Schwarz

US Army Corps
of Engineers
Walla Walla District

Water Control Manual
For
Little Goose Lock and Dam

Snake River, Washington

WATER CONTROL MANUAL REVISIONS
FOR LITTLE GOOSE LOCK AND DAM

The following revisions are provided for the updating of the water control manual. These revisions will be reviewed annually and updated if necessary. Major revisions pertaining to format and content in accordance with references ETL 110-2-251 and ER 1110-2-240 will be accomplished as time and manpower become available.

FEBRUARY 2011 REVISIONS:

1. Emergency Regulation Assistance Procedures (Pink Sheets, Page iv)
2. Personnel and Telephone Numbers (Pages 6-11 and 6-12)
3. Exhibit 8-1 (Page 8-8)

DECEMBER 1988 REVISIONS:

1. Emergency Regulation Assistance Procedures (Pink Sheets, Page iv)
2. TABLE OF CONTENTS (Pages a to f)
3. SECTION V - DATA COLLECT ION AND COMMUNICATION NETWORKS (Pages 5-1 to 5-4)
4. FIGURE 5-1, CROHMS Data Collection System (Page 5-5)
5. Personnel and Telephone Numbers (Pages 6-11 and 6-12)
6. SECTION IX - EFFECT OF WATER CONTROL PLAN (Pages 9-1 to 9-5)
7. PLATE 9-2, Annual Peak Discharge Frequency -Columbia River at The Dalles.

JUNE 1988 REV ISIONS:

1. Emergency Regulation Assistance Procedures (Pink Sheets, page iv & v)

WATER CONTROL MANUAL

FOR

LITTLE GOOSE LOCK AND DAM

SNAKE RIVER, WASHINGTON

U.S. ARMY CORPS OF ENGINEERS

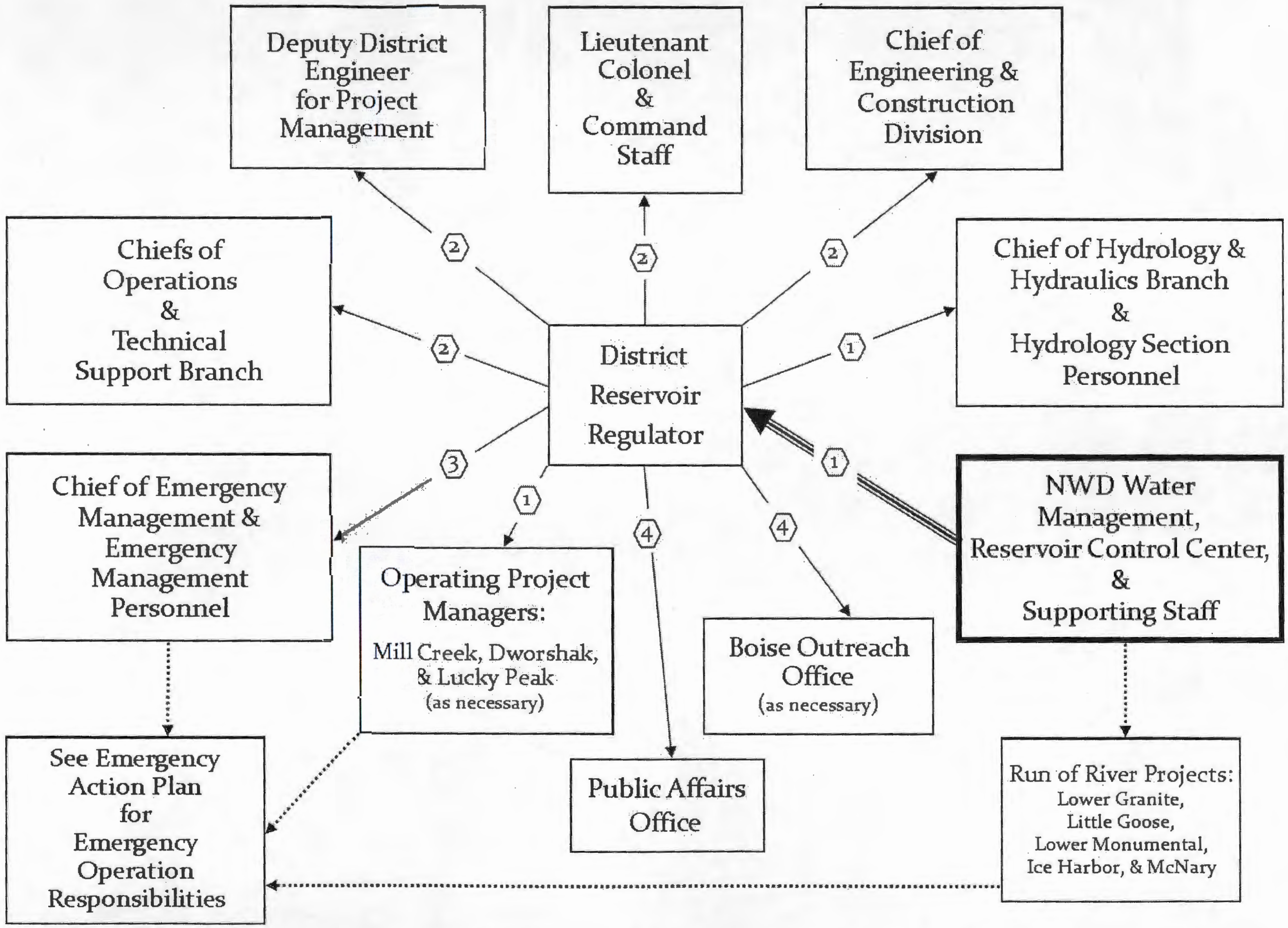
WALLA WALLA DISTRICT

FEBRUARY 1988

LITTLE GOOSE LOCK AND DAM

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 looseleaf 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 also used if physical and/or structural failures occur at the Little Goose 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 floods, (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.

Castastrophic floods include:

(1) Flooding resulting from failures at Lower Granite Dam.

(2) Flooding resulting from failures at upstream dams.

(3) Natural flood such as spillway design floods.

(4) Flooding and damage caused by earthquakes, sabotage, cracking, equipment malfunction, leakage, and foundation failures.

Catastrophic floods should be coordinated according to existing criteria within the Flood Emergency Subplans - Little Goose Lock and Dam - Snake River, Washington, U.S. Army Engineer District, Walla Walla, May 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 Little Goose Emergencies," which is in the Little Goose Project Standing Orders.

Project function emergencies affecting power generation and/or navigation are the responsibility of the Granite-Goose Project Engineer or his representative. Emergencies affecting power generation should be coordinated according to "Call-Out Procedures for Little Goose Emergencies", which is in the Little Goose Project 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 Little Goose Project under various types of national emergencies (terrorist attack, sabotage, nuclear war, etc.)

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LITTLE GOOSE LOCK AND DAM

PERTINENT DATA

1. GENERAL

Location:	
State	Washington
County	Columbia and Whitman
River	Snake
River Mile	70.3
River Miles Upstream from Lower Monumental Dam	28.7
Owner	U.S. Army Corps of Engineers, Walla Walla District
Authorized Purpose	Power generation and inland navigation
Other Uses	Fishery and recreation
Type of Project	Run-of-river
Real Estate:	
Fee acquisition land above pool elevation 638, acres	11,179

2. RESERVOIR

Name	Lake Bryan1/
Elevations (feet mean sea level):	
Maximum at dam for spillway design flood	646.5
Normal operating range gaged at dam	638 - 633
At Pool Elevation 638:	
Length, miles	37.2
Length of shoreline, miles	92
Average width, miles	0.4
Maximum width, miles	0.8
Surface area (low flow 30,000 cfs or less), acres	10,025
Storage Below Elevation 638 (low flow), acre-feet	565,200
Storage Below Elevation 633 (low flow), acre-feet	516,300
Storage Between Elevations 633 and 638	48,900
Height Normal High Pool Elevation 638 to Tailwater Elevation 540 (low flow 30,000 cfs or less), feet	98

1/ For the purpose of continuity with existing Little Goose Lock and Dam documents, the use of the term "pool" or "reservoir" is used interchangeably. The term "lake" is used only to designate a geographical body of water.

1.64
× 12
328
164
19.68

646.5
581
65.5

1.64
40 | 65.5

3. DAM (GENERAL)

Axis (Lambert)	N 10°57'W
Length and Widths, feet:	
Dam total length at crest	2,655
North abutment embankment	878.5
North nonoverflow monoliths length	189
Spillway overall length (between abutment centerline)	512
Spillway to powerhouse nonoverflow	48.5
Powerhouse overall length	656
Powerhouse to navigation lock nonoverflow length	57
Navigation lock overall width	328
Concrete Heights, feet:	
Maximum overall concrete height (powerhouse sump deck to deck)	253
Maximum nonoverflow monoliths height (north)	200
Maximum lock wall monolith height (culverts to deck)	165
Deck Elevations, feet msl:	
Intake, spillway bridge, nonoverflow sections, and upstream end of navigation lock	651
Downstream end of navigation lock	646
South shore fish ladder	558
Tailrace and fishwater intake	558
North abutment embankment	656

4. SPILLWAY

Number of Bays	8
Overall length, feet (abutment centerlines)	512
Deck elevation, feet msl	651
Ogee crest elevation, feet msl	581
Flip lip elevation	532
Control gates:	
Type	Tainter
Size	50'W x 60'H
Gantry crane (joint use with powerhouse) capacity, tons	100
Stilling basin length, feet	118
Stilling basin elevation, feet msl	466.5
Maximum design capacity, cfs	850,000

5. POWERHOUSE

Length Overall, feet	656
Spacing, feet:	
Units 1 through 5	90
Unit 6	96
Erection and service bay	110

5. POWERHOUSE (Continued)

Width overall, transverse section, feet	243
Maximum Height (draft tube invert to intake deck), feet	226
Turbines:	
Type	Kaplan, 6-blade
Runner diameter, inches	312
Revolutions per minute	90
Rating horsepower	212,400
Distributor centerline elevation	501
Generators:	
Rating (nameplates), kilowatts	135,000
Power factor	0.95
Kilovolt ampere rating	142,100
Units Installed Complete Initially	3
Skeleton Units Provided Initially	3
Total Units Now Installed	6
Plant Capacity, Nameplate Rating, kilowatts	810,000
Crane Capacities, tons:	
Intake (joint use with spillway)	100
Bridge	600
Draft tube gantry	50

6. NAVIGATION LOCK AND CHANNELS

Net Clear Length, Lock Chamber, feet	668
Net Clear Width, Lock Chamber, feet	86
Operating Water Surface Elevations in Chamber	537 - 638
Maximum Operating Lock Lift, feet	101
Upstream Gate:	
Type	Submersible tainter
Height, feet	22
Downstream Gate:	
Type	Miter
Height, feet	85
Length of Guidewalls (from face of gate), feet:	
Upstream (floating)	665
Downstream	700
Downstream Approach Channel:	
Width, feet	250
Bottom elevation	521
Lower Lock Sill Elevation	522
Upper Lock Sill Elevation, feet	618
Maximum Depth Over Sills, feet	20
Minimum Depth Over Sills, feet	15

7. ABUTMENT EMBANKMENT

Embankment Elevation	656
Embankment Top Width, feet	43
Material	Gravel fill with rock facing impervious silt core
Upstream	Combination sand and gravel filters
Downstream	Gravel and sand filters
Slope, upstream	1V on 2H
Slope, downstream	1V on 2H

8. FISH FACILITIES

Upstream Migrants Fish Ladder:	
Number of fish ladders	1
Slope	1V on 10H
Ladder clear width, feet	20
Design capacity, cfs	75
Exit Channel:	
Location	Between weir 637 and pool in nonoverflow section
Top of trashrack elevation	632
Invert elevation	627
Width	6 feet
Normal Operating Range:	
Pool elevations	633 to 638
Tailwater elevations	537 to 544
Riverflow	0 to 225,000 cfs
Maximum Operating Range:	
Pool elevations	632 to 639
Tailwater elevations	537 to 547.5
Riverflow	0 to 340,000 cfs
Pumps for Fish Attraction Water:	
Number	3
Rated capacity, cfs	2,550
Downstream Migrants:	
Traveling fish screens	18
Fingerling collection gallery	1
Fingerling transportation pipe	1
Fingerling handling facility	1
Fingerling transportation facilities:	
Truck loading facility	1
Barge loading facility	1
Design pool range	633 to 638

9. HYDROLOGIC DATA

(Based on streamflow data for Snake River near Clarkston, Washington)

Drainage Area, square miles	103,200
Period of Record	October 1915 to September 1972 Discontinued December 1972
Discharges, cfs:	
Instantaneous maximum of record, 29 May 1948	369,000
Instantaneous minimum of record, 2 September 1958	6,660
Average annual flow	50,300
Average annual mean daily peak flow	188,300
Extreme Outside Period of Record:	
Flood of June 1894	409,000
Flood of June 1894, controlled by existing projects	295,000
Standard Project Flood, Controlled by Existing Projects:	
Snake River below Clearwater River	420,000
Snake River above Clearwater River	295,000
Clearwater River above Snake River	150,000
Spillway Design Flood	850,000

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 October 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 1110-2-251, "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 Little Goose 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. History of project.

b. Description of project.

c. Basin characteristics.

d. Data collection and communication networks.

e. Water control management.

f. Streamflow forecasts.

g. Water control plan.

h. Effect of water control plan.

Section VI - Water Control Management outlines responsibilities of the Corps of Engineers, Bonneville Power Administration (BPA), and other agencies involved indirectly with the regulation of the Little Goose project. Section VIII - Water Control Plan contains information necessary for understanding the objectives of the project and instructions to implement the regulation of the reservoir. The Master Water Control Manual for the Columbia River Basin, dated December 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 operation of Little Goose project, Snake River, Washington.

a. Design Memorandum No. 2 - General Design Memorandum (4 volumes), 20 October 1961.

b. Design Memorandum No. 8 - Spillway, 16 October 1963.

c. Design Memorandum No. 9 - Navigation Facilities, 23 May 1963. Supplement No. 1 - Design and Cost Revisions, 11 May 1964.

d. Design Memorandum No. 10 - Fish Facilities, 16 July 1964.

e. Little Goose Lock and Dam, Operation and Maintenance Manual, July 1974 (3 volumes).

f. Final Environmental Impact Statement, October 1974.

g. Draft, Little Goose Lock and Dam, Master Plan, June 1975.

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

i. Flood Emergency Subplans, Identification, Operation, Repair, Notification, and Inundation Maps - Little Goose Lock and Dam Project, May 1982.

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

k. Design Memorandum No. 10.2 - Permanent Juvenile Bypass Facilities, November 1986.

l. 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 Little Goose 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 Little Goose 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 Little Goose and upon request from RCC aids in its regulation by providing technical advice. BPA is authorized to market electrical energy generated at Little Goose 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 Little Goose and other Corps of Engineers, North Pacific Division, projects.

II - HISTORY OF PROJECT

2-01. Authorization and Purpose. Little Goose 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...."

2-02. Early History. Prior to the authorization of slack-water 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 slack-water 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 (RM) 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 of a definite project report on relocations and flowage. Locations of the other three dams (Ice Harbor, Lower Monumental, and Lower Granite) are shown on the lower Snake River map, Plate 3-1.

Detailed studies on Little Goose 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 RM 70.3 was selected on the basis of geology and navigation channel excavation requirements.

2-03. Significant Construction Dates. Construction work on Little Goose Dam was initiated on 12 June 1963 with notice to proceed on Contract No. DA-45-164-CIVENG-63-407. The first step cofferdam was closed on 26 November 1963. Closure of the upstream leg of the second step cofferdam and diversion through three powerhouse skeleton units was accomplished on 18 July 1969. Raising of the reservoir was started at 1300 hours on 25 January 1970 by closing the powerhouse gates in the three skeleton units. This closure was nearly a month early due to the high water in the Snake River and a buildup of trash on the trashracks of the skeleton units which reduced the capacity of the units and created excessive head on the racks and between units. The water surface rose rapidly to the spillway crest elevation 581.0 feet by 2210 hours on 25 January. The pool reached a maximum elevation of 597.5 feet at midnight on 27 January with all eight spillway gates on free flow. Then, as flows receded, the forebay leveled off near elevation 592.

The raising of the reservoir to normal operating levels was started on the originally planned filling date of 16 February 1970. At 0800 hours the spillway gates were lowered to reduce the discharge past the project to 15,000 cfs. The discharge was maintained about 60,000 cfs less than inflow until the pool reached elevation 633 at 1800 hours, 18 February. The reservoir was held between elevations 632 and 633 to check the embankment until 21 February, then slowly raised. Reservoir reached full pool elevation 638 at 1100 hours, 25 February.

The first power unit was put on the line 26 March 1970. Unit 2 was added 30 October 1970. Unit 3 was put on the line 8 December 1970. Units 4, 5, and 6 were placed in operation on 25 January 1978, 19 May 1978, and 5 July 1978, respectively.

III - PROJECT DESCRIPTION

3-01. Project Location. Little Goose Dam is located in southeastern Washington on the Snake River, 70.3 miles above its confluence with the Columbia River. The dam is 394.6 river miles above the mouth of the Columbia River and about 290 airline miles east of the Pacific Ocean. Plate 3-1 shows the geographical location of Little Goose in relation to the overall Columbia River system and to other major dam and reservoir developments.

3-02. Project Purposes. The primary purposes of the project are inland navigation and hydroelectric power generation. In addition, it provides fish and wildlife and recreation benefits. Flood control is not a designated or planned project function.

3-03. Physical Components.

a. General. The following paragraphs provide a general description of the physical components of the Little Goose project. Design Memorandums (DM's) and project reports provide details on planning, design, and construction of the project (refer to paragraph 1-03, "Related Manuals and Reports").

b. Dam. Main structures of the dam consist of a powerhouse, concrete spillway and stilling basin, navigation lock, fish facilities, concrete nonoverflow sections, and a rockfill embankment on the north shore. The dam is 2,655+ feet in length, including the embankment. Concrete sections have a maximum height of 256.4 feet, from a low elevation of 394.6 feet in the erection bay to top of deck elevation 651. Plate 3-2 and the project photograph in the front of this manual show the relative locations of the principal components of the dam. Data on various features are summarized in the Pertinent Data on page A, and more detailed descriptions of the equipment are contained in the Operation and Maintenance Manual.

(1) Powerhouse. The powerhouse consists of six generator bays, an erection bay, control room, and project office space. The powerhouse general plan is shown on Plate 3-3 and a transverse section of the generator bays is shown on Plate 3-4. The overall powerhouse length, including the abutment piers, is 656 feet. Generator bays are approximately 243 feet in width. Generator bays Nos. 1 through 5 are 90 feet in

length, 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.

(2) Generators. The generators are the vertical shaft, synchronous type and are driven by six-blade, Kaplan-type hydraulic turbines. The six 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 with a maximum output of 155 MW. Continuous minimum power generation is limited to 80 MW. The following performance and operating data were provided 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 to 500
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° C, and stator core 55° C when delivering rated output continuously at rated voltage, power factor, and frequency, and with cooling air entering the generator at no more than 40° C.

(3) Turbines.

(a) Design Characteristics. Turbines for units 1 to 3 were supplied by the Baldwin-Lima-Hamilton Corporation and turbines for units 4 to 6 were supplied by Allis Chalmers. 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 501 feet msl, and the elevation of the water surface in the tailrace will vary from 537 to 567 feet msl. Each turbine is guaranteed to develop 212,400 horsepower at rated net head of 93 feet and 204,500 horsepower at net head of 90.5 feet. The turbines are designed to have good efficiencies throughout a wide load range and for heads varying from 90.5 to 101 feet. Design is based on the following reservoir and plant operating conditions:

	Elevation (feet msl)
Maximum pool (850,000 cfs)	646.5
Top of power pool	638.0
Normal full pool	638.0
Minimum power pool	633.0
Maximum tailwater (850,000 cfs)	567.0
Normal maximum tailwater (340,000 cfs)	547.6
Tailwater at rated condition (139,000 cfs)	541.5
Normal tailwater (30,000 cfs or less)	540.0
Minimum tailwater (zero flow)	537.0

	Head (feet)
Extreme maximum (zero flow)	101.0
Normal maximum	98.0
Average operating	97.0
Rated	93.0
Minimum for power	90.5

(b) Operating Characteristics. Table 3-1 and Plates 3-5 and 3-6 show power-discharge relationships for both unit and plant 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. No turbine limits are shown on these charts other than the full gate limit. Maximum and minimum operating limits were presented in the original contract guarantee. It should be noted that heads referenced on the charts are gross heads and no accounting has been made for trashrack and other hydraulic losses.

(4) 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 OA/FA, type suitable for

outdoor operation. Each transformer is rated 164/218 MVA, 13.2-500 Grd. Y/289 kV, single-phase. Six generators serve the six transformer banks 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) Station Service Power. Two station transformers are available for use. One is used for in-service and the second acts as a spare. Station service power is provided by one 2,700 kVA 13.8-4.16 Y/2.4 kV, 3-phase transformer manufactured by Westinghouse Electric Corporation. It is a 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 500-kW water-cooled diesel-powered generator.

(6) Spillway. The spillway has a total length of 512 feet between abutment centerlines, including seven intermediate piers, and consists of eight gate-controlled bays, each 50 feet wide. Piers 14 feet wide separate the bays. Elevation of the spillway crest is 581. Bays 2 through 7 have spillway deflectors (flip lips) at elevation 532. The primary purpose of the flip lips is to minimize nitrogen supersaturation in spilled water. The spillway has a maximum height, foundation to deck, of 204.4 feet, with a 20-foot-wide roadway on top at elevation 651. Plate 3-2 shows a general plan and a typical spillway section.

Spillway discharges are controlled by eight tainter gates each 50 feet wide by 60.03 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 579.97. Side seal plates and sill beams of all eight center gate bays are heated by circulating electrically heated oil through embedded tubing behind the seal plates and sill beam to prevent formation of ice at the gate seals. The design capacity of the spillway is 850,000 cfs, with a corresponding maximum pool of 646.5 feet. At normal pool elevation 638, the spillway will pass a maximum of 676,000 cfs. Table 3-2 and Plate 3-7 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 bucket slab with teeth-type stilling basin. The stilling basin has been designed to contain the jump for all discharges up to 850,000 cfs. Plate 3-8 shows tailwater rating curves below Little Goose Dam (RM 70.3) which are based on backwater profiles from Lower Monumental Dam (RM 41.6).

(7) 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 668 feet. The maximum lift with Lower Monumental Reservoir at elevation 537, Little Goose forebay elevation 638, and zero Little Goose outflow is 101 feet. The lock is closed by a tainter gate at the upstream end and hydraulically operated miter gates at the downstream end. Plate 3-2 shows the general plan and typical section for the navigation lock. Provision is made for a floating bulkhead to be installed above the upstream gate and below the downstream gate for maintenance and emergency use. However, it would be impossible to install the bulkhead in flowing water. Guide walls extend 733 feet downstream and 765 feet upstream of the gates along the left bank. A guard wall extends 689 feet downstream on a diagonal riverward of the channel. In the forebay, a guard wall section extends 190 feet upstream of the lock gate parallel to the guide wall, then a 309-foot floating guard wall section flairs riverward to create a wider entrance and protect tows from accidentally being carried into the powerhouse forebay or over to the spillway. The entrances created by the guide and guard walls, both upstream and downstream of the lock, open into deep water. Maximum rock elevation downstream is 520 and upstream is 617 in the approach area.

Lock control facilities are located in sheltered control stands on the river wall of the lock adjacent to the upstream and downstream gates. Partial control stations for the downstream gates are located in the lock machinery room for maintenance and emergency operation. Each gate has to be operated from its own machinery room. Minimum elevation of the wall between the lock chamber and the machinery room is 639.8. Air bubblers installed in the gate groin recesses clean trash and ice away from the recess. Other dimensions are given in the pertinent data tabulation.

(8) Fish Facilities. Fish facilities at Little Goose Dam include an adult fish passage system for upstream migrants and a juvenile fish passage system for downstream migrants.

(a) Adult Fish Passage Facilities. The adult fish passage facilities at Little Goose Dam consist of a fish ladder on the south shore with two south shore entrances, a powerhouse collection system, three north shore entrances with a transportation channel underneath the spillway to the powerhouse collection system, and an auxiliary water supply system. The powerhouse collection system is comprised of four floating orifice entrances, three entrances on the north end of the powerhouse, and a common transportation channel which leads to the beginning of the fish ladder. Plate 3-9 shows the general plan for Little Goose's adult fishway system.

The adult fishway facilities provide satisfactory fish passage conditions for the design range which includes normal operating pool elevations between 633 and 638 and for tailwater elevations between 537 and 544 for all riverflows from minimum to 225,000 cfs. The adult fishway system also operates within acceptable criteria for pool elevations between 632 to 639, 1 foot below and above the normal power pool range of 633 to 638, and between tailwater elevations 537.0 to 547.5 for all riverflows from minimum to 340,000 cfs.

1. Fish Ladder and Counting Station. The fish ladder is located between the south end of the powerhouse and the navigation lock. The ladder is 20 feet wide and rises 95 feet with 100 fixed weirs. Weirs are numbered 538 to 637. The ladder is 1,139 feet long from weir 558 to the exit channel. Weirs 538 through 627 have 5.5-foot-wide overflow crests on each side of a 9-foot-wide baffle nonoverflow section in the center of the weir. Orifices, 18 by 18 inches, are located at the base of the weirs with centerlines 3.5 feet from each wall. Weirs 538 to 627 are spaced on 10-foot centers except at the fish counting station, on the curves, and in the orifice-slot control section (weirs 628 to 637). Weirs 628 to 637 are on 16-foot spacing. Weirs 628 to 637 are the regulation control section of the fish ladder and function as baffles since water flows through a submerged orifice and narrow slot and not over the weirs. Upstream of weir 637 the ladder is reduced from a 20-foot-wide to a 6-foot-wide channel through the dam to the forebay to maintain adequate transportation velocities. The exit channel is 34 feet long including

the 7-foot transition section which reduces the ladder width. The invert of the channel exit is at elevation 627 which provides a 6-foot depth at minimum pool elevation 633. Bulkheads necessary for closure of the fish ladder exit are stored on top of the trashrack panel. A small triangular floating log boom is located upstream of the fish ladder exit to keep large trash away from the fish exit area.

Discharge in the upper portion of the fish ladder above weir 627 is regulated by the control section (weirs 628 to 637) and diffuser 13. Diffuser 13, located between the last orifice control weir (628) and the first overflow weir (627), adds water to maintain a constant 75-cfs discharge in the ladder below weir 628 as forebay elevations vary.

The combination fish counting station and public fish viewing room is located in the ladder between weirs 563 and 564. The counting station utilizes a back-lighted vertical counting board viewed through an underwater window in the side of the ladder. Fish counting is conducted electronically without species differentiation and only gross fish passage is monitored. The distance between the window and counting board may be varied by moving the board back and forth to permit visibility for various degrees of turbidity. The public can view fish passage through three underwater windows in the side of the ladder immediately downstream of the counting board. This section of the ladder is illuminated by lights below the windows and in the opposite wall of the ladder.

2. Fishway Entrances. The fishway entrances are made up of main entrance weirs (with hoist and automatic controls) and floating orifices. The floating orifices operate automatically and require only periodic inspection. If any automatic controls malfunction, the entrance weirs can be operated manually by project personnel and kept within operating criteria.

The two south shore entrance gates (SSE 1 and SSE 2) are located immediately downstream of the erection bay in the south shore retaining wall. The south shore entrances lead fish to the beginning of the fish ladder.

There are only four floating orifice entrances (1, 4, 6, and 10) in operation across the tailrace of Powerhouse Units 1 through 5. Six other floating orifice entrances (2, 3, 5, 7, 8, and 9) are closed. The floating orifice entrances allow fish to enter the powerhouse collection channel.

The three entrances at the north end of the powerhouse at Unit 6 consist of two entrances (NPE 1 and NPE 2) facing downstream and one side entrance (NPE 3) leading from the stilling basin. Normal operation is accomplished by use of overflow weirs NPE 1 and NPE 2 with NPE 3 closed. The side entrance from the stilling basin (NPE 3) can be used as an alternate to either NPE 1 or NPE 2 and is used only during periods of no spillway flow. The entrance from the stilling basin (NPE 3) is controlled with a closure gate that is either 100 percent open or closed by use of a mobile crane. These entrances at the north end of the powerhouse also lead fish into the powerhouse collection channel.

There are three north shore entrances (NSE 1, NSE 2, and NSE 3) at the north end of the powerhouse at Unit 6. Normal operation is accomplished by use of overflow weirs NSE 1 and NSE 2 with NSE 3 closed. Automatic control is provided for the two downstream facing weirs (NSE 1 and NSE 2). The NSE 3 side entrance from the stilling basin can be operated as an alternate to NSE 1 when no spillway flow is occurring, but not as a slave or for automatic adjustment. The NSE 3 side entrance is either 100 percent open or closed by use of a mobile crane. The NSE 3 side entrance from the stilling basin is identical to NPE 3 and is operated in the same manner. NSE 3 and NPE 3 will be closed when spill is occurring. The north shore entrances lead fish into the transportation channel.

3. Transportation and Collection Channel. The extension of the collection channel through the spillway from the north shore entrances permitted the elimination of a fish ladder on the north shore. A 17.5-foot-wide channel with invert at elevation 525 provides fish passage from the north shore entrances to the powerhouse collection channel beginning at Powerhouse Unit 6. The powerhouse collection channel then continues under the tailrace deck at invert elevation 532 to the beginning of the fish ladder.

4. Auxiliary Water Supply System. The auxiliary attraction water supply for the adult fishway system at Little Goose is any flow which exceeds the 75-cfs flow in the ladder from the pool.

Auxiliary water is supplied by three turbine-driven pumps located in the erection bay. All three pumps are required for normal operation. The intakes for the pumps are located on the south shore downstream from the south shore fish entrance. Each pumping unit is rated at 850 cfs (including turbine discharge) at a gross turbine head of 93 feet. The turbine discharge is included with the pump discharge when considering pumping plant capacity. Variations in the attraction water requirements are accomplished by varying the speed of the pumps.

The pumped flow to the fish ladder leaves the discharge chamber in three separate conduits: the south conduit to Diffusers 1 through 5, the north conduit beneath and upstream from the collection channel to Diffusers 6 through 11 (Powerhouse Units 1 through 6), and the second north conduit directly beneath the collection channel to Diffuser 12. Bulkheads are provided at the entrance to each of these conduits to permit isolation of the pump discharge chamber and various portions of the fishway for maintenance.

Tailwater is the independent variable on which the operation hinges for this system. Plate 3-8 shows tailwater rating curves at RM 70.2, 500 feet below the axis of Little Goose Dam. These curves are based on backwater computed from Lower Monumental Dam at RM 41.6. Effects of various combinations of flows through the powerhouse and spillway are not shown. Refer to Technical Report No. 110-1, Little Goose Dam, Snake River, Washington, dated April 1975 for details on the results of hydraulic model studies on flow conditions for selected discharges and methods of project operation.

(b) Juvenile Fish Passage Facilities. Little Goose's juvenile fish facilities consist of a bypass system and a juvenile collection system. The fingerling bypass system for the passage of downstream migrants past the dam consists of: (1) submersible traveling screens in each power intake, (2) bulkhead slots with orifices in each power intake, (3) a collection gallery across the powerhouse, and (4) a transportation pipe that carries the fish to the collection facilities. Plate 3-10 shows the general plan and sections for the fingerling bypass facilities. Submersible traveling screens guide the fingerlings out of the turbine intakes and into the bulkhead slots. From the bulkhead slots, smolts enter the collection channel, which discharges them into the transportation pipe. This pipe carries them to the fingerling collection facilities below the dam. For more information on fingerling bypass facilities and anticipated modifications, refer to DM No. 10.2, Permanent Juvenile Bypass Facilities, dated November 1986.

The collection facilities can be operated to either collect and hold juveniles for transportation by tanker trucks and barges or to bypass them back to the river. The direct return of juveniles back to the river does not normally occur except for problems occurring in the collection facilities, special studies, and early and late running fish.

The North Pacific Division Fish Facilities Manual, dated March 1981, provides additional information on adult and juvenile fish passage facilities at North Pacific Division (NPD) projects. For details on the operation and maintenance of the fish facilities at Little Goose, refer to the Little Goose Lock and Dam - Operation and Maintenance Manual, dated 1974.

(9) Nonoverflow Sections. Little Goose Dam has three concrete gravity nonoverflow sections (south, central, and north) and an earth abutment. The south nonoverflow section extends 57 feet from the lock to the powerhouse and contains the fish ladder exit structure. The central nonoverflow section, 48.5 feet long, is between the powerhouse and the spillway and contains the fingerling bypass enumerator room and exit facilities. The north nonoverflow section between the spillway and the north shore embankment is 189 feet long.

The north shore earth embankment extends from the concrete north nonoverflow section approximately 878 feet to the right bank. The maximum height of this earth fill is 173.4 feet measured from the unwatering sump excavation lowest elevation 482.6 feet to the abutment crest elevation 656 feet. 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.

c. Reservoir. Little Goose Reservoir is 37.2 miles long from Little Goose Dam to Lower Granite Dam. It has an average width of about 2,300 feet and a maximum depth of about 136 feet just upstream of Little Goose Dam. The reservoir has a surface area of 10,025 acres at normal pool elevation 638. Plates 3-11.1 and 3-11.2 show a detailed reservoir and land use map, and Plate 3-2 shows the general shape and configuration of the reservoir on a small-scale map. Reservoir regulation at Little Goose project for power generation will normally be confined to the use of storage between elevations 633 and 638, measured at the dam. That storage amounts to about 49,000 acre-feet at low flows and about 47,000 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 3-12.1 shows water surface profiles for various significant river discharges with elevations 633 and 638 at Little Goose Dam. Plate 3-12.2 shows the river bottom profile and natural water surface profiles. Table 3-3 and Plate 3-13 show the storage-discharge relationship for a wide range of riverflows.

