.9	7.6
67.9	.3	.9	1.8	2.7	4.7	5.6	7.2	7.8	8.9	9.6
69.0	.3	.9	1.8	2.7	4.6	5.4	6.8	7.3	8.1	8.7
70.0	.3	1.0	1.9	2.7	4.6	5.4	6.7	7.1	7.9	8.5

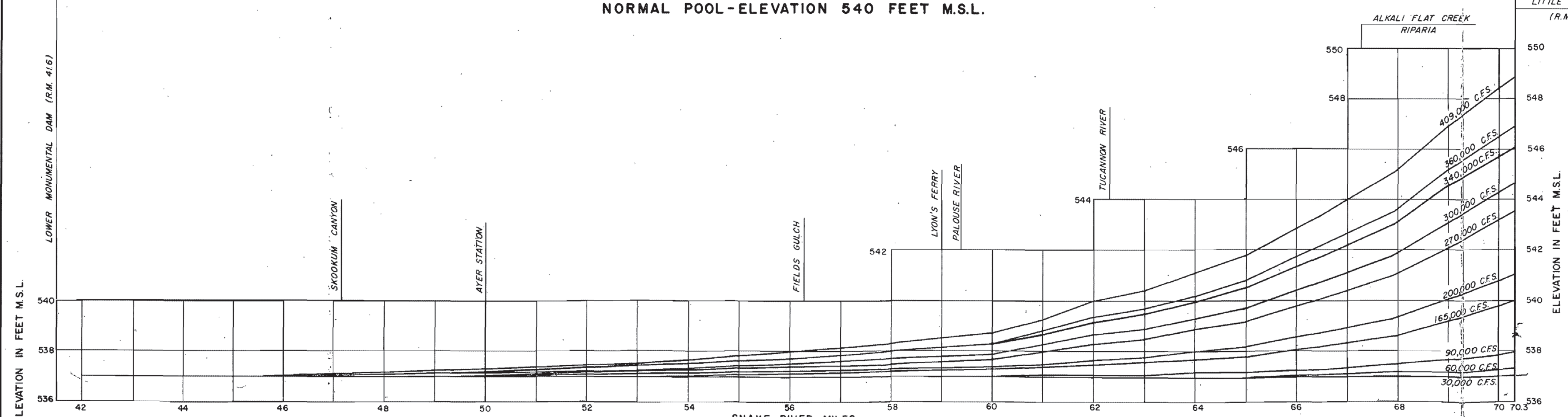
MEAN SECTIONAL VELOCITIES AT SELECTED LOCATIONS IN THE LOWER MONUMENTAL RESERVOIR 537 FOOT POOL ELEVATION AT LOWER MONUMENTAL DAM



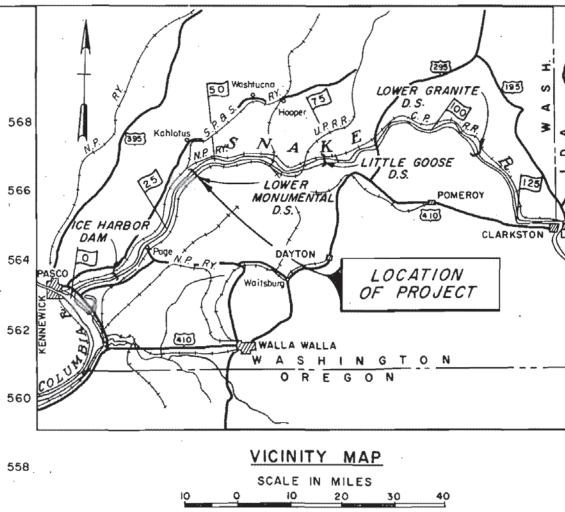
NORMAL POOL-ELEVATION 540 FEET M.S.L.

(543 - 537)

537 - 541



DRAWDOWN POOL-ELEVATION 537 FEET M.S.L.

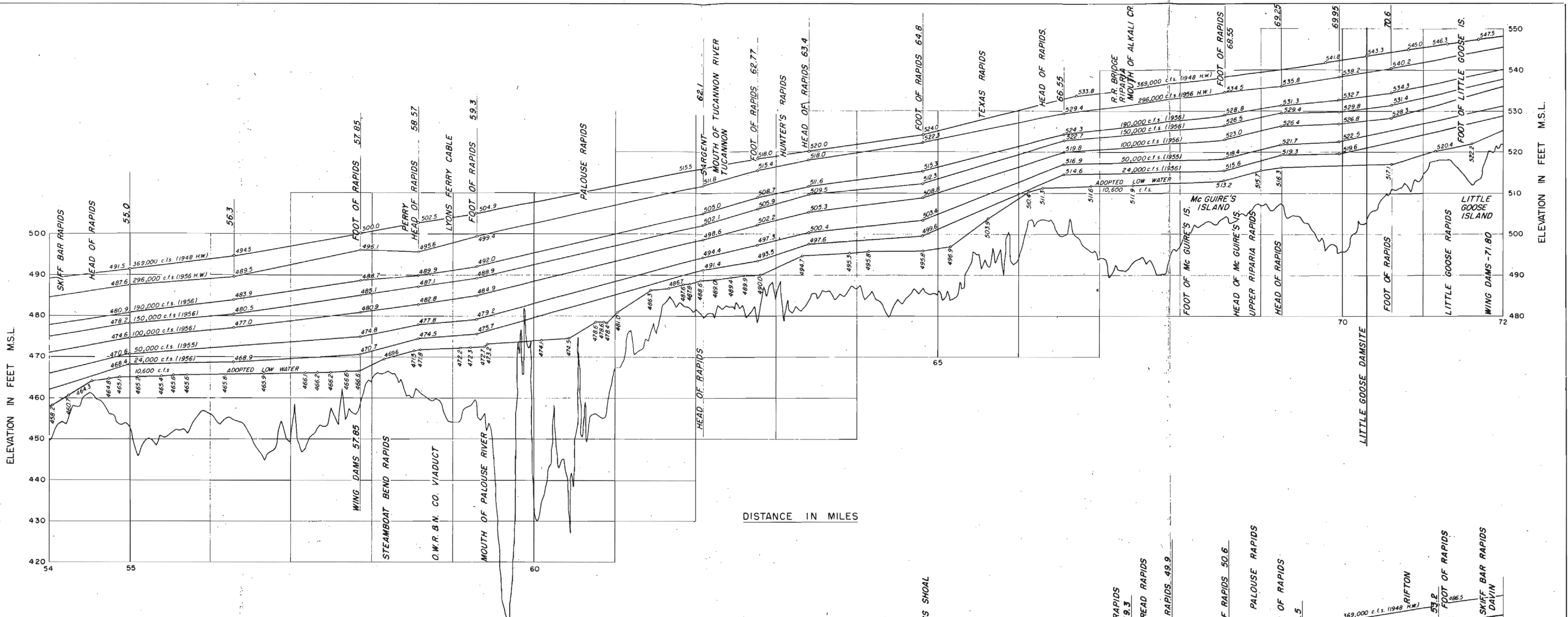


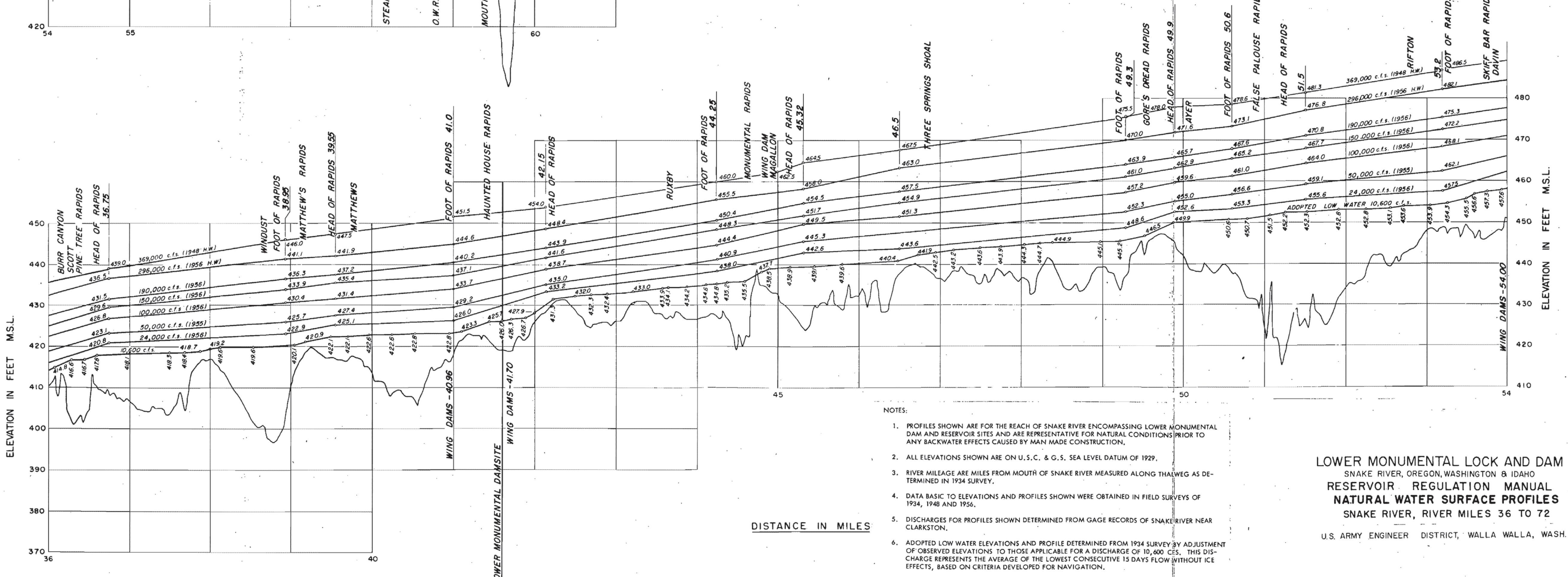
VICINITY MAP

SCALE IN MILES

NOTE: These curves do not reflect the local effects of Little Goose Dam at River Mile 70.3.

LOWER MONUMENTAL LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON & IDAHO
RESERVOIR REGULATION MANUAL
RESERVOIR BACKWATER PROFILES
540 AND 537 FOOT POOL ELEVATION AT DAM
U.S. ARMY ENGINEER DISTRICT, WALLA WALLA, WASH.



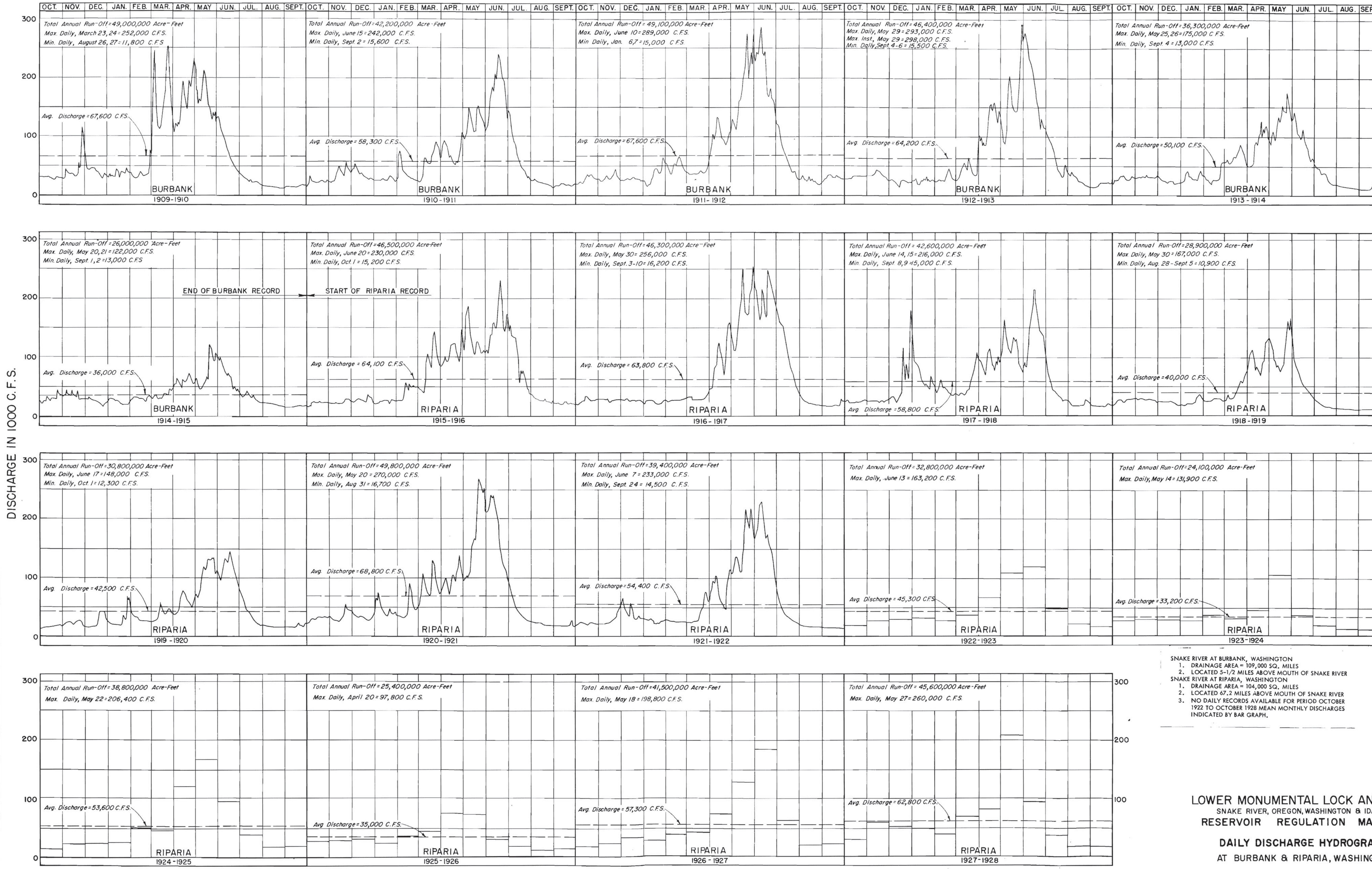


NOTES:

