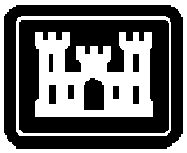

**US Army Corps
of Engineers**

Preparation of Water Control Manuals

Project and Basin-Wide for

Lakes

Dams and Reservoirs

Tidal Barriers

Locks and Dams

Reregulating Structures

Controlled Channels and Floodways

Revised

_____ 19 __

GENERAL

The main purpose of a manual is for day-to-day use in water control for essentially all foreseeable conditions affecting a project or a system. Therefore, appreciable effort should be made to compile the manual in a concise and usable form. This Engineer Regulation (ER) describes the preparation of Water Control Manuals for "individual" water resource projects; however, it can also be used for basin-wide ("master") water control manuals. Descriptions and regulation criteria for structures that are part of the water resource project, such as reregulation, pumpback, or diversion facilities, should be included within the manual of that individual project. Water control plans for neighboring water resources projects within the same system, which are not integrated components of a given project, should be prepared individually.

A separate manual, or appendix to a master manual, is prepared for each water control project for the user’s convenience during real-time applications. An important secondary purpose for preparing separate manuals/appendices is to document for reference those aspects of projects that relate to water control.

TEXT OF MANUALS

The standardized format and content herein include chapter titles, topics, subtopics, and pertinent data applicable to many types of projects requiring manuals. The chapter titles should always be used, regardless of scope, while a limited amount of flexibility may be employed in the selection of topics and subtopics. The format and content as presented in this ER are intended for individual water control manuals, however, they can be used as guidelines for "master" water control manuals. See Part B, "Outlines For Preparing Master Water Control Manuals," of this ER.

The required scope of individual project manuals may be less extensive in certain chapters or topics for those projects within basins or systems where master manuals are available or planned; e.g. when hydrologic forecasting or water control objectives are broad areal tasks . . . provided these subjects are adequately presented in the master manual.

EDITORIAL GUIDANCE

The following editorial guidance should be used in the preparation of manuals:

a. Use of the term "regulation" should be restricted to either: (1) water control procedures and decisions that normally are determined by regulating engineers (hydrologic or hydraulic), or (2) legal rules, agreements, or contracts; e.g. Section 7 Flood Control or Navigation Regulations, ER 1110-2-240, FERC licenses, water supply contracts, and ruling of interstate compacts.

b. Use of the term "operation" should be restricted to physical manipulation of spillway gates, outlet works, or instrumentation associated with projects.

c. Use of the term "damtender" refers to the individual who has the responsibility for the physical "operation" of the project.

d. Tables one page or less in size will be dispersed throughout the text, as appropriate. To facilitate reading the text, tables longer than one page are to be included in a section following the text. Although these tables are located separately, the numbering system should be the same as for tables dispersed through the text, i.e. 2-3, 2-4. Page numbering for the section on tables would be the same as numbering chapters except page numbers would be preceded by a "T." Reference to a table would read as follows . . . shown in table 6-2 (see page T6-1) and in the List of Tables as:

Table		Page
6-1	_____	6-2
6-2	_____	T6-1
6-3	_____	6-4

e. New chapters should always begin on the right-hand page.

f. Number pages by chapter so that future revisions will not affect page numbers of other chapters. For example, pages in chapter 2 would be numbered 2-1, 2-2, 2-3, etc.

g. Plate and table numbers should correspond to chapter numbers where first referenced. Example: plate 1-1, 1-2, 1-3, 2-1, 2-2, etc.

h. Title block on plates should be readily readable when the manual is opened, with the preferred location in the lower right-hand corner.

i. Scales used on plates should be divided into units of 1, 2, 5, or multiples of 10 per inch. The scale selected should be easy to read and usable for actual operations.

j. Numbering and updating manuals -- should be handled like DM’s to keep all copies up-to-date.

k. Revised pages should be dated to show revision date.

l. All manuals should have a spine labeled with the project name.

m. Pages in the manuals should be dimensioned 8-1/2 by 11 inches and loosely bound with good cover stock.

n. Optional -- manual covers could be color coded by basin.

o. Based on the guidance in ER 1110-2-240, appropriate copies of the manual should be furnished to Division and/or Headquarters, US Army Corps of Engineers.

PART A
PREPARATION OF
WATER CONTROL MANUALS

(Individual Project)

U.S. Army Corps of Engineers
(District/Division name)
(Date of Issue or Revision)

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NOTE: Additional subparagraphs may be used to adequately define or clarify each paragraph

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Part B
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PART B 1
OUTLINE FOR PREPARING
MASTER WATER CONTROL MANUALS

(Sample Title Page)

WATER CONTROL MANUAL

DEEP HOLE DAM AND RESERVOIR

Purewater River Basin
Massachusetts

U.S. ARMY CORPS OF ENGINEERS
ATLANTIC OCEAN DIVISION
CITY, STATE

JUNE 1970
REVISED SEPTEMBER 1993

PHOTOGRAPH

Include a choice photograph of the dam and reservoir or a composite of photos on one page showing spillways, outlet works, energy dissipators, exit channels, power facilities, overflow embankments, fuse plugs, and other pertinent control structures.

If additional photographs are desired, include on separate pages.