3-04. Project Lands. Project lands total about 21,204 acres and were acquired for the damsite, the lake area, and relocations. Fee acquisition lands above a flat pool elevation of 638 account for 11,179 acres.

Real estate acquisition for Little Goose was based on a preliminary taking line 300 feet horizontally landward of a flat 638 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 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 backwater profile of the 1894 flood (409,000 cfs regulated to 340,000 cfs) 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.

3-05. Recreation Facilities. As a part of Little Goose project development, recreation facilities were built to allow the public to benefit from the recreation opportunities provided by the reservoir. These opportunities include water-oriented sports and activities, camping, fishing, and hunting. The following tabulation shows the services available at the Little Goose recreation facilities.

SITE	RIVER MILE	SWIMMING BEACH	BOAT LAUNCHING	BOAT DOCKS	RESTROOMS	PICNIC FACILITIES	MARINA	CAMPING	TRAILER FACILITIES	TRAILER DUMP FACILITIES	POWER HOOKUPS	DRINKING WATER	SHOWERS
Little Goose Dam	(70.3)					X						X	
Little Goose Landing	(71.5)		X	X	X	X							
Central Ferry State Park	(82.6)	X	X	X	X	X		X	X	X	X	X	X
Garfield County Ramp	(82.8)		X	X	X								
Willow Landing	(88.0)		X	X	X	X							
Illia Landing	(104.1)		X	X	X	X							
Illia Dunes	(104.5)				X								
Boyer Park and Marina	(105.6)	X	X	X	X	X	X	X	X	X	X	X	X

Detailed information on existing recreation sites can be found in the "Walla Walla District Recreation Facilities Guide," dated March 1984.

IV - BASIN CHARACTERISTICS

4-01. General. Little Goose Dam has a tributary area of 103,900 square miles, comprising very nearly the entire Snake River Basin. Although this is 4,600 square miles less than at Ice Harbor, only a small amount of runoff occurs below Little Goose Dam, primarily from the Tucannon and Palouse Rivers. 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 Water Control Manual dated December 1984 describes the basin in greater detail.

The Snake River is 1,078 miles long and is the largest tributary of the 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 the Columbia River near Pasco, Washington. Total fall of the Snake River from its source near Two Ocean Plateau, Wyoming, to Little Goose Dam is about 8,000 feet. Principal tributary streams are given in the following tabulation:

Stream	Drainage Area Square Mile	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
Grande Ronde	4,070	169
Clearwater	9,640	139

The numerous artificial reservoirs and partially controlled lakes in the Snake River Basin have a substantial effect on the flow of the lower Snake River. Total usable storage in the 50 largest reservoirs and lakes amounts to about 9,600,000 acre-feet. Dworshak Reservoir has the greatest usable capacity with 2,000,000 acre-feet, followed by American Falls Reservoir with 1,700,000 acre-feet, Palisades Reservoir with 1,202,000 acre-feet, Brownlee Reservoir with 980,000 acre-feet, and a combined storage in the Boise River reservoir system of 974,000 acre-feet.

4-02. 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 Grand Teton Mountain in Wyoming to 540 feet, which is normal Lower Monumental pool elevation. The basin mean elevation is about 5,300 feet.

4-03. Geology and Soils.

a. Snake River Basin. The Snake River flows across a section of the Pacific Northwest known as the Columbia Plateau which is comprised of mainly horizontal lava flows covered with 50 to 75 feet of soil. In areas where the river has cut canyons, the dark basalt rock is a primary surface feature. Many of the soils of the plateau are light and highly erodible with low rainfall limiting the ability of vegetative cover to reestablish once removed. This results in heavy sediment loads in the river, especially during the spring runoff season.

b. Little Goose Dam Region. The Little Goose damsite is located in an area where the Snake River flows about 1,000 feet below the surrounding plateau. Canyon walls generally are formed by nearly vertical basalt cliffs separated by talus slopes and occasional benches of alluvial material. Soils on the canyon walls and floor are rare and thin, with most of the alluvial benches and deposits inundated by the pool. Soils of the plateau lands above the canyon are generally a heavy layer of windblown loess, which is responsible for the area's rolling topography and prominence as a major grain-producing area.

4-04. Sediment. Studies using data from the Snake and Clearwater Rivers at Lewiston and the Snake River at Central Ferry (RM 83) and experience with run-of-river reservoirs on the Columbia River suggest that sedimentation of Little Goose 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.

4-05. Climate.

a. Snake River Basin.

(1) General. 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 in the local climate. Plate 4-1 shows a basin map of the Snake River Basin.

(2) 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 runoff at Little Goose project lies in the effect of temperature and solar radiation on snowmelt. The shape, timing, and peak discharge of the spring snowmelt runoff of the 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 Little Goose and other hydroelectric projects which serve the area.

Normal summer maximum temperatures for most climatological stations are between 80° and 90° F and normal winter minimums are between zero and 20° F. Extreme recorded temperatures are minus 66° F at West Yellowstone, Montana, barely outside the Upper Snake River Basin boundary, and 118° F 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) 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. Plate 4-1 shows the normal annual precipitation isohyetal pattern over the Snake River Basin. Much of the winter precipitation is in the form of snow, a factor of great hydrologic importance.

b. Little Goose Region.

The climate of the immediate Little Goose project area is semiarid, sometimes classified as middle-latitude steppe climate. Winters are generally mild, and summers are dry and warm to hot. Table 4-3 shows climatological data for other longer-period stations in the area which are considered reasonably representative for Little Goose Dam.

4-06. Storms and Floods.

a. Lower Snake River. Floods in the lower Snake River are of two types: (1) annual spring floods caused primarily by snowmelt but sometimes augmented by rainstorms and (2) 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 spring flood peaks for the Snake River near Clarkston generally occur in May. Some 57 percent or 37 of the annual peaks over a 65-year period (1910-1974) have occurred in May, 29 percent or 19 peaks occurred in June, 11 percent or 7 peaks occurred in April, and about 1.5 percent each, or one peak, occurred in December and March. Table 4-2 summarizes annual runoff volumes and extreme discharges from 1910 to 1974 for the Snake River near Clarkston. 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 individual peaks of the spring snowmelt runoff season. Unregulated and regulated hydrographs of the 1894, 1948, and 1956 floods are shown on Plate 4-2.

The 1894 flood was by far the largest known flood in both peak and volume on the lower Columbia River and the largest known historical flood on the lower Snake River. The 1894 flood had a peak discharge 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 of 850,000 cfs 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 was 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 for the Snake River near Clarkston is shown on Plate 4-2. The regulated peak is 295,000 cfs as regulated by existing projects including Dworshak.

Frequencies of unregulated and regulated annual flood peaks are shown for the Snake River at Lower Granite Dam on Plate 9-1. Natural peaks were computed by adjusting the observed peaks for storage changes in the larger upstream reservoirs and for estimates of depletions for irrigation. Statistics for the natural peak frequencies were adjusted to the long-term record of peak flows of the Columbia River near The Dalles.

b. Standard Project Flood. The standard project flood was derived for Little Goose project by simulating the maximum possible adverse meteorological conditions that could be reasonably expected to occur for the several contributing upstream basins. The runoff volume produced was reduced for upstream storage and was adopted as the standard project flood for design studies on Little Goose Dam and Reservoir. Standard project flood unregulated and regulated peak discharges for (1) Clearwater River at Spalding, (2) Snake River above Clearwater River, and (3) Snake River below Clearwater River (Lower Granite inflow) are summarized in the following tabulation:

Location	Unregulated Peak Discharge (cfs)	Regulated Peak Discharge (cfs)
Clearwater River at Spalding	280,000	150,000
Snake River above Clearwater River	365,000	295,000
Snake River below Clearwater River	575,000	420,000

c. 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 Little Goose 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. Plate 4-4 shows the spillway design flood.

4-07. Runoff Characteristics.

a. General. The normal pattern of streamflow for the Snake River consists of low flows from August through February and high flows from March through July. At Lower Granite Dam the peak inflow usually occurs in May or June and is primarily the result of snowmelt, sometimes augmented by rainfall. Regulation by upstream projects does much to moderate these peaks. Daily discharge hydrographs on Plates 4-5.1 to 4-5.5 illustrate the characteristic runoff pattern and the year-to-year variations for the lower Snake River. Plate 4-6 shows summary hydrographs for the Snake River near Clarkston. Table 4-2 summarizes the annual runoff volumes and extreme discharges from 1910 to 1974 for the Snake River near Clarkston. Table 4-2A summarizes the annual computed inflow volumes and daily inflow extremes from 1975 to 1986 for Lower Granite Reservoir. Little Goose Reservoir inflows have been computed since 1970 and Plate 4-7 shows summary hydrographs for Little Goose inflows. Table 4-3 summarizes the annual computed inflow volumes and daily inflow extremes from 1970 to 1986 for Little Goose Reservoir. Table 4-4 summarizes Little Goose computed monthly inflow volumes by water years.

b. Discharge Records. Discharge records for the Snake River near Clarkston (drainage area 103,200 square miles) and Lower Granite Reservoir computed inflow (drainage area 103,500 square miles) are considered comparable because runoff contributions between the two stations are not significant. The computed mean annual runoff of the Snake River near Clarkston for the period 1910-1986 is 37,500,000 acre-feet. Annual runoff volumes ranged from a minimum of 20,430,000 acre-feet in the 1977 water year to a maximum of 57,410,000 acre-feet in the 1974 water year. In average depths of water over the drainage area of 103,200 square miles above the Clarkston gage the mean, minimum, and maximum annual runoffs are 6.7 inches, 3.7 inches, and 10.4 inches, respectively. The mean annual discharge is 51,000 cfs. Mean daily maximum and minimum discharges averaged 191,000 cfs and 16,000 cfs, respectively, for the 1910-1986 water year period. The maximum historical flood peak was 409,000 cfs on 5 June 1894, which is outside of the 1910-1986 period. The instantaneous low flow was 6,660 cfs on 2 September 1958 and was caused by construction closure at Brownlee Dam during the 1910-1986 water year period. For the water year period 1973-1986, mean daily maximum and minimum discharges averaged 174,000 cfs and 19,000 cfs, respectively, with system regulation by Dworshak and other existing projects above Lower Granite. In addition, the maximum mean daily discharge was 332,000 cfs on 18 June 1974, and the minimum mean daily discharge was 10,900 cfs on 21 August 1977.

c. Uncontrolled Runoff. Much of the runoff above Little Goose is uncontrolled, especially during the spring flood season. This uncontrolled runoff is due mainly to the Salmon, Grande Ronde, and Clearwater River Basins. The relationship between regulated and unregulated components of flow above Lower Granite Dam is shown in the following tabulation.

	Drainage Area (Sq. Mi.)		Average Annual Discharge1/ (cfs)		Average May Discharge1/ (cfs)	
Above Dworshak Reservoir	2,440	(2%)	5,637	(11%)	17,990	(15%)
Above Brownlee Reservoir	72,590	(70%)	17,540	(36%)	24,050	(20%)
Uncontrolled Area above Lower Granite Dam	28,470	(28%)	25,974	(53%)	76,460	(65%)
	103,500	(100%)	49,250	(100%)	118,500	(100%)

1/ From 1980 Level Modified Streamflow Report dated July 1983.

4-08. Water Quality. A post-impoundment investigation of the lower Snake River region was jointly carried out by the Departments of Fishery Resources and Bacteriology at the University of Idaho and the Department of Civil and Environmental Engineering at Washington State University from April 1975 through October 1977 under contract with the Corps of Engineers. The major objective of the study was to describe the physical, chemical, planktonic, bacterial, and aquatic weed characteristics of the Lower Snake River Reservoirs. Twenty-six physiochemical parameters were regularly measured in addition to biological measurements which included water quality bacteriological indicators, primary production rates, algal and zooplankton evaluations, macrophyte distribution, and algal assays. A final report entitled "Limnology of an Impoundment Series in the Lower Snake River" was submitted to the Corps of Engineers in 1979. Results from this study are summarized in the following paragraphs.

Pronounced thermal and chemical stratification did not occur in these flow-through reservoirs. Summer temperature differentials were as little as 2° C from surface to bottom layers and did not exceed 5° C. Minimum deep water dissolved oxygen levels during a low flow year (1977) were 28 percent of saturation. Quiescent reservoir waters have allowed faster settling of particulate materials, resulting in greater light penetration and reduced phosphorus.

Impoundment stimulated the growth of reservoir algae (diatoms, green, and blue-green algae). Blue-green algal blooms increased and occurred further upstream as pre-impoundment studies had predicted earlier. On occasion both phosphorus and nitrogen became limiting to continued algal growth. Chlorophyll 'a' and carbon-14 productivity measurements indicated that the four reservoirs were in a mesotrophic state of enrichment. Bacterial, biochemical oxygen demand, and chemical oxygen demand measurements indicated that water quality has improved to some degree since impoundment. One possible explanation of the improved water quality conditions is improved municipal and industrial wastewater treatment. Secondary production (zooplankton production) was less than earlier expectations and showed a decrease at downstream stations compared to pre-impoundment.

4-09. Upstream and Downstream Structures.

a. General. The Snake River and its tributaries are regulated upstream by a number of dams operated by the Corps, Bureau of Reclamation, Idaho Power Company, and private irrigation companies. Dams on the lower Snake River are Corps of Engineers run-of-river structures and include: (1) Lower Granite Dam, (2) Little Goose Dam, (3) Lower Monumental Dam, and (4) Ice Harbor Dam. Little Goose, along with other major projects, is operated for multiple purposes on a system basis. For a listing of coordination organizations and agreements, refer to paragraph 6-02. In addition, details on reservoir system operation are provided in the Columbia River Basin, Master Water Control Manual dated December 1984.

b. Travel Times. Releases from Dworshak Dam on the Clearwater River and Hells Canyon Dam on the Snake River determine much of the inflow at Lower Granite. Large changes in releases could have an effect on operation of Lower Granite, Little Goose, Lower Monumental, and Ice Harbor Dams; for example, advance drawdown to moderate extreme flood peaks. The following tabulation shows travel times from Dworshak Dam and Hells Canyon Dam to Lewiston, Idaho, and from Lewiston to the mouth of the Snake River. Plate 4-8 illustrates travel time from Hells Canyon to downstream locations for various discharge magnitudes.

Location	Flow (kcfs)	Approximate Travel Time to Lower Granite
Dworshak Dam to Lewiston, Idaho (42.4 miles)	16	8 hrs
Clearwater River at Spalding to Lewiston, Idaho (11.6 miles)	16	2.5 hrs.
Snake River at Anatone to Lewiston, Idaho (27.7 miles)	12-18	4-6 hrs.
Hells Canyon Dam to Lewiston, Idaho (107.5 miles)	5-12 1/	16-20 hrs.
Lewiston to Mouth of Snake River (140 miles)	20	4.6 days

1/ Release at Hells Canyon, 21-27 March 1973 (see Plate 4-10).

Plate 4-10 provides detailed information on travel times and relative stages of the Snake River discharges from Hells Canyon Dam (RM 247) to the Lewiston area (RM 141.9) for various discharges. Refer to the Columbia River Basin Master Water Control Manual for details on travel times in the major rivers and lakes in the Columbia River Basin System.

4-10. Water Supplies. Lower Snake River flows have been undergoing progressive modification during the entire period of recorded flows because of upstream irrigation and storage developments. The depletions above Little Goose 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 to June 1948, a period of subnormal flow. From these data, system studies were made as of the year 1985 (average of condition 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 Little Goose 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 summarized the flows determined in these studies for Snake River at Little Goose Dam:

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

	Average			Maximum			Minimum		
Month	Act	Mod	Reg	Act	Mod	Reg	Act	Mod	Reg
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

Act - Actual historical.
Mod - Discharges modified by irrigation, 1985 conditions.
Reg - Discharges regulated by at-site and upstream power storage, Sequence IV-H, 1985 conditions.

An emergency closure of Brownlee Dam caused a minimum instantaneous low of 6,660 cfs on 2 September 1958 and a minimum mean daily flow of 9,320 cfs on 3 September 1958 in the Snake River at Clarkston. The minimum mean daily discharge otherwise has only fallen as low as 9,800 cfs on 29 August 1924. The minimum mean monthly flow was 11,000 cfs during August 1931. Minimum flows are not likely to be as low in the future as in the past. Since 1973 with Dworshak and other existing projects above Lower Granite, the effect has been a higher magnitude of base flows and a lengthening of the duration for 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 and 13,600 cfs with regulation by these main stream projects.

4-11. Economic Data.

a. Snake River Basin.

(1) Population. Overall, the Snake River Basin is sparsely populated, with two-thirds of the people living on farms or in small towns. The 1970 census indicates a basin population of 678,000 (upstream of Clarkston gage), which is equivalent to an average density of about six persons per square mile. The largest cities are Boise and Pocatello, with metropolitan area populations of approximately 80,000 and 40,000, respectively. Both rural and urban populations are concentrated along the Snake River and major tributaries where the principal towns and agricultural areas are located.

(2) 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 Little Goose Dam is discussed in paragraph 4-10 of this manual. House Document 403, 87th Congress, contains additional information on development of the agricultural and other resources.

(3) 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 the Snake River to Lewiston, Idaho, and played a most important part in the growth of the area. Following completion of watergrade railroads, the need for water transport over a hazardous unimproved river route was eliminated and commercial navigation operations on Snake River were soon suspended. The completion of the Lower Snake River Navigation System has re-established navigation for water transport of grain, petroleum, and other bulk commodities to terminals along the river up to Lewiston, Idaho.

b. Little Goose Region.

(1) Population. The population data presented in the following tabulations show the population changes in the three counties adjacent to the Little Goose region during a 30-year period, 1950 to 1980.

POPULATION OF LITTLE GOOSE DAM REGION

Year	County: Columbia	County: Garfield	County: Whitman
1950	4,860	3,204	32,469
1960	4,569	2,976	31,263
1970	4,489	2,911	37,900
1980	4,057	2,468	40,103

(2) Industry. Timber and agriculture are the major economic resources within the three counties (Columbia, Garfield, and Whitman) in the Little Goose region. They have a total area of about 2.4 million acres. The following tabulation outlines the land use distribution within these three counties.

LAND USE IN LITTLE GOOSE REGION

Land Use	Area (1,000 Acres)	Percent of Total Area
Forest	401	17
Agriculture	1,502	64
Range	450	19
Totals	2,353	100

(3) Irrigation. Previous preliminary investigations and the recent detailed studies made by the Bureau of Reclamation on the irrigation aspects of Lower Granite project indicate there are only a few small

scattered areas of adjacent tillable land that could be served by low-lift pumping. In view of the scattered nature of the irrigable areas and the small amount of land above normal pool level suitable for irrigation of any significance, Federal development of a reclamation project would not be feasible. Therefore, no provision has been made in the project plan for the inclusion of irrigation facilities either along the reservoir shoreline or in the dam structure. Private development of sprinkler pumping systems by individual farm ownerships could occur, with the extent and number of developments being subject to the availability of suitable access.

V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01. Data Collection.

a. General. Project data and hydrometeorological data is collected daily in order to schedule day-to-day and future regulation for both project and system operation. Project data is collected by recorded observations on gages at the dam for reporting reservoir elevations (forebay and tailwater), project inflows and outflows, power generation, and miscellaneous data (fish counts, navigation lockages, power unit status, etc.). Hydrometeorological data (climatic, streamflow, and snow course) is collected from remote locations upstream of Little Goose Dam by other subbasins with automated hydromet networks.

b. Project Gages (Water Control).

(1) Reservoir Elevation Gages. Little Goose Reservoir elevation is recorded only at the powerhouse forebay gage. This gage is a servomanometer sensor with a bubbler system. The orifice is located on the forebay face of the erection bay at elevation 618.0. The gage reading is telemetered to a two-pen recorder in the control room where it is recorded in combination with the tailwater gage.

Little Goose tailwater elevations are determined by the same type gage. The orifice is located 8 feet south of centerline of Unit 1 on downstream wall at elevation 529.0. Elevations are telemetered to the recorder in the control room. In addition to the recording water-surface elevation gages, a number of nonrecording gages are installed at various locations at the project. Four staff gages are located in the landward wall of the navigation lock:

(a) Downstream of downstream lock gate at station 42+29.75 extending from elevation 535.9 to 557.0 feet msl.

(b) Upstream of downstream lock gate at station 42+95.50 extending from elevation 535.9 to 643.0 feet msl.

(c) Downstream of upstream lock gate at station 49+52.00 extending from elevation 535.9 to 643.0 feet msl.

(d) Upstream of upstream lock gate at station 49+98.73 extending from elevation 631.9 to 643.0 feet msl.

(2) Temperature Gage. Intake water temperature at Little Goose is measured each morning by project personnel. This temperature is taken at the turbine scroll case where cooling water is withdrawn. Temperature is manually entered into the Columbia Basin Telecommunications (CBT) network, usually at the same time as daily fish counts.

(3) Reporting. The Corps of Engineers, Walla Walla District operates a project data acquisition controller for the lower Snake area. The lower Snake data acquisition system collects project data from the four lower Snake River reservoirs (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor) and Dworshak and transmits data on a scheduled basis to the Columbia River Operational Hydromet Management System (CROHMS) via the CBT network.

(4) Maintenance. Maintenance of the project gages is the responsibility of the Granite-Goose Project Engineer.

5-02. Corps of Engineers - CBT Network.

The CBT, operated by the Corps of Engineers, is basically a manual input system used for (1) transmitting project data on an hourly basis and (2) issuing day-to-day operating instructions and schedules to the project. Data is transmitted to CROHMS either by manually typing data on the teletype keyboard or by manually attaching a pre-punched paper tape. The CBT is also used to provide instructions and information from McNary, RCC, and other stations on the CBT network to the project. Commercial land-line facilities are used exclusively in this system. The Mid-Columbia Project Controller System is operated by Douglas, Grant, and Chelan County Public Utility Districts, and provides data for the CBT from the five mid-Columbia projects. The CBT network does not have inquiry capability to the remote stations. Refer to CBT Users Manual revised 15 September 1980 for details on the CBT network.

5-03. Corps of Engineers - CROHMS System.

a. General. The CROHMS is a real-time water resources data management system. A computer system is used for data reduction, system modeling, forecasting, and data base support functions. The data acquisition for these functions is supported through the Central Facility Data Controller (CFDC). Figure 5-1 on page 5-5 shows the CROHMS network diagram. Details on the CROHMS data collection system are contained in the following documents:

(1) Columbia River Basin Master Water Control Manual, December 1984.

(2) Central Facility Data Controller Users Manual, February 1984.

In addition, the CBT network, operated by the Corps of Engineers, is now merged with CROHMS. The CROHMS central facility, instead of the LINCO, performs the polling functions for the CBT circuit.

b. Use of CROHMS Data. The real-time data are used for the operational management and forecasting of the Columbia River system. The output system is designed to be flexible and easy to use in carrying out the water management responsibilities on a day-to-day basis or for special operating conditions, for maintaining surveillance of the river and reservoir system, and for developing forecasts or operating plans for future regulation.

5-04. Water Quality Stations. The Walla Walla District Environmental Resources Branch is responsible for collecting water quality data. Water quality data is collected quarterly at two stations within Lower Granite reservoir (RM's 107 and 120) and at three downstream stations: RM 83 (Little Goose), RM 44 (Lower Monumental), and RM 18 (Ice Harbor). The parameters collected in profile are temperature, pH, turbidity, and alkalinity. Samples for selected chemical, physical, and biological parameters are also collected at these stations. Dissolved gases data has been collected seasonally during the downstream migration of the salmon and steelhead smolts. At present (October 1985), permanent stations with satellite reporting capabilities are being established at the four lower Snake River Dams.

5-05. Communications. Direct communication between the project and the District Office is normally by telephone via a leased line between McNary and Walla Walla, then via microwave to Little Goose.

A large amount of river, reservoir, weather, and related operating data are transmitted via the CBT network. The CBT network connects NPD and the Walla Walla, Portland, and Seattle District offices with all major projects in the Columbia River Basin system. The network also includes BPA, Portland, Oregon; British Columbia Hydro Office, Vancouver, British Columbia; Bureau of Reclamation and Weather Bureau offices, Boise, Idaho; and the Geological Survey Northwest Regional Water Data Center in Portland, Oregon. In the Walla Walla District, a transmitting and receiving teletype machine for this network is located in Operations Division. This system is also capable of accepting computer output tapes or producing computer input tapes in addition to the standard printouts and manually cut tapes. This permits computer processing of hand reports, etc. from the projects and some loading and regulation message tapes to be used and transmitted directly by the project system optimizer controller.

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 (MHz). Two relay stations, one near Pomeroy in the Blue Mountains and one near Kennewick, are provided to increase mobile and portable units radio coverage. Microwave radio channels link the project control rooms and the District office.

When the operator at Little Goose leaves the control room, McNary can switch the microwave radio system so that it is rebroadcast over the mobile or portable frequency, 163.4125 MHz, 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. He 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.

CROHMS

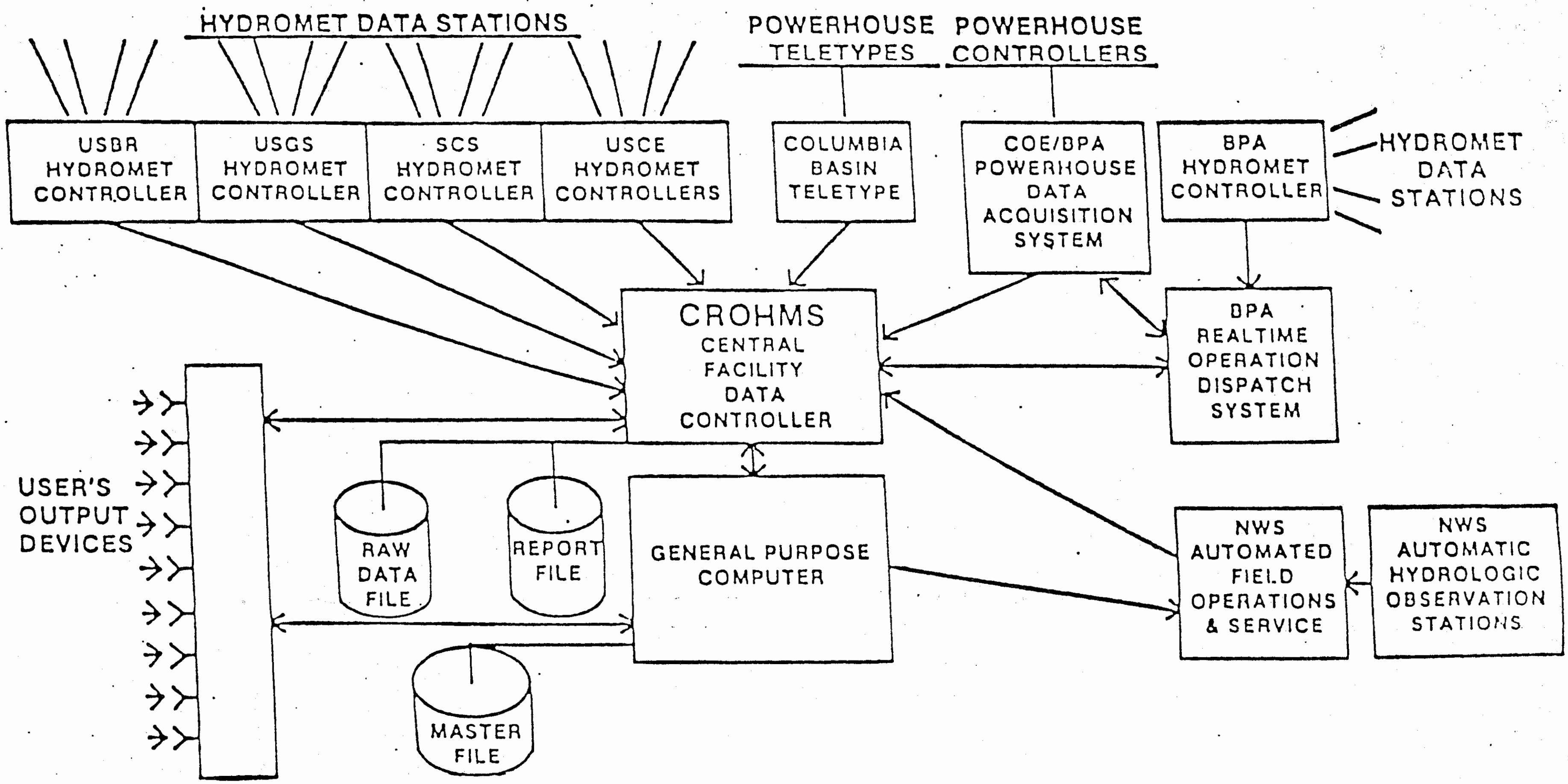


FIG. 5-1 CROHMS NETWORK DIAGRAM

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. Little Goose is a part of this system. Functional water regulation at Little Goose project is the responsibility of NPD's Engineering Division. Physical operation and maintenance are the responsibility of 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 Little Goose 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 Little Goose project is the responsibility of the project engineer who is under the supervision of the Operations Division, Walla Walla District. Pages 6-9 through 6-12 show organizational charts, corresponding personnel names and telephone numbers pertinent to the operation of Little Goose for the Corps of Engineers and BPA.

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 BPA. 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, BPA

c. 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. Little Goose 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 NPD and BPA documents the policies and procedures to be 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.

d. 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 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 Northwest Power Pool are carried out by means of an Operating Committee and a Coordinating Group:

(1) Operating Committee. The Operating Committee handles Northwest Power Pool matters and consists of one member from each participating utility or agency. 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 PUD

(5) Colockum Transmission Company
(6) Cowlitz County PUD
(7) Douglas County PUD
(8) Eugene Water and Electric Board
(9) Grant County PUD
(10) Montana Power Company
(11) Pacific Power and Light Company
(12) Pend Oreille County PUD
(13) Portland General Electric Company
(14) Puget Sound Power and Light Company
(15) Seattle City Light
(16) Snohomish County PUD
(17) Tacoma City Light
(18) 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 FLCC.

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 ECC'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 be 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.