1. PROFILES SHOWN ARE FOR THE REACH OF SNAKE RIVER ENCOMPASSING LOWER MONUMENTAL DAM AND RESERVOIR SITES AND ARE REPRESENTATIVE FOR NATURAL CONDITIONS PRIOR TO ANY BACKWATER EFFECTS CAUSED BY MAN MADE CONSTRUCTION.
2. ALL ELEVATIONS SHOWN ARE ON U.S.C. & G.S. SEA LEVEL DATUM OF 1929.
3. RIVER MILEAGE ARE MILES FROM MOUTH OF SNAKE RIVER MEASURED ALONG THALWEG AS DETERMINED IN 1934 SURVEY.
4. DATA BASIC TO ELEVATIONS AND PROFILES SHOWN WERE OBTAINED IN FIELD SURVEYS OF 1934, 1948 AND 1956.
5. DISCHARGES FOR PROFILES SHOWN DETERMINED FROM GAGE RECORDS OF SNAKE RIVER NEAR CLARKSTON.
6. ADOPTED LOW WATER ELEVATIONS AND PROFILE DETERMINED FROM 1934 SURVEY BY ADJUSTMENT OF OBSERVED ELEVATIONS TO THOSE APPLICABLE FOR A DISCHARGE OF 10,600 CFS. THIS DISCHARGE REPRESENTS THE AVERAGE OF THE LOWEST CONSECUTIVE 15 DAYS FLOW WITHOUT ICE EFFECTS, BASED ON CRITERIA DEVELOPED FOR NAVIGATION.
7. STREAM BED AND RAILWAY PROFILES FROM 1934 SURVEY.

LOWER MONUMENTAL LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON & IDAHO
RESERVOIR REGULATION MANUAL
NATURAL WATER SURFACE PROFILES
SNAKE RIVER, RIVER MILES 36 TO 72

U.S. ARMY ENGINEER DISTRICT, WALLA WALLA, WASH.



SNAKE RIVER AT BURBANK, WASHINGTON
1. DRAINAGE AREA = 109,000 SQ. MILES
2. LOCATED 5-1/2 MILES ABOVE MOUTH OF SNAKE RIVER

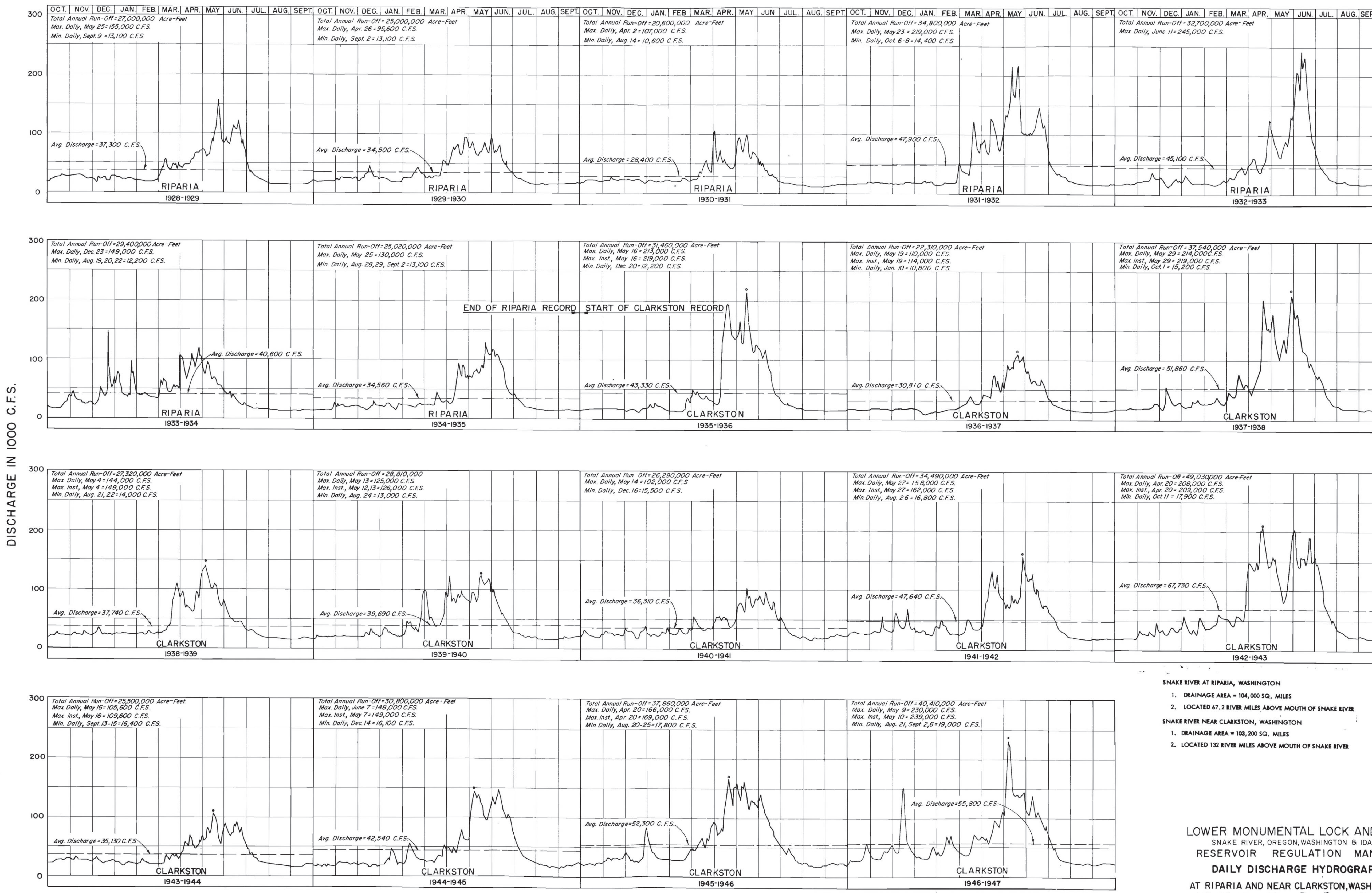
SNAKE RIVER AT RIPARIA, WASHINGTON
1. DRAINAGE AREA = 104,000 SQ. MILES
2. LOCATED 67.2 MILES ABOVE MOUTH OF SNAKE RIVER
3. NO DAILY RECORDS AVAILABLE FOR PERIOD OCTOBER 1922 TO OCTOBER 1928 MEAN MONTHLY DISCHARGES INDICATED BY BAR GRAPH.

LOWER MONUMENTAL LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON & IDAHO
RESERVOIR REGULATION MANUAL

DAILY DISCHARGE HYDROGRAPH
AT BURBANK & RIPARIA, WASHINGTON

U.S. ARMY ENGINEER DISTRICT, WALLA WALLA, WASH.

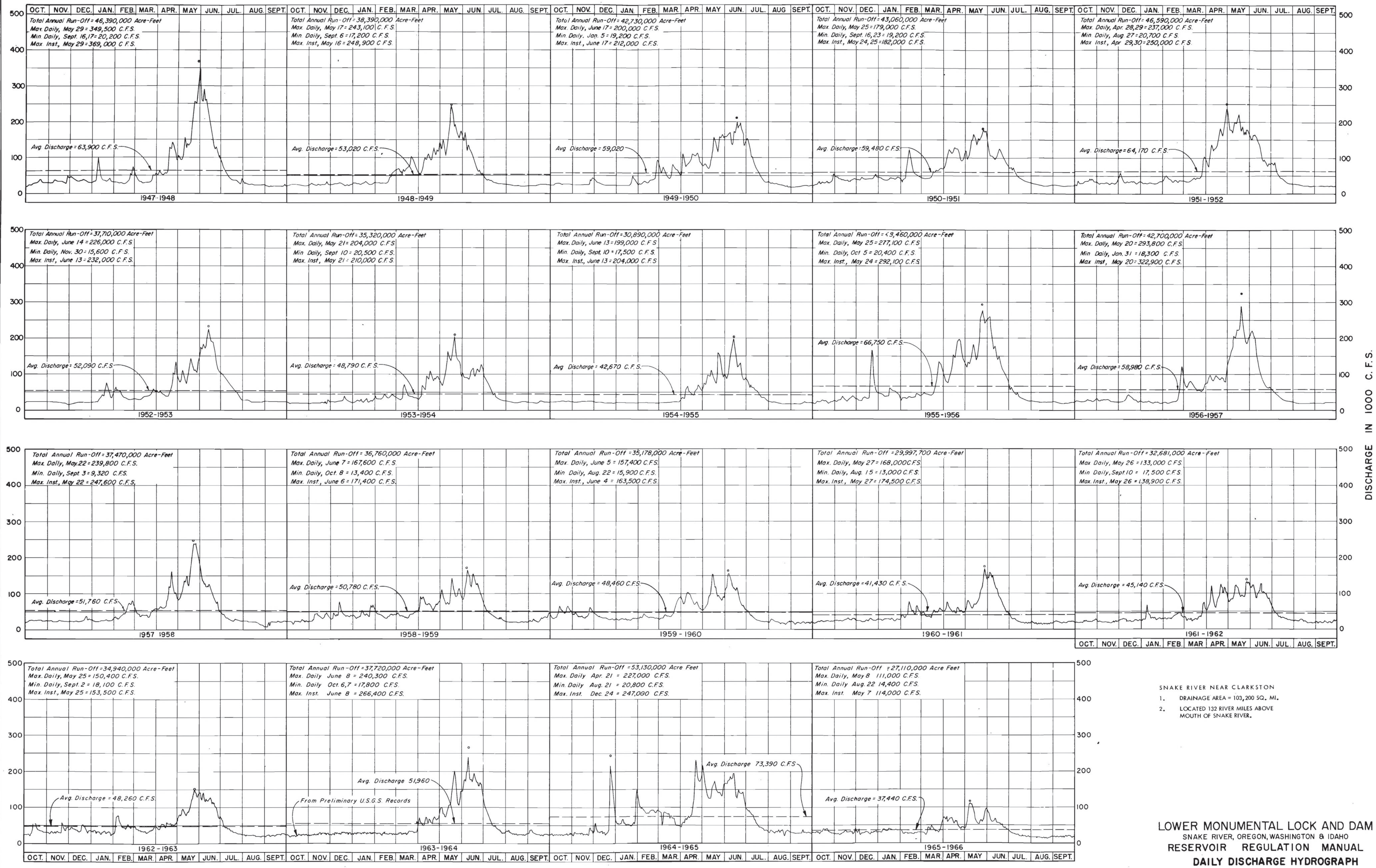
WALLA WALLA UNION-BULLETIN, WALLA WALLA, WASH.



SNAKE RIVER AT RIPARIA, WASHINGTON
1. DRAINAGE AREA = 104,000 SQ. MILES
2. LOCATED 67.2 RIVER MILES ABOVE MOUTH OF SNAKE RIVER

SNAKE RIVER NEAR CLARKSTON, WASHINGTON
1. DRAINAGE AREA = 103,200 SQ. MILES
2. LOCATED 132 RIVER MILES ABOVE MOUTH OF SNAKE RIVER

LOWER MONUMENTAL LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON & IDAHO
RESERVOIR REGULATION MANUAL
DAILY DISCHARGE HYDROGRAPH
AT RIPARIA AND NEAR CLARKSTON, WASHINGTON
U.S. ARMY ENGINEER DISTRICT, WALLA WALLA, WASH.



LOWER MONUMENTAL LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON & IDAHO

RESERVOIR REGULATION MANUAL

DAILY DISCHARGE HYDROGRAPH

NEAR CLARKSTON, WASHINGTON

U.S. ARMY ENGINEER DISTRICT, WALLA WALLA, WASH.

SNAKE RIVER NEAR CLARKSTON, WASHINGTON

1. Drainage area – 103.200 sq. mi.
2. Located 132 river miles above mouth of Snake River.
3. December 1972 gage discontinued.

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

DESIGNED: D. Brooks
DRAWN: GERBER PLOTTER
CHECKED: E. Kim
PREPARED:

LOWER MONUMENTAL LOCK & DAM

SNAKE RIVER, OREGON, WASHINGTON AND IDAHO

DAILY DISCHARGE HYDROGRAPHS

SNAKE RIVER NEAR CLARKSTON, WASH.