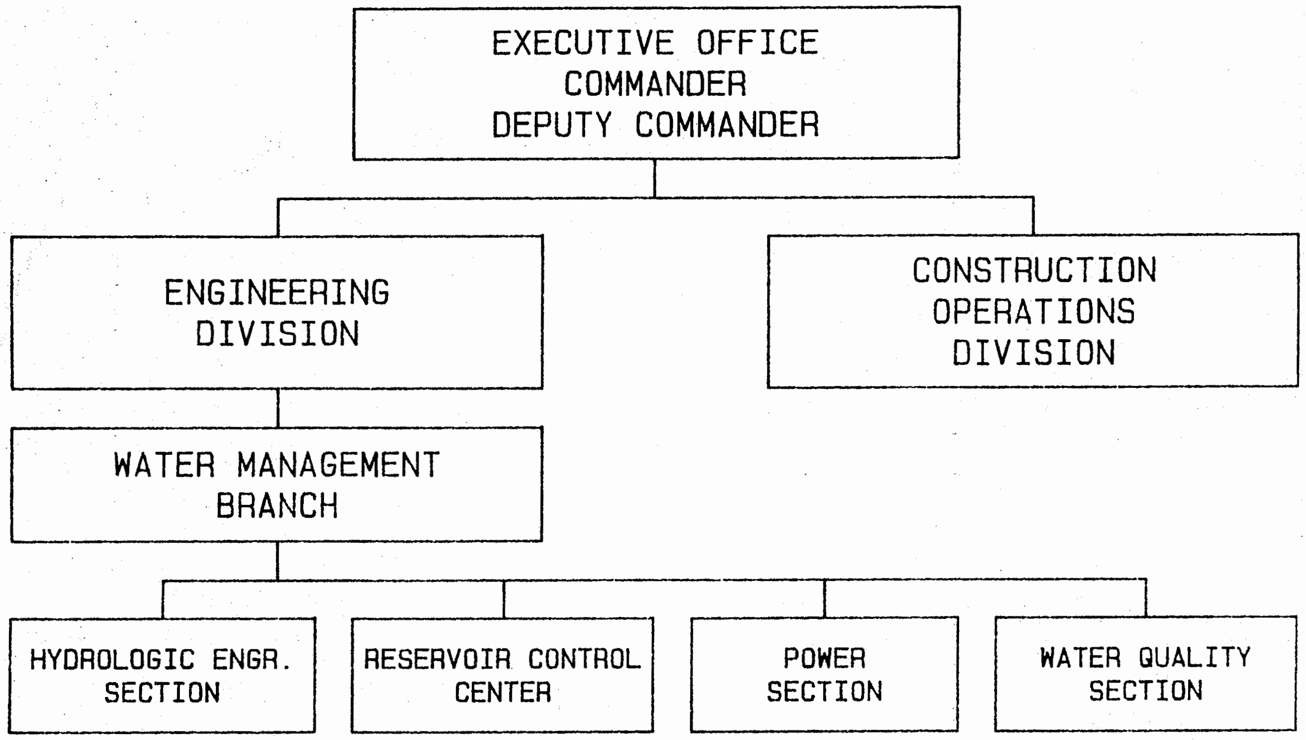
The membership of the Columbia River Management Group is composed of representatives from the following state and Federal agencies:

(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

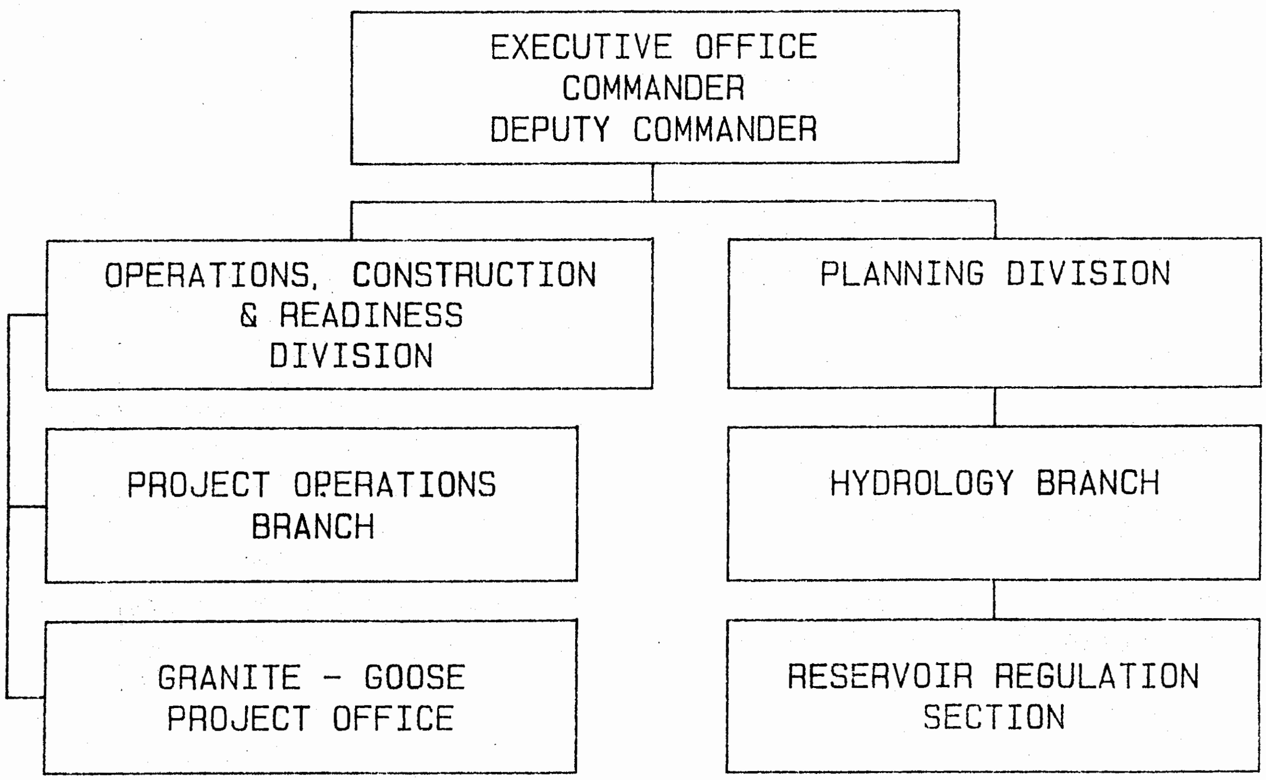
(7) U.S. Forest Service
(8) Soil Conservation Service
(9) Bureau of Land Management
(10) Federal Energy Regulatory Commission
(11) Fish and Wildlife Service
(12) National Marine Fisheries Service
(13) Oregon Water Resources Department
(14) Washington Department of Ecology
(15) Idaho Department of Ecology
(16) Nevada State Engineer
(17) Department of Natural Resources and Conservation (Montana)
(18) Wyoming State Engineer

6-03. Regulation Decisions and Records. The 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 be kept current both at the project and the RCC. Regulation decisions and instructions are discussed with appropriate project personnel and confirmed both on the CBT and the CROHMS (Report No. 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.

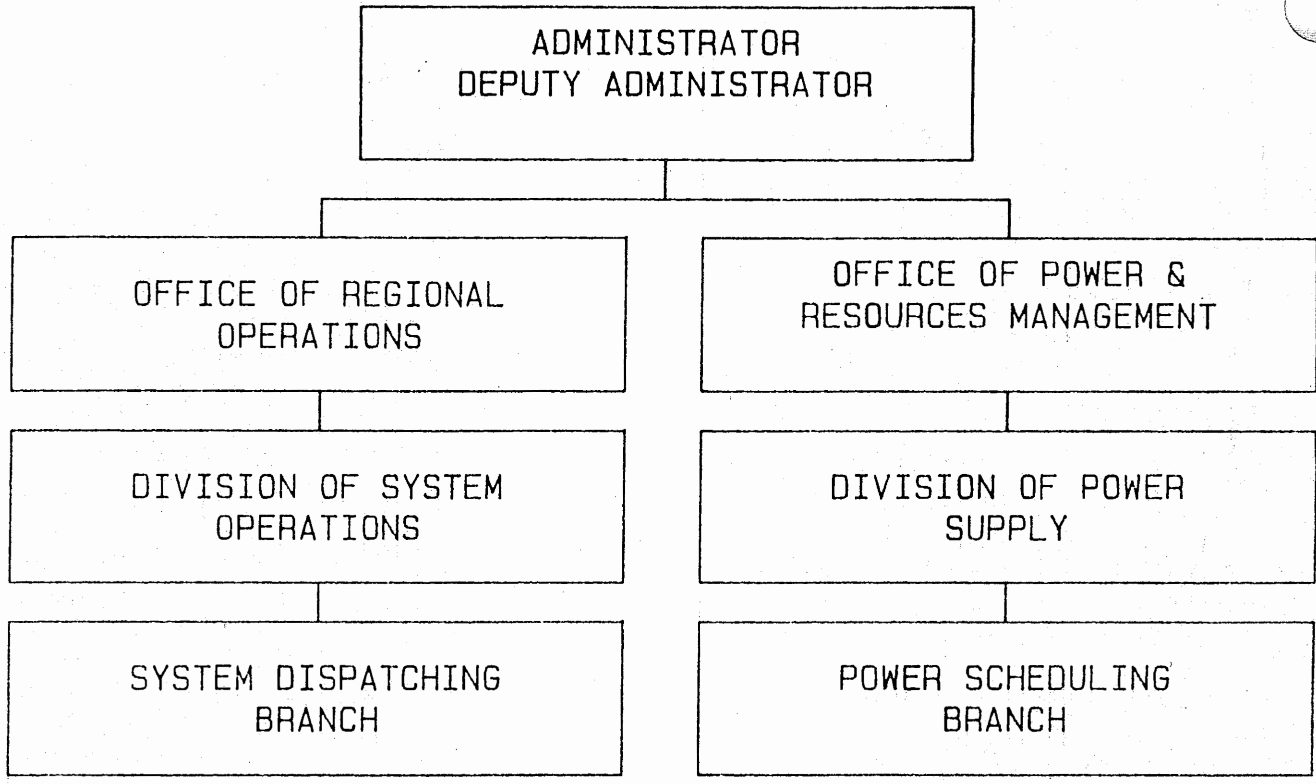
ORGANIZATION CHART
CORPS OF ENGINEERS - NORTH PACIFIC DIVISION



ORGANIZATION CHART
CORPS OF ENGINEERS - WALLA WALLA DISTRICT



ORGANIZATION CHART
BONNEVILLE POWER ADMINISTRATION



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VII - STREAMFLOW FORECASTS

7.01. General. The development of reservoir regulation plans for the Little Goose project is based primarily on power operations and daily streamflow forecasts. The NPD 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, BPA, Bureau of Reclamation, Corps of Engineers, Soil Conservation Service, and the Northwest River Forecast Center. The River Forecast Center 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 RCC uses the Streamflow Synthesis and Reservoir Regulation (SSARR) model. The SSARR model utilizes routing procedures, snowmelt, 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.

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

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

b. 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.

c. 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 (Monday, Wednesday, and Friday) per week. 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 purposes of navigation and power. Regulation to optimize these authorized uses also provides suitable conditions for secondary uses of recreation and fish and wildlife. Flood control is not an authorized or planned project function because as a run-of-river project, the amount of reservoir storage is small compared to riverflows. Irrigation is also not an authorized or planned project function; however, private development of pumping systems could occur with development being limited to the availability of suitable sites.

8-02. Major Constraints.

a. Lake Elevation Limits. Little Goose Reservoir will normally be operated between elevations 633 and 638. 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 632.5-638.5 elevation range will not be violated without prior District Office approval except in an emergency. District Office approval will be coordinated through the Chief, Operations Division. If artificial flooding occurs 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 633 to 638, insofar as possible. The rate of spillway gate movement, 1.0 foot per minute at small openings increasing to 1.3 feet per minute at large gate openings, will accommodate an extremely rapid rise in streamflow if the equipment is functioning normally. When fully open, the eight spillway gates will pass 676,000 cfs at pool elevation 638. Should the riverflow exceed 676,000 cfs, elevation 638 will be exceeded even with all spillway gates fully open. Except in a definite emergency, elevation 638.5 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 riverflow 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 RCC will be responsible for coordinating such "zero" flow requests with the fishery agencies for approval. Water stored under "zero" riverflow conditions may maximize power production from the Columbia River Basin system, but "zero" riverflow operations are not recommended at Little Goose 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-foot-per-hour rate of change for tailwater elevation. Plate 3-8 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 bays and gates are numbered 1 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 page 8-3 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 3-2 is the discharge rating for one spillway gate and Plate 3-7 shows similar data in graphical form.

TABLE 8-1

LITTLE GOOSE SPILL PATTERN
(1 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	1		
1	(1)	0	0	0	0	1	1		
1	1	(1)	0	0	1	1	1		
1	1	1	(1)	1	1	1	1		
1	1	(2)	1	1	2	1	1	10	19
1	1	2	(2)	2	2	1	1		
(2)	1	2	2	2	2	1	2		
2	2	2	2	2	2	(2)	2		
(3)	2	2	2	2	2	2	3		
3	2	(3)	(3)	2	2	2	3	20	39
3	3	3	3	2	(3)	2	3		
3	3	3	3	2	3	(3)	4		
3	3	3	(4)	3	3	3	4		
4	3	(4)	4	3	3	3	4		
4	4	4	4	3	3	(4)	4	30	60
5	(5)	4	4	3	3	4	4		
5	5	(5)	4	4	3	4	4		
5	5	5	4	4	(4)	4	5		
5	(6)	5	5	4	4	4	5		
5	6	5	5	4	4	(5)	6	40	80
(6)	6	5	5	4	5	5	6		
6	6	5	5	(5)	5	6	6		
(7)	6	5	5	5	5	(6)	7		
7	6	5	(6)	6	5	6	7		
7	6	(6)	6	6	6	6	7	50	100
7	6	6	(7)	7	6	6	7		
7	(7)	6	7	7	7	6	7		
7	7	(7)	7	7	7	7	7		
8	7	7	7	7	7	7	(8)		
8	7	(8)	7	8	7	7	8	60	120
8	7	8	(8)	8	8	7	8		
8	(8)	8	8	8	8	8	8		
(9)	8	8	8	8	8	8	9		
9	8	(9)	8	9	8	8	9		
9	8	9	(9)	9	9	8	9	70	140

1/ Reservoir elevation 638.

NOTE: Values in parenthesis may be 1 increment less than indicated. For example: (2) means 2 or 1 increments
(3) means 3 or 2 increments.

Source: Walla Walla District - Fish Facility Operation and Maintenance Plan, Appendix C - Operating Standards for Adult Fish Passage Facilities.

8-03. Flood Control Plan. Flood control is not a planned project function because Little Goose 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 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 RCC some flexibility and judgment in the operation of lower Snake River reservoir system.

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 and 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 fact that most fish passed 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, PL 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 North Pacific Division, Corps of Engineers is responsible for developing and implementing the Juvenile Fish Passage Plan for Corps of Engineers projects.

b. Lower Snake River Fish and Wildlife Program.

(1) Lower Granite Water Budget. The 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 to 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 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 BPA.

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 be 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 Apr - 30 Apr	50
1 May - 31 May	65
1 Jun - 15 Jun	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 NPD 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. Water Budget requests may not be implemented if they conflict with other nonpower constraints at Dworshak. The severity of the conflict will be analyzed by the NPD RCC and appropriate action taken, with documentation of the basis of the decision forwarded to the Fish Passage Managers.

(b) Non-water 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. Juvenile Fish Transportation Program. In addition to the juvenile fish passage facilities for moving fish past the dam during their downstream migration, a program exists whereby barges and trucks are used to transport fish collected at Lower Granite, Little Goose, and McNary to points below Bonneville Dam. This program is a means of decreasing travel times in the river and eliminating passage mortality at downstream projects. When fish are diverted at the power intakes into the bypass system and juvenile collection system, the capability exists to either allow them to enter the bypass for discharge below the dam or to divert them to holding areas for loading into trucks and barges. The facilities at Lower Granite Dam are used mostly for collection, and bypass capability is used only when the collection facility malfunctions, special studies are being conducted, or fish numbers make transportation unfeasible.

The juvenile fish passage facilities are described in paragraph 3-03.b(8)(b). From 1 April to the end of the transportation season, Lower Granite's juvenile fish facilities will be operated according to criteria in the Walla Walla District - Fish Facility Maintenance Plans, Appendix D - Operating Standards For Downstream Migrant Fish Passage Facilities and the Fish Transportation Oversight Team's (FTOT) Annual Work Plan for transport operations at Lower Granite, Little Goose, and McNary Dams.

Spillway releases may be required during the outmigration period to facilitate fish passage past the dam if problems develop with the bypass system, juvenile collection system, or transport operations. This is separate from the Water Budget, which is only intended to facilitate migration downstream between the dams.

8-05. Power Plan. Little Goose project is operated for power within the foregoing pondage and release limitations and in accordance with a working agreement between the Corps of Engineers and BPA, the marketing agency for Federally generated power in the Pacific Northwest. Power scheduling for Little Goose is accomplished by BPA in coordination with NPD Corps of Engineers. To implement scheduling and maintain optimum operating conditions, close coordination between the Little Goose and McNary powerplant operators and the BPA dispatchers is essential. Routine power operations are remotely controlled from McNary through the system optimizer controller, which can also remotely control Ice Harbor, Lower Monumental, and Lower Granite projects. Discussion of overall coordinated operation of the Northwest Federal Power System is presented in the Columbia River Basin Master Water Control Manual dated December 1984.

Load factoring may be accomplished by making use of the 49,000 acre-feet of storage between elevations 633 and 638 when the reservoir inflow is less than powerplant hydraulic capacity and downstream projects accommodate the extra flow. The discharge capacity of the powerplant is about 130,000 cfs in the range of normal operating head.

Generally, the power units will be operated to provide maximum 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 fingerling fish which pass through the turbines. Turbine unit operating priority is 1, 2, 3, and then 4 through 6. All operations will be within the safe limitations of the equipment as set forth in the Operations and Maintenance Manual. The BPA 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 breakup which would leave Little Goose project the only major generating facility on an isolated segment of the BPA 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 5-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 when the project operates within normal operating levels (638 to 633) for multipurpose project functions. However, special navigation requirements are met by special regulation of pool levels.

The lock facilities are operable at the full range of normally experienced riverflows. 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 unscheduled closure of the lock facilities or other navigation matters is provided 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 1-hour period.

Head	Lockage Volume	
(feet)	(acre-feet)	(cfs-hour)
104	150	1814
100	144	1744
96	138	1675
92	133	1605
88	127	1535
84	121	1465
80	115	1396

8-07. Recreation Plan. The plan of operation of Little Goose project does not specifically provide for special regulation of the reservoir in the interest of recreation. The recreation facilities are constructed to accommodate the 5-foot reservoir fluctuations between elevations 633 and 638 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 special interest of recreation for short periods.

8-08. Special Operations. Special reservoir regulation activities, which are not considered 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 RCC 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 Little Goose project will be issued by Operations Division of the Walla Walla District Corps of Engineers. 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 Granite-Goose 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. Little Goose 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. Table B-1 in 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 through 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 CBT systems outage, communication between the project and the RCC will be established via the Walla Walla District radio system.

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:

a. Production of hydroelectric power.

b. Water-oriented recreational opportunities for the public.

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

d. 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. Since Little Goose is operated as a run-of-river project, the amount of reservoir storage is small compared to the volume of flow in the river and, as a result, riverflow passing the dam would not be significantly reduced by reservoir routing. However, the cumulative of drawing down Lower Granite 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. Little Goose 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. A fish ladder at the project is effective in providing passage past the dam for upstream migrating fish. A bypass system is also effective in moving 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 being drawn through the turbines. The juvenile passage through the turbines is hazardous because juveniles are subjected to extreme pressure differences and impacts in the turbines that can easily result in injury or death. A mechanical device called a submersible traveling screen is used to divert fish out of turbine intakes and into gatewells from where they continue their passage through the bypass system. Physical transport by truck or barge 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 and collection facilities and physical transport methods.

b. Flow Augmentation for Downstream Migrants. In addition to fish passage facilities and physical transport, well-timed and increased flows through the Little Goose Reservoir will also contribute to greater survival rates for outmigrating fish. The effects of the slow-moving current through the reservoir on juveniles include increased migration time, increased stress, 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 Dam and Little Goose Dam. Hydraulic capacity of the powerplant is approximately 130,000 cfs. However, if problems develop with the juvenile bypass and collection facilities, 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 may be drawn from storage in Dworshak and Brownlee if available. The effect on Dworshak and Brownlee is a reduction of the FELCC, which will also affect the FELCC of the entire Federal Columbia River Power System.

9-04. Hydroelectric Power. Power produced by Little Goose 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 Granite 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 Little Goose 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 Little Goose project has greatly improved the recreation opportunities for the region's major population centers of Lewiston-Clarkston and Moscow-Pullman. The relatively stable pool levels provided by operation between elevations 638 and 633 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 water quality in Little Goose Reservoir is influenced mainly by the following factors:

a. The water quality of the inflows from the Snake and Clearwater Rivers.

b. The ability of the cities of Lewiston and Clarkston and the Potlatch Corporation to meet state and Federal effluent treatment standards.

c. Changes in water quality by impoundment in Lower Granite Reservoir immediately upstream.

The regulation of Little Goose 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 Little Goose. 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 from 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	5	298,000	214,000
50	2	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 (127 years) period. Observed flows have been adjusted for irrigation depletion 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:

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	5	730,000	450,000
50	2	580,000	365,000

LITTLE GOOSE LOCK AND DAM - WATER CONTROL MANUAL

TABLES

TABLE 3-1

LITTLE GOOSE 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
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

TABLE 3-1 (Continued)

LITTLE GOOSE MEAN UNIT PERFORMANCE

Power Output MW	GROSS HEAD IN FEET 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
	DISCHARGE IN CFS																							
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
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

TABLE 3-1 (Continued)

LITTLE GOOSE MEAN UNIT PERFORMANCE

Power Output	GROSS HEAD IN FEET																							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	MW
	DISCHARGE IN CFS																							
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	15299	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	14016	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

TABLE 3-1 (Continued)

LITTLE GOOSE MEAN UNIT PERFORMANCE

Power Output	GROSS HEAD IN FEET																							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	MW
	DISCHARGE IN CFS																							
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

TABLE 3-2

LITTLE GOOSE DAM
GATED SPILLWAY RATING TABLE

STOP 1/	GATE 2/	REVC 3/	632.0	632.5	633.0	633.5	634.0	634.5	635.0	635.5	636.0	636.5	637.0	637.5	638.0	638.5	639.0
			POOL ELEVATION - M.S.L.														
			Flow Under One Gate in 1,000 cfs														
1	0.95	12.9	1.74	1.75	1.75	1.76	1.77	1.78	1.79	1.80	1.80	1.81	1.82	1.83	1.84	1.84	1.85
2	1.98	25.9	3.61	3.62	3.64	3.66	3.68	3.69	3.71	3.73	3.75	3.76	3.78	3.80	3.81	3.83	3.85
3	3.07	38.9	5.57	5.60	5.63	5.65	5.68	5.71	5.74	5.76	5.79	5.81	5.84	5.87	5.89	5.92	5.95
4	4.16	51.9	7.52	7.55	7.59	7.63	7.66	7.70	7.74	7.77	7.81	7.85	7.88	7.92	7.95	7.99	8.02
5	5.25	64.9	9.45	9.49	9.54	9.59	9.64	9.68	9.73	9.78	9.82	9.87	9.91	9.96	10.00	10.05	10.09
6	6.35	77.9	11.38	11.44	11.49	11.55	11.61	11.66	11.72	11.78	11.83	11.89	11.95	12.00	12.06	12.11	12.17
7	7.45	90.9	13.29	13.36	13.43	13.50	13.56	13.63	13.70	13.76	13.83	13.90	13.96	14.03	14.09	14.16	14.22
8	8.57	103.9	15.22	15.30	15.38	15.46	15.54	15.62	15.70	15.77	15.85	15.93	16.00	16.08	16.15	16.23	16.30
9	9.68	116.9	17.12	17.21	17.30	17.39	17.48	17.57	17.66	17.75	17.83	17.92	18.01	18.09	18.18	18.26	18.35
10	10.84	129.9	19.09	19.19	19.30	19.40	19.50	19.60	19.70	19.80	19.89	19.99	20.09	20.19	20.28	20.38	20.48
11	12.02	142.9	21.08	21.19	21.31	21.42	21.53	21.64	21.75	21.87	21.98	22.08	22.19	22.30	22.41	22.52	22.62
12	13.21	155.9	23.06	23.18	23.31	23.44	23.56	23.68	23.81	23.93	24.05	24.17	24.29	24.41	24.53	24.65	24.77
13	14.39	168.9	25.01	25.15	25.29	25.42	25.56	25.70	25.83	25.97	26.10	26.23	26.37	26.50	26.63	26.76	26.89
14	15.58	181.9	26.96	27.11	27.26	27.42	27.56	27.71	27.86	28.01	28.15	28.30	28.45	28.59	28.73	28.88	29.02
15	16.77	194.9	28.90	29.07	29.23	29.39	29.56	29.72	29.88	30.04	30.20	30.35	30.51	30.67	30.82	30.98	31.13
16	17.95	207.9	30.82	31.00	31.18	31.35	31.53	31.70	31.88	32.05	32.22	32.39	32.56	32.73	32.90	33.06	33.23
17	19.17	220.9	32.79	32.98	33.17	33.36	33.55	33.74	33.92	34.11	34.30	34.48	34.66	34.84	35.03	35.21	35.39
18	20.41	233.9	34.78	34.98	35.19	35.40	35.60	35.80	36.00	36.20	36.40	36.60	36.80	36.99	37.19	37.38	37.58
19	21.66	246.9	36.79	37.01	37.24	37.46	37.67	37.89	38.11	38.32	38.54	38.75	38.96	39.17	39.38	39.59	39.80
20	22.91	259.9	38.79	39.03	39.27	39.50	39.74	39.97	40.20	40.43	40.66	40.89	41.12	41.34	41.56	41.79	42.01
21	24.16	272.9	40.82	41.08	41.33	41.58	41.83	42.08	42.33	42.57	42.82	43.06	43.30	43.54	43.78	44.02	44.25
22	25.41	285.9	42.85	43.12	43.39	43.66	43.93	44.19	44.46	44.72	44.98	45.24	45.50	45.75	46.01	46.26	46.51
23	26.65	298.9	44.85	45.14	45.43	45.71	46.00	46.28	46.56	46.84	47.11	47.39	47.66	47.93	48.21	48.47	48.74
24	27.89	311.9	46.88	47.19	47.49	47.79	48.10	48.39	48.69	48.99	49.28	49.57	49.86	50.15	50.44	50.72	51.01

1/ Increment stops; reading on bidirectional digital counter.
2/ Nominal gate opening, feet; vertical distance, gate seal to gate; average of 8 bays.
3/ Revolution counter reading.

TABLE 3-3

Little Goose Water Control Manual
RESERVOIR STORAGE CAPACITY

Res. Inflow Pool Elev.	Reservoir Capacity in Acre-feet 30,000 cfs or less Volume	Diff.	100,000 cfs Volume	Diff.	200,000 cfs Volume	Diff.
632.0	506,700	960	507,800	940	511,200	900
632.1	507,660		508,740		512,100	
632.2	508,620		509,680		513,000	
632.3	509,580		510,620		513,900	
632.4	510,540		511,560		514,800	
632.5	511,500		512,500		515,700	
632.6	512,460		513,440		516,600	
632.7	513,420		514,380		517,500	
632.8	514,380		515,320		518,400	
632.9	515,340		516,260		519,300	
633.0	516,300	970	517,200	950	520,200	940
633.1	517,270		518,150		521,140	
633.2	518,240		519,100		522,080	
633.3	519,210		520,050		523,020	
633.4	520,180		521,000		523,960	
633.5	521,150		521,950		524,900	
633.6	522,120		522,900		525,840	
633.7	523,090		523,850		526,780	
633.8	524,060		524,800		527,720	
633.9	525,030		525,750		528,660	
634.0	526,000	970	526,700	960	529,600	950
634.1	526,970		527,660		530,550	
634.2	527,940		528,620		531,500	
634.3	528,910		529,580		532,450	
634.4	529,880		530,540		533,400	
634.5	530,850		531,500		534,350	
634.6	531,820		532,460		535,300	
634.7	532,790		533,420		536,250	
634.8	533,760		534,380		537,200	
634.9	534,730		535,340		538,150	
635.0	535,700	970	536,300	980	539,100	960
635.1	536,670		537,280		540,060	
635.2	537,640		538,260		541,020	
635.3	538,610		539,240		541,980	
635.4	539,580		540,220		542,940	
635.5	540,550		541,200		543,900	
635.6	541,520		542,180		544,860	
635.7	542,490		543,160		545,820	
635.8	543,460		544,140		546,780	
635.9	544,430		545,120		547,740	

TABLE 3-3 (Continued)

Little Goose Water Control Manual
RESERVOIR STORAGE CAPACITY

Res. Inflow Pool Elev.	Reservoir Capacity in Acre-feet: 30,000 cfs or less Volume	Diff.	100,000 cfs Volume	Diff.	200,000 cfs Volume	Diff.
636.0	545,400	980	546,100	1,000	548,700	980
636.1	546,380		547,100		549,680	
636.2	547,360		548,100		550,660	
636.3	548,340		549,100		551,640	
636.4	549,320		550,100		552,620	
636.5	550,300		551,100		553,600	
636.6	551,280		552,100		554,580	
636.7	552,260		553,100		555,560	
636.8	553,240		554,100		556,540	
636.9	554,220		555,100		557,520	
637.0	555,200	1,000	556,100	1,000	558,500	990
637.1	556,200		557,100		559,490	
637.2	557,200		558,100		560,480	
637.3	558,200		559,100		561,470	
637.4	559,200		560,100		562,460	
637.5	560,200		561,100		563,450	
637.6	561,200		562,100		564,440	
637.7	562,200		563,100		565,430	
637.8	563,200		564,100		566,420	
637.9	564,200		565,100		567,410	
638.0	565,200	1,000	566,100	1,000	568,400	990
638.1	566,200		567,100		569,390	
638.2	567,200		568,100		570,380	
638.3	568,200		569,100		571,370	
638.4	569,200		570,100		572,360	
638.5	570,200		571,100		573,350	
638.6	571,200		572,100		574,340	
638.7	572,200		573,100		575,330	

SUMMARY OF CLIMATOLOGICAL DATA
REPRESENTATIVE FOR LITTLE GOOSE DAMSITE

Climatological Element	Station		Record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
						Temperature - degrees F										
Long-term mean	Dayton	1WSW 1/	59 Years	31.9	36.2	43	50.4	57.3	63	70.4	69	62.1	52.2	40.3	35.2	50.9
	LaCrosse	3ESE 2/	51 Years	30	34.6	42.2	49.4	56.2	62.5	70.1	68	60.7	50.4	38.6	33.4	49.7
	Wawawai	2NW 3/	18 Years	34.4	38.6	48	54.8	61.6	67.4	76.6	74.8	66.8	56.7	43	38	55.1
Average maximum	Dayton	1WSW	55 Years	39.1	43.9	53.1	62.4	70	77.2	87.1	85.1	75.3	64.3	49.5	41.3	62.3
	LaCrosse	3ESE	45 Years	36.1	42.8	53.8	63.5	71.2	78.6	88.9	87.2	77	64.2	47.8	38.8	62.3
	Wawawai	2NW	16 Years	41.3	47	56.7	67.5	75.7	81.4	92.1	90.6	81.6	67.5	50.2	44.2	66.3
Average minimum	Dayton	1WSW	55 Years	24.2	28.1	33.9	38.7	44.1	49.5	54.5	53.7	47.3	39.6	32	27.6	39.3
	LaCrosse	3ESE	45 Years	21.9	26.8	32.1	35.8	41	46.9	51.5	49.6	43.2	35.8	30.2	25.7	36.8
	Wawawai	2NW	16 Years	28.3	31.2	37.2	42.7	48	53.3	60.3	58.6	53	45	35.5	32.1	45.8
Highest recorded	Dayton	1WSW	59 Years	70	71	84	93	99	105	108	109	100	92	79	69	109
	LaCrosse	3ESE	51 Years	64	64	80	92	98	105	110	106	104	92	71	65	110
	Wawawai	2NW	18 Years	64	71	78	96	103	109	112	110	105	94	77	69	112
Lowest recorded	Dayton	1WSW	59 Years	-22	-22	2	17	26	29	32	32	19	7	-9	-19	-22
	LaCrosse	3ESE	51 Years	-29	-30	0	8	23	26	32	28	15	0	-8	-17	-30
	Wawawai	2NW	18 Years	-9	-6	16	19	35	39	45	42	29	11	9	-2	-10
						Precipitation - inches										
Long-term mean	Dayton	1WSW	60 Years	2.39	1.92	2.15	1.57	1.4	1.55	0.46	0.27	0.81	1.92	2.42	2.72	19.58
	LaCrosse	3ESE	51 Years	1.8	1.4	1.34	0.97	0.92	1.19	0.3	0.26	0.69	1.36	1.76	2.18	14.17
	Pleasant View 4/		23 Years	1.18	1.3	1.18	1.03	1.15	1.15	0.16	0.14	0.63	1.13	1.47	1.53	12.05
Maximum year	Dayton	1WSW	1882	2.56	6.16	1.97	4.08	1.93	0.77	0.83	0.14	0.94	4.14	2.61	7.12	33.52
	LaCrosse	3ESE	1927	2.2	2.79	2.36	0.62	1.32	1.09	0.14	0.37	5.15	2.14	4.62	1.1	23.9
	Pleasant View		1948	1.9	1.98	0.37	2.12	2.91	1.69	1.1	0.24	0.54	0.73	1.21	2.4	17.19
Minimum year	Dayton	1WSW	1944	0.92	2.53	0.77	2.19	0.72	1.13	T	T	0.91	0.23	1.47	1.2	12.07
	LaCrosse	3ESE	1944	0.55	1.71	0.28	1.83	0.49	0.81	T	0.26	0.41	0.3	1.22	0.72	8.58
	Pleasant View		1939	1.01	0.85	1.43	0.45	0.21	0.35	0.12	0	0.2	0.44	0.06	2.73	7.85
Maximum monthly	Dayton	1WSW	60 Years	6.23	6.16	5.79	4.08	4.13	4.41	2.6	3.04	4.79	4.96	5.41	7.93	----
	LaCrosse	3ESE	51 Years	5.19	4.92	4.5	3.52	4.59	3.28	1.84	1.78	5.15	3.63	5.1	4.38	----
	Pleasant View		23 Years	4.64	4.92	2.64	2.17	3.16	3.15	1.1	0.76	2.2	4.01	3.33	3.2	----
Minimum monthly	Dayton	1WSW	60 Years	0.82	0.31	0.05	0.06	0.12	0.07	0	0	0.01	0	0.04	0.85	----
	LaCrosse	3ESE	51 Years	0.33	0.22	0	0.1	0.04	0.02			0		0.05	0.61	----
	Pleasant View		23 Years	0.24	0.34	0.31	0.03	0.21	0.1	0	0	0	0	0.01	0.41	----
Maximum 24-hour	Dayton	1WSW	60 Years	1.36	1.7	2.08	1.23	2.12	1.62	1.56	2.12	1.4	1.48	1.99	2.06	----
	LaCrosse	3ESE	59 Years	1.04	1.15	1.25	1.24	1.18	1.2	1.01	1.02	1.19	1.34	1.52	1.16	----
	Wawawai	2NW	18 Years	1.47	1.61	2.5	1.15	1.26	2	0.8	0.75	2.08	1.4	1.82	1.64	----
						Snowfall - inches										
Long-term mean	Dayton	1WSW	53 Years	8.5	5.6	2.5	0.2	T	0	0	T	T	0.1	2	5.1	24
	LaCrosse	3ESE	44 Years	7.6	4.5	1	0.2	T	0	0	0	T	0.4	1.4	5	20.1
	Wawawai	2NW	17 Years	2.4	1.5	0.3	T	0	0	0	0	0	T	0.2	1.6	6
						Wind speed - miles per hour										
Prevailing direction	Kennewick	5/	35 Years	SW	SW	SW	SW	SW	SW	SW	SW	W	SW	W	W	SW
Average speed		6/	73 Years	7	7	8	9	9	8	8	8	8	7	6	6	7.6
Highest speed		6/	69 Years	56	54	56	50	40	60	57	50	40	56	54	70	----
						Mean relative humidity in percent										
4:00 a.m. PST		7/	7/	80	80	70	68	66	64	55	55	62	70	82	80	----
10:00 a.m. PST		7/	7/	76	72	60	50	48	44	36	38	46	60	73	76	----
4:00 a.m. PST		7/	7/	74	64	46	38	35	34	22	22	34	50	68	74	----
10:00 a.m. PST		7/	7/	84	82	72	65	62	60	46	46	58	74	84	85	----

Notes:
1/ Dayton, Washington, elevation 1,557 feet, located about 19 miles south of damsite.
2/ LaCrosse, Washington, elevation 1,546 feet, located about 15 miles north of damsite.
3/ Wawawai, Washington, elevation 657 feet, located about 32 miles east of damsite on Snake River.
4/ Pleasant View, Washington, elevation 1,650 feet, located about 16 miles southwest of damsite.
5/ Kennewick, Washington, elevation 510 feet, located about 58 miles southwest of damsite.
6/ Based on U.S. Weather Bureau records at Spokane, Yakima, and Walla Walla, Washington.
7/ Developed from charts using 13 years of record at Yakima, 66 years of record at Spokane, and 25 years of record at Walla Walla, Washington; 13 years of record at Lewiston, Idaho, and 20 years of record at Pendleton, Oregon.

TABLE 4-2

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

Water Year	Station Name	Annual KAF	Runoff Inches	Mean Daily Discharge Maximum cfs	Date	Minimum cfs	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	213,000	16 MAY	12,200	20 DEC
1937	CLARKSTON	22,310	4.06	110,000	19 MAY	10,800	10 JAN
1938	CLARKSTON	37,540	6.82	214,000	29 MAY	15,200	1 OCT
1939	CLARKSTON	27,320	4.96	144,000	4 MAY	14,000	21 AUG
1940	CLARKSTON	28,810	5.23	125,000	13 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	208,000	20 APR	17,900	11 OCT
1944	CLARKSTON	25,500	4.63	105,600	16 MAY	16,400	13 SEP
1945	CLARKSTON	30,800	5.60	148,000	7 JUN	16,100	14 DEC
1946	CLARKSTON	37,860	6.88	166,000	20 APR	17,800	20 AUG
1947	CLARKSTON	40,410	7.34	230,000	9 MAY	19,000	21 AUG
1948	CLARKSTON	46,390	8.43	349,500	29 MAY	20,200	16 SEP
1949	CLARKSTON	48,390	6.97	243,100	17 MAY	17,200	3 SEP
1950	CLARKSTON	42,730	7.76	200,000	17 JUN	19,200	5 JAN

TABLE 4-2 (Continued)

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

Water Year	Station Name	Annual Runoff KAF	Annual Runoff Inches	Mean Daily Discharge Maximum cfs	Date	Minimum cfs	Date
1951	CLARKSTON	43,060	7.82	179,000	25 MAY	19,200	16 SEP
1952	CLARKSTON	46,590	8.46	237,000	28 APR	20,700	27 AUG
1953	CLARKSTON	37,710	6.85	226,000	14 JUN	15,600	30 NOV
1954	CLARKSTON	35,320	6.42	204,000	21 MAY	20,500	10 SEP
1955	CLARKSTON	30,890	5.61	199,000	13 JUN	17,500	10 SEP
1956	CLARKSTON	48,460	8.80	277,100	25 MAY	20,400	5 OCT
1957	CLARKSTON	42,700	7.76	293,800	20 MAY	18,300	31 JAN
1958	CLARKSTON	37,470	6.81	239,800	22 MAY	9,320 7/	3 SEP
1959	CLARKSTON	36,760	6.68	167,600	7 JUN	13,400	8 OCT
1960	CLARKSTON	35,180	6.39	157,400	5 JUN	15,900	22 AUG
1961	CLARKSTON	30,000	5.45	168,000	27 MAY	13,000	15 AUG
1962	CLARKSTON	32,680	5.94	133,000	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
1967	CLARKSTON	33,790	6.14	205,000	24 MAY	15,500	22 AUG
1968	CLARKSTON	31,100	5.65	129,000	4 JUN	16,100	11 OCT
1969	CLARKSTON	42,010	7.63	187,000	20 MAY	17,100	29 AUG
1970	CLARKSTON	38,180	6.94	227,000	7 JUN	18,300	1 SEP
1971	CLARKSTON	54,340	9.87	253,000	30 MAY	20,000	27 AUG
1972	CLARKSTON	50,660	9.20	237,000	2 JUN	19,900	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 1/	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 on 2 Sept. 1958.
8/ Average for period water years 1910-1974.

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

TABLE 4-2A

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

Water Year	Annual Runoff KAF	Annual Runoff Inches 3/	Mean Daily Discharge Maximum cfs	Date	Mean Daily Discharge Minimum cfs	Date
1975 2/			77,300	7 JUN	24,100	15 AUG
1976	50,780	9.20	92,800	11 MAY	22,000	5 SEP
1977	20,430	3.70	62,200	3 MAY	10,900	21 AUG
1978	40,370	7.31	48,800	9 JUN	18,700	3 SEP
1979	30,970	5.60	41,200	25 MAY	13,700	13 AUG
1980	32,810	5.94	33,200	13 JUN	16,100	1 SEP
1981	33,920	6.15	76,100	10 JUN	15,700	24 AUG
1982	51,000	9.24	05,600	18 JUN	17,400	25 OCT
1983	48,400	8.77	94,300	29 MAY	22,800	31 AUG
1984	54,750	9.92	44,800	31 MAY	19,400	2 OCT
1985	35,280	6.39	24,400	8 Jun	28,600	6 Aug
1986	44,320	8.03	11,000	1 Jun	23,800	30 Aug
Average	40,270	7.30	68,000		19,000	
Maximum	54,750	9.92	44,800	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 square miles above Lower Granite Dam.

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

TABLE 4-3

SUMMARY OF RUNOFF AND DISCHARGE DATA
Little Goose Reservoir Computed Regulated Inflows 1/

Water Year	Annual KAF	Runoff Inches 3/	Maximum cfs	Date	Minimum cfs	Date
1970 2/			220,300	7 JUN	17,000	1 SEP
1971	54,413	9.82	244,100	30 MAY	20,500	27 AUG
1972	50,728	9.15	231,200	2 JUN	19,700	4 SEP
1973	26,457	4.77	92,700	19 MAY	15,900	19 AUG
1974	56,556	10.21	303,700	18 JUN	20,600	23 OCT
1975	45,528	8.22	186,700	8 JUN	6,700	15 FEB
1976	51,217	9.24	194,200	15 MAY	15,600	1 AUG
1977	21,136	3.81	63,800	4 MAY	5,200	20 SEP
1978	40,168	7.25	146,700	9 JUN	12,500	1 OCT
1979	31,095	5.61	139,500	25 MAY	8,900	16 SEP
1980	32,728	5.91	133,800	13 JUN	4,100	6 JAN
1981	33,712	6.08	174,800	10 JUN	11,400	16 AUG
1982	50,984	9.20	206,000	18 JUN	11,700	1 NOV
1983	48,370	8.73	194,500	29 MAY	20,600	22 AUG
1984	54,451	9.83	245,500	31 MAY	15,300	2 OCT
1985	35,747	6.45	125,300	9 JUN	15,100	21 JUL
1986	44,127	7.96	208,200	2 JUN	15,000	6 OCT
Average	42,339	7.64	180,669		14,131	
Maximum	56,556	10.21	303,700	1974	20,500	1972
Minimum	21,136	3.81	63,800	1977	4,100	1980

1/ Inflows computed at Little Goose are for the period 1971-1986
2/ Water year 1970 data based on March-September 1970 period of record.
3/ 1.0 basin inches = 5,541 KAF for a drainage area of 103,900 square miles above Little Goose Dam.

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

TABLE 4-4

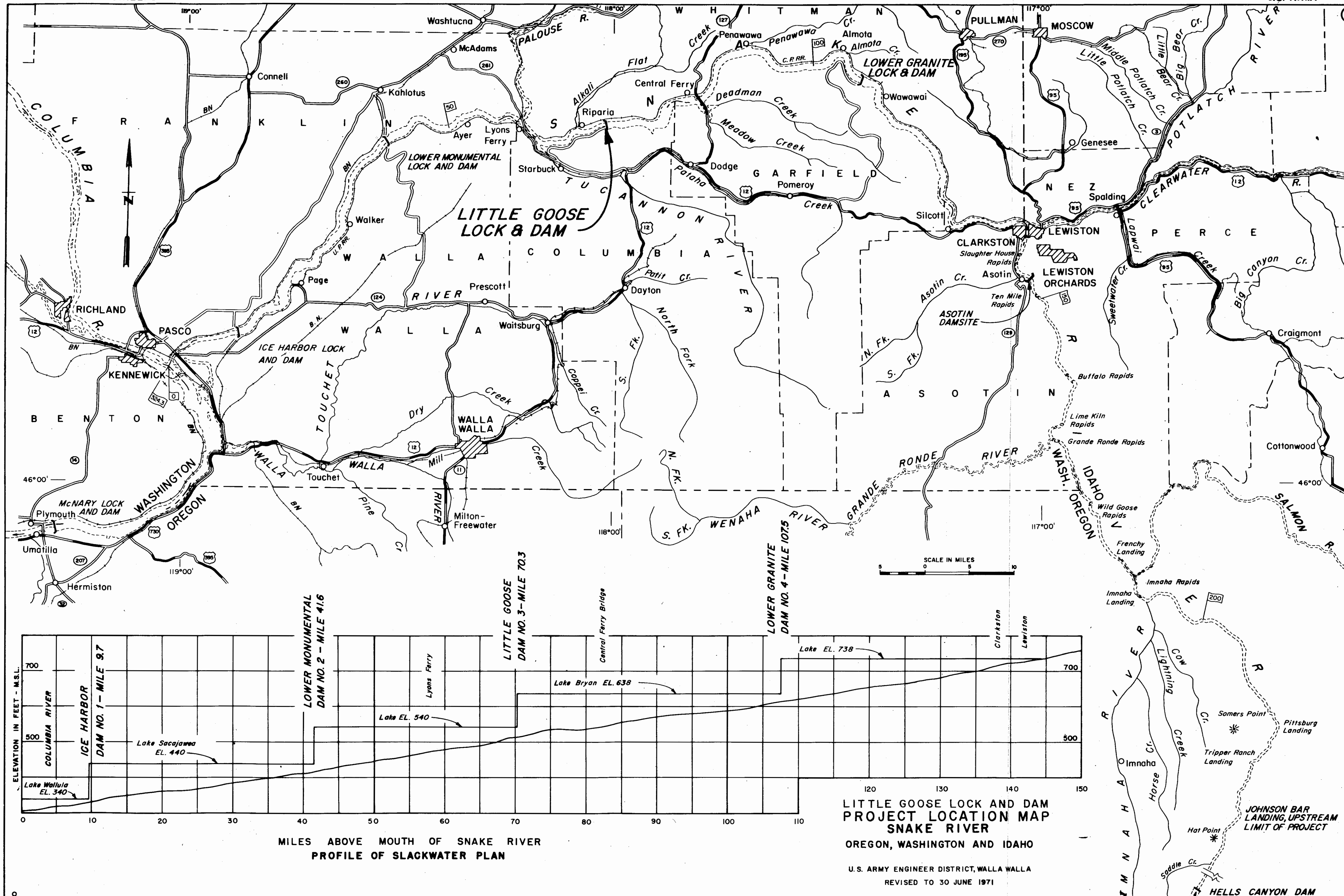
LITTLE GOOSE RESERVIOR
Regulated Monthly Inflow Volume in 1,000 Acre-Feet

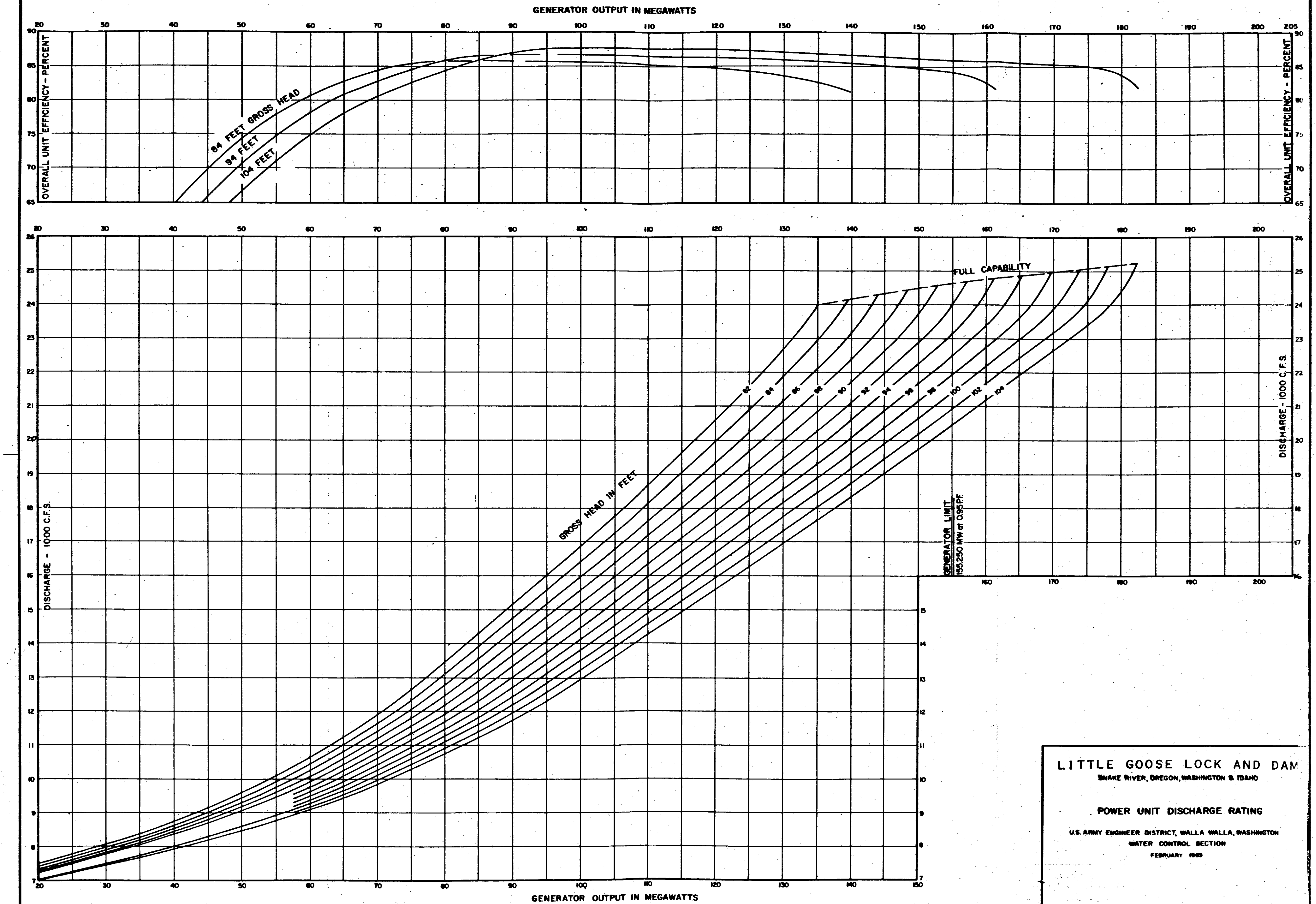
Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1970						2596.8	2814.8	7321.1	8938.6	3267.8	1337.1	1600.7
1971	1727.0	2024.8	2395.9	3602.4	4510.1	4061.2	6748.9	11656.2	10303.9	4286.9	1566.2	1529.3
1972	2011.7	2079.7	2134.0	2731.3	3491.4	7828.1	5935.0	8866.4	9456.7	3149.2	1567.2	1477.1
1973	1969.4	2094.8	2479.2	2672.0	1972.6	2163.8	2058.1	3792.5	3103.6	1473.7	1136.5	1541.0
1974	1459.5	2318.7	2855.6	4674.3	3721.0	5566.3	7775.9	8117.1	12179.3	4527.7	1706.0	1654.0
1975	1739.7	1929.7	1929.7	2428.0	2447.4	4059.0	4682.4	7727.5	9539.2	4982.0	1976.8	2086.4
1976	2203.3	2515.9	4215.7	3775.8	3545.9	4228.0	6787.1	9621.0	7248.3	3124.8	1983.3	1968.0
1977	1904.8	1927.4	2064.4	2012.9	1459.5	1568.8	1908.9	2618.6	2402.4	1309.1	936.2	1023.5
1978	1495.0	1726.8	3129.6	2882.0	2690.2	3944.0	4657.9	6161.9	6451.5	3465.6	1577.9	1986.0
1979	1403.8	1745.8	2311.4	2163.0	2011.3	3373.7	3423.9	6194.3	4365.5	1843.5	1128.6	1130.2
1980	1321.4	1584.0	1758.0	1980.5	1811.9	2188.2	3468.3	6637.0	6354.9	2607.7	1322.4	1693.1
1981	1467.0	1915.7	2638.8	2489.3	2448.8	2308.0	2953.4	5600.8	7023.7	2193.9	1110.4	1562.2
1982	1542.4	1710.0	2411.3	2554.0	4056.9	6256.0	5937.4	8401.1	9250.8	5145.0	1743.5	1976.0
1983	2212.8	2301.7	2960.6	3465.0	3332.1	6155.0	4773.9	7519.3	7789.8	3961.0	1928.2	1970.8
1984	1915.9	2769.8	2991.0	3613.3	2876.3	4946.5	6728.8	9440.9	10925.9	4150.7	1922.0	2169.9
1985	2206.8	2688.6	2586.3	2778.1	2416.7	2687.2	5152.7	5672.0	4484.9	1663.2	1511.4	1899.0
1986	1772.5	2020.8	1994.4	1955.1	3898.6	7641.6	5809.1	6906.0	6822.8	1882.1	1286.9	2137.0
STATISTICS												
N	16	16	16	16	16	17	17	17	17	17	17	17
AVERAGE	1772.1	2084.6	2553.5	2861.1	2918.2	4210.1	4801.0	7191.4	7449.5	3119.6	1514.2	1729.7
MAXIMUM	2212.8	2769.8	4215.7	4674.3	4510.1	7828.1	7775.9	11656.2	12179.3	5145.0	1983.3	2169.9
MIMIMUM	1321.4	1584.0	1758.0	1955.1	1459.5	1568.8	1908.9	2618.6	2402.4	1309.1	936.2	1023.5

Notes: 1. Data source U.S. Army Corps of Engineers, Walla Walla District, Hydrology Branch.
2. Period of Record: March 1970 - 1986.

LITTLE GOOSE LOCK AND DAM - WATER CONTROL MANUAL

PLATES

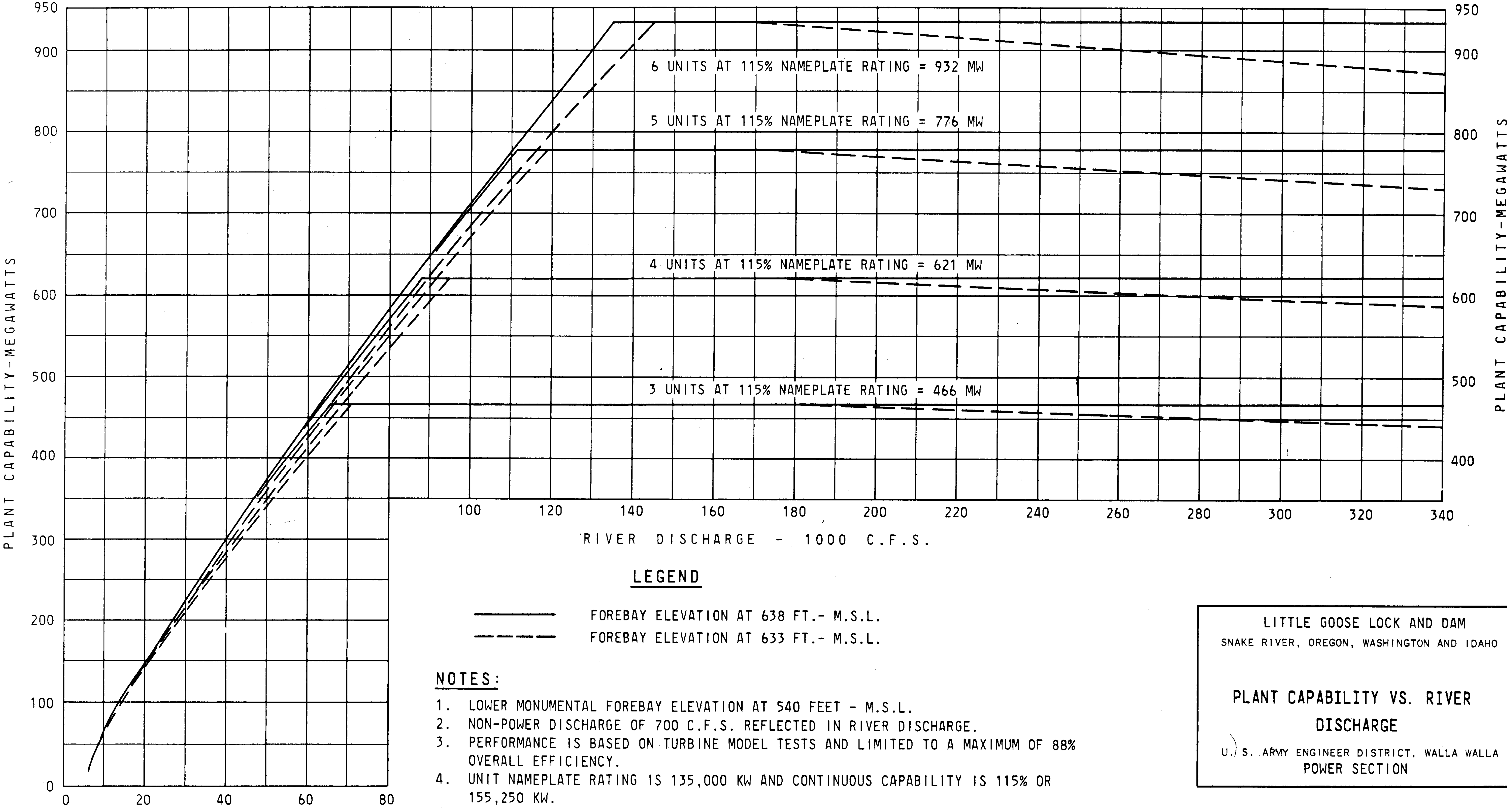

4
LITTLE GOOSE LOCK & DAM
LOWER MONUMENTAL LOCK AND DAM
LOWER GRANITE LOCK & DAM
ICE HARBOR LOCK AND DAM
McNARY LOCK AND DAM
ASOTIN DAMSITE
JOHNSON BAR LANDING, UPSTREAM LIMIT OF PROJECT
HELLS CANYON DAM
FRANKLIN
WALLA WALLA
COLUMBIA
GARFIELD
WHITMAN
ASOTIN
NEZ PERCE
BENTON
WASHINGTON
OREGON
IDAHO
PASCO
KENNEWICK
RICHLAND
WALLA WALLA
LEWISTON
CLARKSTON
LEWISTON ORCHARDS
PULLMAN
MOSCOW
SCALE IN MILES
LOWER MONUMENTAL DAM NO. 2 - MILE 41.6
LITTLE GOOSE DAM NO. 3 - MILE 70.3
LOWER GRANITE DAM NO. 4 - MILE 107.5
ICE HARBOR DAM NO. 1 - MILE 9.7
COLUMBIA RIVER
Lyons Ferry
Central Ferry Bridge
Clarkston
Lewiston
Lake Wallula EL. 340
Lake Sacajawea EL. 440
Lake EL. 540
Lake Bryan EL. 638
Lake EL. 738
ELEVATION IN FEET - M.S.L.
MILES ABOVE MOUTH OF SNAKE RIVER
PROFILE OF SLACKWATER PLAN
LITTLE GOOSE LOCK AND DAM
PROJECT LOCATION MAP
SNAKE RIVER
OREGON, WASHINGTON AND IDAHO
U. S. ARMY ENGINEER DISTRICT, WALLA WALLA
REVISED TO 30 JUNE 1971



LITTLE GOOSE LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON & IDAHO

POWER UNIT DISCHARGE RATING

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



LEGEND

———	FOREBAY ELEVATION AT 638 FT.- M.S.L.
— — —	FOREBAY ELEVATION AT 633 FT.- M.S.L.

NOTES:

1. LOWER MONUMENTAL FOREBAY ELEVATION AT 540 FEET - M.S.L.
2. NON-POWER DISCHARGE OF 700 C.F.S. REFLECTED IN RIVER DISCHARGE.
3. PERFORMANCE IS BASED ON TURBINE MODEL TESTS AND LIMITED TO A MAXIMUM OF 88% OVERALL EFFICIENCY.
4. UNIT NAMEPLATE RATING IS 135,000 KW AND CONTINUOUS CAPABILITY IS 115% OR 155,250 KW.

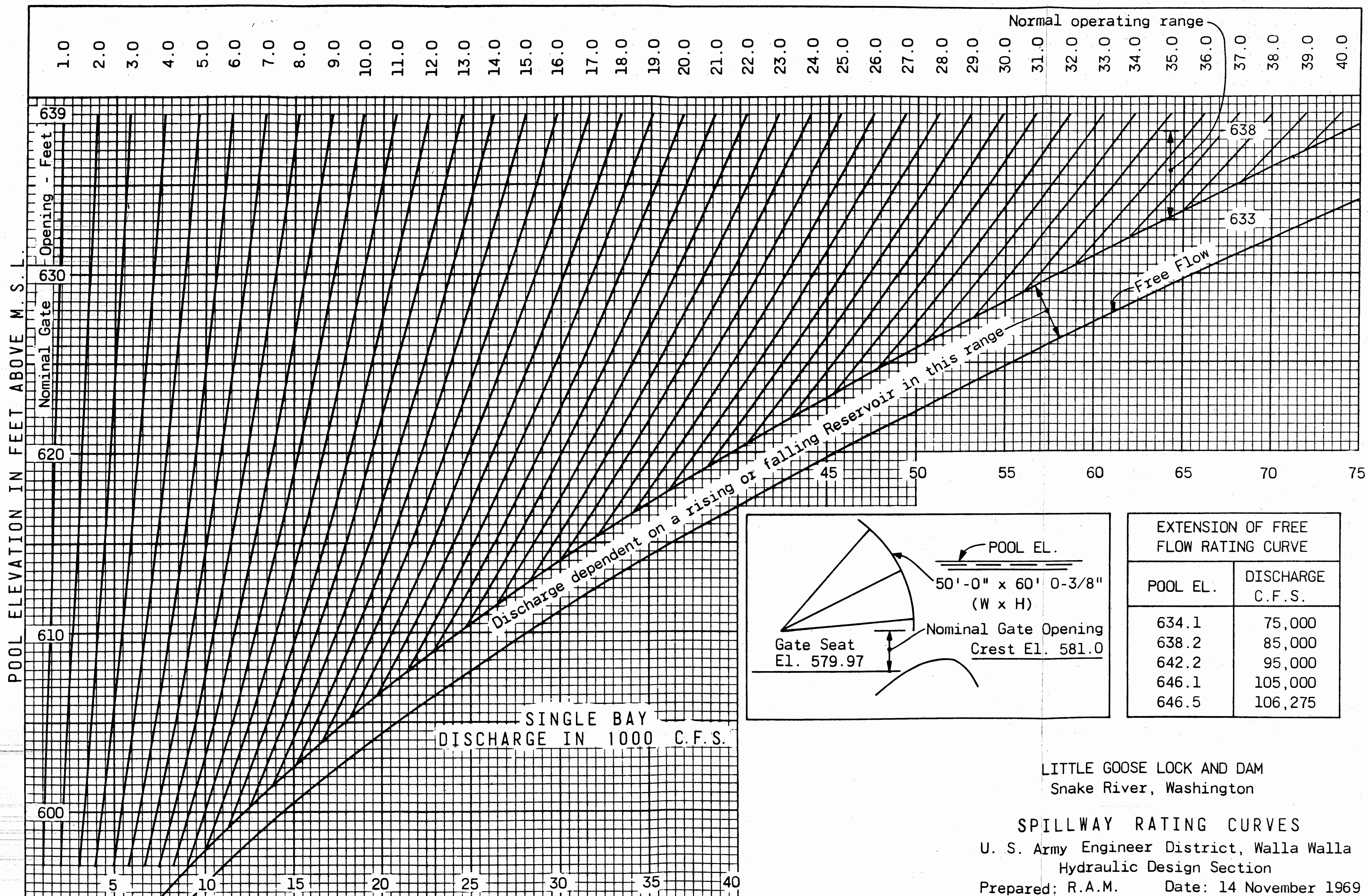
LITTLE GOOSE LOCK AND DAM

SNAKE RIVER, OREGON, WASHINGTON AND IDAHO

PLANT CAPABILITY VS. RIVER DISCHARGE

U. S. ARMY ENGINEER DISTRICT, WALLA WALLA

POWER SECTION



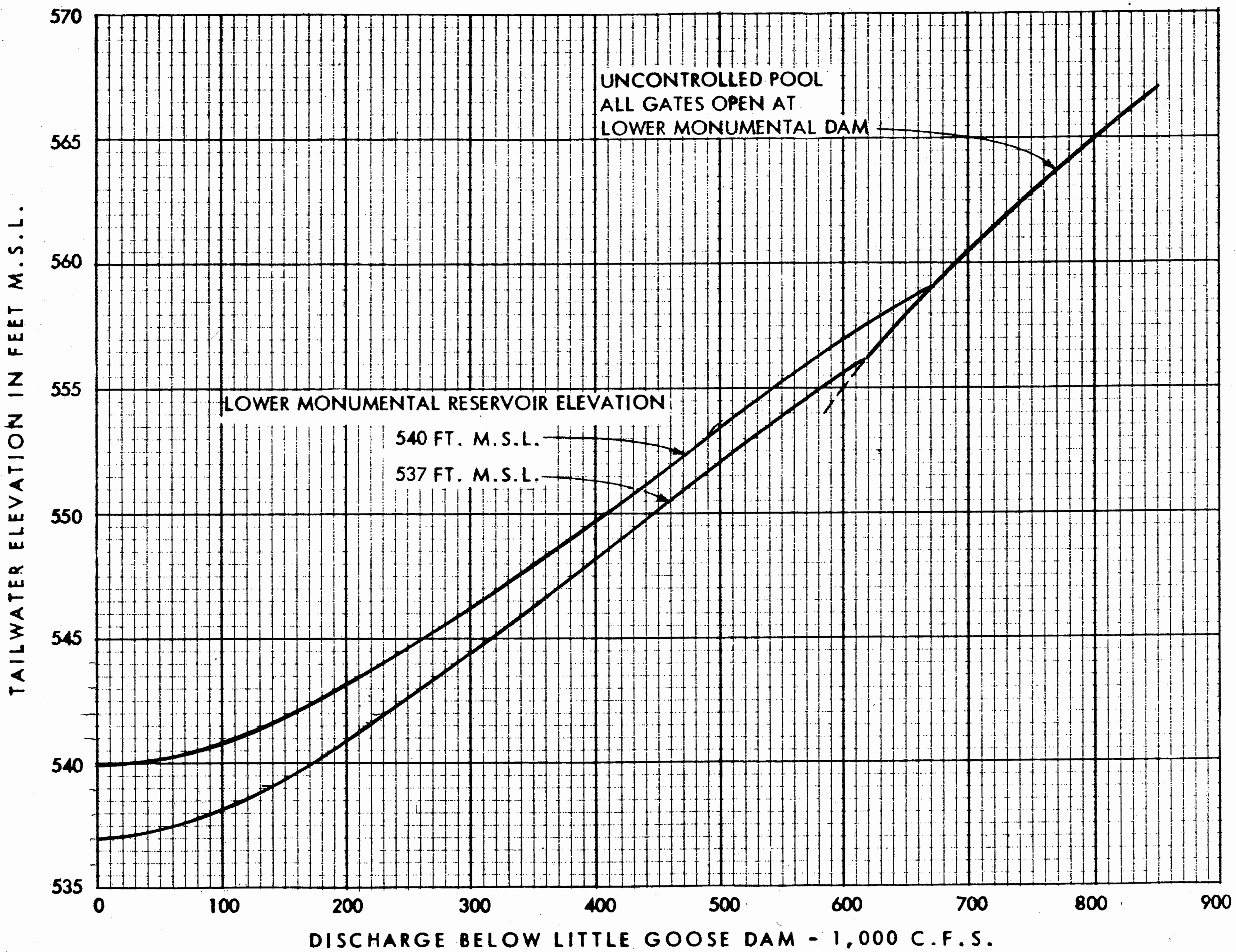
EXTENSION OF FREE FLOW RATING CURVE

POOL EL.	DISCHARGE C.F.S.
634.1	75,000
638.2	85,000
642.2	95,000
646.1	105,000
646.5	106,275

LITTLE GOOSE LOCK AND DAM
Snake River, Washington

SPILLWAY RATING CURVES

U. S. Army Engineer District, Walla Walla
Hydraulic Design Section
Prepared: R.A.M. Date: 14 November 1969



NOTES:

1. These curves are based on backwater computed from Lower Monumental Dam at River Mile 41.6 to River Mile 69.0 using natural stream sections and from River Mile 69.0 to 70.2 using sections as will exist after construction of Little Goose Dam.

2. These curves reflect conditions at a section 500 feet below the axis of Little Goose Dam. Effects of various combinations of flows through the powerhouse and spillway are not shown. Refer to Technical Report No. 110-1, Little Goose Dam, Snake River, Washington, April 1975 for details on flow conditions for selected discharges and methods of project operation.