1967 – 1972

SUPERVISED: R S Kuhl
CHIEF, HYDROLOGY BRANCH
SUBMITTED: (Actg) Brian J Beechie
CHIEF, PLANNING DIVISION

APPROVED: DATE

SCALE AS SHOWN | INV. NO. ENG. | FILE NO.

SHEET

WATER CONTROL MANUAL

PLATE 8 A

LOWER GRANITE RESERVOIR

1. Drainage area = 103,500 sq. mi.
2. Located 107.5 miles above mouth of Snake River

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

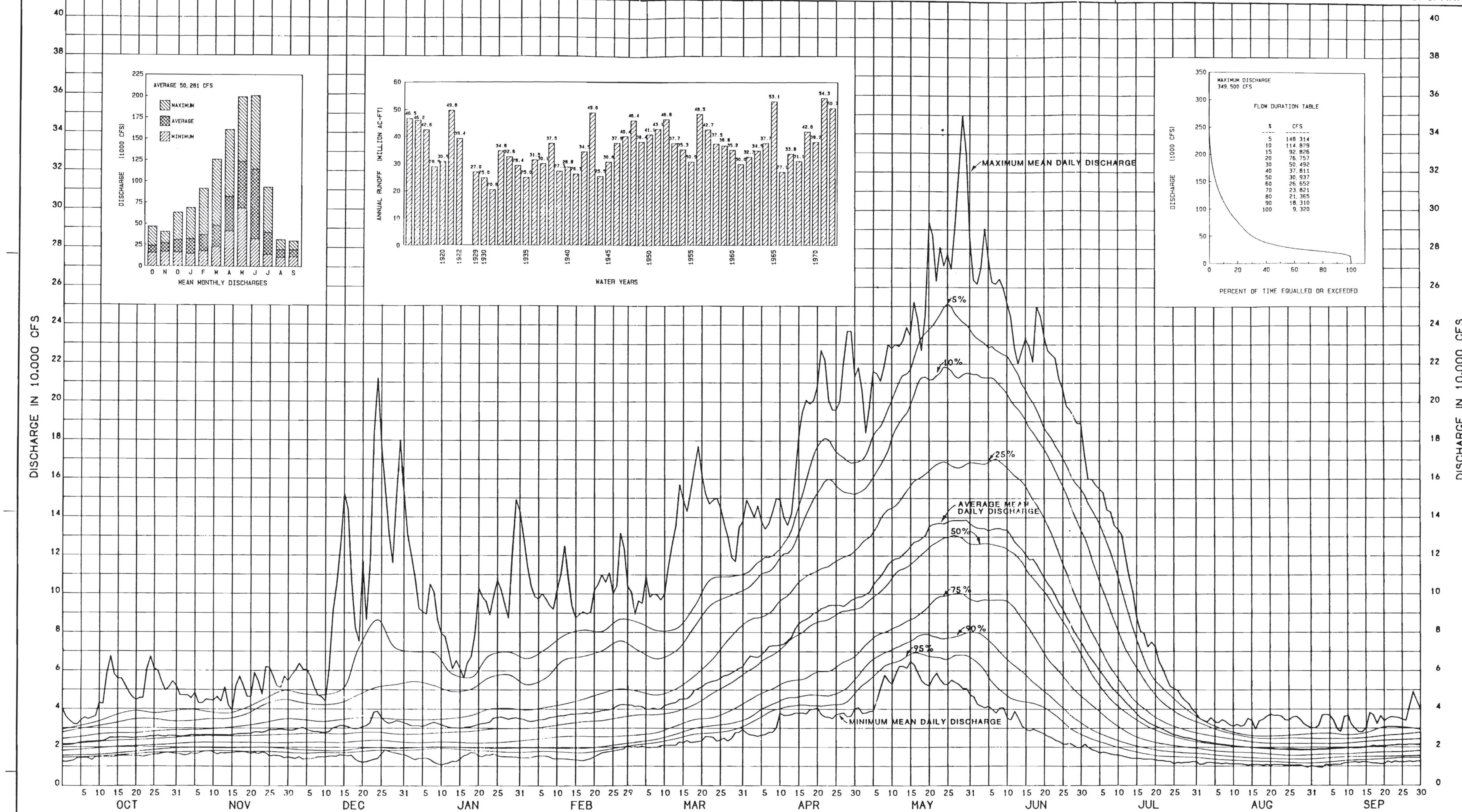
LOWER MONUMENTAL LOCK & DAM

SNAKE RIVER, OREGON, WASHINGTON, & IDAHO

DAILY DISCHARGE HYDROGRAPHS

LOWER GRANITE RESERVOIR
COMPUTED REGULATED INFLOWS
1976-1986

DESIGNED: D. Brooks
DRAWN: GERBER PLOTTER
CHECKED: E. Kim
PREPARED: [signature]
CHIEF HYDROLOGY BR
SUPERVISED: (acting) [signature]
CHIEF, PLANNING DIVISION
SUBMITTED:
CHIEF.
APPROVED: DATE
SCALE AS SHOWN
INV. NO. ENG.
FILE NO.
SHEET



NOTES:

1. RECORDS USED:
   a. WATER YEARS 1916-1922 AND 1929-1935, OBSERVED DISCHARGES AT RIPARIA, WASHINGTON. DRAINAGE AREA IS 104,000 SQUARE MILES.
   b. WATER YEARS 1936-1972, OBSERVED DISCHARGES AT CLARKSTON, WASHINGTON. DRAINAGE AREA IS 103,200 SQUARE MILES.
   c. DISCHARGE RECORDS USED ARE FROM DATA PUBLISHED BY U.S.G.S.
2. DISCHARGE RECORDS AT CLARKSTON AND RIPARIA HAVE BEEN CONSIDERED COMPARABLE AND HAVE BEEN USED WITHOUT CORRECTIONS FOR INCIDENTAL INFLOW BETWEEN THESE STATIONS.
3. DISCHARGES USED ARE THOSE OBSERVED AT THE TIME AND REFLECT VARYING EFFECTS OF PROGRESSIVE IRRIGATION AND RESERVOIR STORAGE DEVELOPMENTS.
4. CURVES OF PERCENT CHANCE OF OCCURRENCE REPRESENT THE AVERAGE DAILY DISCHARGE FOR THAT DAY. A POINT ON AN EXCEEDENCE CURVE REPRESENTS THE AVERAGE DAILY DISCHARGE FOR A SPECIFIC DAY WHICH HAS BEEN EXCEEDED THE GIVEN PERCENTAGE OF TIME.

MAXIMUM ANNUAL MEAN DAILY DISCHARGES

WATER YEAR	DATE	CFS		WATER YEAR	DATE	CFS
1916	JUN 20	230,000		1942	MAY 27	158,000
1917	MAY 30	256,000		1943	APR 20	208,000
1918	JUN 14	216,000		1944	MAY 16	105,600
1919	MAY 30	167,000		1945	JUN 7	148,000
1920	JUN 17	148,000		1946	APR 20	166,000
1921	MAY 20	270,000		1947	MAY 9	23,000
1922	JUN 7	233,000		1948	MAY 29	349,500
1929	MAY 25	155,000		1949	MAY 17	243,100
1930	APR 26	95,600		1950	JUN 17	200,000
1931	APR 2	107,000		1951	MAY 25	179,000
1932	MAY 23	219,000		1952	APR 28	237,000
1933	JUN 11	245,000		1953	JUN 14	226,000
1934	DEC 23	149,000		1954	MAY 21	204,000
1935	MAY 25	130,000		1955	JUN 13	199,000
1937	MAY 19	110,000		1956	MAY 25	277,100
1938	MAY 29	214,000		1957	MAY 20	293,800
1939	MAY 4	144,000		1958	MAY 22	239,800
1940	MAY 13	125,000		1959	JUN 7	167,600
1941	MAY 14	102,000		1960	JUN 5	157,400

MAXIMUM ANNUAL MEAN DAILY DISCHARGES

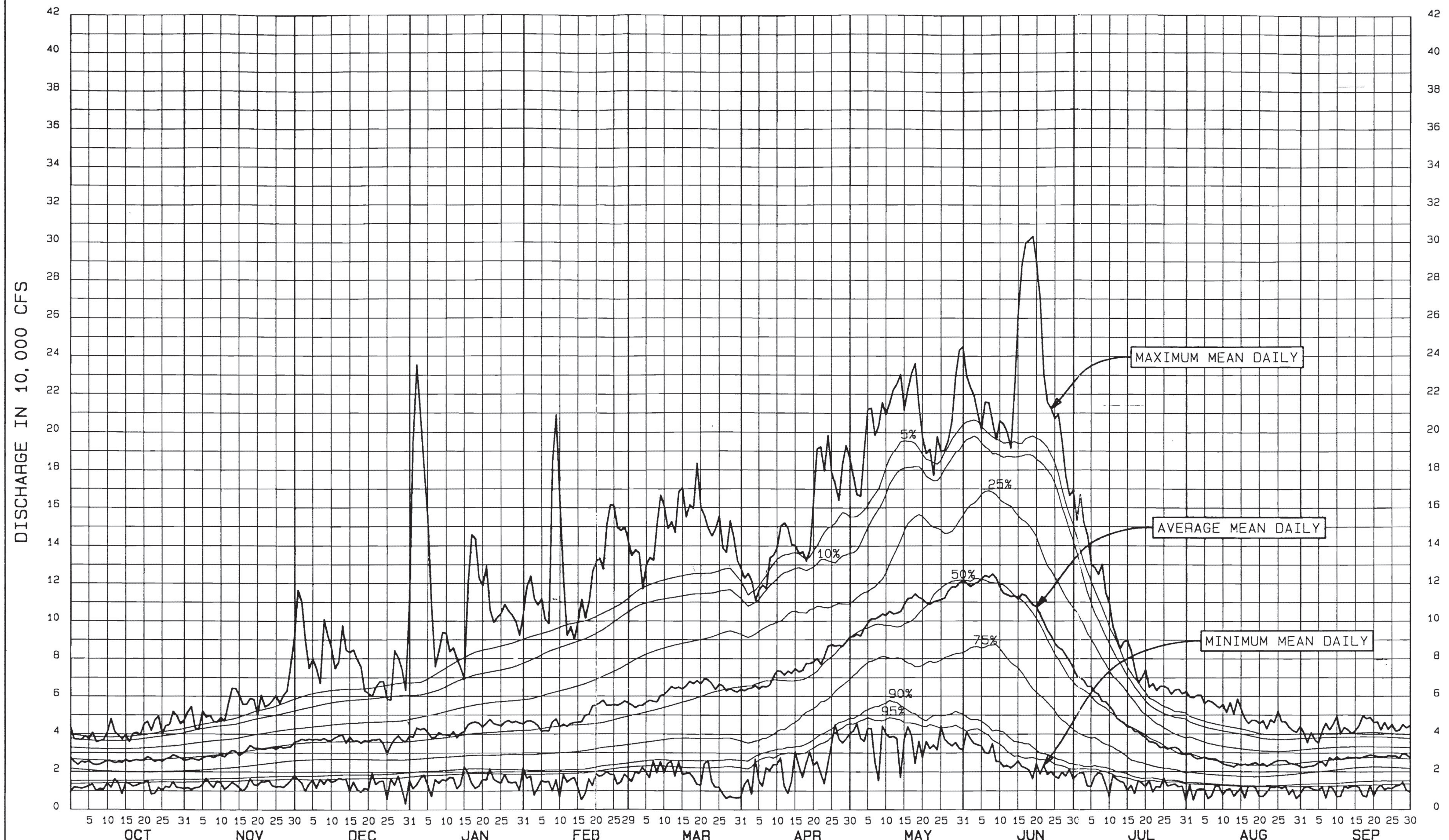
WATER YEAR	DATE	CFS		WATER YEAR	DATE	CFS
1961	MAY 27	168,000				
1963	MAY 25	150,400				
1964	JUN 9	240,300				
1965	APR 21	227,000				
1966	MAY 8	111,000				
1967	MAY 24	205,000				
1968	JUN 4	129,000				
1969	MAY 20	182,000				
1970	JUN 7	227,000				
1971	MAY 30	253,000				
1972	JUN 2	237,000				

REVISION	DATE	DESCRIPTION	CHKD	APPR

U. S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

LOWER MONUMENTAL LOCK & DAM
SNAKE RIVER, OREGON, WASHINGTON, & IDAHO
SUMMARY HYDROGRAPHS
SNAKE RIVER NEAR CLARKSTON, WASH.