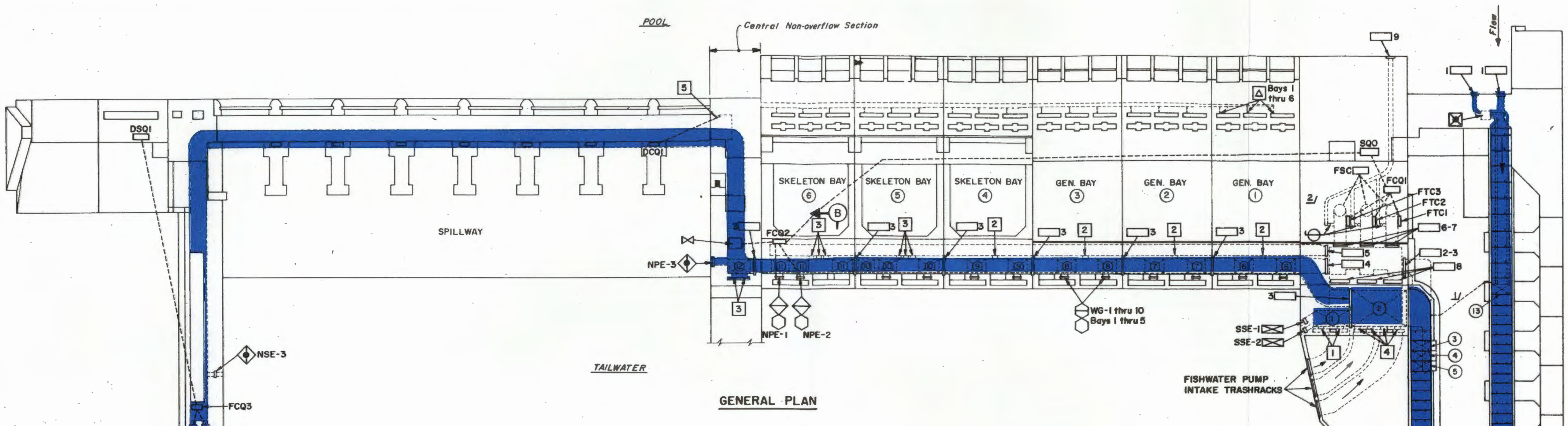
3. Tailwater elevation for the spillway design flood (850,000 cfs at Little Goose Dam) is 567.0 feet M.S.L. and corresponds to a maximum pool elevation of 548.0 feet at Lower Monumental Dam.

LITTLE GOOSE LOCK AND DAM
Snake River, Oregon, Washington and Idaho

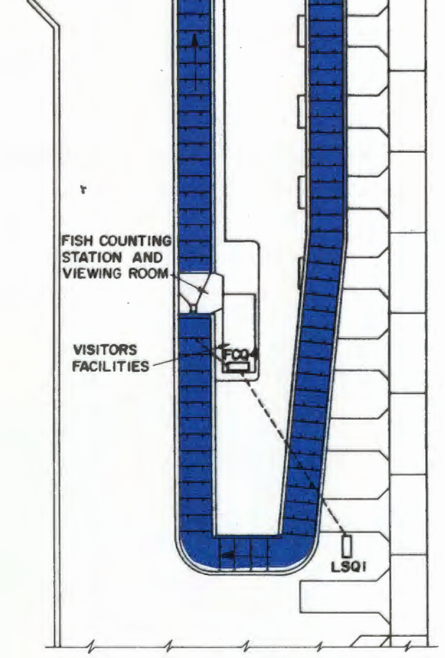
LITTLE GOOSE TAILWATER RATING CURVES
WITH BACKWATER FROM
LOWER MONUMENTAL DAM

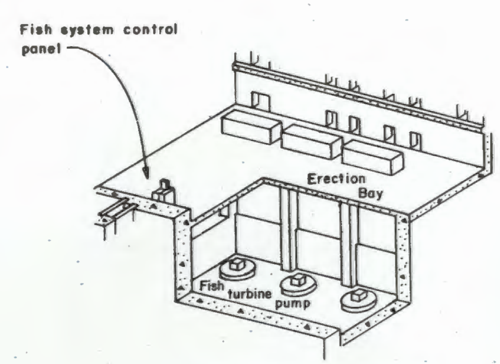
U.S. Army Engr. Dist., Walla Walla
Water Control Section

Prepared: J.A.A. Date: July 1961



GENERAL PLAN





LOCATION DIAGRAM
FISH SYSTEM CONTROL

LEGEND

- SSE-1, SSE-2 — South Shore Fishway Entrance - Combination Weir Gate and Bulkhead
- WG-1 thru 10 — Powerhouse Fishway Channel Entrance - Bays 1 thru 5 - Floating Orifice Gate
- Powerhouse Fishway Entrance Bulkhead
- NPE-1, NPE-2 — Powerhouse Fishway Channel Entrance - Bay 6 - Weir Gate
- NPE-3 — Central Non-Overflow Fishway Channel Side Entrance Gate
- NSE-1, NSE-2 — North Shore Fishway Channel Entrance Gate
- NSE-3 — North Shore Fishway Channel Side Entrance Gate
- Fingerling By-Pass Entrance Gate
- 17 — Diffuser
- Butterfly Valve - Fishwater Turbine Pumps
- Central Non-Overflow Fishway Channel Regulating Gate
- Sluice Gate - Fish Ladder Auxiliary Water Supply to Diffuser No. 13
- 1 — Sluice Gate - Diffuser No. 1
- 2 — Sluice Gate - Diffusers 6 thru 9
- 3 — Sluice Gate - Diffusers 10, 11 and 12
- 4 — Sluice Gate - Diffuser No. 2
- 5 — Sluice Gate - Fingerling By-Pass
- 1 — Stoplog - Fish Ladder Exit and Auxiliary Water Supply
- 2 — Bulkhead - Water Supply to Diffusers 1 thru 5
- 3 — Bulkhead - Transverse - Fishway Collection Channel
- 4 — Bulkhead - North Shore Fishwater Supply
- 5 — Bulkhead - Powerhouse Fishwater Supply
- 6 — Bulkhead - Fishwater Pump Discharge
- 7 — Bulkhead - Fishwater Turbine Discharge
- 8 — Bulkhead - Fishwater Pump Intake
- 9 — Bulkhead - Fishwater Turbine Intake

NOTES:

1/ Mud Valve Drain Line for Diffuser No. 13

2/ Fishwater Turbine Pumps (3 Units)

REFERENCE LITTLE GOOSE O&M MANUAL, 1974, PLATE 25.01-1

FISHWAY GENERAL ARRANGEMENT
GATES, CONTROL AND POWER

Little Goose
LAND USE

- PROJECT BOUNDARY
- ROADS
- RAILROADS
- NORMAL POOL 540 feet m.s.l.
- *60 RIVER MILE

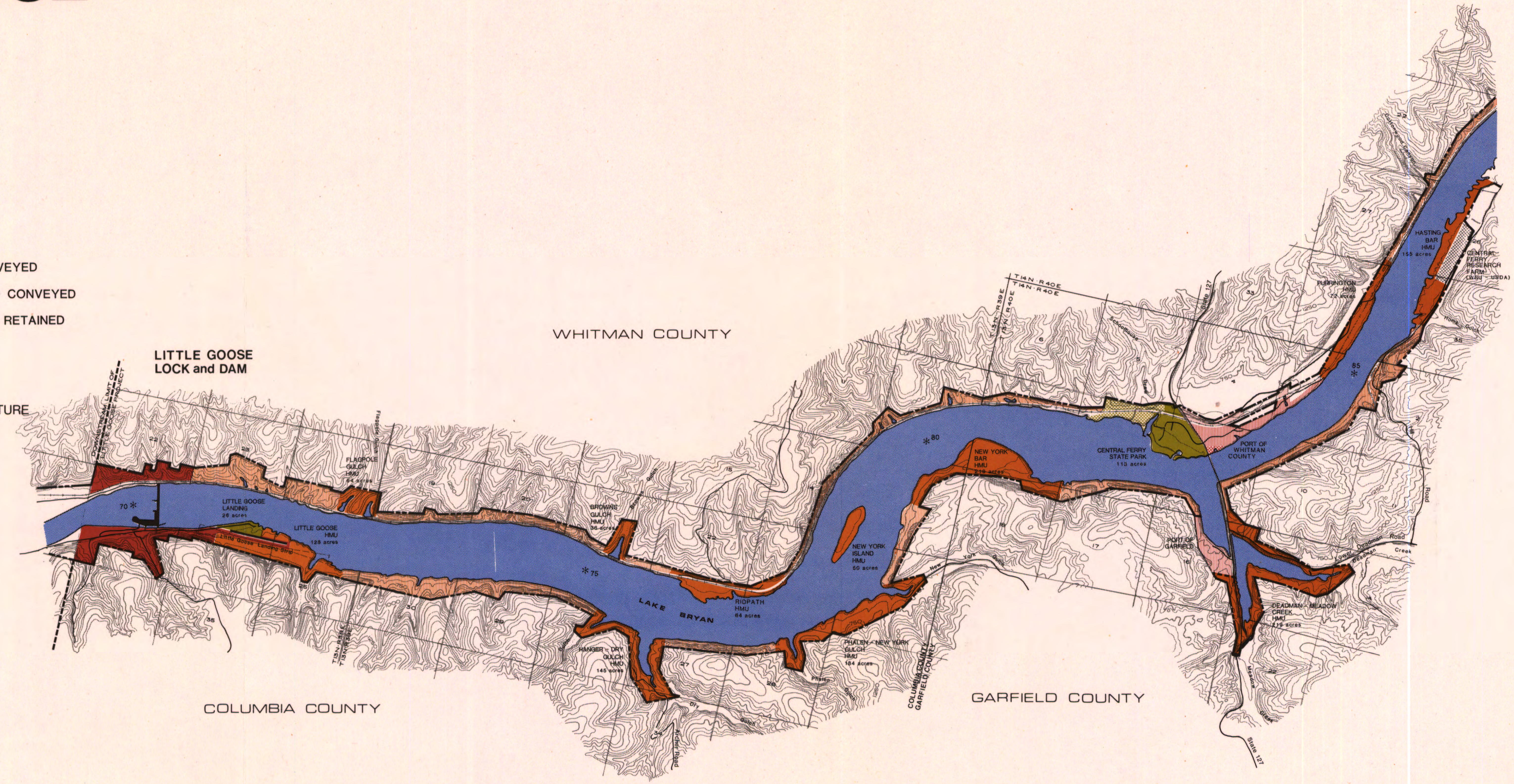
- PROJECT OPERATIONS
- PUBLIC PORT TERMINAL • CONVEYED
- INDUSTRIAL USE and ACCESS • CONVEYED
- INDUSTRIAL USE and ACCESS • RETAINED

- RECREATION INTENSIVE
- RECREATION INTENSIVE FUTURE
- RECREATION LOW DENSITY

- WILDLIFE INTENSIVE HABITAT MANAGEMENT UNIT (HMU)
- WILDLIFE MODERATE

- SPECIAL USE

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



0 1 2 4 feet 8000

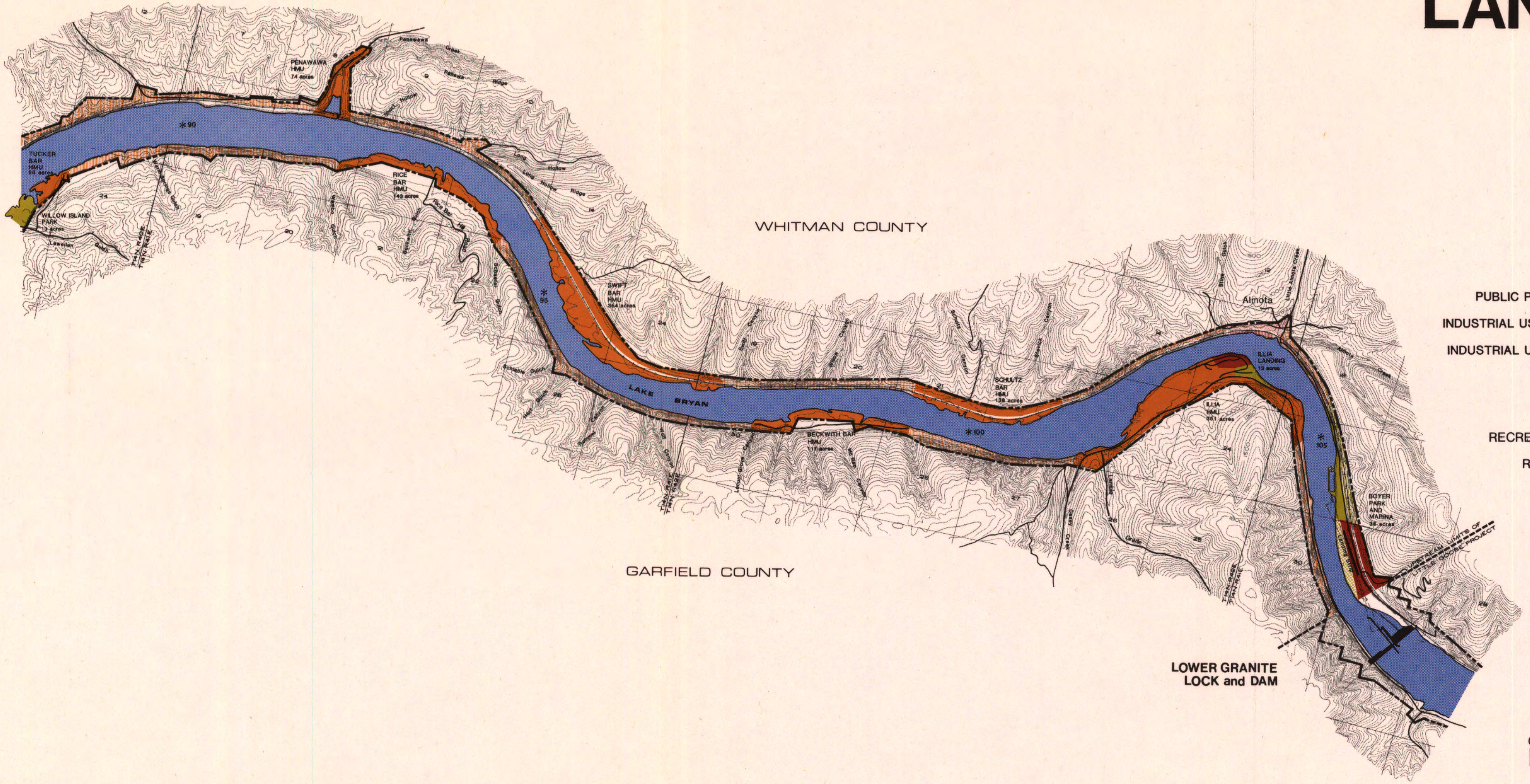
5

1983

LOWER SNAKE RIVER PROJECT U.S. ARMY ENGINEER DISTRICT Walla Walla, Washington

WATER CONTROL MANUAL PLATE 3-11.1

Little Goose
LAND USE



PROJECT BOUNDARY

ROADS

RAILROADS

NORMAL POOL
540 feet m.s.l.

RIVER MILE *60

PROJECT OPERATIONS

PUBLIC PORT TERMINAL • CONVEYED

INDUSTRIAL USE and ACCESS • CONVEYED

INDUSTRIAL USE and ACCESS • RETAINED

RECREATION INTENSIVE

RECREATION INTENSIVE FUTURE

RECREATION LOW DENSITY

WILDLIFE INTENSIVE
HABITAT MANAGEMENT UNIT (HMU)

WILDLIFE MODERATE

SPECIAL USE

are either railroads or highway right-of-way

uncolored areas within the project boundary

0 1 2 4 feet 8000

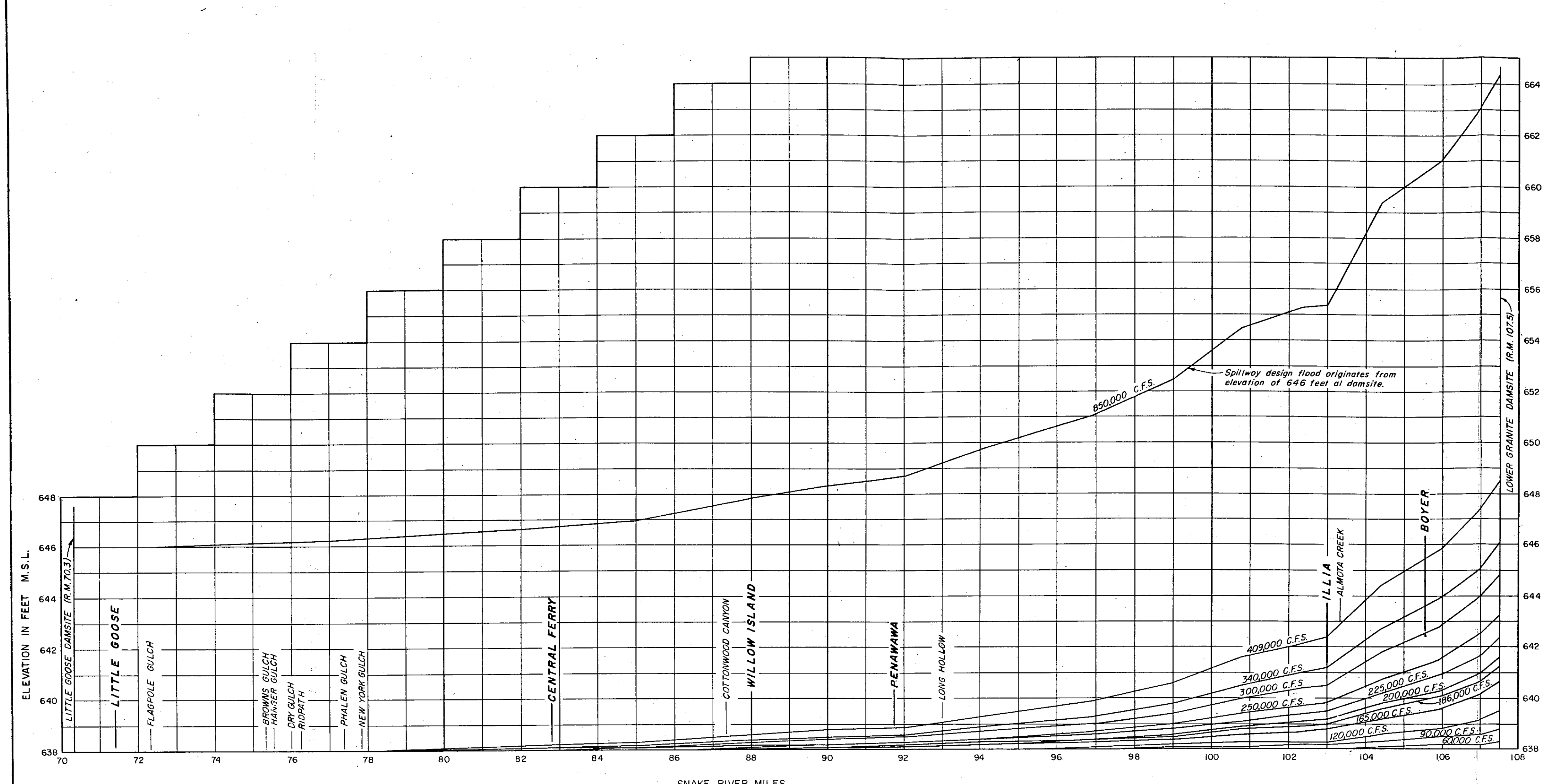
5

1983

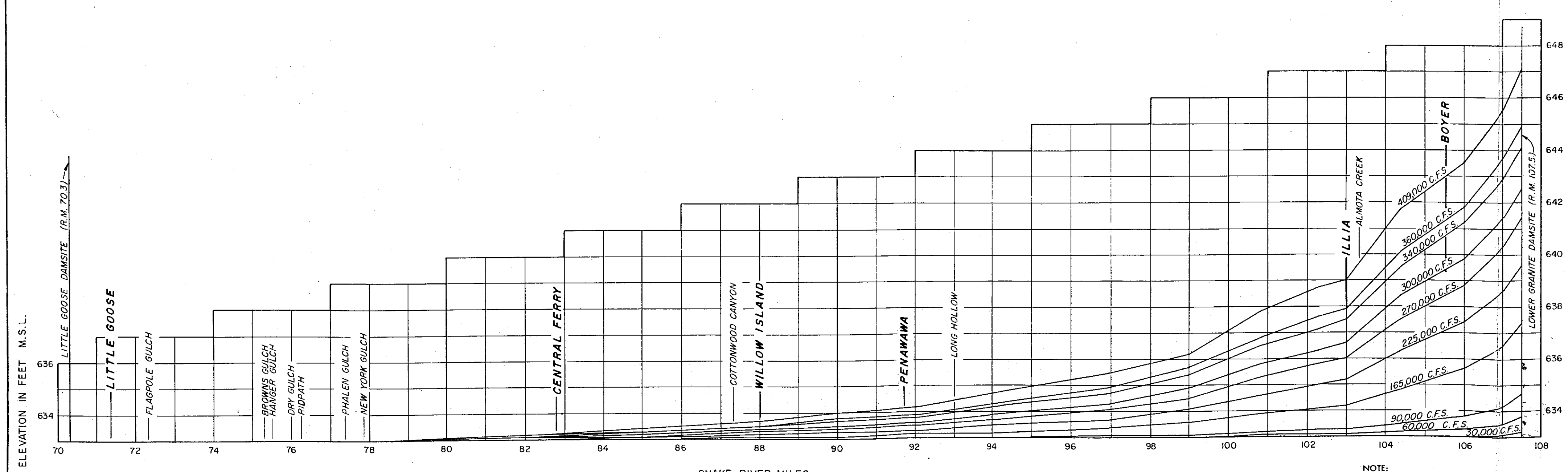
U.S. ARMY ENGINEER DISTRICT
Walla Walla, Washington

LOWER SNAKE RIVER PROJECT

WATER CONTROL MANUAL PLATE 3-11.2

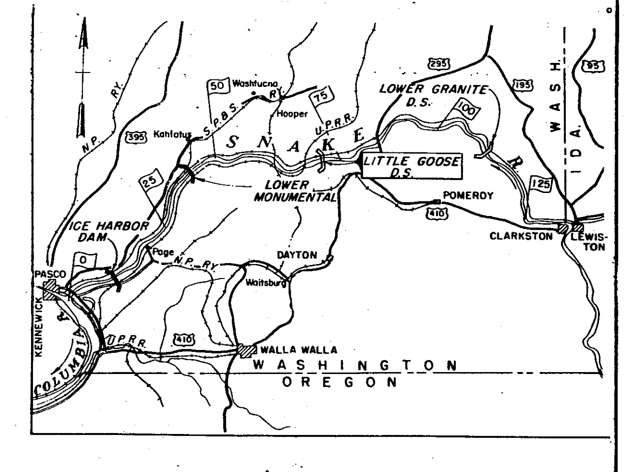


PROFILES FOR POOL ELEVATION 638 FEET M.S.L.



PROFILES FOR POOL ELEVATION 633 FEET M.S.L.

NOTE:
THESE CURVES DO NOT REFLECT THE LOCAL EFFECTS OF LOWER GRANITE DAM AT RIVER MILE 107.5.



VICINITY MAP
SCALE IN MILES
10 0 10 20 30 40

MEAN SECTIONAL VELOCITIES AT SELECTED LOCATIONS IN LITTLE GOOSE RESERVOIR
638 FOOT POOL ELEVATION AT LITTLE GOOSE DAM

RIVER MILE	DISCHARGE - 1000 C.F.S. 10	30	60	90	120	165	186	200	225	250	300	340	409	850
	MEAN SECTIONAL VELOCITIES IN FEET/SECOND													
70.3	.1	.1	.2	.3	.5	.6	.7	.8	.9	1.0	1.1	1.3	1.6	3.0
72.9	.1	.1	.2	.4	.5	.7	.8	.8	.9	1.0	1.3	1.4	1.7	3.2
77.0	.1	.1	.3	.4	.5	.7	.8	.9	1.0	1.1	1.3	1.5	1.8	3.4
82.0	.1	.2	.4	.6	.7	1.0	1.1	1.2	1.4	1.5	1.8	2.1	2.5	4.4
85.0	.1	.3	.5	.8	1.1	1.4	1.6	1.8	2.0	2.2	2.6	3.0	3.6	6.5
88.0	.1	.3	.5	.8	1.0	1.4	1.6	1.7	2.0	2.2	2.6	2.9	3.5	6.3
90.0	.1	.2	.5	.7	1.0	1.3	1.5	1.6	1.8	2.0	2.4	2.7	3.3	5.7
92.1	.1	.3	.7	1.0	1.3	1.8	2.0	2.2	2.5	2.7	3.3	3.7	4.4	7.8
94.0	.1	.3	.7	1.0	1.4	1.9	2.1	2.3	2.5	2.8	3.4	3.8	4.5	7.5
96.9	.1	.4	.8	1.2	1.6	2.2	2.5	2.7	3.0	3.3	3.9	4.4	5.2	8.6
99.0	.2	.5	1.0	1.5	2.0	2.7	3.0	3.2	3.6	4.0	4.8	5.3	6.3	9.9
100.8	.2	.5	.9	1.4	1.8	2.4	2.7	2.9	3.3	3.6	4.3	4.8	5.5	8.3
102.3	.2	.6	1.2	1.9	2.5	3.3	3.7	4.0	4.5	4.9	5.8	6.4	7.5	11.1
103.0	.3	.8	1.6	2.4	3.2	4.3	4.8	5.1	5.7	6.3	7.4	8.3	9.6	14.7
104.4	.2	.7	1.4	2.0	2.7	3.6	4.0	4.3	4.8	5.2	6.1	6.7	7.6	11.0
106.0	.3	.9	1.8	2.7	3.6	4.8	5.3	5.6	6.2	6.8	7.8	8.5	9.6	13.5
107.0	.4	1.1	2.1	3.1	4.0	5.3	5.8	6.2	6.8	7.3	8.3	9.0	10.0	13.4

MEAN SECTIONAL VELOCITIES AT SELECTED LOCATIONS IN LITTLE GOOSE RESERVOIR
633 FOOT POOL ELEVATION AT LITTLE GOOSE DAM

RIVER MILE	DISCHARGE - 1000 C.F.S. 10	30	60	90	165	225	270	300	340	360	409
	MEAN SECTIONAL VELOCITIES IN FEET/SECOND										
70.3	.1	.1	.2	.4	.7	.9	1.1	1.2	1.4	1.4	1.6
72.9	.1	.1	.3	.4	.7	1.0	1.2	1.3	1.5	1.6	1.8
77.0	.1	.1	.3	.4	.8	1.1	1.3	1.4	1.6	1.7	1.9
82.0	.1	.2	.4	.6	1.1	1.5	1.8	2.0	2.3	2.4	2.8
85.0	.1	.3	.6	.9	1.6	2.1	2.6	2.8	3.2	3.4	3.9
88.0	.1	.3	.6	.9	1.6	2.1	2.6	2.8	3.2	3.4	3.8
90.0	.1	.3	.5	.8	1.5	2.0	2.4	2.7	3.0	3.2	3.6
92.1	.1	.4	.7	1.1	2.0	2.7	3.2	3.6	4.1	4.3	4.8
94.0	.1	.4	.8	1.1	2.1	2.8	3.4	3.7	4.2	4.5	5.0
96.9	.2	.5	.9	1.4	2.5	3.3	4.0	4.4	4.9	5.2	5.8
99.0	.2	.6	1.1	1.7	3.1	4.2	4.9	5.4	6.0	6.3	7.1
100.8	.2	.5	1.1	1.6	2.9	3.8	4.5	4.9	5.4	5.7	6.2
102.3	.2	.7	1.5	2.2	3.9	5.1	6.0	6.6	7.2	7.5	8.3
103.0	.3	.9	1.8	2.8	4.9	6.5	7.6	8.3	9.2	9.6	10.6
104.4	.3	.8	1.7	2.5	4.3	5.5	6.3	6.8	7.4	7.7	8.3
106.0	.4	1.1	2.2	3.3	5.6	7.1	8.1	8.6	9.3	9.7	10.4
107.0	.5	1.4	2.7	3.9	6.3	7.7	8.6	9.1	9.8	10.0	10.7

U. S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

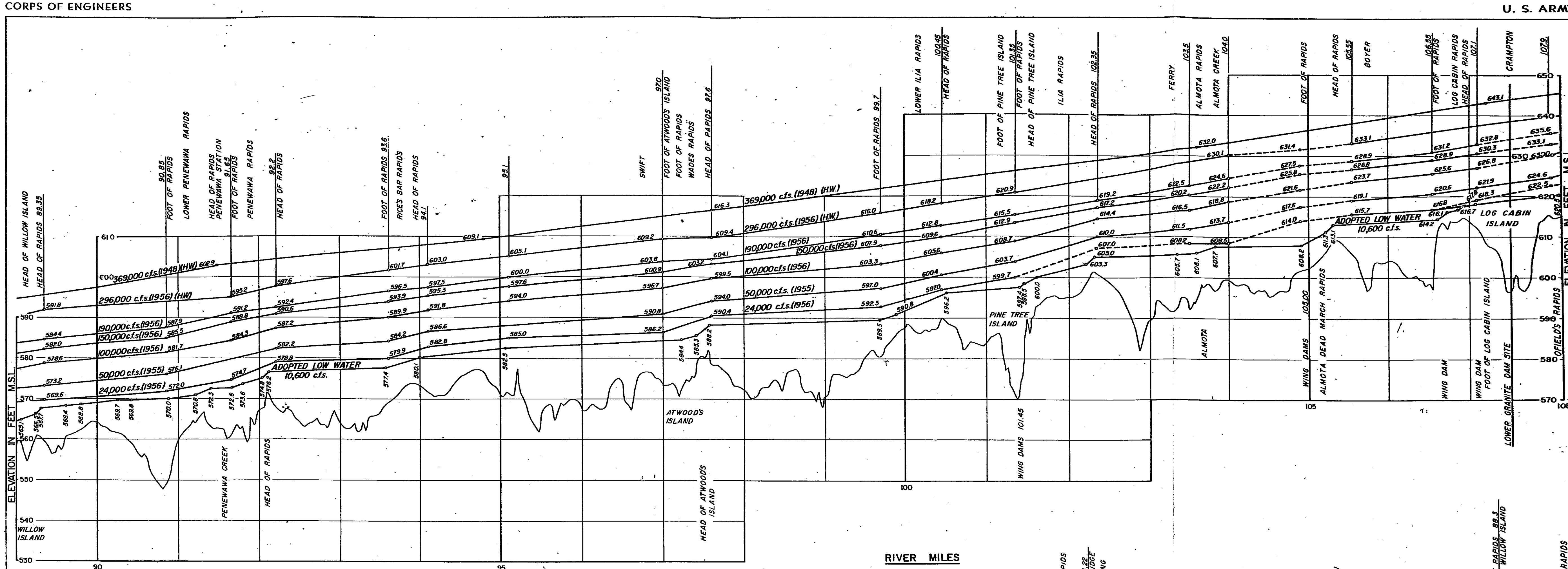
DESIGNED: J.D.A.
DRAWN: T.Richerzhagen
CHECKED: J.A.A.
SUPERVISED: [signature]
CHIEF, WATER CONT. SEC.
SUBMITTED: [signature]
CHIEF, PL. PLANNING BRANCH
RECOMMENDED: W. E. [signature]
CHIEF, ENGINEERING DIVISION

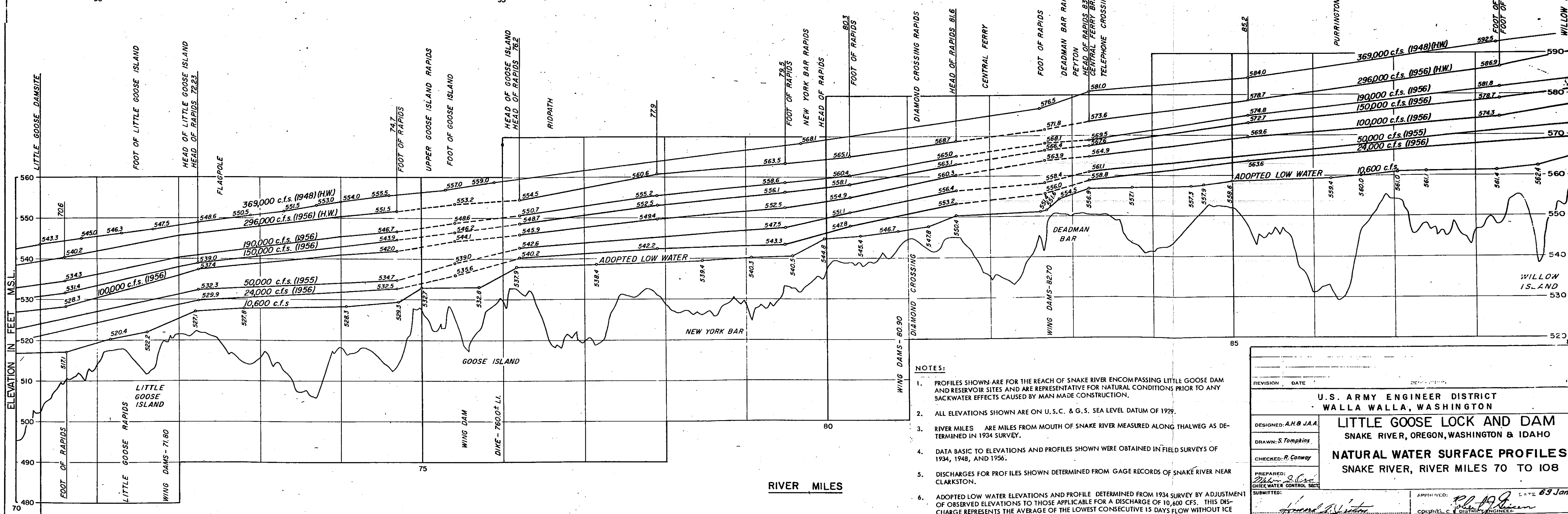
LITTLE GOOSE LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON & IDAHO

RESERVOIR BACKWATER PROFILES
638 AND 633 FOOT POOL ELEVATIONS AT DAM

APPROVED: [signature] DATE 69 May 27
COLONEL, C. E. DISTRICT ENGINEER
SCALE AS SHOWN | INV. NO. ENG.
SHEET | FILE NO. LG-05-46/14

(No Scale)





NOTES:

1. PROFILES SHOWN ARE FOR THE REACH OF SNAKE RIVER ENCOMPASSING LITTLE GOOSE 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 MILES 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.