D. Brooks — DESIGNED BY
Gerber Plotter — DRAWN BY
E Kim — CHECKED BY
SUPERVISED: K. S. Kiel[illegible] — CHIEF, HYDROLOGY BR
SUBMITTED: (Acting) [signature] — CHIEF, PLANNING DIVISION
RECOMMENDED
CHIEF
APPROVED DATE
SCALE AS SHOWN | INV NO.
SHEET NO FILE NO



NOTES:

1. SUMMARY HYDROGRAPHS PLOTTED FROM CORPS OF ENGINEERS MEAN DAILY OUTFLOW DATA FOR LOWER MONUMENTAL DAM.

2. PERIOD OF RECORD IS OCTOBER 1969 THROUGH SEPTEMBER 1997.

3. DRAINAGE AREA AT LOWER MONUMENTAL DAM IS 103,200 SQUARE MILES (APPROXIMATELY).

4. EXCEEDENCE LINES REPRESENT THE PERCENTAGE OF TIME THE FLOW IS EQUALLED OR EXCEEDED ON THAT PARTICULAR DAY.

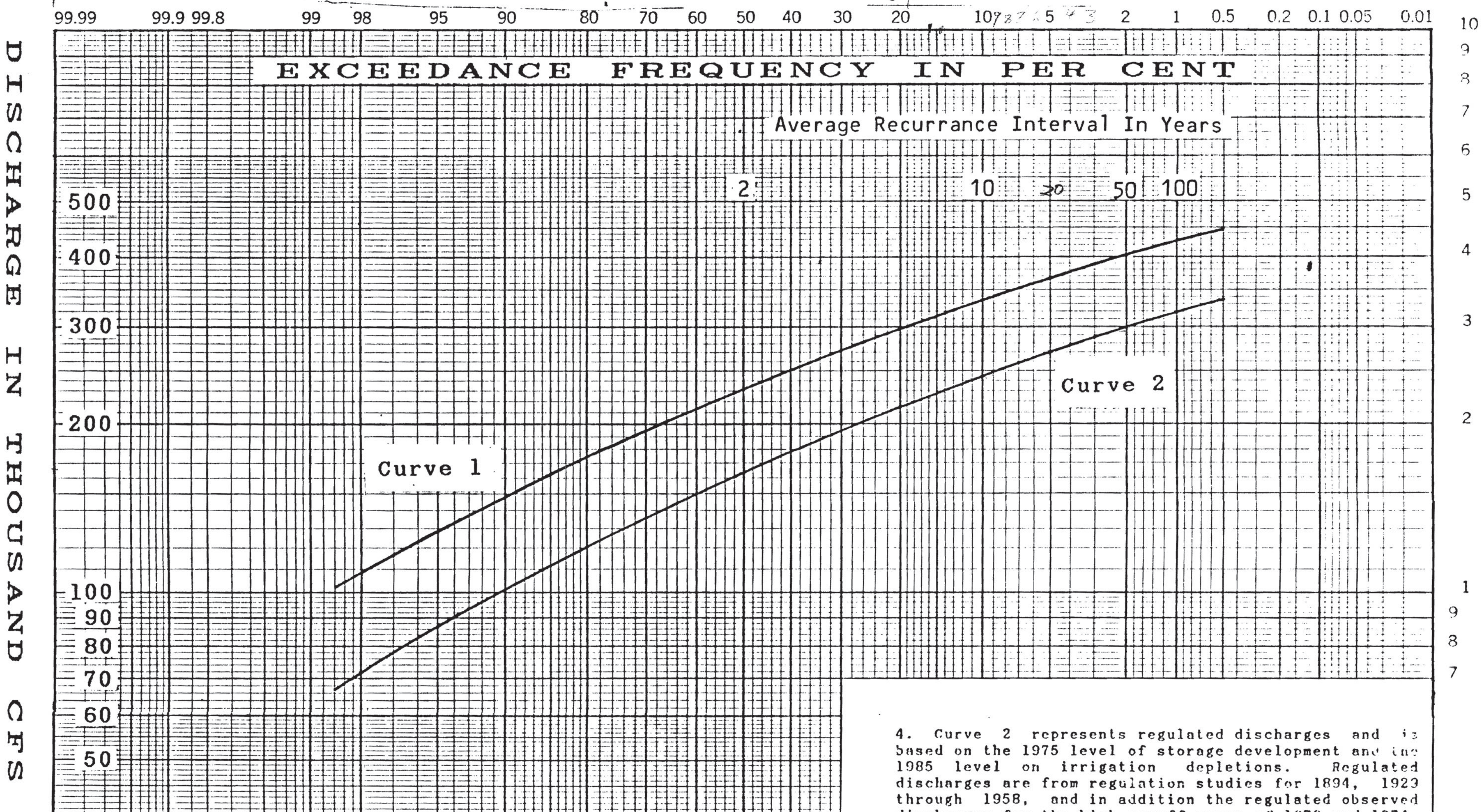
SNAKE RIVER, WASHINGTON
LOWER MONUMENTAL DAM OUTFLOW

SUMMARY HYDROGRAPHS

U.S. ARMY ENGINEER DISTRICT
WALLA WALLA - HYDROLOGY BRANCH

MAXSON — MARCH 1998

From Ed Kim
8/01
Note this is LoMo Outflow; Plate 9 is flow @ Clarkston



4. Curve 2 represents regulated discharges and is based on the 1975 level of storage development and the 1985 level on irrigation depletions. Regulated discharges are from regulation studies for 1894, 1923 through 1958, and in addition the regulated observed discharges for the high runoff years of 1972 and 1974. The plotting positions for the regulated event years are for the natural frequency curve. Curve 2 is a graphical fit of the regulated data.

NOTES

1. Drainage area equals 103,200 sq. mi.

2. This is a preliminary graph subject to revision.

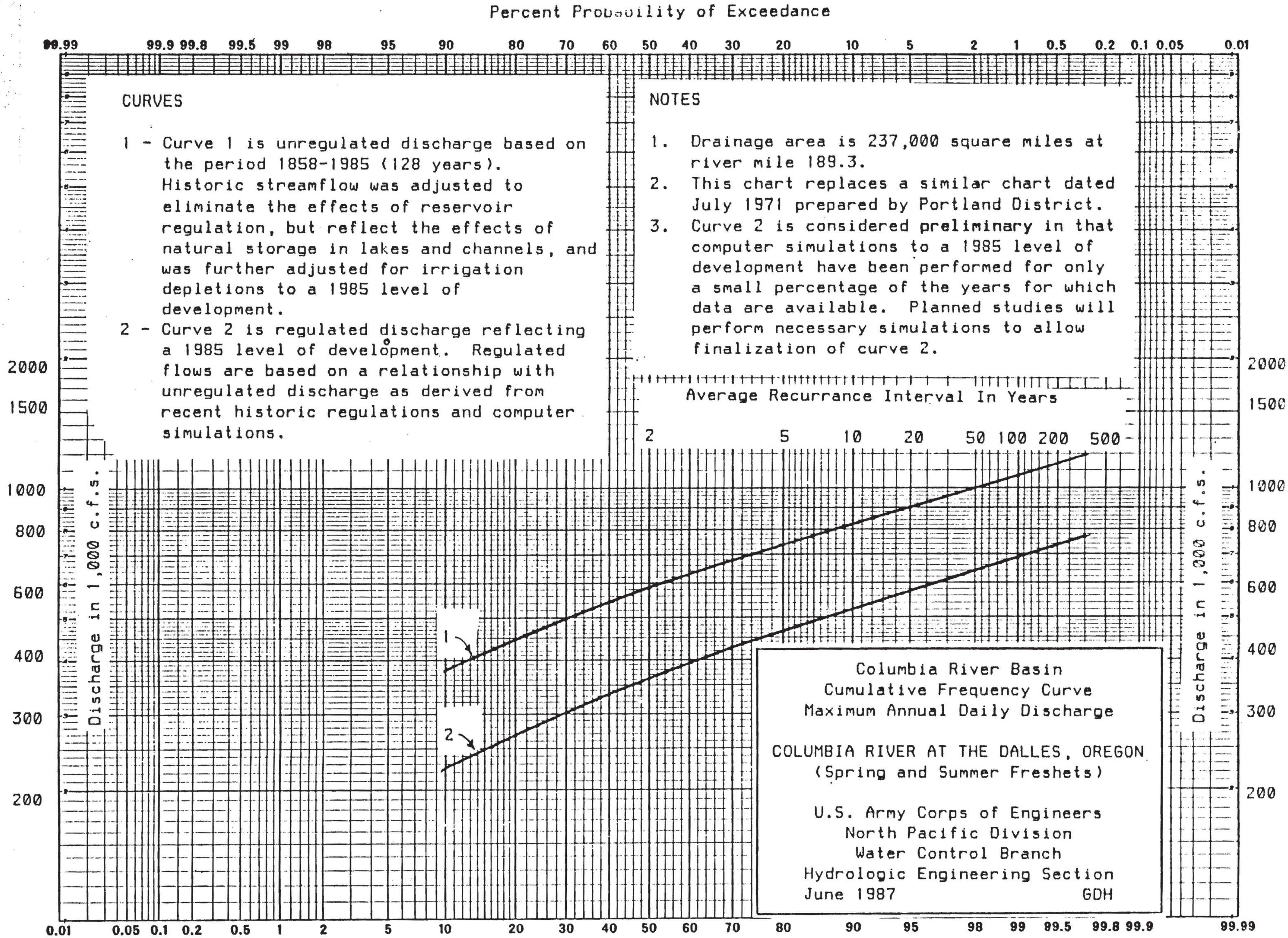
3. Curve 1 represents natural discharges and is based on the 1894-1975 station record adjusted for irrigation depletions and storage and extended by correlation with the 1858-1975 Columbia River at The Dalles station record. It includes an expected probability adjustment. The station and adopted skew is -0.5. Natural discharges for the 1894-1975 period of record are plotted based on their ranking within the extended record. The median plotting position method was utilized.

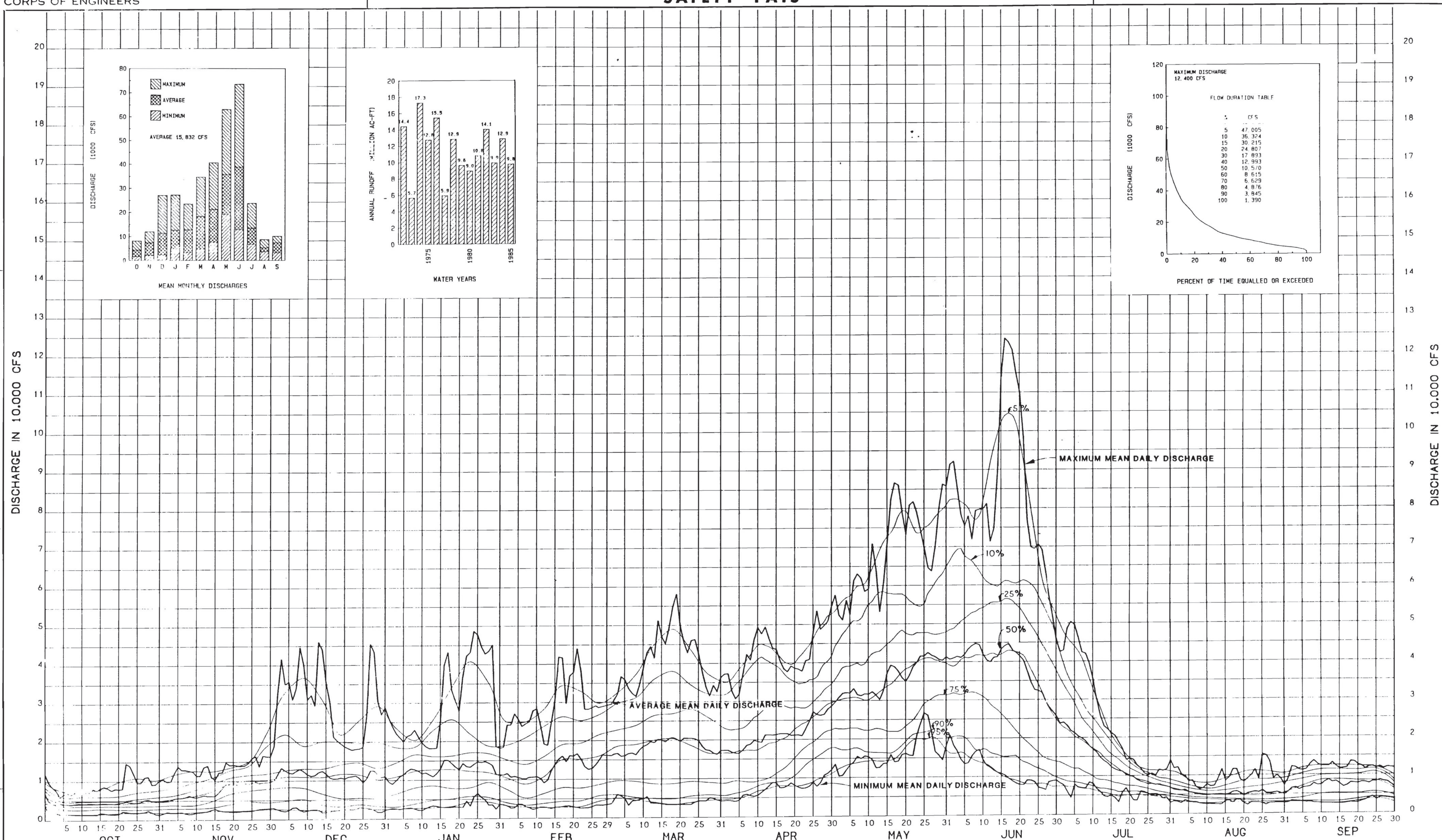
LOWER MONUMENTAL LOCK AND DAM

SNAKE RIVER, WASHINGTON

ANNUAL PEAK DISCHARGE FREQUENCIES
Snake River At Lower Granite Dam

U.S. Army Engineer Division, N.P.
NPDEN-WM-HES May 1978


Percent Probability of Exceedance
CURVES
1 - Curve 1 is unregulated discharge based on the period 1858-1985 (128 years). Historic streamflow was adjusted to eliminate the effects of reservoir regulation, but reflect the effects of natural storage in lakes and channels, and was further adjusted for irrigation depletions to a 1985 level of development.
2 - Curve 2 is regulated discharge reflecting a 1985 level of development. Regulated flows are based on a relationship with unregulated discharge as derived from recent historic regulations and computer simulations.
NOTES
1. Drainage area is 237,000 square miles at river mile 189.3.
2. This chart replaces a similar chart dated July 1971 prepared by Portland District.
3. Curve 2 is considered preliminary in that computer simulations to a 1985 level of development have been performed for only a small percentage of the years for which data are available. Planned studies will perform necessary simulations to allow finalization of curve 2.
Average Recurrance Interval In Years
2 5 10 20 50 100 200 500
Discharge in 1,000 c.f.s.
1
2
Columbia River Basin
Cumulative Frequency Curve
Maximum Annual Daily Discharge
COLUMBIA RIVER AT THE DALLES, OREGON
(Spring and Summer Freshets)
U.S. Army Corps of Engineers
North Pacific Division
Water Control Branch
Hydrologic Engineering Section
June 1987 GDH



NOTES:

1. RECORDS USED:
   WATER YEARS 1972-1985, OBSERVED DISCHARGES FOR THE CLEARWATER RIVER AT SPALDING, IDAHO.
   DISCHARGE RECORDS USED ARE FROM DATA PUBLISHED BY U.S.G.S.
2. DRAINAGE AREA IS 9,570 SQUARE MILES.
3. CURVES OF PERCENT CHANCE OF OCCURRENCE REPRESENT THE AVERAGF FLOW FOR THAT DAY. A POINT ON AN EXCEEDENCE CURVE REPRESENTS THE AVERAGE DAILY DISCHARGE FOR A SPECIFIC DAY WHICH HAS BEEN EXCEEDED THE GIVEN PERCENTAGE OF TIME.

MAXIMUM ANNUAL MEAN DAILY DISCHARGES

WATER YEAR	DATE	CFS		WATER YEAR	DATE	CFS
1972	JUN 2	92,200				
1973	MAY 18	34,200				
1974	JUN 16	124,000				
1975	JUN 3	74,200				
1976	MAY 11	70,800				
1977	MAY 3	28,500				
1978	JUN 7	54,000				
1979	MAY 24	60,700				
1980	MAY 26	48,200				
1981	JUN 20	64,000				
1982	JUN 17	62,500				
1983	MAY 28	54,800				
1984	MAY 31	75,700				
1985	JUN 8	55,100				

REVISION	DATE	DESCRIPTION	BY

U. S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

DESIGNED: D. Brooks
DRAWN: Gerber Plotter
CHECKED: E. Kim
SUPERVISED: K. Kuhl
CHIEF, HYDROLOGY BRANCH
SUBMITTED (acting) Brian Beckie
CHIEF, PLANNING DIVISION

LOWER MONUMENTAL LOCK & DAM
SNAKE RIVER, ORE., WASH. AND IDAHO
SUMMARY HYDROGRAPHS
CLEARWATER RIVER AT SPALDING, IDAHO
REGULATED DISCHARGE

DATE
SCALE AS SHOWN | INV. NO.
FILE NO.
SHEET

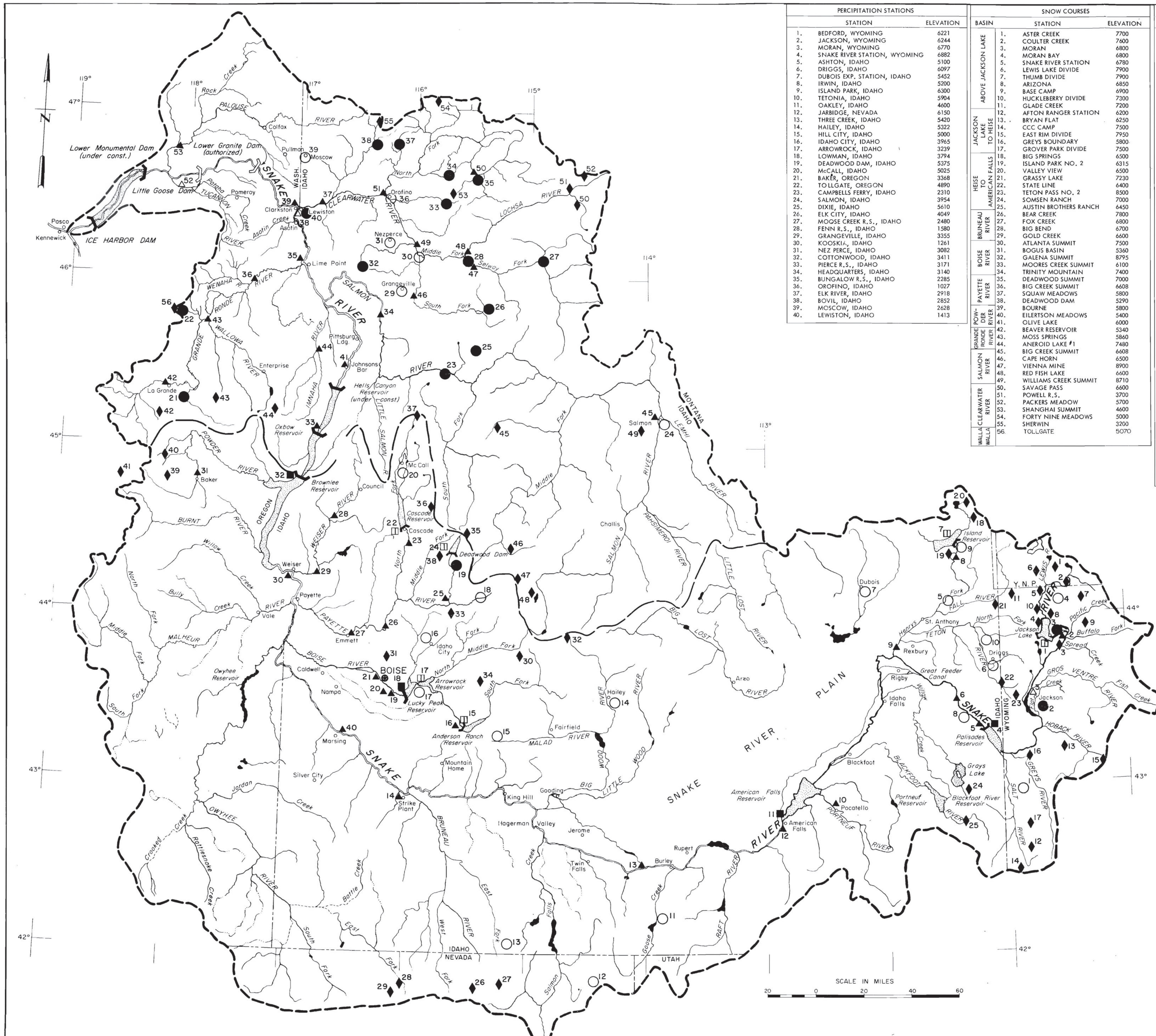
PERCIPITATION STATIONS		
	STATION	ELEVATION
1.	BEDFORD, WYOMING	6221
2.	JACKSON, WYOMING	6244
3.	MORAN, WYOMING	6770
4.	SNAKE RIVER STATION, WYOMING	6882
5.	ASHTON, IDAHO	5100
6.	DRIGGS, IDAHO	6097
7.	DUBOIS EXP. STATION, IDAHO	5452
8.	IRWIN, IDAHO	5200
9.	ISLAND PARK, IDAHO	6300
10.	TETONIA, IDAHO	5904
11.	OAKLEY, IDAHO	4600
12.	JARBIDGE, NEVADA	6150
13.	THREE CREEK, IDAHO	5420
14.	HAILEY, IDAHO	5322
15.	HILL CITY, IDAHO	5000
16.	IDAHO CITY, IDAHO	3965
17.	ARROWROCK, IDAHO	3239
18.	LOWMAN, IDAHO	3794
19.	DEADWOOD DAM, IDAHO	5375
20.	McCALL, IDAHO	5025
21.	BAKER, OREGON	3368
22.	TOLLGATE, OREGON	4890
23.	CAMPBELLS FERRY, IDAHO	2310
24.	SALMON, IDAHO	3954
25.	DIXIE, IDAHO	5610
26.	ELK CITY, IDAHO	4049
27.	MOOSE CREEK R.S., IDAHO	2480
28.	FENN R.S., IDAHO	1580
29.	GRANGEVILLE, IDAHO	3355
30.	KOOSKIA, IDAHO	1261
31.	NEZ PERCE, IDAHO	3082
32.	COTTONWOOD, IDAHO	3411
33.	PIERCE R.S., IDAHO	3171
34.	HEADQUARTERS, IDAHO	3140
35.	BUNGALOW R.S., IDAHO	2285
36.	OROFINO, IDAHO	1027
37.	ELK RIVER, IDAHO	2918
38.	BOVIL, IDAHO	2852
39.	MOSCOW, IDAHO	2628
40.	LEWISTON, IDAHO	1413

SNOW COURSES			
BASIN		STATION	ELEVATION
ABOVE JACKSON LAKE	1.	ASTER CREEK	7700
	2.	COULTER CREEK	7600
	3.	MORAN	6800
	4.	MORAN BAY	6800
	5.	SNAKE RIVER STATION	6780
	6.	LEWIS LAKE DIVIDE	7900
	7.	THUMB DIVIDE	7900
	8.	ARIZONA	6850
	9.	BASE CAMP	6900
	10.	HUCKLEBERRY DIVIDE	7300
	11.	GLADE CREEK	7200
JACKSON LAKE TO HEISE	12.	AFTON RANGER STATION	6200
	13.	BRYAN FLAT	6250
	14.	CCC CAMP	7500
	15.	EAST RIM DIVIDE	7950
	16.	GREYS BOUNDARY	5800
	17.	GROVER PARK DIVIDE	7500
HEISE TO AMERICAN FALLS	18.	BIG SPRINGS	6500
	19.	ISLAND PARK NO. 2	6315
	20.	VALLEY VIEW	6500
	21.	GRASSY LAKE	7230
	22.	STATE LINE	6400
	23.	TETON PASS NO. 2	8500
	24.	SOMSEN RANCH	7000
	25.	AUSTIN BROTHERS RANCH	6450
BRUNEAU RIVER	26.	BEAR CREEK	7800
	27.	FOX CREEK	6800
	28.	BIG BEND	6700
	29.	GOLD CREEK	6600
BOISE RIVER	30.	ATLANTA SUMMIT	7500
	31.	BOGUS BASIN	5360
	32.	GALENA SUMMIT	8795
	33.	MOORES CREEK SUMMIT	6100
	34.	TRINITY MOUNTAIN	7400
PAYETTE RIVER	35.	DEADWOOD SUMMIT	7000
	36.	BIG CREEK SUMMIT	6608
	37.	SQUAW MEADOWS	5800
	38.	DEADWOOD DAM	5290
POW-DER RIVER	39.	BOURNE	5800
	40.	EILERTSON MEADOWS	5400
	41.	OLIVE LAKE	6000
GRANDE RONDE RIVER	42.	BEAVER RESERVOIR	5340
	43.	MOSS SPRINGS	5860
	44.	ANEROID LAKE #1	7480
SALMON RIVER	45.	BIG CREEK SUMMIT	6608
	46.	CAPE HORN	6500
	47.	VIENNA MINE	8900
	48.	RED FISH LAKE	6600
	49.	WILLIAMS CREEK SUMMIT	8710
CLEARWATER RIVER	50.	SAVAGE PASS	6600
	51.	POWELL R.S.	3700
	52.	PACKERS MEADOW	5700
	53.	SHANGHAI SUMMIT	4600
	54.	FORTY NINE MEADOWS	5000
	55.	SHERWIN	3200
WALLA WALLA	56.	TOLLGATE	5070