REVISION DATE

U.S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

DESIGNED: A.H.B J.A.A.
DRAWN: S. Tompkins
CHECKED: R. Conway
PREPARED: CHIEF, WATER CONTROL SECT.

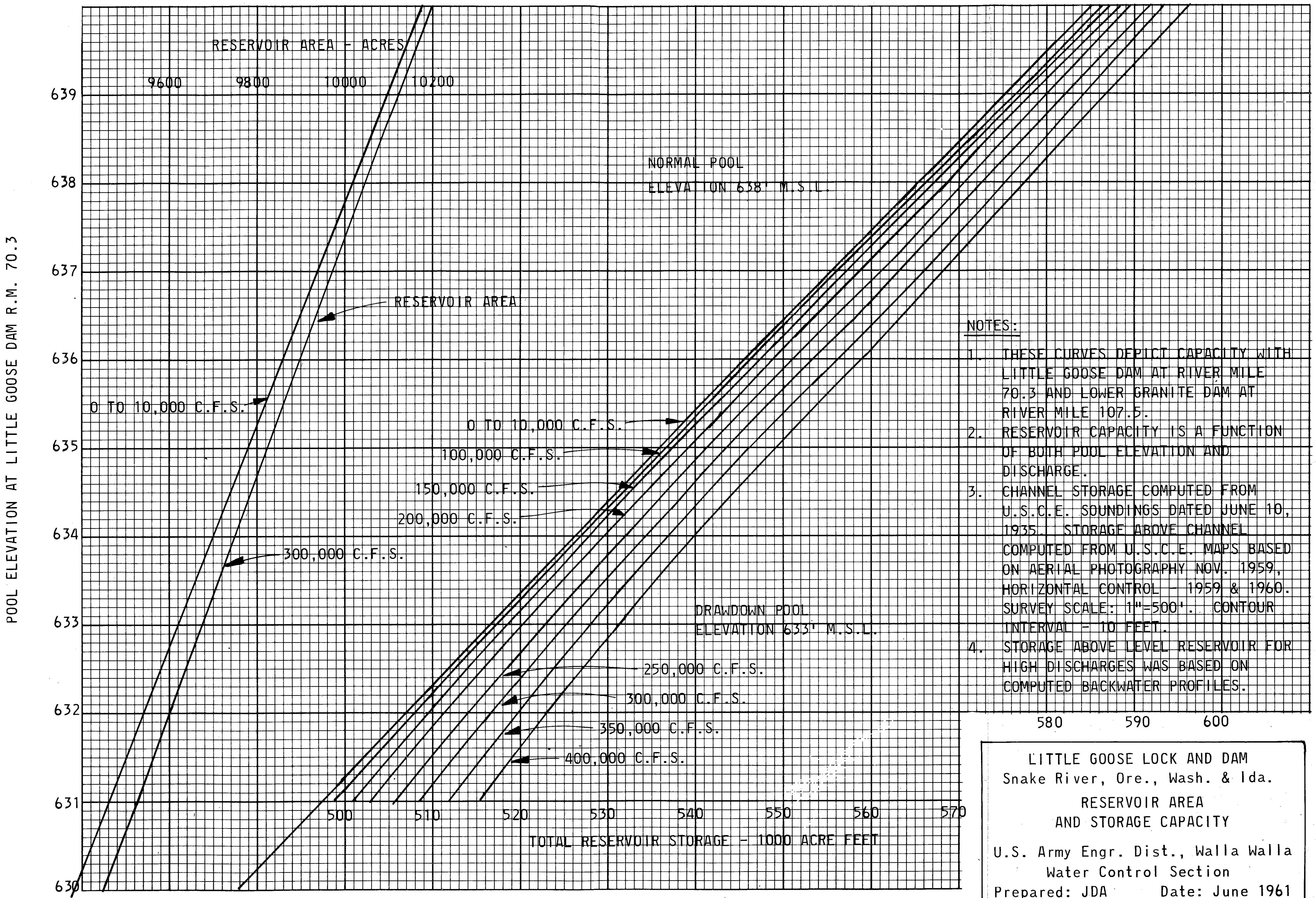
LITTLE GOOSE LOCK AND DAM

SNAKE RIVER, OREGON, WASHINGTON & IDAHO

NATURAL WATER SURFACE PROFILES

SNAKE RIVER, RIVER MILES 70 TO 108

SUBMITTED: CHIEF, PLANNING BRANCH
RECOMMENDED: CHIEF, ENGINEERING DIVISION
APPROVED: COLONEL, C.E. DISTRICT ENGINEER
DATE 69 Jan. 10
SCALE AS SHOWN
INV. NO. ENG.
FILE NO.
SHEET OF
LG-05-43/16



LITTLE GOOSE LOCK AND DAM
Snake River, Ore., Wash. & Ida.

RESERVOIR AREA
AND STORAGE CAPACITY

U.S. Army Engr. Dist., Walla Walla
Water Control Section
Prepared: JDA Date: June 1961

CLIMATOLOGICAL STATIONS

STA. NO.	STATION	STA. EL. FT. M.S.L.
	WASHINGTON	
1	ANATONE	3,750
2	DAYTON	1,610
3	KAHLOTUS	1,350
4	LACROSSE 3 ESE	1,546
5	POMEROY	1,890
6	PULLMAN	2,545
7	WALLA WALLA	949
	IDAHO	
8	BIG CREEK	5,686
9	BOISE	2,842
10	BURLEY	4,180
11	CHALLIS	5,171
12	COUNCIL	2,930
13	DEADWOOD DAM	5,375
14	DUBOIS C.A.A. - A.P.	2,717
15	GOODING C.A.A. - A.P.	3,696
16	GRANGEVILLE	3,355
17	HAILEY	5,322
18	IDAHO CITY	3,965
19	IDAHO FALLS C.A.A. - W.B.	4,730
20	KOOSKIA	1,261
21	LEWISTON	1,436
22	OBSIDIAN	6,875
23	PAYETTE	2,110
24	PIERCE R.S.	3,175
25	POCATELLO W.B. A.P.	4,444
26	RIGGINS R.S.	1,801
27	ST. ANTHONY	4,968
28	SALMON	3,949
	OREGON	
29	BAKER	3,368
30	HARPER	2,518
31	HUNTINGTON	2,150
32	LA GRANDE	2,805
33	OWYHEE DAM	2,400
34	WALLOWA	2,923
35	WARM SPRINGS RES.	3,332
	WYOMING	
36	MORAN	6,798
	NEVADA	
37	OWYHEE	5,396

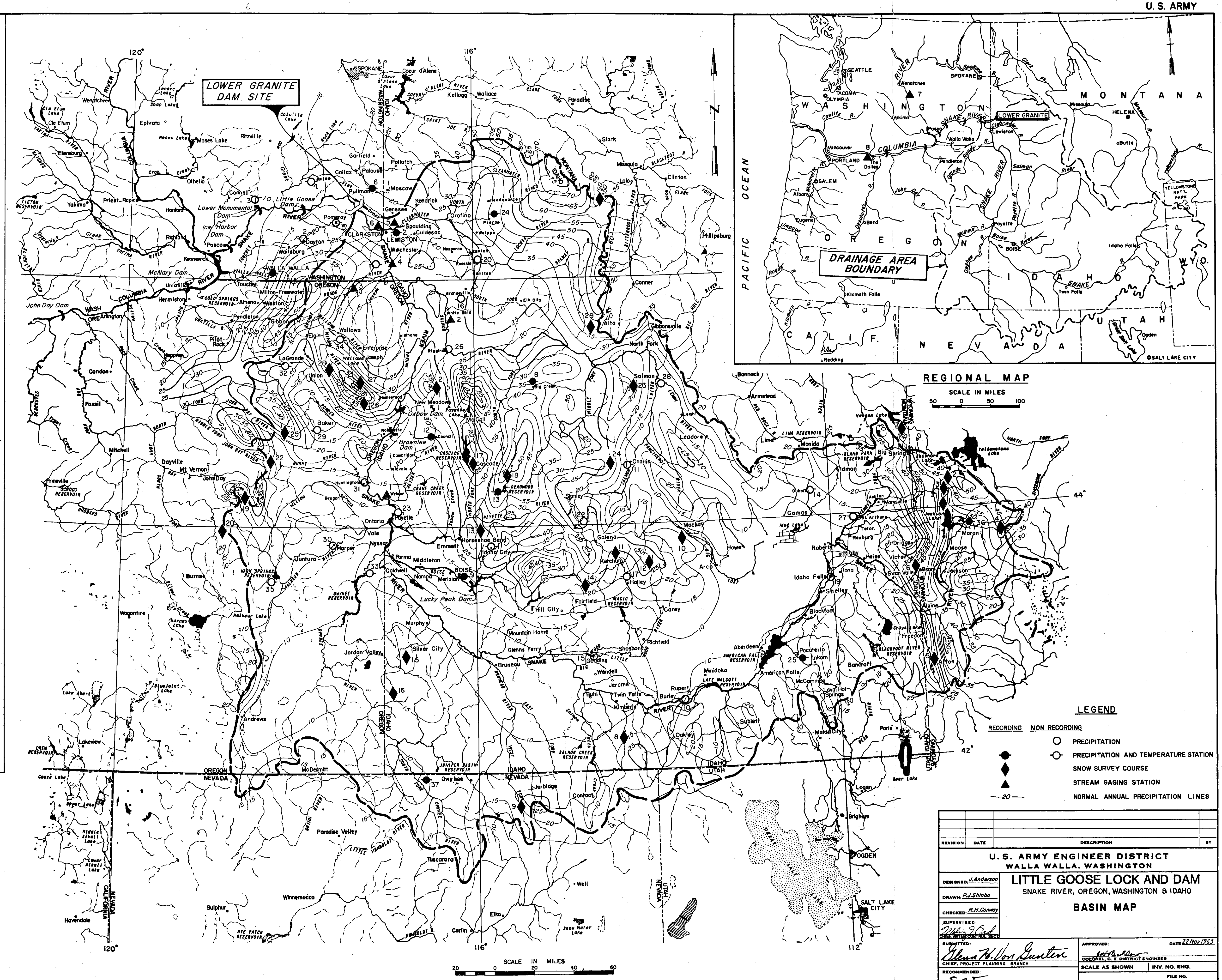
SNOW COURSES

STA. NO.	COURSE	STA. EL. FT. M.S.L.
1	ARIZONA, WYOMING	6,850
2	ASTER CREEK, WYOMING	7,700
3	SNAKE RIVER STATION, WYOMING	6,780
4	BLACKROCK, WYOMING	8,600
5	AFTON RANGER STATION, WYOMING	6,200
6	BECHLER RANGER STA., WYOMING	6,400
7	WEST YELLOWSTONE, MONTANA	6,700
8	MAGIC MOUNTAIN, IDAHO	6,700
9	BEAR CREEK MEADOWS, NEVADA	7,800
10	WHITE KNOB, IDAHO	7,700
11	GRAHAM RANCH, IDAHO	6,200
12	MASCOT MINE, IDAHO	7,900
13	BOGUS BASIN, IDAHO	6,400
14	COUCH SUMMIT, IDAHO	7,000
15	JACK CREEK, IDAHO	7,000
16	SOUTH MOUNTAIN NO. 2, IDAHO	5,100
17	CRAWFORD RANGER STA., IDAHO	4,800
18	DEADWOOD RIVER DAM, IDAHO	5,500
19	BLUE MTN. SPRINGS, OREGON	5,900
20	ROCK SPRINGS, OREGON	5,100
21	BOULDER CREEK, IDAHO	5,500
22	BLUE MTN. SUMMIT, OREGON	5,098
23	WILLIAMS CR. SUMMIT, IDAHO	8,710
24	MILL CREEK SUMMIT, IDAHO	8,870
25	EILERTSON MEADOWS, OREGON	5,400
26	SCHNEIDER MEADOWS, OREGON	5,400
27	ANEROID LAKE NO. 1, OREGON	7,480
28	MOSS SPRING, OREGON	5,850
29	NEZ PERCE PASS, IDAHO	6,575
30	PACKERS MEADOW, IDAHO	5,700

STREAM GAGING STATIONS

STA. NO.	STREAM AND LOCATION
1	SNAKE RIVER AT WEISER, IDAHO
2	SALMON RIVER AT WHITEBIRD, IDAHO
3	GRANDE RONDE RIVER AT TROY, OREGON
4	SNAKE RIVER NEAR ANATONE, WASHINGTON
5	CLEARWATER RIVER AT SPALDING, IDAHO
6	SNAKE RIVER NEAR CLARKSTON, WASHINGTON
7*	COLUMBIA RIVER AT TRINIDAD, WASHINGTON
8*	COLUMBIA RIVER NEAR THE DALLES, OREGON

* SHOWN ON REGIONAL MAP



LEGEND

RECORDING | NON RECORDING

PRECIPITATION

PRECIPITATION AND TEMPERATURE STATION

SNOW SURVEY COURSE

STREAM GAGING STATION

—20— NORMAL ANNUAL PRECIPITATION LINES

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

DESIGNED: J.Anderson

DRAWN: P.J.Shinbo

CHECKED: R.H.Conway

SUPERVISED: [signature] CHIEF WATER CONTROL SECT.

LITTLE GOOSE LOCK AND DAM

SNAKE RIVER, OREGON, WASHINGTON & IDAHO

BASIN MAP

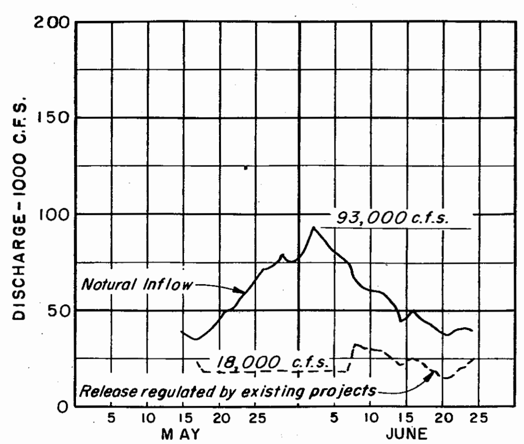
SUBMITTED: Glenn H. Von Gunten
CHIEF, PROJECT PLANNING BRANCH

RECOMMENDED: E.C. [signature]
CHIEF ENGINEERING DIVISION

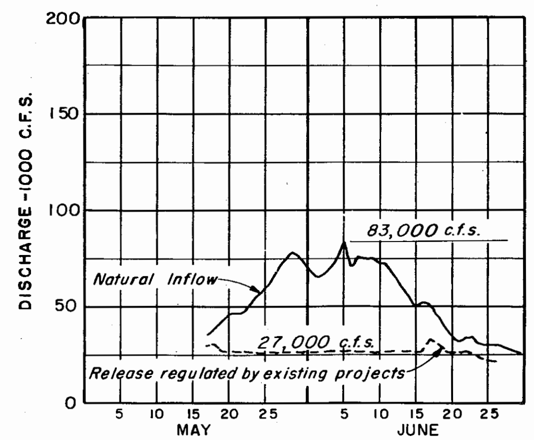
APPROVED: [signature] DATE 22 Nov.1963
COLONEL, C. E. DISTRICT ENGINEER

SCALE AS SHOWN | INV. NO. ENG.

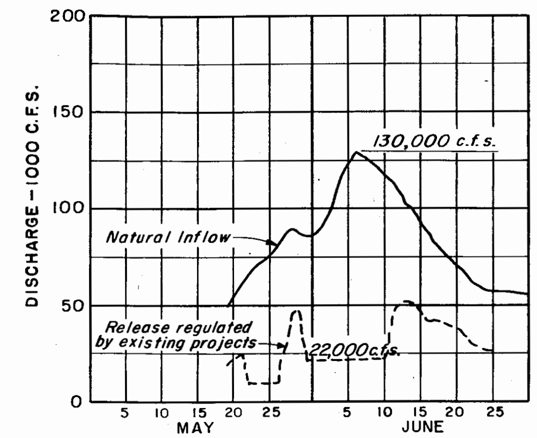
SHEET | FILE NO. GD-05-3/3



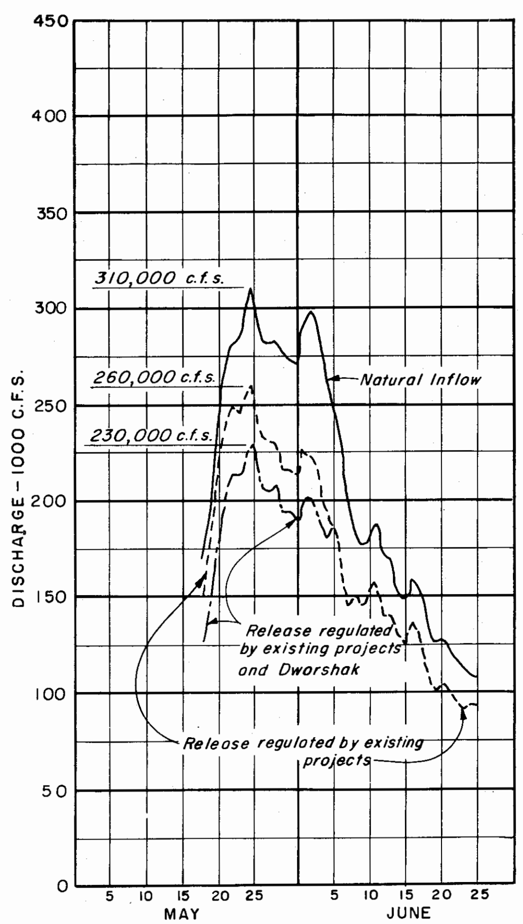
SNAKE RIVER AT BROWNLEE-1956



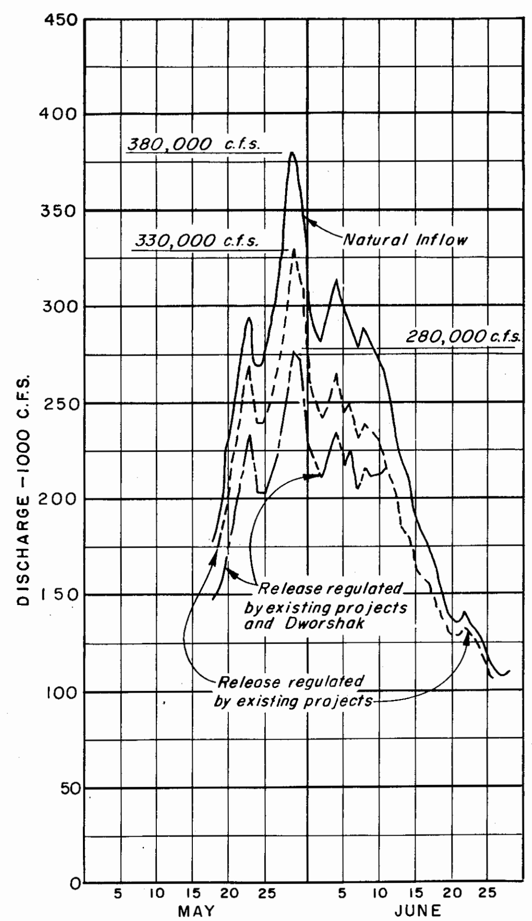
SNAKE RIVER AT BROWNLEE-1948



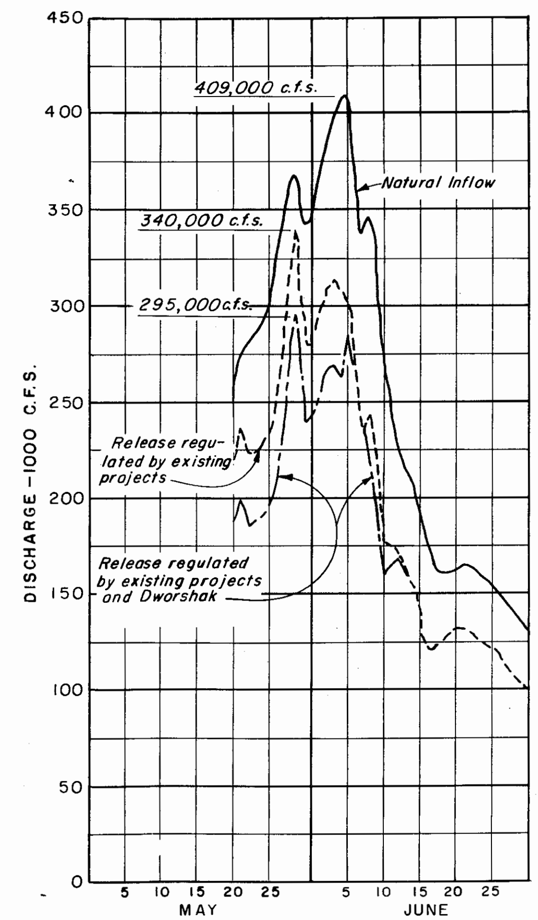
SNAKE RIVER AT BROWNLEE-1894



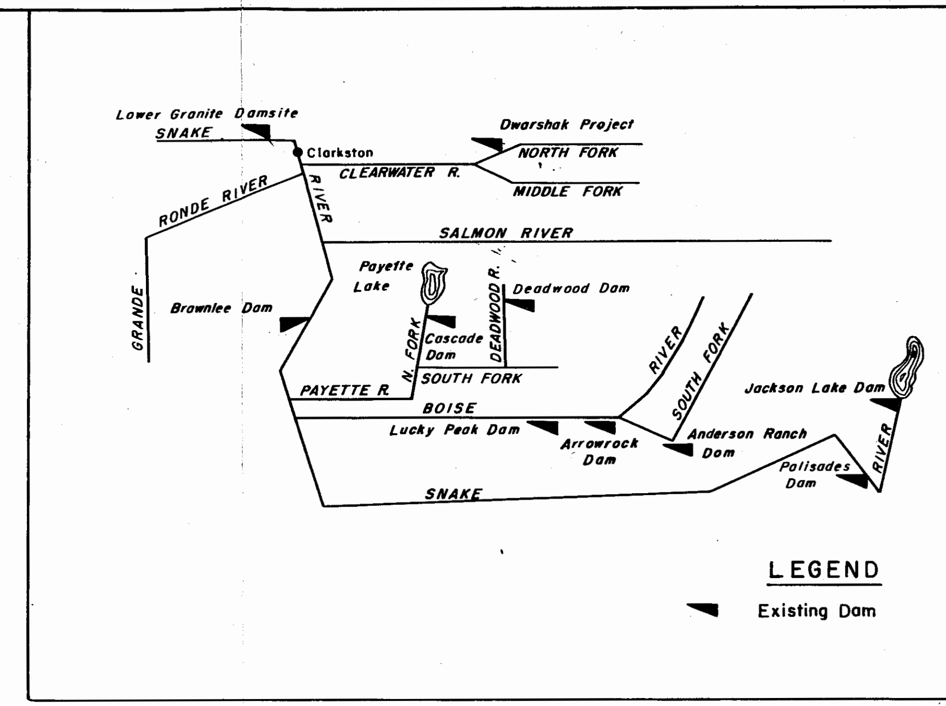
SNAKE RIVER AT CLARKSTON-1956



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."

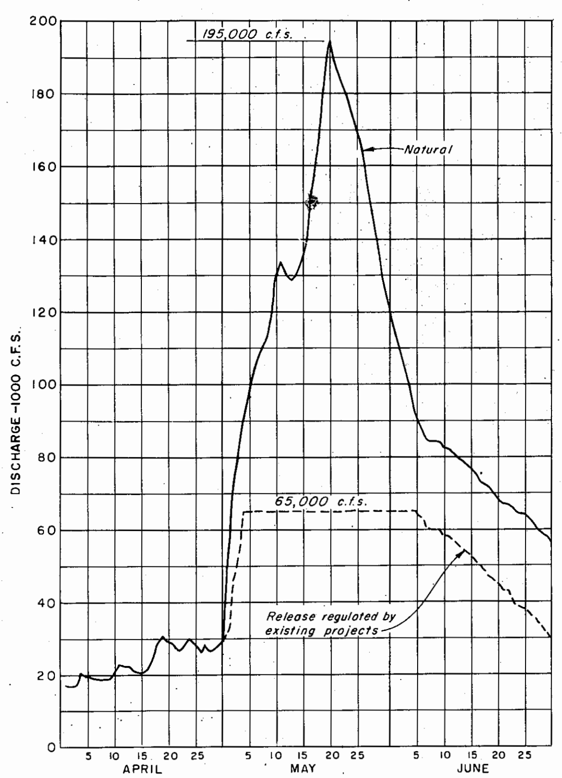
REVISION	DATE	DESCRIPTION	BY

U. S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

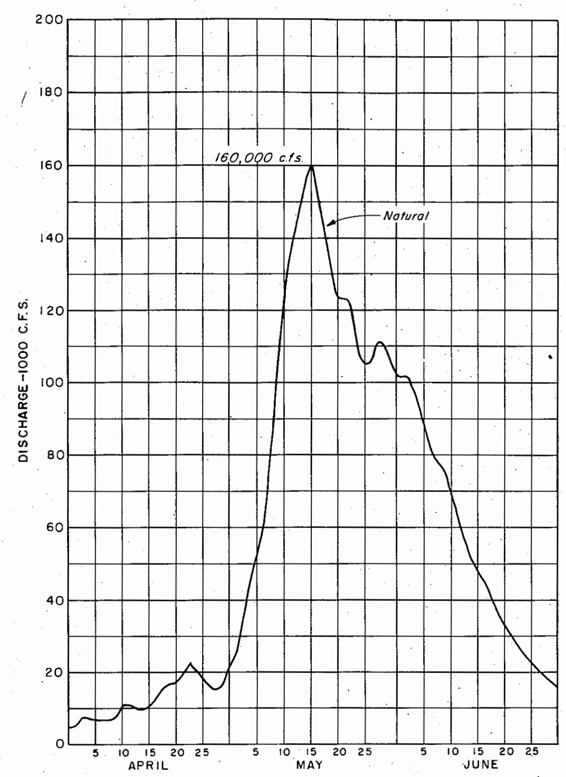
LITTLE GOOSE LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO

REGULATION OF LARGE SNAKE RIVER FLOODS

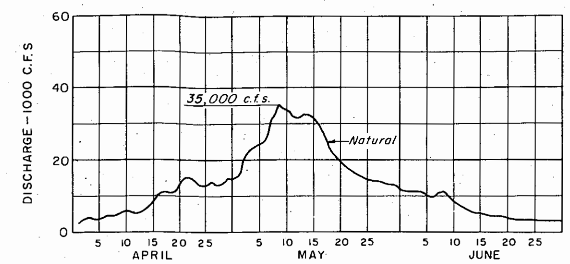
DESIGNED: K. Armocost
DRAWN: R. L. G.
CHECKED: R. Conway
PREPARED: CHIEF, WATER CONTROL SEC.
SUBMITTED: Glenn H. Von Gunten, CHIEF, PROJECT PLANNING BRANCH
RECOMMENDED: E. C. [illegible], CHIEF, ENGINEERING DIVISION
APPROVED: DATE 22 Nov. 1963, COLONEL, C. E., DISTRICT ENGINEER
SCALE AS SHOWN | INV. NO. ENG.
FILE NO. GD-05-3/18
SHEET



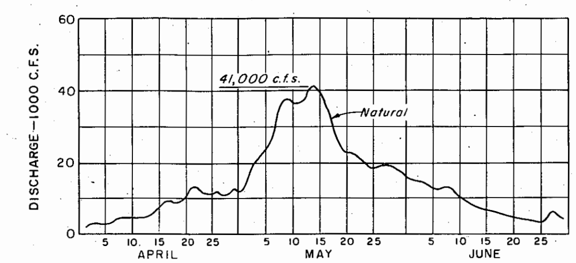
CONTRIBUTION FROM SNAKE RIVER AT BROWNLEE



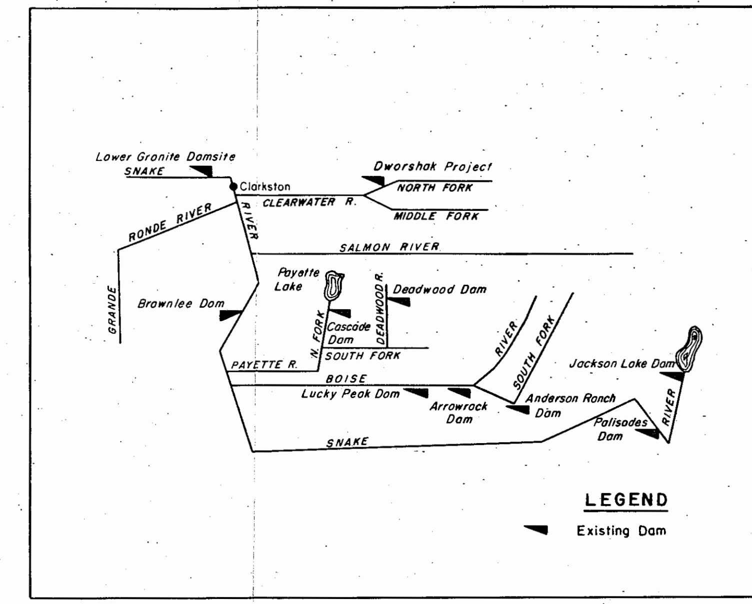
CONTRIBUTION FROM SALMON RIVER AT WHITEBIRD



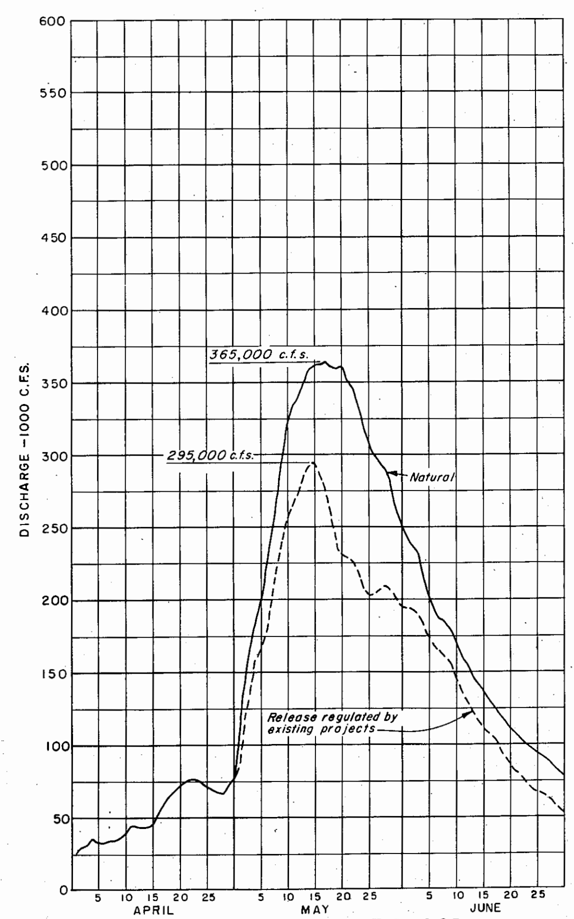
CONTRIBUTION FROM UNGAGED AREAS BETWEEN BROWNLEE AND CLEARWATER CONFLUENCE



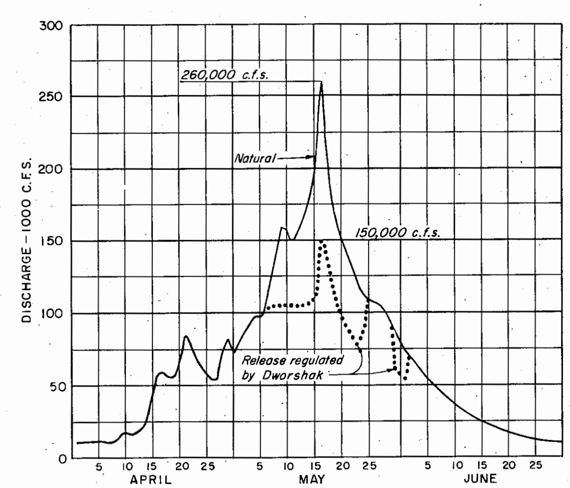
CONTRIBUTION FROM GRANDE RONDE RIVER AT TROY



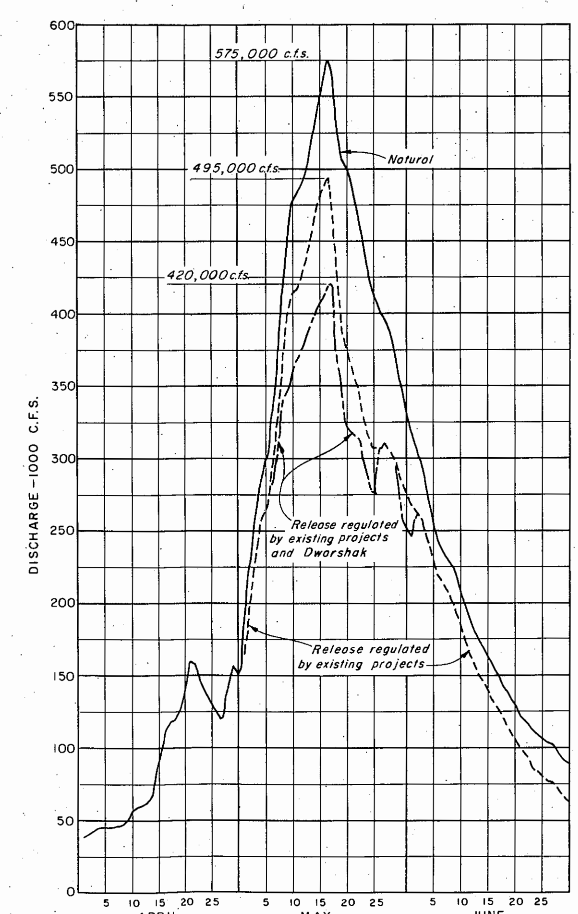
SCHEMATIC DIAGRAM OF MAJOR PROJECTS WITH FLOOD CONTROL STORAGE



STANDARD PROJECT FLOOD SNAKE RIVER ABOVE CLEARWATER RIVER CONFLUENCE



CLEARWATER RIVER STANDARD PROJECT FLOOD AT SPALDING



STANDARD PROJECT FLOOD-SNAKE RIVER AT LOWER GRANITE DAMSITE

BASIN	DRAINAGE AREA SQ. MI.
SNAKE RIVER AT BROWNLEE	72,500
SALMON RIVER AT WHITEBIRD	13,550
GRANDE RONDE AT TROY	3,275
UNGAGED AREA BETWEEN BROWNLEE AND CLEARWATER CONFLUENCE	4,175
SNAKE RIVER ABOVE CLEARWATER CONFLUENCE	93,500
CLEARWATER RIVER AT SPALDING	9,570
AREA BETWEEN SPALDING AND LOWER GRANITE DAMSITE (ASSUMED NON-CONTRIBUTING DURING FLOOD)	430
SNAKE RIVER AT LOWER GRANITE DAMSITE	103,500

NOTE

THE FLOODS SHOWN AS CONTRIBUTIONS FROM SNAKE RIVER AT BROWNLEE, SALMON RIVER AT WHITEBIRD, GRANDE RONDE RIVER AT TROY, AREA ON SNAKE RIVER BETWEEN BROWNLEE AND CLARKSTON, AND CLEARWATER RIVER AT SPALDING ARE NOT STANDARD PROJECT FLOODS FOR THE INDIVIDUAL AREAS BUT CONTRIBUTIONS FROM THESE AREAS TO THE LOWER SNAKE RIVER STANDARD PROJECT FLOODS.