STEAM AND RESERVOIR GAGING STATIONS		
	STATION	COMMUNICATIONS
1.	JACKSON L. AT MORAN, WYO.	DAM-BR BURLEY-TT WB/BOISE-SR
2.	SNAKE R. AT MORAN, WYO.	DAM-BR BURLEY-TT WB/BOISE-SR
3.	SNAKE R. AT WILSON, WYO.	OBS-PALISADES DAM-TG WB/BOISE-SR
4.	PALISADES RESERVOIR, IDAHO	DAM-BR BURLEY-TT WB/BOISE-SR
5.	SNAKE R. BELOW PALISADES DAM	DAM-BR BURLEY-TT WB/BOISE-SR
6.	SNAKE R. NEAR HEISE, IDAHO	OBS-PALISADES DAM-TG WB/BOISE-SR
7.	ISLAND PARK RESERVOIR, IDAHO	DAM-BR BURLEY-TT WB/BOISE-SR
8.	HENRYS FORK NEAR ISLAND PARK, IDAHO	DAM-BR BURLEY-TT WB/BOISE-SR
9.	HENRYS FORK NEAR REXBURG, IDAHO	OBS-PALISADES DAM-TG WB/BOISE-SR
10.	PORTNEUF R. AT POCATELLO, IDAHO	OBS-TEL WB/POCATELLO-SR
11.	AMERICAN FALLS RESERVOIR, IDAHO	DAM-BR BURLEY-TT WB/BOISE-SR
12.	SNAKE R. AT NEELEY, IDAHO	DAM-BR BURLEY-TT WB/BOISE-SR
13.	SNAKE R. AT MILNER, IDAHO	IPC-TEL WB/BOISE-SR
14.	SNAKE R. AT STRIKE PLANT, IDAHO	IPC-TEL WB/BOISE-SR
15.	ANDERSON RANCH RESERVOIR, IDAHO	DAM-BOARD OF CONTROL-TEL WB/BOISE-SR
16.	S. FK. BOISE R. AT ANDERSON DAM	DAM-BOARD OF CONTROL-TEL WB/BOISE-SR
17.	ARROWROCK RESERVOIR, IDAHO	DAM-BOARD OF CONTROL-TEL WB/BOISE-SR
18.	LUCKY PEAK RESERVOIR, IDAHO	CE-TEL WB/BOISE-SR
19.	BOISE R. AT DIVERSION DAM	DAM-BOARD OF CONTROL-TEL WB/BOISE-SR
20.	NEW YORK CANAL, IDAHO	DAM-BOARD OF CONTROL-TEL WB/BOISE-SR
21.	BOISE R. AT BOISE, IDAHO	OBS-TEL WB/BOISE-SR
22.	CASCADE RESERVOIR, IDAHO	BR-TEL WB/BOISE-SR
23.	N. FK. PAYETTE R. AT CASCADE	BR-TEL WB/BOISE-SR
24.	DEADWOOD RESERVOIR, IDAHO	BR-TEL WB/BOISE-SR
25.	DEADWOOD R. NEAR LOWMAN, IDAHO	BR-TEL WB/BOISE-SR
26.	PAYETTE R. AT HORSESHOE BEND, IDAHO	IPC-TEL WB/BOISE-SR
27.	PAYETTE R. AT EMMETT, IDAHO	BR-TEL WB/BOISE-SR
28.	WEISER R. NEAR CAMBRIDGE, IDAHO	OBS-TEL WB/BOISE-SR
29.	WEISER R. NEAR WEISER, IDAHO	OBS-TEL WB/BOISE-SR
30.	SNAKE R. AT WEISER, IDAHO	TM GS BOISE-TT BPA-TT CE
31.	POWDER R. AT BAKER, OREGON	OBS-TEL WB/BOISE-SR
32.	BROWNLEE RESERVOIR, IDAHO	DAM-C BPA-TT CE
33.	SNAKE R. AT OXBOW, OREGON	DAM-C BPA-TT CE
34.	SALMON R. AT WHITEBIRD, IDAHO	TM WB/LEWISTON-SR
35.	SNAKE R. NEAR ANATONE, WASHINGTON	TM WB/LEWISTON-SR
36.	GRANDE RONDE R. AT TROY, OREGON	OBS-TEL WB/BOISE-SR
37.	CLEARWATER R. AT SPALDING, IDAHO	WWP-TEL WB/LEWISTON-SR
38.	SNAKE R. AT LEWISTON, IDAHO	OBS-TEL WB/LEWISTON-SR
39.	SNAKE R. NEAR CLARKSTON, WASHINGTON	TM WB/LEWISTON-SR
40.	SNAKE R. NEAR MURPHY, IDAHO	GS-MAIL-ON REQUEST
41.	SNAKE R. AT JOHNSONS BAR, OREGON	GS-MAIL-CE
42.	GRANDE RONDE R. AT LA GRANDE, OREGON	OBS-TEL WB/BOISE-SR
43.	GRANDE RONDE R. AT RONDOWA, OREGON	GS-PUBLISHED MONTHLY
44.	IMNAHA R. AT IMNAHA, OREGON	GS-PUBLISHED MONTHLY
45.	SALMON R. AT SALMON, IDAHO	OBS-TEL WB/BOISE-SR
46.	S.F. CLEARWATER R. NEAR GRANGEVILLE, IDA.	OBS-TEL WB/LEWISTON-SR
47.	SELWAY R. NEAR LOWELL, IDAHO	OBS-TEL WB/LEWISTON-SR
48.	LOCKSA R. NEAR LOWELL, IDAHO	OBS-TEL WB/LEWISTON-SR
49.	M.F. CLEARWATER R. AT KAMIAH, IDAHO	TM WB/LEWISTON-SR
50.	N.F. CLEARWATER R. AT BUNGALOW R.S., IDA.	GS-PUBLISHED MONTHLY
51.	N.F. CLEARWATER R. AT AHSAHKA, IDAHO	TM WB/LEWISTON-SR
52.	TUCANNON R. AT STARBUCK, WASHINGTON	OBS-TEL CE/WALLA WALLA AS REQUESTED
53.	PALOUSE R. AT HOOPER, WASHINGTON	TM CE/WALLA WALLA-TT

LEGEND

TG - TELEGRAM
C - CARRIER
SR - WEATHER BUREAU SERVICE C
WB - U.S. WEATHER BUREAU
TT - TELETYPE
OBS - OBSERVER
BR - U.S. BUREAU OF RECLAMATION
GS - U.S. GEOLOGICAL SURVEYS
IPC - IDAHO POWER CO.
TM - TELEMARK
TEL - TELEPHONE
BPA - BONNEVILLE POWER AD.
CE - CORPS OF ENGINEERS
WWP - WASH. WATER POWER CO.



MAP LEGEND

GAGE	RECORDING	NON-RECORDING
PRECIPITATION	●	○
STREAM	▲	△
RESERVOIR	■	◫
SNOW	♦	

LOWER MONUMENTAL LOCK AND DAM

SNAKE RIVER, OREGON, WASHINGTON & IDAHO

RESERVOIR REGULATION MANUAL

HYDROLOGIC REPORTING NETWORK

U.S. ARMY ENGINEER DISTRICT, WALLA WALLA, WASH.

Exhibits

No.	
1-1 **	Design Memorandums
8-1 **	Part 207 - Navigation Regulations

** ADDED BY REVISION

EXHIBIT 1-1

LOWER MONUMENTAL LOCK AND DAM
DESIGN MEMORANDAUMS

No.		Cover Date
1	General Design Memorandum, Volumes 1-5	5 October 1959
2	First Step Cofferdam	25 May 1960
3.1	South Shore Access Roads	30 June 1960
3.2	North Shore Access Road	24 May 1961
	Letter Supplement 1, "Rockfall Correction and Project to Windust Detour Road”	19 February 1964
4	South Shore Temporary Project Office and Visitor Facilities	1 July 1960
5	Northern Pacific Railway, Dam Site Shoofly	18 May 1960
6	Relocation Union Pacific Railroad, Hinkle-Spokane Main Line	27 March 1961
	Supplement 1, Design and Cost Revisions	2 November 1962
	Supplement 2, Design and Cost Revisions	27 January 1965
	Letter Supplement, "Relocation of Power Lines; Columbia Rural Electric Association, Inc."	19 June 1965
7A	Preliminary Master Plan, Part of the Master Plan for Lower Monumental Lock and Dam	28 February 1963
7B	Master Plan for Development and Management of Lower Monumental Reservoir	6 May 1966
	Appendix 1, Cost Estimates	12 August 1966
	Supplement 1	13 February 1969
8	Concrete Aggregate Investigations	28 April 1961
9	Navigation Facilities	14 March 1961
	Letter Supplement 1 - Monolith Joint Repair	25 September 1974
	Supplement 2, Miscellaneous Repairs	
10	Spillway	21 February 1961
11	South Shore Permanent Fish Facilities	30 March 1961
	Supplement 1	
12	South Abutment Embankment	29 June 1961
13	Real Estate	
	Part 1 - Dam Site Construction Area, North and South Shore Access Roads, and Partial Relocations of Union Pacific and Northern Pacific Railroads	17 October 1960
	Part 2 – North Shore Windust Aggregate Area and South Shore Project Requirements from River Mile 49.5 to River Mile 74	19 January 1962

No.		Cover Date
	Part 3 – North Shore Project Requirements from River Mile 42.5 to River Mile 70, Balance of the Project	11 July 1962 Revised 15 November 1962
14	Union Pacific Railroad Relocation, Tekoa-Ayer and Tucannon Branches	13 March 1962
	Supplement 1, Design and Cost Revisions	19 May 1965
	Letter Supplement, "Relocation of 36" Gas Pipeline, Pacific Gas Transmission Company	26 May 1965
	Letter Supplement, "Relocation of Power Lines; Columbia Rural Electric Association, Inc."	19 July 1965
	Letter Supplement 3, "Fields Gulch Drainage Area, Hinkle-Spokane Main Line, Union Pacific Railroad Company"	29 September 1967
	Letter Supplement 4, "Relocation of Power Lines; Inland Power and Light Company	27 December 1966
14.1	U.P.R.R., Tekoa-Ayer Branch Line, Snake River Bridge, Mile 61.8	19 February 1962
15	Northern Pacific Railway Relocation (Deleted)	
16	North Abutment Embankment	25 January 1961
17	Non-overflow Dam Lock to Spillway	13 March 1961
18	Camas Prairie Railroad Relocation (Deleted – see D.M. 14, Supplement 1)	
19	Powerplant	17 November 1961
19.1	Powerhouse Architectural Design	26 August 1963
19.2	Powerhouse Structural Design	26 August 1963
19.3	Powerhouse Mechanical Equipment	October 1963
19.4a	Powerhouse Lighting Design	13 January 1964
19.4b	Powerhouse Grounding System	20 December 1963
19.5	Letter Report, Power Plant Units 4-6	15 January 1974
20	Second and Third Step Cofferdams	11 June 1962
21	Relocation of Washington Secondary State Highway 11-B	5 May 1965
22	Water Supply, Storage and Distribution	28 January 1964
	Supplement 1, Additional Water Supply Requirements	5 March 1973
23	100-Ton Combined Spillway and Powerhouse Intake Gantry Crane	Not Issued
24	Foundation Grouting	20 March 1964
25	Relocation of Riparia School (Deleted)	
26	Cost Allocation Studies (Interim)	5 June 1962
26.1	Cost Allocation	March 1976
27	Recreation Facilities and Public Use Areas	June 1968
27.1	Lyons Ferry - Palouse Falls Trail System	24 April 1973

No.		Cover Date
27.2	Turner Bay Marine Breakwater	5 December 1973
27.3	Lyon's Ferry Marina	24 November 1975 Revised 3 March 1976
28	Visitor Facilities and Project Beautification	December 1970
29	Ayer School Relocation (Deleted)	
30	Temporary North Shore Visitors' Facilities	24 July 1963
31	North Abutment Treatment	18 September 1963
32	Permanent Operators' Quarters	18 September 1964
33	Aircraft Landing Strip	18 January 1965
34	Navigation in Reservoir	21 January 1965
35	Navigation Lock, Modification of Gate Monoliths	1 February 1966
	Supplement 1, Modification of Filling Culvert Valve Shaft Monoliths	12 September 1967
	Supplement 2, Modification of Emptying System	June 1968
36	Reservoir Clearing	February 1968

EXHIBIT 8-1

PART 207 - NAVIGATION REGULATIONS

207.718 NAVIGATION LOCKS AND APPROACH CHANNELS, COLUMBIA AND SNAKE RIVERS, OREGON AND WASHINGTON.

a. General. All locks, approach channels, and all lock appurtenances, shall be under the jurisdiction of the District Engineer, Corps of Engineers, United States Army, in charge of the locality. The district engineer may, after issuing a public notice and providing a 30-day opportunity for public comment,set (issue) a schedule for the daily lockage of recreation vessels Recreational vessels are pleasure boats such as a row, sail, or motor boats used for recreational purposes. Commercial vessels include licensed commercial passenger vessels operating on a published schedule or regularly operating in the "for hire" trade. Any recreation schedule shall provide for a minimum of one scheduled recreation lockage upstream and downstream (two lockages) each day. At the discretion of the district engineer, additional lockages may be scheduled. Each schedule and any changes to the schedule will be issued at least 30 days prior to implementation. Prior to issuing any schedule or any changes to the schedule, the district engineer will consider all public comments and will evaluate the expected energy situation, water supply, and recreation use of the lock to determine the seasonal need for the schedule or change in schedule. The district engineer's representative at the locks shall be the Project Engineer, who shall issue orders and instructions to the Lock Master in charge of the lock. Hereinafter the term "Lock Master" shall be used to designate the person in immediate charge of the lock at any given time. In case of emergency and on all routine work in connection with the operation of the lock, the Lock Master shall have authority to take action without waiting for instructions from the Project Engineer.

b. Lockage Control. The Lock Master shall be charged with the immediate control and management of the lock, and of the area set aside as the lock area, including the lock approach channels. Upstream and downstream approach channels extend to the end of the wing or guide wall, whichever is longer. At Bonneville lock the upstream approach channel extends to the upstream end of Bradford Island and the downstream approach channel extends to the downstream end of the lower moorage. The Lock Master shall demand compliance with all laws, rules and regulations for the use of the lock and lock area and is authorized to issue necessary orders and directions, both to employees of the Government or to other persons within the limits of the lock or lock area, whether navigating the lock or not. Use of lock facilities is contingent upon compliance with regulations, Lock Master instructions and the safety of people and property.

c. No one shall initiate any movement of any vessel in the lock or approaches except by or under the direction of the Lock Master. ("Vessel" as used herein includes all connected units, tugs, barges, tows, boats or other floating objects.)

d. Signals.

(1) Radio. All locks are equipped with two-way FM radio operating on channel 14, frequency of 156.700 MHz, for both the calling channel and the working channel. Vessels equipped with two-way radio desiring a lockage shall call WUJ 33 Bonneville, WUJ 34 The Belles, WUJ 35 John Day, WUJ 41 McNary, WUJ 42 Ice Harbor, WUJ 43 Lower Monumental, WUJ 44 Little Goose or WUJ 45 Lower Granite at least one-half hour in advance of arrival since the Lock Master is not in constant attendance of the locks. Channel 14 shall be monitored constantly in the vessel pilot house from the time the vessel enters the approach channel until its completion of exit. Prior to entering the lock chamber, the commercial freight or log-tow vessel operator shall report the nature of any cargo, the maximum length, width and draft of the vessel and whether the vessel is in any way hazardous because of its condition or the cargo it carries or has carried.

(2) Pull-cord Signal Stations. Pull cord signal stations marked by large instructional signs and located near the end of the upstream and downstream lock entrance walls may be used in place of radios to signal the Lock Master for a lockage.

(3) Entering and Exit Signals. Signal lights are located outside each lock gate. When the green (go) light is on, all vessels will enter in the sequence prescribed by the Lock Master except at Bonneville where freight and log-tow vessels will enter on the amber light. When the red (stop) light is on, the lock is not ready for entrance and vessels shall stand clear. In addition to the above visual signals, the Lock Master will signal that the lock is ready for entrance by sounding one long blast on the lock air horn. The Lock Master will signal that the lock is ready for exit by lighting the green exit light and sounding one short blast on the air horn.

e. Permissible Dimensions of Vessels. Nominal overall dimensions of vessels allowed in the lock chamber are 84 feet wide and 650 feet long, except at Bonneville where these dimensions are 74 feet wide and 500 feet long. Depth of water in the lock depends upon river levels which may vary from day to day. Staff gauges showing the minimum water level depth over gate sills are located inside the lock chamber near each lock gate and outside the lock chamber near the end of both upstream and downstream guide walls. Vessels which do not have a draft of at least one foot less than a gauge reading shall not pass that gauge. Information concerning allowable draft for vessel passage through the locks may be obtained from the Lock Master. Minimum lock chamber water level depth is 15 feet except at Ice Harbor where it is 14 feet and at Bonneville where it is 24.2 feet. When the river flow at Lower Granite exceeds 330,000 cubic feet per second the normal minimum 15-foot depth may be decreased to as little as eight feet. At Bonneville, a tow may be rearranged to less than clear lock dimensions (74 feet by 500 feet) prior to entering the lock, and be passed in one lockage. Such rearrangements at Bonneville may be done at the moorage in the downstream lock approach channel or above the upstream guide wall and with the Lock Master's permission at the upstream guide wall. In consideration of river and swing bridge traffic at Bonneville the Lock Master may authorize rearrangement of vessels within the lock chamber only when both miter gates at the open end of the lock are in their recesses in the lock walls and rearrangement will not be hazardous to them. Vessels wider than 50 feet will not be permitted to enter the Bonneville Lock during extreme high water when tailwater at the lock is higher than 35 feet above m.s.l. since the downstream guide wall will be inundated.

f. Precedence at Lock. Subject to the order of precedence, the vessel or tow arriving first: at the lock will be locked through first, however, this precedence may be modified at the discretion of the Lockmaster. If immediate passage is required, lockage of vessels owned or operated by the United States shall take precedence. The precedence of all other vessels shall be as follows:

(1) When a recreational vessel lockage schedule is in effect, at the appointed time for lockage of recreation craft, recreation craft shall take precedence; however, commercial vessels may be locked through with recreational craft if safety and space permit. At other than the appointed time, the lockage of commercial and tow vessels shall take precedence and recreational craft may (only) lock through with commercial as provided in paragraph (h) of this sections.

(2) If a recreational vessel lockage schedule is not in effect, commercial and tow vessels shall take precedence Recreational craft may be locked through with commercial craft. If no commercial vessels are scheduled to be locked through within a reasonable time, not to exceed one hour after the arrival of the recreational vessel at the lock, the recreational vessel may be locked through separately. If a combined lockage cannot be arranged the recreational craft shall be locked through after waiting three commercial lockages.

g. Loss of Turn. Boats that fail to enter the lock with reasonable promptness, after being authorized to do so, shall lose their turn.

h. Lockage.

(1) Multiple Lockage. The Lock Master shall decide whether one or more vessels or tows may be locked through at the same time. Vessels with flammable or highly hazardous cargo will be passed separately from all other vessels. Hazardous materials are described in Part 171, Title 49, Code of Federal Regulations. Flammable materials are defined in the National Fire Code of the National Fire Protection Association.

(2) Recreational Craft. By mutual agreement of (all parties) the Lockmaster and the captains of the vessels involved, recreational vessels may be locked through with commercial vessels. Under the recreational vessel schedule, separate lockage will not be made by recreational vessels except in accordance with the recreational lockage schedule or when circumstances warrant, such as in an emergency. When recreational craft are locked simultaneously with commercial vessels, the recreational vessel will enter the lock chamber after the commercial

vessel is secured in the chamber and when practicable will depart while the commercial vessel remains secured.

(3) Special Schedules. Recreational boating groups may request special schedules by contacting the district engineer. The schedule for the daily lockage of recreational vessels will indicate the number of boats required in order to arrange a special schedule.

i. Mooring in Approaches Prohibited. Mooring or anchoring in the approaches to the lock is prohibited where such mooring will interfere with navigation.

j. Waiting for Lockage. Vessels waiting for lockage shall wait in the clear outside of the lock approach channel, or contingent upon permission by the Lock Master, may at their own risk, lie inside the approach channel at a place specified by the Lock Master. At Bonneville vessels may, at their own risk, lay-to at the downstream moorage facility on the south shore downstream from the guide wall: Provided, that a 100-foot-wide open channel is maintained and vessels upstream may lay-to against the guide wall, at their own risk, provided they remain not less than 400 feet upstream of the upstream lock gate: or contingent upon prior radio clearance by the Lock Master they may, at their own risk, tie to the upstream guide wall.

k. Mooring in Lock. All vessels must be moored within the lock chamber so that no portion of any vessel extends beyond the lines painted on the lock walls. Moorage within the lock chamber will be to floating mooring bits only and will be accomplished in a proper no-slip manner. Small vessels will not be locked with a large vessel unless the large vessel is so moored (two mooring bits) that no lateral movement is possible. The vessel operator will constantly monitor the position of his vessel and his mooring bit ties to assure that there is no fore or aft movement of his vessel and lateral movement is minimized. Propulsion by vessels within the lock chamber will not be permitted during closure operation of a lock chamber gate or as otherwise directed by the Lock Master.

l. Crew to Move Craft. During the entire lockage, the vessel operator shall constantly attend the wheelhouse, be aware of the vessel's position, and monitor radio channel 14 on frequency 156.700 MHz, or otherwise be constantly able to communicate with the Lock Master. At a minimum, vessels shall be as vigilantly manned as if underway.

m. Speed. Vessels shall be adequately powered to maintain a safe speed and be under control at all times. Vessels shall not be raced or crowded alongside another in the approach channels. When entering the lock, speed shall be reduced to a minimum consistent with safe navigation. As a general rule, when a number of vessels are entering the lock, the hollowing vessel shall remain at least 200 feet astern of the vessel ahead.

n. Delay in Lock. Vessels shall not unnecessarily delay any operation of the locks.

o. Landing of Freight. No freight, baggage, personnel, or passengers shall be landed on or over the walls of the lock, except by permission and direction of the Lock Master.

p. Damage to Lock or Other Structures. The regulations in this section shall not relieve the liability of the owners and/or operators of vessels from liability for any damage to the lock or other structures or for the immediate removal of any obstruction. No vessel in less than stable floating condition or having unusual sinking potential shall enter the locks or its approaches. Vessels must use great care not to strike any part of the lock, any gate or appurtenance thereto, or machinery for operating the gates, or the walls protecting the banks of the approach channels. All vessels with projecting irons, or rough surfaces which may damage the gates or lock walls, shall not enter the lock unless provided with suitable buffers and fenders. Vessels having chains, lines, or drags either hanging over the sides or ends or dragging on the bottom for steering other purposes will not be permitted to pass.

q. Tows. Prior to a lockage, the person in charge of a vessel towing a second vessel by lines shall, at a safe distance outside of the incoming approach channel, secure the second vessel to the towing vessel and keep it secured during the entire course of a lockage and until safely clear of the outgoing approach channel.

r. Violation of Regulations. Any violation of these regulations may subject the owner or master of any vessel to any or all of the following: (1) Penalties prescribed by law of the United States Government (33 U.S.C. 1): (2) Report of violation to the titled owner of the vessel: (3) Report of the violation to the U.S. Coast Guard: (4) Refusal of lockage at the time of violation.

s. Refuse in Locks. No materiel of any kind shall be thrown or discharged into the lock, or be deposited in the lock area. Vessels leaking or spilling cargo will be refused lockage and suitable reports will be made to the U.S. Coast Guard. Deck cargo will be so positioned so as not to be subject to falling overboard.

t. Handling Valves, Gates, Bridges, and Machinery. No person, unless authorized by the Lock Master, shall open or close any bridge, gate, valve, or operate any machinery in connection with the lock. However, the lock master may call for assistance from the master of any vessel using the lock, should such aid be necessary, and when rendering such assistance, the men so employed shall be directly under the orders of the Lock Master. Masters of boats refusing to give such assistance when it is requested of them may be denied the use of the lock by the Lock Master.

u. Statistics. On each passage through the lock, masters or pursers of vessels shall furnish to the Lock Master a written statement of passengers, freight, and registered tonnage and other information as indicated on forms furnished boat operators by the Lock Master.

v. Hazardous Areas. At McNary, Ice Harbor, Lower Monumental, Little Goose, and Lower Granite Dams, all water from the downstream face of the dam to a line straight across the river at the downstream end of the downstream lock guide wall is considered hazardous and vessels may enter only at their own risk.

w. Restricted Areas. No vessel shall enter or remain in any restricted area at any time without first obtaining permission from the District Engineer, Corps of Engineers, U.S. Army, or his duly authorized representative.

(1) At Bonneville Dam. The waters restricted to only Government vessels are described as all waters of the Columbia River and Bradford Slough within 1,000 feet above and 2,000 feet below the powerhouse. The restricted areas will be designated by signs.

(2) At the Dalles Dam. The waters restricted to only Government vessels are described as all downstream waters other than those of the navigation lock downstream approach channel which lie between the Pasco County Bridge and the project axis including those waters between the powerhouse and the Oregon shore and all upstream waters other than those of the navigation lock upstream approach channel which lie between the project axis and a line projected from the upstream end of the navigation lock guide wall to the junction of the concrete structure with the earth fill section of the dam near the upstream end of the powerhouse.

(3) At the John Day Dam. The waters restricted to only Government vessels are described as all of the waters within a distance of about 1,000 yards above the dam lying south of the navigation channel leading to the lock and bounded by a line commencing at the upstream end of the guide wall, and running in a direction 54° 01' 37" true for a distance of 771 yards, thence 144° 01' 37" true across the river to the south shoreline. The downstream limit is marked by orange and white striped monuments on the north and south shores.

(4) At McNary Dam. The waters restricted to only Government vessels are described as all of the waters within a distance of about 1,000 yards above the dam lying south of the navigation channel leading to the lock and bounded by a line commencing at the upstream end of the guide wall, and running in a direction 93° 30' true for a distance of 495 yards, thence 175° 15' true for 707 yards, thence 179° 00' true for 441 yards, thence 235° 00' true for 585 yards, thence 268° 00' true for 146 yards to the head of the fish ladder.

(5) At Ice Harbor Dam. The waters restricted to only Government vessels are described as the waters within a distance of about 800 yards upstream of the dam lying south of the navigation channel leading to the lock and bounded by a

line commencing at the upstream end of the guide wall, and running a direction 83° 00' true for a distance of 600 yards, thence 175° 00' true for a distance of 250 yards, thence 241° 00' true to the upstream face of the dam.

(6) At Lower Monumental Dam. The waters restricted to only Government vessels are described as the waters within a distance of about 1,200 yards upstream of the dam lying north of the navigation channel leading to the lock and bounded by a line commencing at the upstream end of the fixed guide wall and running in a direction 48° OC'true for a distance of 340 yards, thence 326° 00'true for a distance of 366 yards, thence 260° 00' true for a distance of 160 yards, thence 270° 00'true to the north shore.