REVISION	DATE	DESCRIPTION	BY

U. S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

DESIGNED: Armacost
DRAWN: R.L.G.
CHECKED: Conway
SUPERVISED: CHIEF, WATER CONTROL SECT.

LITTLE GOOSE LOCK AND DAM
SNAKE RIVER, ORE., WASH. & IDA.
STANDARD PROJECT FLOODS AND CONTRIBUTIONS

SUBMITTED: Glenn H. Von Gunten
CHIEF, PROJECT PLANNING BRANCH

APPROVED: DATE 22 Nov. 1963
COLONEL, C. E. DISTRICT ENGINEER

SCALE AS SHOWN | INV. NO. ENG.

RECOMMENDED: E. C. Tramp
CHIEF, ENGINEERING DIVISION

SHEET FILE NO. GD-05-3/17

Notes:

1. Data for this chart are from records of climatological stations in the Snake River Basin, adjusted to 50-year period. Mean annual precipitation at elevations higher than the elevations of the climatological stations were obtained from the isohyetal map, plate 2.

2. The mean annual precipitation for each sub-basin was obtained from the isohyetal map, plate 2. In drawing the "precipitation distribution" curve for a sub-basin the mean annual precipitation was made equal to the sum of the weighted mean for all zones in that sub-basin.

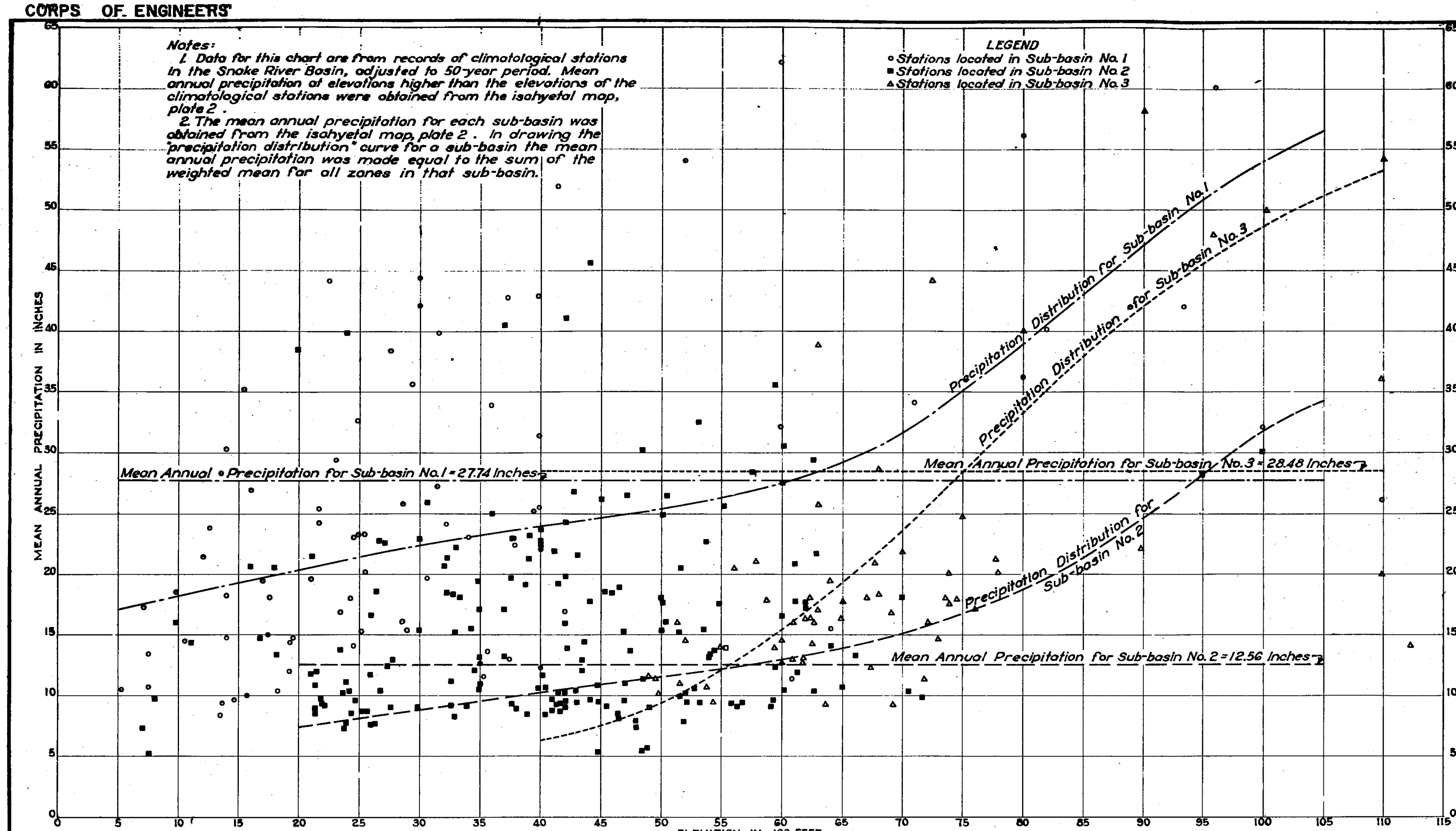


FIG. 1 - PRECIPITATION - ELEVATION DISTRIBUTION GRAPH

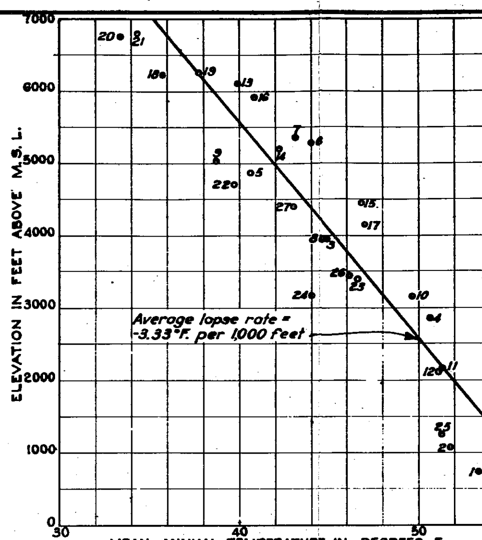


FIG. 2 - TEMPERATURE - ELEVATION CORRELATION

STATION	INDEX		
No.	Location	No.	Location
1	Lewiston, Idaho	16	Mackay, Idaho
2	Orofino, "	17	Burley, "
3	Salmon, "	18	Afton, Wyo.
4	Boise, "	19	Jackson, "
5	Cascade, "	20	Moran, "
6	Challis, "	21	Snake River, Wyo.
7	Hailey, "	22	Alpha, Idaho
8	Idaho City, "	23	Grangeville, Idaho
9	Mc Call, "	24	Pierce, Idaho
10	Mountain Home, Idaho	25	Kooskia, "
11	Payette, Idaho	26	Baker, Oregon
12	Weiser, "	27	Joseph, "
13	Driggs, "		
14	Irwin, "		
15	Pocatello, "		

Note:

1. Similar curves which were drawn for monthly mean temperatures of individual years indicated that the mean annual temperature lapse rate of -3.33 degrees F. per 1,000 feet is also representative of monthly mean temperature lapse rates.

Sub-basin	Drainage Area in Sq. Mi.	Mean Annual Precip.	Factor from Curves	Max. 7-Month Precip.
No. 1	45,200	27.74	137	38.0
No 2	50,200	12.56	180	22.6
No. 3	8,800	28.48	147	41.9

Notes:

1. Data for this graph were obtained from report titled "Tentative Estimates of Maximum Possible Flood Producing Meteorological conditions in the Columbia River Basin," by the Hydrometeorological Section of the U.S. Weather Bureau, dated January 25, 1945.

2. Maximum 7-month precipitation for each sub-basin is given in table above.

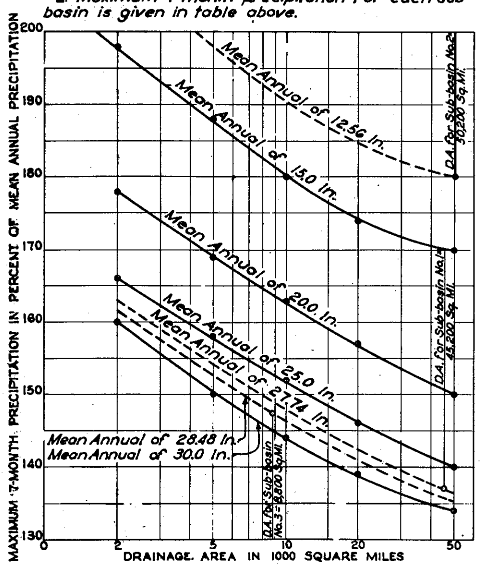


FIG. 3 - MAX. POSSIBLE 7-MONTH PRECIPITATION

Notes:

1. Seven-month (Nov.-May) precipitation was obtained for each year studied from U.S. Weather Bureau records at the following stations:

Sub-basin No. 1

a. Baker, Oregon — e. Kooskia, Idaho
b. Boise, Idaho — f. Orofino, "
c. Challis, " — g. Moscow, "
d. Grimes Pass, Idaho — h. Salmon, "

Sub-basin No. 2

a. Idaho Falls, Idaho — d. Soldier's Creek, Idaho
b. Pocatello, " — e. Twin Falls, Idaho
c. Riverside, Oregon

Sub-basin No. 3

a. Afton, Wyoming — b. Moran, Wyoming

2. The mean 7-month precipitation for each year in each sub-basin for stations studied was multiplied by the ratio of station mean annual to basin mean annual precipitation to obtain the 7-month precipitation for each year.

3. The annual run-off was obtained from U.S. Geological Survey records corrected for irrigation depletions and base flow.

TABULATION OF LOSSES

Sub-basin	Annual Losses: Max. 7-Month Precip., In.	Annual Losses: Min. Loss Inches	Annual Losses: Direct Run-off Inches	Oct.-Feb. Losses: Ground-water Discharge, In.	Oct.-Feb. Losses: Evap., Trans. and Soil Moisture, In.	Oct.-Feb. Losses: Total	Net Accumulation of Snow on Mar. 1	March-Sept. Losses: Ground-water Discharge, In.	March-Sept. Losses: Evap., Trans. and Soil Moisture, In.	March-Sept. Losses: Total
No. 1	38.0	20.2	17.8	2.1	3.2	5.3	32.7	3.8	11.1	14.9
No. 2	22.6	19.5	3.1	1.1	5.0	6.1	16.5	1.8	11.6	13.4
No. 3	41.9	16.8	25.1	1.8	2.5	4.3	37.6	6.6	5.9	12.5

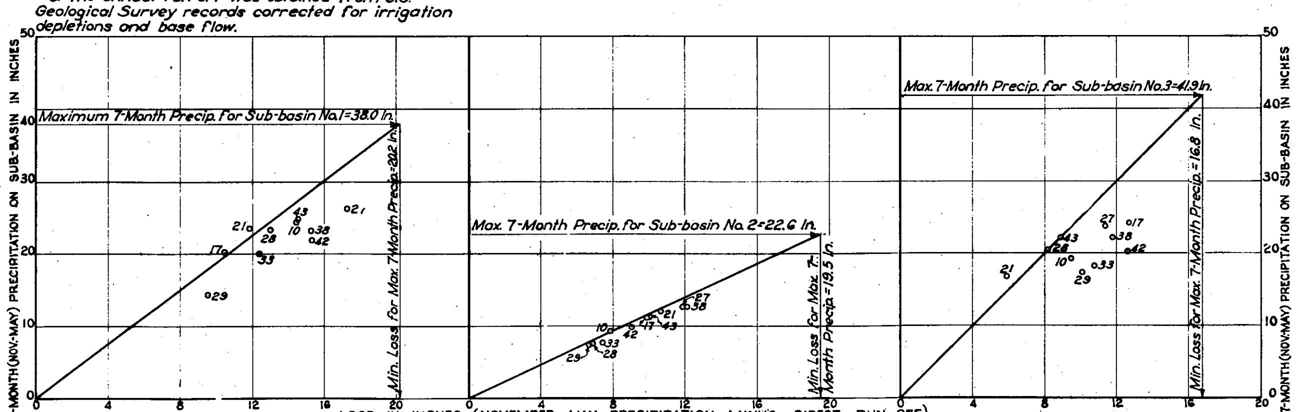
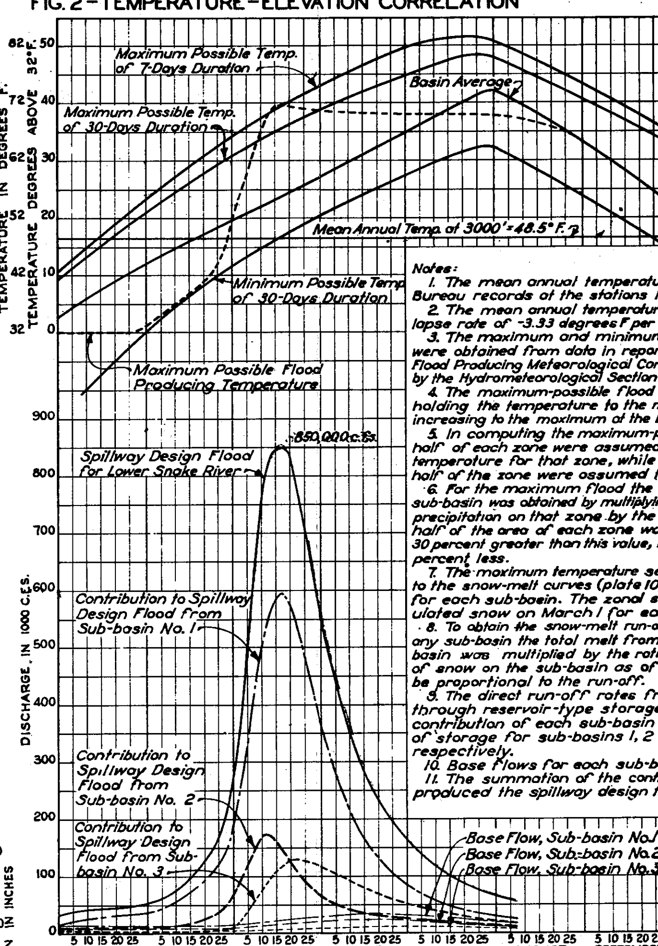


FIG. 4 - PRECIPITATION - LOSS CURVES



Notes:

1. The mean annual temperature was determined from U.S. Weather Bureau records at the stations listed in table of figure 2.

2. The mean annual temperature for each station was adjusted by the lapse rate of -3.33 degrees F per 1,000 feet to obtain the mean at 3,000 ft.

3. The maximum and minimum possible temperature envelope curves were obtained from data in report titled, "Tentative Estimates of Maximum Flood Producing Meteorological Conditions in the Columbia River Basin," by the Hydrometeorological Section of the U.S. Weather Bureau.

4. The maximum-possible flood producing temperature sequence is holding the temperature to the minimum up to the last week in April, and increasing to the maximum at the beginning of the third week in May.

5. In computing the maximum-possible flood the temperatures for one-half of each zone were assumed to be 2 degrees F above the mean temperature for that zone, while the temperatures for the other one-half of the zone were assumed to be 2 degrees F below the mean.

6. For the maximum flood the accumulated snow on each zone in a sub-basin was obtained by multiplying the percent of the mean annual precipitation on that zone by the accumulated snow as of March 1. One-half of the area of each zone was assumed to have snow accumulated 30 percent greater than this value, while the other half was assumed 30 percent less.

7. The maximum temperature sequence was applied by 5-day periods to the snow-melt curves (plate 10, figures 2, 3, & 4) commencing with March 1 for each sub-basin. The zonal snow melt continued until the accumulated snow on March 1 for each zone was melted.

8. To obtain the snow-melt run-off rates during the flood period from any sub-basin the total melt from all contributing zones in that sub-basin was multiplied by the ratio of direct run-off to water equivalent of snow on the sub-basin as of March 1. Losses were assumed to be proportional to the run-off.

9. The direct run-off rates from each sub-basin were routed through reservoir-type storage by Snyder's method to obtain the contribution of each sub-basin to the spillway design flood. The times of storage for sub-basins 1, 2 and 3 are 7.5, 8.8, and 10 days respectively.

10. Base flows for each sub-basin were added as shown.

11. The summation of the contributions from each sub-basin produced the spillway design flood for the lower Snake River.

FIG. 5 - SPILLWAY DESIGN FLOOD

REVISION	DATE	DESCRIPTION	BY

U. S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

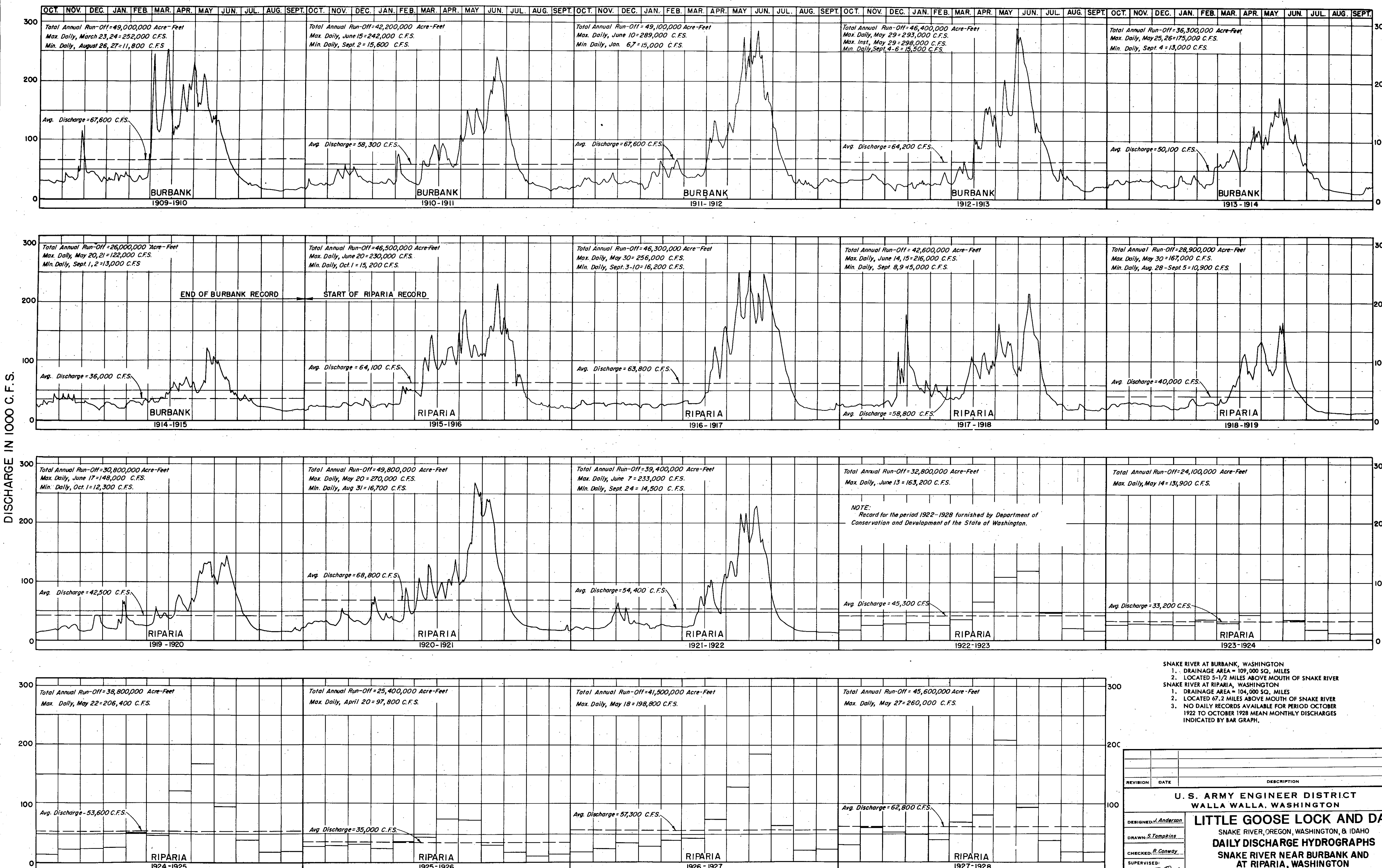
DESIGNED: C.D., D.M.R., & J.A.A.
DRAWN: S. Tompkins
CHECKED: R. H. Conway
SUPERVISED: [signature] CHIEF, WATER CONTROL SECT.

LITTLE GOOSE LOCK AND DAM

SNAKE RIVER, OREGON, WASHINGTON & IDAHO

SPILLWAY DESIGN FLOOD

SUBMITTED: Glenn H. Von Gunten, CHIEF, PROJECT PLANNING BRANCH
APPROVED: [signature] COLONEL, C. E. DISTRICT ENGINEER — DATE 22 Nov. 1963
RECOMMENDED: E. C. Franzen, CHIEF, ENGINEERING DIVISION
SCALE AS SHOWN — INV. NO. ENG.
SHEET — FILE NO. GD-05-3/20



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.

REVISION	DATE	DESCRIPTION	BY

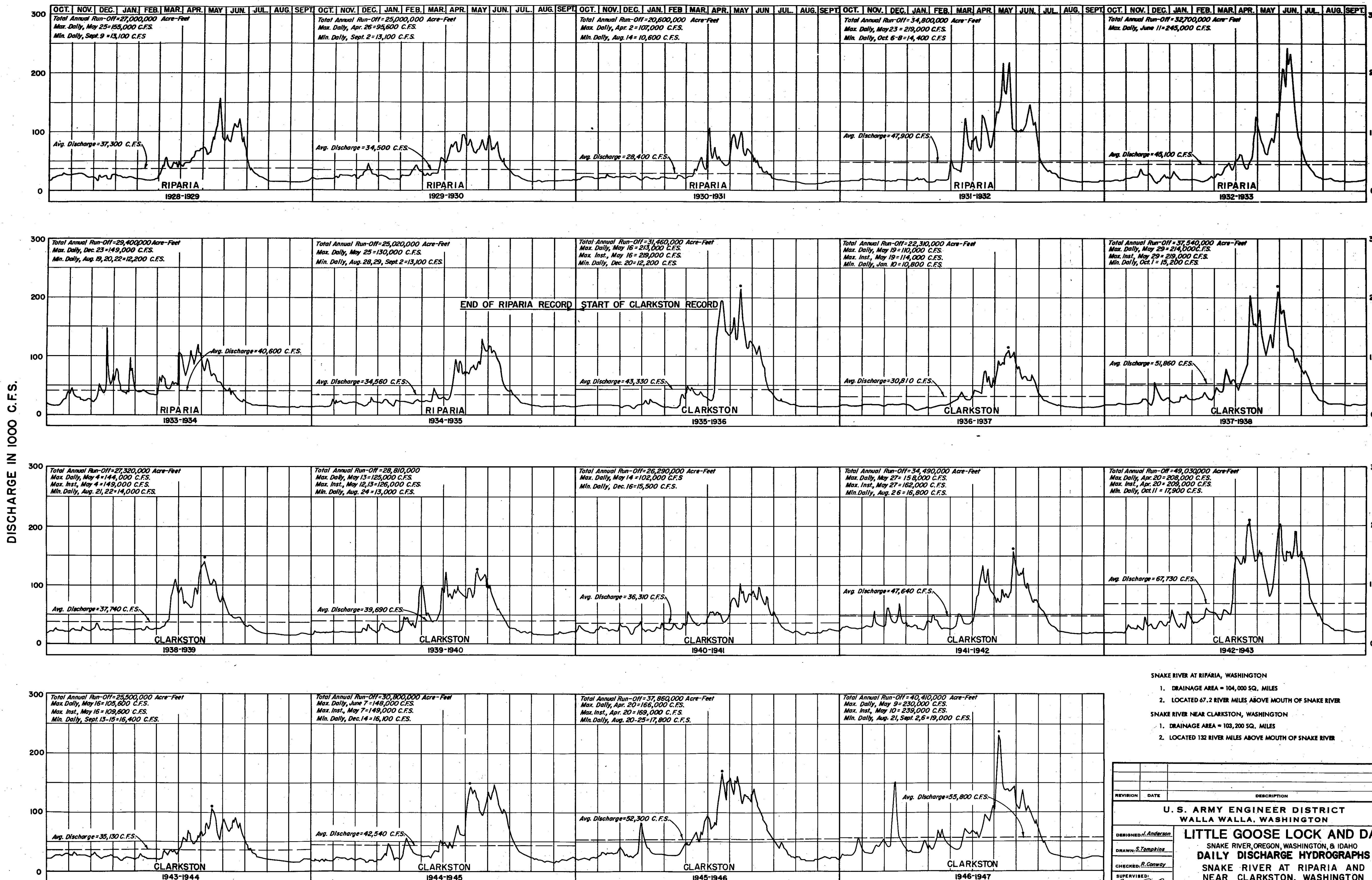
U. S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

DESIGNED: J. Anderson
DRAWN: S. Tompkins
CHECKED: R. Conway
SUPERVISED: [signature] CHIEF WATER CONTROL SECT.

LITTLE GOOSE LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON, & IDAHO

DAILY DISCHARGE HYDROGRAPHS
SNAKE RIVER NEAR BURBANK AND AT RIPARIA, WASHINGTON
1910-1928

SUBMITTED: Glenn H. Von Gunten, CHIEF PROJECT PLANNING BRANCH
RECOMMENDED: E. C. [signature], CHIEF, ENGINEERING DIVISION
APPROVED: [signature] COLONEL, C. E. DISTRICT ENGINEER
DATE 22 Nov. 1963
SCALE AS SHOWN | INV. NO. ENG.
SHEET | FILE NO. GD-05-3/6



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

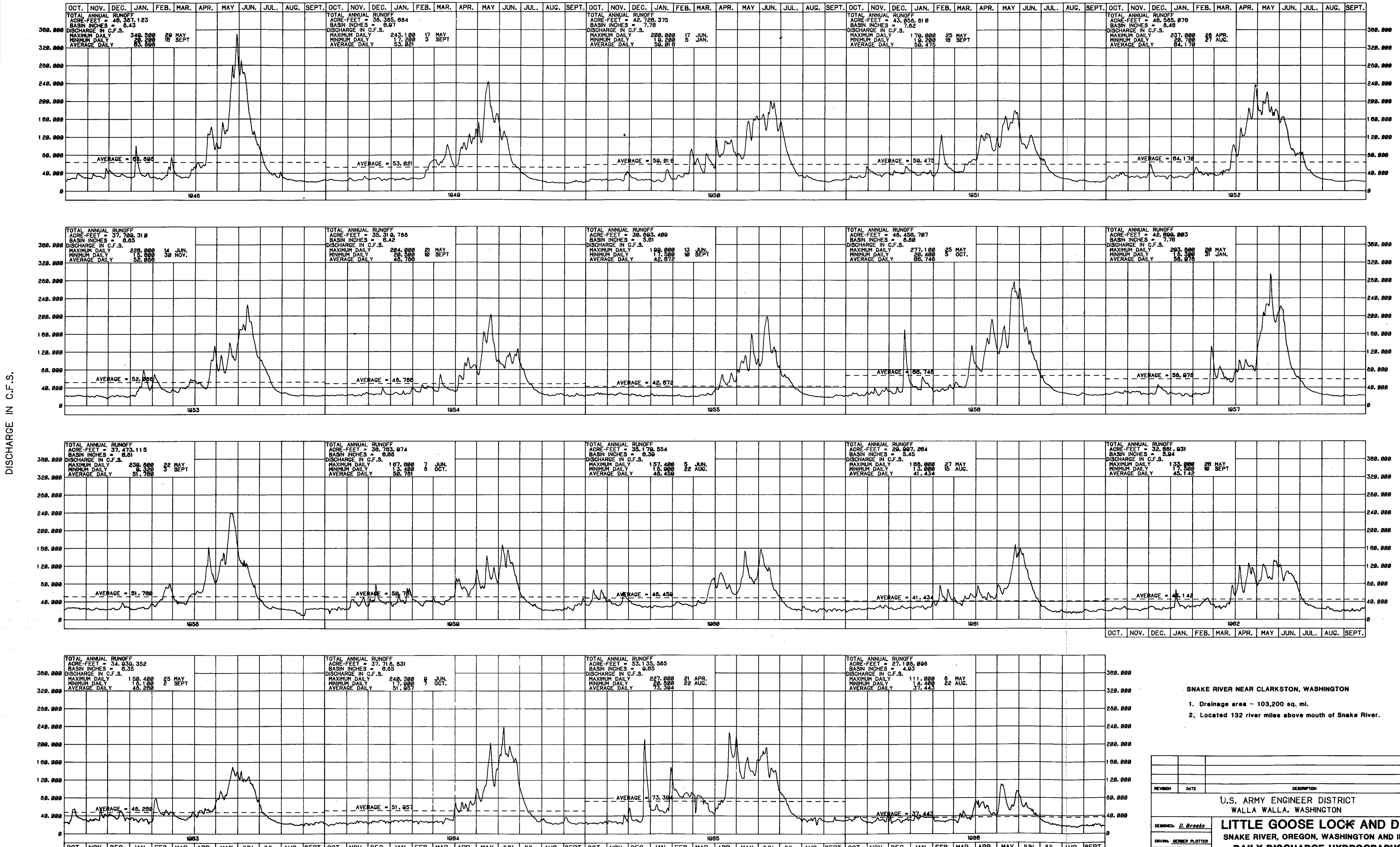
REVISION	DATE	DESCRIPTION	BY

U. S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

DESIGNED: J. Anderson
DRAWN: S. Tompkins
CHECKED: R. Conway
SUPERVISED: CHIEF, WATER CONTROL SECT.

LITTLE GOOSE LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON, & IDAHO
DAILY DISCHARGE HYDROGRAPHS
SNAKE RIVER AT RIPARIA AND NEAR CLARKSTON, WASHINGTON
1929 – 1947

SUBMITTED: Glenn H. Von Gunten — CHIEF, PROJECT PLANNING BRANCH
RECOMMENDED: E. C. Fraser — CHIEF, ENGINEERING DIVISION
APPROVED: COLONEL, C. E. DISTRICT ENGINEER — DATE 22 Nov. 1963
SCALE AS SHOWN — INV. NO. ENG.
SHEET — FILE NO. GD-05-3/7



SNAKE RIVER NEAR CLARKSTON, WASHINGTON

1. Drainage area – 103,200 sq. mi.
2. Located 132 river miles above mouth of Snake River.

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

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

LITTLE GOOSE LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO

DAILY DISCHARGE HYDROGRAPHS
SNAKE RIVER NEAR CLARKSTON, WASH.

1948 – 1966

SUPERVISED: R.E. Riehl
CHIEF, HYDROLOGY BRANCH
SUBMITTED: Brian J. Beechie
CHIEF, PLANNING DIVISION

APPROVED: DATE
SCALE AS SHOWN | INV. NO. ENG.
FILE NO.
SHEET

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:

LITTLE GOOSE LOCK AND DAM

SNAKE RIVER, OREGON, WASHINGTON AND IDAHO

DAILY DISCHARGE HYDROGRAPHS

SNAKE RIVER NEAR CLARKSTON, WASH.