(7) At Little Goose Dam. The waters restricted to only Government vessels are described as those within a distance of 800 yards above the dam lying north of the guide wall and bounded by a line commencing at the upstream end of the guide wall and running in a direction 64° 13'true for a distance of 567 yards, thence 349° 03'true for a distance of 610 yards to the north shoreline.

(8) At Lower Granite Dam. The waters restricted to only Government vessels are described as those within a distance of 800 yards above the dam lying south of the guide wall and upstream end of the guide wall and running in a direction 136° true for a distance of 586 yards±. Thence 214 degrees true for a distance of 250 yards to the south shoreline.

Drawings which depict the hazardous andrestricted areas in paragraphs (v) and (w) of this section are available from the District Engineers for areas within their respective jurisdictions.

TABLE B-1
NOTIFICATION LIST IN CASE OF UNSCHEDULED LOCK CLOSURES
OR
OTHER NAVIGATION MATTERS

PRIMARY CONTACT: WALLA WALLA DISTRICT - Operations Division
[redacted]

Who will in turn notify:

1. Chief, Project Operations, Walla Walla District.

2. Public Affairs Office, Walla Walla District.

3. Chief, Project Operations, Northwest Division.

4. Columbia River Towboat Association.

APPENDIXES

A. Memorandum of Agreement Between the Corps of Engineers and Bonneville Power Administration for the Operation of Lower Monumental Project

B. Part 207 - Navigation Regulations

C. Sample, Public Notice

APPENDIX A

MEMORANDUM OF AGREEMENT BETWEEN THE CORPS OF ENGINEERS AND BONNEVILLE POWER ADMINISTRATION FOR THE OPERATION OF LOWER MONUMENTAL PROJECT

(To be provided by NPD)

DEPARTMENT OF THE ARMY
WALLA WALLA DISTRICT, CORPS OP ENGINEERS
Bldg. 602, City-County Airport
Walla Walla, Washington 99362

APPENDIX B
TITLE 33 - NAVIGATION AND NAVIGABLE WATERS
CHAPTER II - CORPS OF ENGINEERS, DEPARTMENT OF THE ARMY
PART 207 - NAVIGATION REGULATIONS
LOWER MONUMENTAL DAM NAVIGATION LOCK AND APPROACH CHANNELS
SNAKE RIVER, WASHINGTON

Pursuant to the provisions of Section 7 of the Rivers and Harbor Act of 8 August 1917 (40 Stat. 266; 33 U.S.C. 1), Section 207.717 is hereby prescribed governing the use, administration, and navigation of the Lower Monumental Dam navigation lock and approach channels in Snake River, Washington, effective 30 *days* after publication in the FEDERAL REGISTER, as follows:

207.717 Lower Monumental Dam Navigation Lock and Approach Channels, Snake River Wash.; use administration, and navigation.

a. General. The lock and its approach channels, and all its appurtenances, shall *be* under the jurisdiction of the District Engineer, Corps of Engineers, United States Army, in charge of the locality. His representative at Ice Harbor Dam shall be the Project Engineer, who shall customarily give orders and instructions to the lock master and assistant lock masters in charge of the lock. Hereinafter, the term "lock master" shall be used to designate the lock official in immediate charge of the lock at any given time. In case of emergency, and on all routine work in connection with the operation of the lock, the lock master shall have authority to take such steps as may be immediately necessary without waiting for instructions from the Project Engineer.

b. Immediate Control. The lock master shall be charged with the immediate control and management of the lock, and of the area set aside as the lock area, including *the* lock approach channels. He shall see that all laws, rules, and regulations for the use of the lock and lock area are duly complied with, to which end he is authorized to give all necessary orders and directions, both to employees of the Government and to any and every person within the limits of the lock or lock area, whether navigating the lock or not. It shall be the duty of the Project Engineer to establish lines of succession for the men operating the lock on all shifts in order that, in case of absence or *accident* to the designated lock master, one of his assistants will immediately assume the position of lock master.

c. Authority of lock master. No one shall cause any movement of any vessel, boat, or other floating thing in the lock or approaches except by or under the direction of the lock master or his assistants.

d. Signals.

(1) Sound. All craft desiring lockage shall signal by two long and two short blasts of their whistle, delivered at a distance of one-half mile from the lock. When the lock is ready for entrance, notice will be given by one long blast. Permission to leave the lock will be given by one short blast.

(2) Visual. Visual signals are located outside each lock gate and will *be* used in conjunction with the sound signals. When the green light *is* on, the lock is ready for entrance and vessels may enter under full control. When the red light is on, the lock cannot be made ready immediately and the vessel shall stand clear.

(3) Radio. The lock is equipped with two-way radio operating on frequencies of 146.8000 MHz and 156.6500 MHz. These frequencies are monitored by the lock master. Vessels equipped with two-way radio may communicate with the crew operating the lock but communications or signals so received will only augment and not replace the sound and visual signals.

e. Permissible Dimensions of Boats. Single tows aggregating 650 feet or less in length and 84 feet or less in width will be permitted to lock through without disassembly. At normal pool elevation of 540 feet above m.s.l., the depth of water over the upstream gate sill will be 19 feet. The upstream sill elevation is 521 feet m.s.l. The depth of water over the downstream *gate* sill will depend upon the flow in the river but will usually exceed 18 feet when Ice Harbor pool is at 440 feet m.s.l. The downstream gate sill elevation is 422 feet m.s.l. Gauges are located on the guide walls at each end of the lock and on the lock walls at each end. These gauges indicate water surface elevations in feet above m.s.l. Depth of water over the sills should be calculated before entrance into the lock. A craft must not attempt to enter the lock if its beam and length are greater than the above-indicated dimensions or if its draft exceeds the calculated depth over the sills with adequate allowances for safe clearances.

f. Precedence at Lock. Ordinarily the boat arriving before all others at the lock will *be* locked through first; however, depending upon whether the lock is full or empty, this precedence may be modified at the discretion of the lock master if boats are approaching from the opposite direction and are within reasonable distance of the lock at the time of the approach by the first boat. When several boats are to pass, precedence shall be given as follows:

First. Boats and craft owned by the United States and engaged upon river and harbor improvement work.

Second. Freight and tow boats.

Third. Rafts.

Fourth. Passenger boats.

Fifth. Small vessels and pleasure craft.

g. Loss of turn. Boats that fail to enter the lock with reasonable promptness, after being authorized to do so, shall lose their turn.

h. Multiple lockage. The lock master shall decide whether one or more vessels may be locked through at the same time.

i. Speed. Vessels shall not be raced or crowded alongside another in the approach channels. When entering the lock, speed shall be reduced to a minimum consistent with safe navigation. As a general rule, when a number of vessels are entering the lock, the following vessel shall remain at least 200 feet astern of the vessel ahead.

j. Lockage of small boats.

(1) General. The lockage of pleasure boats, skiffs, fishing boats, and other small craft will be coordinated with the lockage of commercial craft, other than barges handling petroleum products or highly hazardous materials. If no commercial craft are scheduled to be locked through within a reasonable time, not to exceed one hour after the arrival of the small craft at the lock, separate lockage will be made for such small craft.

(2) Signal Stations. Pull-cord signal stations marked by large instructional signs are located near the end of the upstream and downstream lock entrance walls. Small-boat operators desiring lockage may pull the cord to signal the lock master.

(3) Entering and exit signals. Visual signal lights are located outside each lock gate. When the green light is on, the lock *is* ready for entrance and vessels may enter under full control. When the red light is on, the lock is not ready for *entrance* and the vessel shall stand clear. In addition to the above visual signals, the lock master will signal that the lock is ready for entrance by sounding one long blast on the lock air horn, The lock master will signal that the lock is ready for exit by sounding one short blast on the air horn.

k. Mooring in Lock. All boats, rafts, and other craft when in the locks shall be moored by head and spring lines and such other lines as may be necessary to the fastenings provided for that purpose, and the lines shall not be released until the signal is given for the vessel to leave the lock. (Do not moor to stationary bits or ladders).

l. Mooring in Approaches Prohibited. The mooring or anchoring of boats or other craft in the approaches to the lack where such mooring will interfere with navigation through the lock is prohibited. Rafts to be passed through the lock shall be moored so as not to interfere with navigation through the lock or its approaches and, if the raft is to be divided into sections for locking, the sections shall be brought into the lock as directed by the lock *master.* After passing through the lock, the sections shall be reassembled at such a distance from the entrance so as not to obstruct or interfere with navigation through the lock and approaches.

m. Waiting for lockage. Boats and tows waiting downstream of the dam for lockage shall wait in the clear downstream of the navigation lock approach channel or, contingent upon prior radio clearance of the lock master, may at their own risk lie inside the 250-foot approach channel alongside the north shore, provided that a 150-foot wide open channel is maintained between the boat or tow and the offshore guide wall. Vessels waiting upstream of the dam for lockage may lay to against the offshore floating guide wall, provided they remain not less than 400 feet upstream of the upstream lock gate. In either event, a clear channel not less than 150 feet wide shall be kept open to accommodate passing traffic.

n. Delay in Lock. Boats or barges must not obstruct navigation by unnecessary delay in entering or leaving the lock.

o. Damage to Lock or Other Structures. The regulations contained in this section shall not affect the liability of the owners and operators of vessels for any damage by their operations to the lock or other structures. They must use great care not to strike any part of the lock, any gate or appurtenance thereto, or machinery for operating the gates, or *the* walls protecting the banks of the approach channels. All boats with metal nosings or projecting irons or rough surfaces which may damage the gates or lock walls will not *be* permitted to enter the lock unless provided with suitable buffers and fenders.

p. Tows. Persons in charge of vessel towing a second vessel or barge by lines shall take the second vessel or barge alongside at a distance of at least 300 feet from the lock gate toward which the vessel is approaching and keep it alongside until at least 300 feet clear of the gate at the end from which it is departing.

q. Crew to Move Craft. The masters in charge of tows and the persons in charge of tows and the persons in charge of rafts and other craft must provide a sufficient number of men to move barges, rafts, and other craft into and out of the lock easily and promptly.

r. Handling Valves, Gates, Bridges, and Machinery. No person, unless authorized by the lock master, shall open or close any bridge, gate, valve, or operate any machinery in connection with the lock, but the lock master may call for assistance from the master of any boat using the lock, should such aid be necessary, and when rendering such assistance, the men so employed shall be strictly under the orders of the lock master Masters of boats refusing to give such assistance when it is requested of them may be denied the use of the lock by the lock master.

s. Landing of Freight. No one shall land freight or baggage on or over the walls of the lock so as in any way to delay or interfere with navigation or the operations of the lock. Freight and baggage consigned to Lower Monumental project shall *be* landed only at such places as are designated by the lock master or his assistants.

t. Refuse in Locks. No material of any kind shall be thrown or discharged into the lock, and no material of any kind shall be deposited in the lock area.

u. Statistics. On each passage through the lock, masters or pursers of vessels shall make to the lock master such written statement of passengers, freight, and registered tonnage and other information as are indicated on forms furnished such masters or pursers by the lock masters.

v. Persistent Violation of Regulations. If the owner or master of any boat persistently violates the regulations of this section after due notice of the same the boat or master may be refused lockage by the lock master at the time of violation or subsequent thereto if deemed necessary in the opinion of the lock master to protect Government property and works in the vicinity of the lock.

w. Restricted areas.

(1) All the waters described in subparagraphs (2) and (3) of this paragraph are restricted to all boats except those of the United States Coast Guard and Corps of Engineers.

(2) All of the waters downstream of the dam which are bounded on the north by the dam, on the south by the guide wall, on the east by the shore of the river, and on the west by a line approximately one-fourth mile downstream of the dam, the south end of which is indicated by the downstream end of the guide wall and thence on a line bearing 320°24'9" True to the north shore.

(3) All waters within a distance of about 2,220 feet above the dam lying north of the navigation channel leading to the lock. This restricted area is bounded by a line commencing at the upstream end of the fixed guard wall and running in a direction of 80°25'47" True for a distance of 750 yards, thence 320°24'09" True across the river to the north shore.

Approved:

STANLEY R. RESOR /s/
STANLEY R RESOR /t/
Secretary of the Army

DATE: 8 May 1969

DEPARTMENT OF THE ARMY
WALLA WALLA DISTRICT, CORPS OP ENGINEERS
Bldg. 602, City-County Airport
Walla Walla, Washington 99362

APPENDIX C

PUBLIC NOTICE
FLUCTUATION OF LOWER MONUMENTAL AND ICE HARBOR POOLS

Walla Walla, Washington, 5 June 1969: The Walla Walla District Engineer announced today that the present high flows in Snake River are producing excessively turbulent water conditions below Lower Monumental Dam.

To reduce this turbulence, assist fish passage, and allow construction diving operations, the discharge at Lower Monumental will be reduced during the morning and late afternoon and evening hours, possibly during the remainder of June.

These periods of reduced flow will cause a rise in the Lower Monumental Reservoir of three to four feet in the morning hours. The pool will then be lowered and refilled again in late afternoon and evening. The pool will swing through two complete filling and emptying cycles in 24 hours.

Ice Harbor pool fluctuations will be two to three feet per cycle as it reregulates the Lower Monumental discharge. Ice Harbor pool will be emptying when Lower Monumental is filling, and will fill as Lower Monumental is emptying.