1967 - 1972

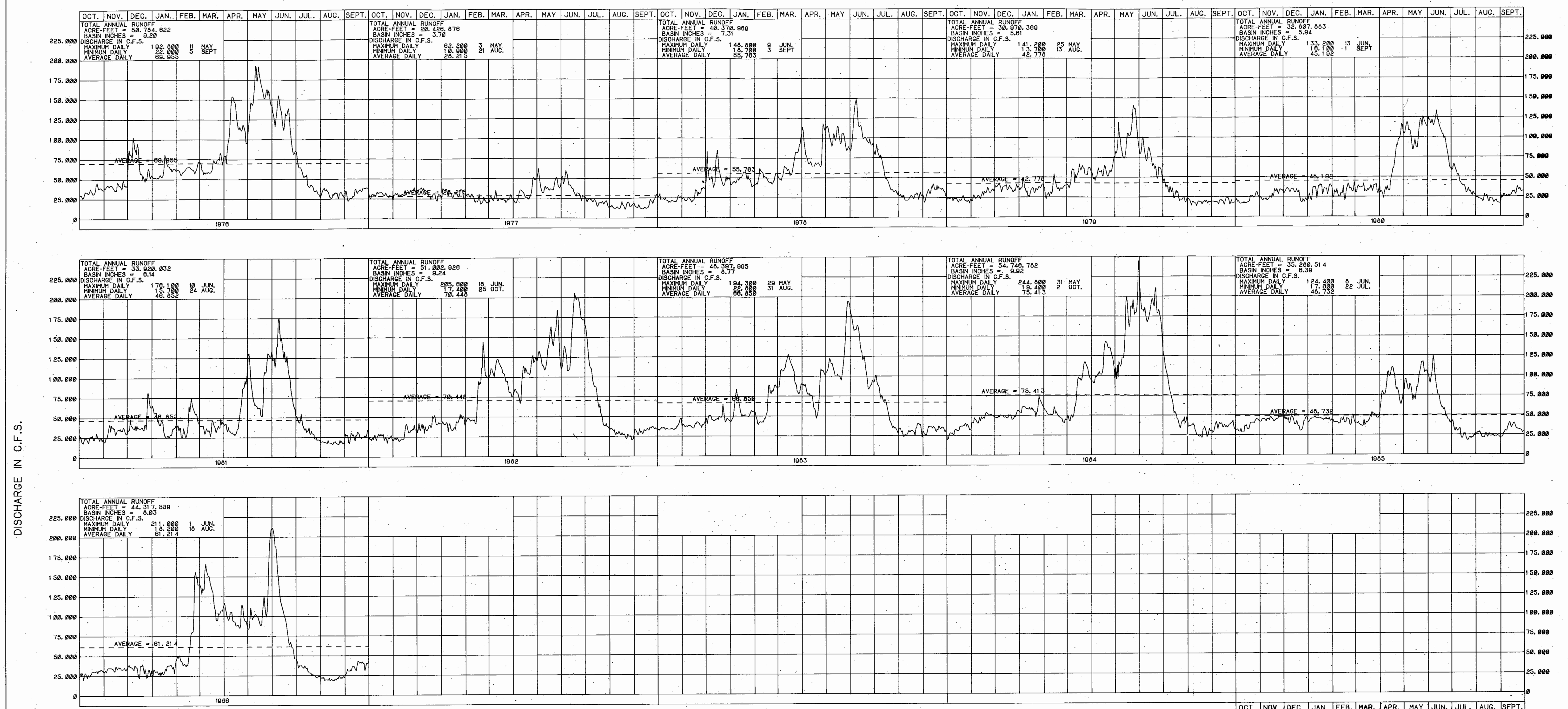
SUPERVISED: R.E. Kuhl
CHIEF, HYDROLOGY BRANCH
SUBMITTED: (Acty) Brian J. Beechie
CHIEF, PLANNING DIVISION

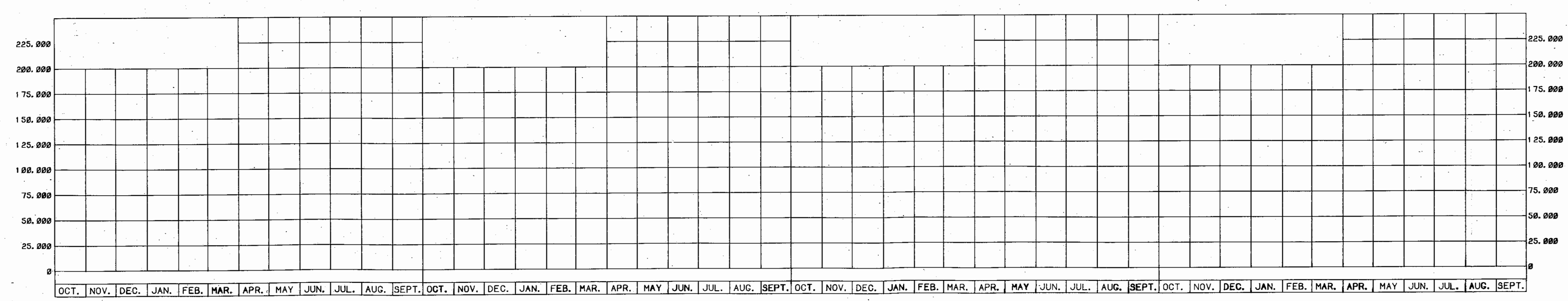
APPROVED: DATE

SCALE AS SHOWN | INV. NO. ENG.

FILE NO.

SHEET





LOWER GRANITE RESERVOIR

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

REVISION	DATE	DESCRIPTION	BY

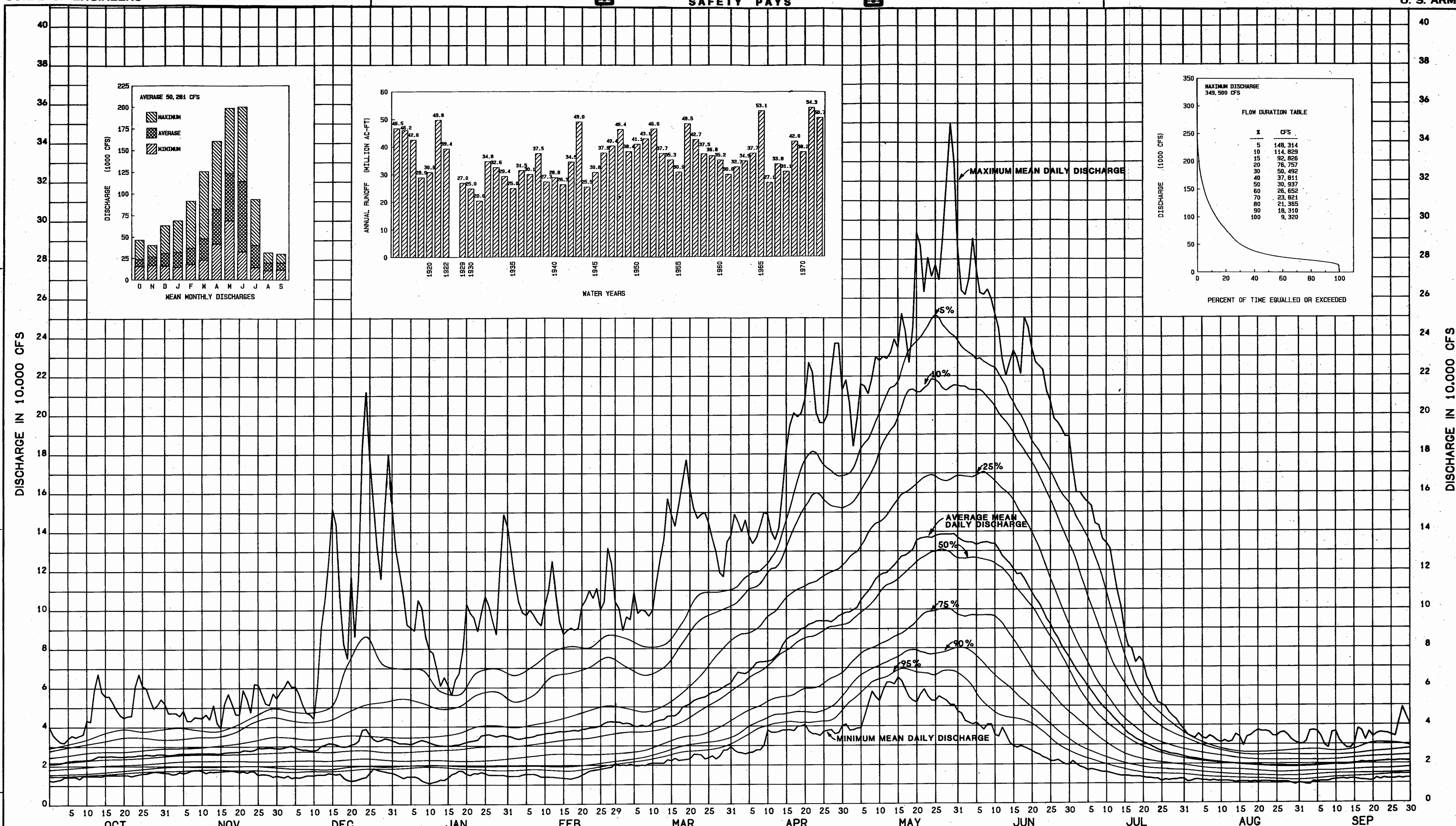
U.S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

DESIGNED: D. Brooks
DRAWN: GERBER PLOTTER
CHECKED: E. Kim
PREPARED: [signature]
CHIEF HYDROLOGY BR

LITTLE GOOSE LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON, & IDAHO
DAILY DISCHARGE HYDROGRAPHS
LOWER GRANITE RESERVOIR
COMPUTED REGULATED INFLOWS
1976-1986

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				

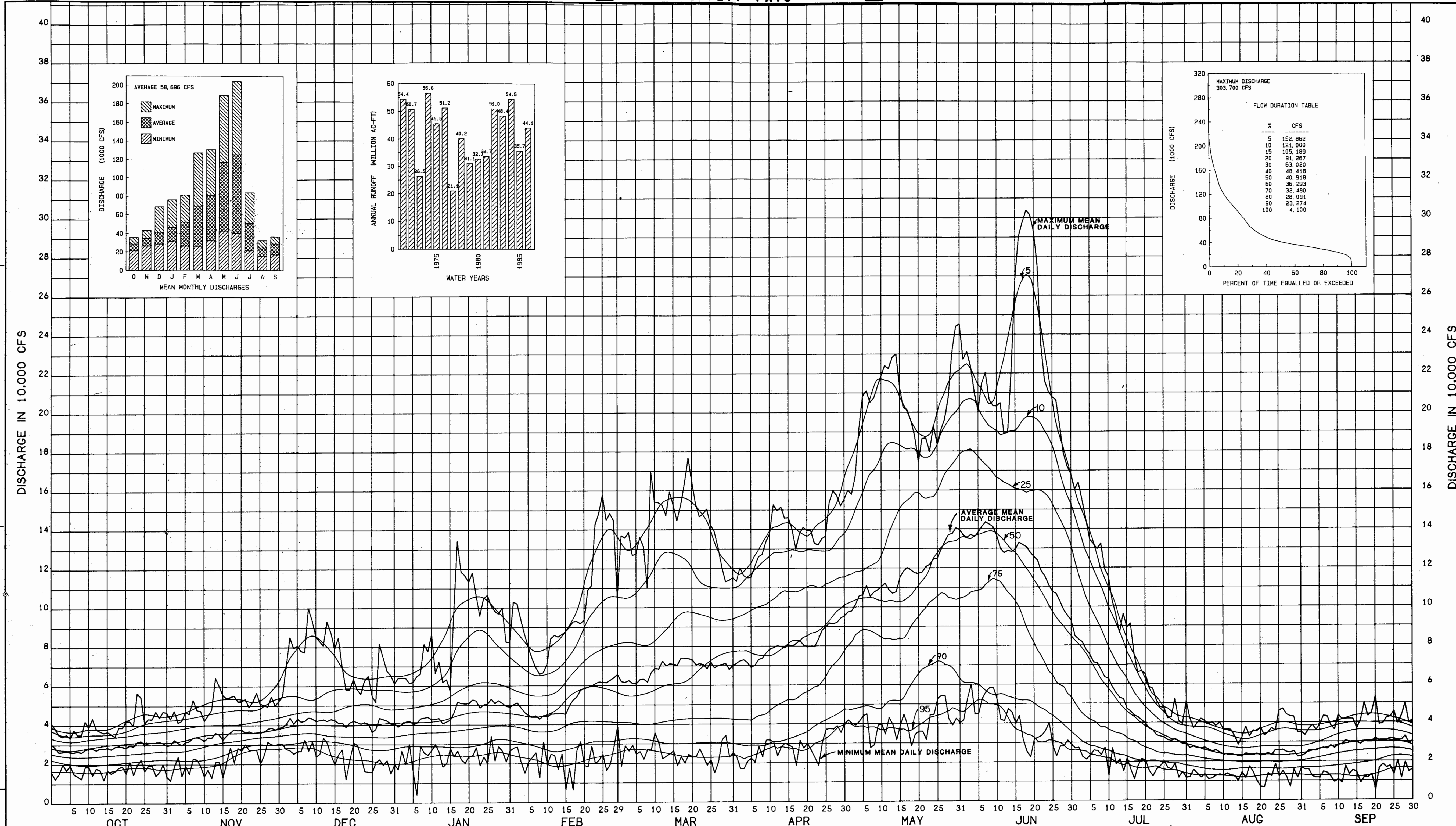
REVISION	DATE	DESCRIPTION	CHKD	APPR

U. S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

D. Brooks — DESIGNED BY
Gerber Plotter — DRAWN BY
E. Kim — CHECKED BY
SUPERVISED: — CHIEF, HYDROLOGY BR.
SUBMITTED: (acting) Brian J. Beeche — CHIEF, PLANNING DIVISION
RECOMMENDED — CHIEF
APPROVED — DATE

LITTLE GOOSE LOCK AND DAM
SNAKE RIVER, OREGON, WASHINGTON, & IDAHO
SUMMARY HYDROGRAPHS
SNAKE RIVER NEAR CLARKSTON, WASH.

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



NOTES:

1. RECORDS USED:

   WATER YEARS 1971 - 1986, LITTLE GOOSE REGULATED INFLOWS COMPUTED BY THE CORPS OF ENGINEERS, WALLA WALLA DISTRICT.

2. DRAINAGE AREA IS 103,900 SQUARE MILES.

3. COMPUTED REGULATED INFLOWS REFLECT THE EFFECTS OF UPSTREAM IRRIGATION AND RESERVOIR STORAGE.

4. CURVES OF PERCENT CHANCE OF OCCURRENCE REPRESENT THE AVERAGE 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
1971	MAY 30	244,100
1972	JUN 2	231,200
1973	MAY 19	92,700
1974	JUN 18	303,700
1975	JUN 8	186,700
1976	MAY 15	194,200
1977	MAY 4	63,800
1978	JUN 9	146,700
1979	MAY 25	139,500
1980	JUN 13	133,800
1981	JUN 10	174,800
1982	JUN 18	206,000
1983	MAY 29	194,500
1984	MAY 31	245,500
1985	JUN 9	125,300
1986	JUN 2	208,200

REVISION	DATE	DESCRIPTION	CHKD	APPR

U. S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

LITTLE GOOSE LOCK AND DAM

SNAKE RIVER, OREGON, WASHINGTON, & IDAHO

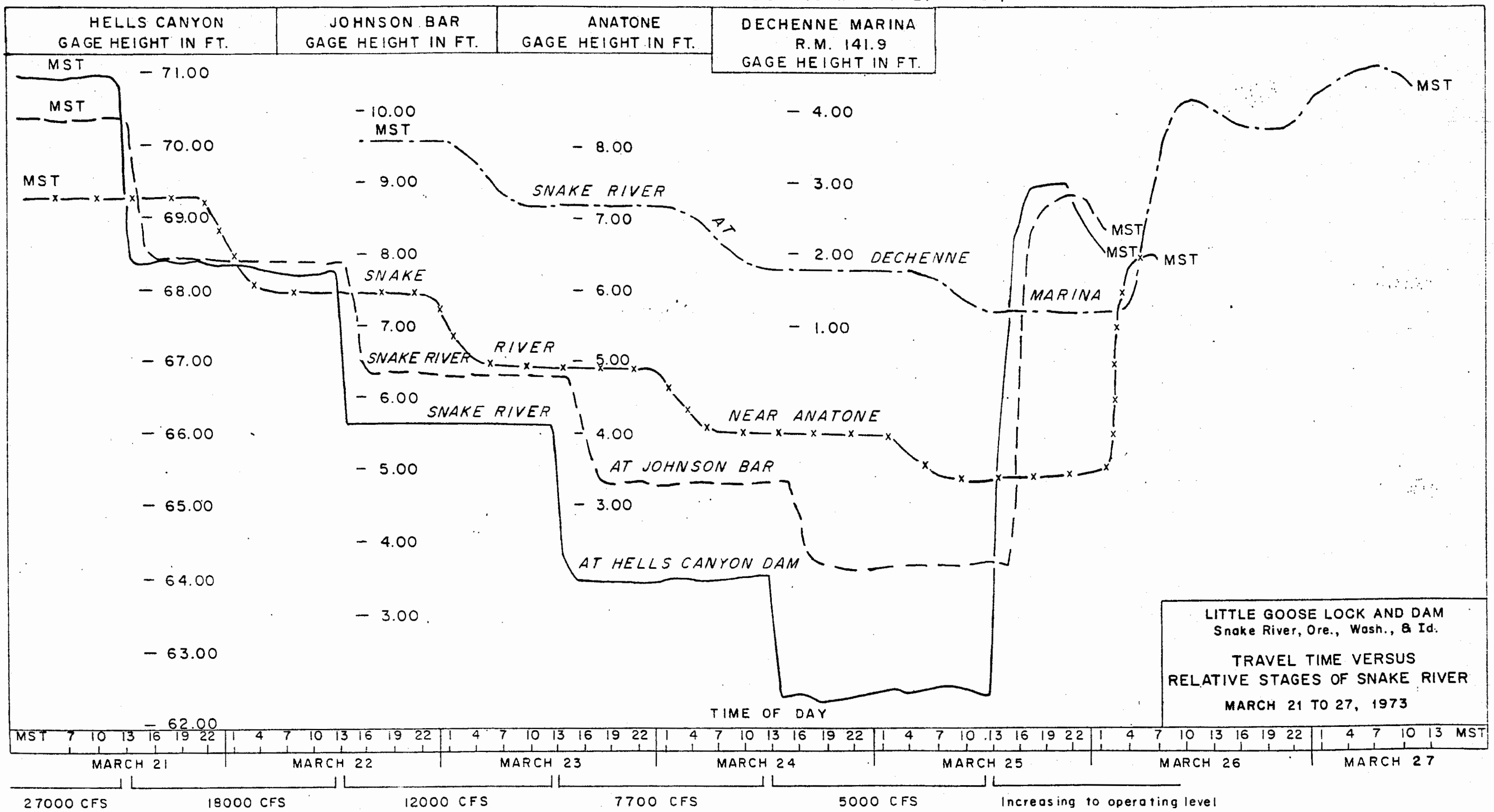
SUMMARY HYDROGRAPHS

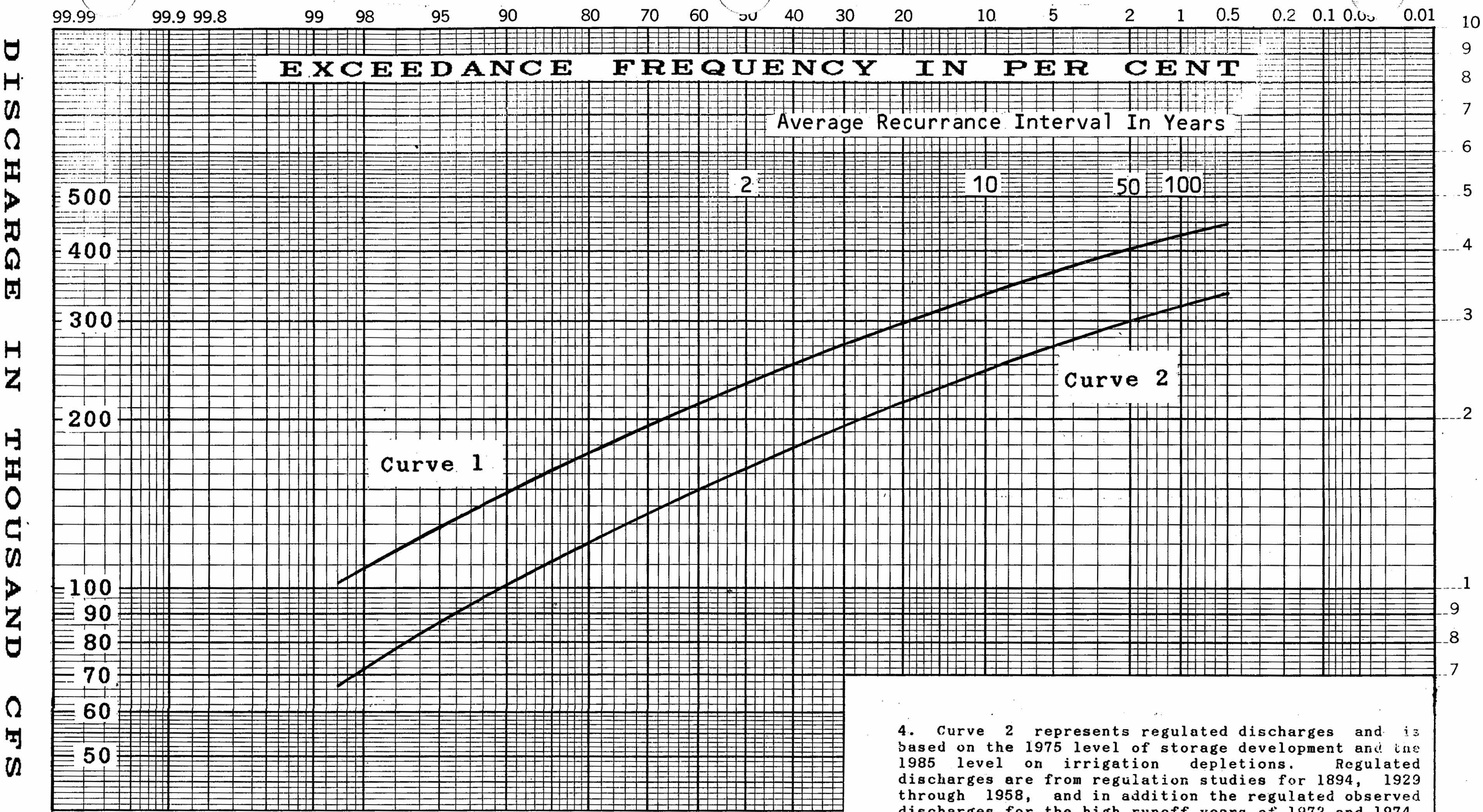
LITTLE GOOSE RESERVOIR

COMPUTED REGULATED INFLOWS

DESIGNED BY
DRAWN BY
CHECKED BY
SUPERVISED:
CHIEF
SUBMITTED:
CHIEF
RECOMMENDED
CHIEF
APPROVED DATE
SCALE AS SHOWN
INV. NO.
SHEET NO. FILE NO.

RELATIVE STAGES OF SNAKE RIVER DURING MARCH 21 TO 27, 1973





NOTES

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

2. This is a preliminary graph subject to revision.

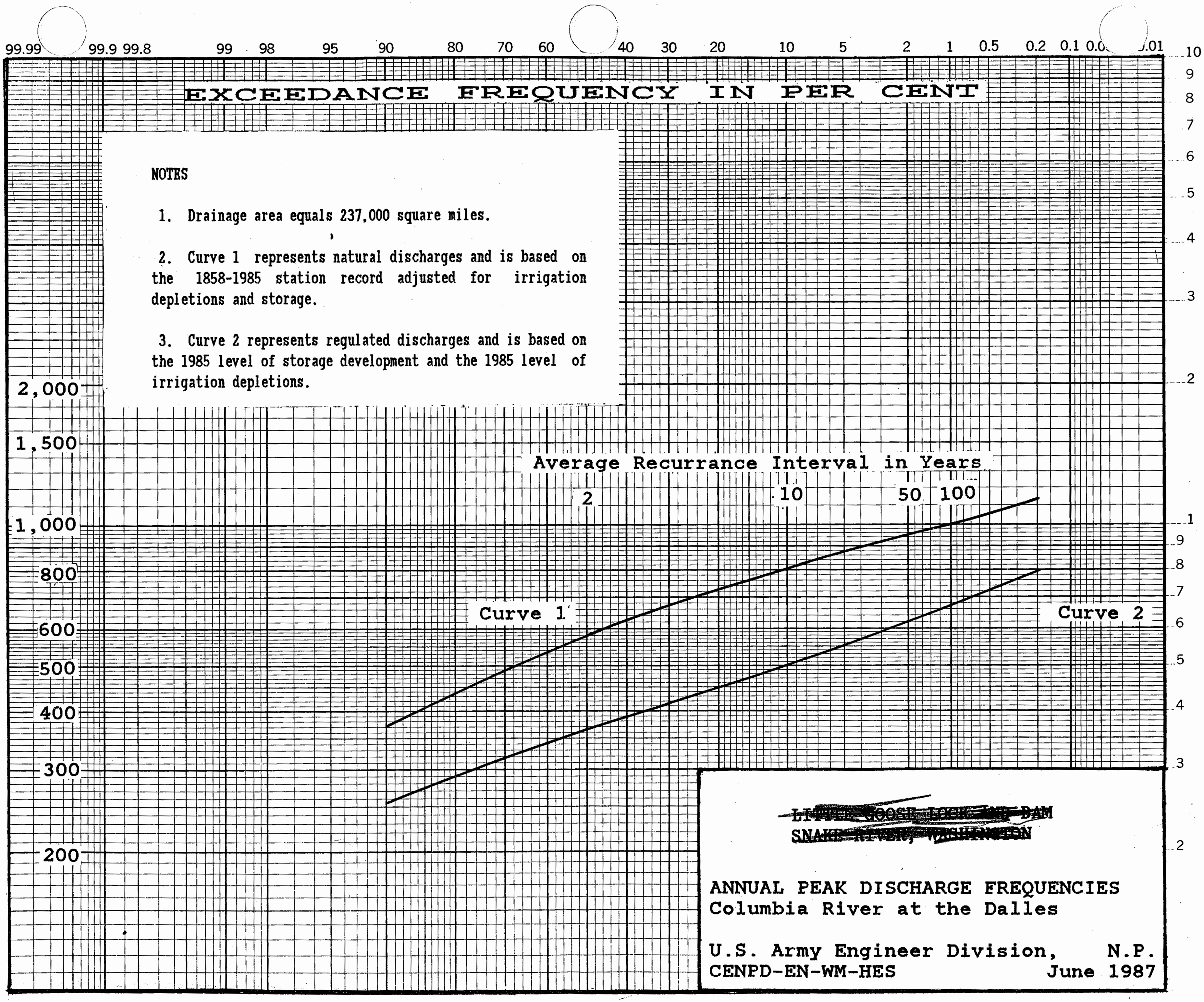
3. Curve 1 represents natural discharges and is based on the 1894-1975 station record adjusted for irrigation depletions and storage and extended by correlation with the 1858-1975 Columbia River at The Dalles station record. It includes an expected probability adjustment. The station and adopted skew 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.

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, 1929 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.

LITTLE GOOSE LOCK AND DAM
Snake River, Ore., Wash., & Ida.

ANNUAL PEAK DISCHARGE FREQUENCIES
Snake River At Lower Granite Dam

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


EXCEEDANCE FREQUENCY IN PER CENT
99.99 99.9 99.8 99 98 95 90 80 70 60 40 30 20 10 5 2 1 0.5 0.2 0.1 0.01
DISCHARGE IN THOUSAND CFS
2,000
1,500
1,000
800
600
500
400
300
200
NOTES
1. Drainage area equals 237,000 square miles.
2. Curve 1 represents natural discharges and is based on the 1858-1985 station record adjusted for irrigation depletions and storage.
3. Curve 2 represents regulated discharges and is based on the 1985 level of storage development and the 1985 level of irrigation depletions.
Average Recurrance Interval in Years
2
10
50
100
Curve 1
Curve 2
~~LITTLE GOOSE LOCK AND DAM~~
~~SNAKE RIVER, WASHINGTON~~
ANNUAL PEAK DISCHARGE FREQUENCIES
Columbia River at the Dalles
U.S. Army Engineer Division, N.P.
CENPD-EN-WM-HES
June 1987

LITTLE GOOSE LOCK AND DAM - WATER CONTROL MANUAL

EXHIBITS

EXHIBIT 1-1

LITTLE GOOSE LOCK AND DAM
DESIGN MEMORANDUMS

	Title	Cover Date
1	Site Selection and Upper Pool Determination	13 February 1961
2	General Design Memorandum (4 Volumes)	20 October 1961
3.	Preliminary Report of Concrete Aggregate Investigations	17 September 1962
	Supp. 1 - Final Report	5 December 1963
	Supp. 2 - Additional Investigations	5 January 1967
4.1	South Shore Access Road	8 November 1962
	Supp. 1 - Design and Cost Revisions	11 April 1963
4.2	Deleted	
5	Camas Prairie Railroad Relocations (2 Volumes)	31 August 1965
	Supp. 1 - Design and Cost Revisions	August 1966
	Supp. 2 - Revised Alignment, Central Ferry Area	9 October 1968
6	Garfield County Road Relocations	22 November 1965
	Supp. 1 - County Road 375, Part 1	18 July 1967
	Supp. 2 - County Road 375, Hastings Hill	11 October 1968
7-Part 1	Real Estate - Damsite Construction Area, North and South Shore Access Roads, Relocated Borrow Areas, Partial Relocations of the Camas Prairie Railroad, Partial Flowage and Public-Use Areas, and Project Housing Area	19 April 1962
7-Part 2	Real Estate - Remainder of Project, Remainder of Camas Prairie Railroad Relocation, State Highway and County Road Relocations, Remainder of Public-Use Areas, and Flowage Requirements	12 April 1963

LITTLE GOOSE LOCK AND DAM
DESIGN MEMORANDUMS
(CONTINUED)

	Title	Cover Date
8	Spillway	16 August 1963
	Supp. 1 - Design and Cost Revisions	16 September 1964
9	Navigation Facilities	23 May 1963
	Supp. 1 - Design and Cost Revisions	11 May 1964
	Letter Supp. 2 - Foundation Stabilization	
	Letter Supp. 3 - Navigation Lock Facilities Modifications to Navigation Lock Discharge Culvert Bulkheads and Guides	3 December 1982
10	Fish Facilities	16 July 1964
10.1	Fingerling Bypass Facilities	21 November 1977
10.2	Permanent Juvenile Bypass Facilities Rewritten	January 1984 November 1986
11	Washington State Highway No. 3	17 July 1967
12	Relocation of Power and Telephone Facilities	18 October 1967
13	First Step Cofferdam	20 February 1963
14A	Preliminary Master Plan	30 March 1962
14	Master Plan	June 1969
14.1	Recreation Facilities and Public Use Areas	June 1969
15	Concrete Non-overflows	23 January 1964
16	North Abutment Embankment and Second Step Cofferdam	6 August 1964
17.1	Powerhouse Architectural Design	October 1963
	Supp. 1 - Paint and Sandblast Building	
17.2	Powerhouse Structural Design	February 1964
17.3	Deleted	

	Title	Cover Date
17.4a	Powerhouse Lighting Design	March 1964
17.4b	Powerhouse Grounding System	March 1964
17.4c	Powerhouse Auxiliary Electrical System	March 1964
17.4d	Powerhouse Control and Emergency D-C and Preferred A-C Sources	March 1964
17.4e	13.8-kv Service to Inland Power and Light Company	2 July 1971
	Supp. 1 - Revisions	11 January 1972
17.5	Preliminary Design Report, Power Units 4 - 6	July 1972
	Supp. 1 - Transmission System, Transformer Windings, and Service to Inland Power and Light Company	31 October 1973
17.6	Letter Supplement, Repair of Erection Bay Intake Monolith	
18	Domestic Water Supply System	10 June 1964
	Supp. 1 - Additional Requirements	30 December 1970
19	100-Ton Combined Spillway & Powerhouse Intake Gantry Crane (see John Day DM 15.8)	
20	Foundation Grouting and Drainage	17 April 1964
21	South Shore Temporary Project Office	24 August 1962
22	Relocation of Penawawa Cemetery	3 May 1965
	Final Report	11 October 1966
23	Permanent Operators' Quarters	16 September 1965
24	Aircraft Landing Strip	2 June 1965

LITTLE GOOSE LOCK AND DAM
DESIGN MEMORANDUMS
(CONTINUED)

	Title	Cover Date
25	Whitman County Road Relocations	18 April 1966
	Supp. 1 - Necessity for Relocation, Roads 800 and 810	13 October 1966
	Supp. 2 - County Road 819	16 October 1968
26	Visitors Facilities and Landscape Treatment	January 1979
27	Isolated Burials near Penawawa	21 May 1968
28	Reservoir Clearing	14 January 1969
29	Cost Allocation	April 1976

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 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 they are 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 Dalles, 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 1 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 riverflow at Lower Granite exceeds 330,000 cubic feet per second, the normal minimum 15-foot depth may be decreased to as little as 8 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 may 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 msl 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 Lock Master. 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 vessels as provided in paragraph (h) of this section.

(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 1 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 for 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 Lock Master 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 following 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 or 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, and/or (4) refusal of lockage at the time of violation.

s. Refuse in Locks. No material 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, U.S. Army Corps of Engineers, 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

Wasco 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 earthfill section of the dam near the upstream end of the powerhouse.

(3) At 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°00' 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° true for a distance of 250 yards to the south shoreline.

Drawings which depict the hazardous and restricted 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
(Rick Werner, 527-7101, or Andrea Valentine, 527-7102)

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.