NOTICE TO USERS OF THIS MANUAL

(This should be located on the page following photograph)

Regulations specify that this Water Control Manual be published in a hard copy binder with 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. Changes to individual pages must carry the date of revision, which is the Division's approval date.

REGULATION ASSISTANCE PROCEDURES

In the event that unusual conditions arise during nonduty hours, communication can be achieved by contacting, in the order listed, one of the following personnel (provide a telephone listing).

TABLE OF CONTENTS

(See Table of Contents for this guide to use as an example)

PERTINENT DATA

The pertinent data shown here should be limited to approximately one page with additional information relating to water control tabulated in exhibit A. Restrict information included here as follows: (specific guidance to be provided by Division).

a. Location (state, county, river, and river mile).

b. Drainage area above the damsite and the uncontrolled areas above any major control points downstream; 1 inch of runoff = ____ acre-feet.

c. Type, length, height, top width of dam, dikes, and tidal barriers; type and size of all discharge facilities; spillway, outlet works, water supply pipes, penstocks, and locks.

d. Real estate guide taking lines by fee and easement.

e. Pertinent elevations with corresponding reservoir areas, incremental and cumulative storage and discharge capacities of spillway and outlet works for maximum pool, top induced surcharge, top flood control pool, top conservation pool, top inactive pool, invert lowest intake, and streambed. Also indicate the volumes of sediment reserve, dead storage, and the range of any seasonal joint use or comingled storage reservations, when applicable.

GUIDE FOR NARRATIVE DEVELOPMENT

TEXT OF MANUAL

I - INTRODUCTION

1-01. Authorization. Cite applicable OCE Directives regarding preparation of manual: ER 1110-2-240, ER 1110-2-241, Section 7 of 22 December 1944 Flood Control Act and, when applicable, by request of local interests to regulate project, and other.

1-02. Purpose and Scope. Brief discussion of purpose and scope of manual (use language in ER 1110-2-240). Refer to guidance in EM 1110-2-3600 and this ETL on scope and content.

1-03. Related Manuals and Reports. Master manual and others in same system; list of prior reports pertinent to project such as design memorandums, master plans, and emergency plans.

1-04. Project Owner. Name of agency.

1-05. Operating Agency. Dam attended continuously or part-time (specify period of attendance); damtender living nearby, name, office phone, damtender also operating other structures (reregulation, diversion, other) by remote control/manually; a non-Corps project with physical operation and maintenance officially performed by Corps (see instructions to damtender in back of this manual).

1-06. Regulating Agencies. Corps direct and indirect responsibility for various project purposes including hydrologic forecasts; cite authority of Corps (owner, Section 7 Regulation, through FERC, non-Corps project with regulation officially performed by Corps, other); phone and address of regulating office if non-Corps (see chapter VII for details).

II - DESCRIPTION OF PROJECT

2-01. Location. Stream, river mile, basin, state, county, nearby community.

2-02. Purpose. Concise paragraph stating (not explaining) authorized purposes and incidental benefits.

a. Those assigned by Congress initially in the legislation authorizing the project construction.

b. Those subsequently assigned by Congress in law(s) specific to the project.

c. Those contained in or derived from general Congressional acts, namely:

(1) PL 78-534 Flood Control Act of 1944 (recreation, surplus water)

(2) PL 85-624 Fish and Wildlife Coordination Act of 1958 (fish/wildlife)

(3) PL 85-500 Water Supply Act of 1958 (water supply)

(4) PL 93-205 Endangered Species Act of 1973 (endangered or threatened fish/wildlife)

(5) PL 92-500 Federal Water Pollution Control Act Amendments of 1972 (water quality)

d. Incidental benefits - those which accrue to any purpose other than an authorized purpose incidentally to the operation for the authorized purposes.

2-03. Physical Components. Structural in general, hydraulic in particular, operating machinery (see chapter IV for watershed description). Show subparagraphs for embankment, dikes, barriers, spillway, outlet works, hydroelectric power facilities, water supply facilities, etc. Discuss multilevel outlets for water quality control.

2-04. Related Control Facilities. Integrated components of subject project; e.g. reregulation, diversion, pumpback, local protection, or other structures.

2-05. Real Estate Acquisition. Fee and easement takings in reservoir area, downstream channels, etc. Show backwater curves (profiles), if appropriate.

2-06. Public Facilities. Number and type of public use sites; contour map showing location of sites, especially campsites, islands, and trailer parks upstream and downstream of damsite (see chapter V for flood warning facilities).

III - HISTORY OF PROJECT

3-01. Authorization. Cite Congressional legislation applicable to project formulation; i.e. Flood Control Act, House Document, Public Laws, etc. (project document).

3-02. Planning and Design. Brief history of planning and design.

3-03. Construction. Significant dates such as start of construction, diversion, deliberate impoundment, filling of conservation, and start of hydropower generation (may be shown in a table).

3-04. Related Projects. Other projects (Corps and non-Corps) in same system that affect water control objectives.

3-05. Modifications to Regulations. Brief history of changes to the water control plan due to change in needs and conditions since project formulation, related studies.

3-06. Principal Regulation Problems. Associated with regulation since project completion; erosion, boils, severe leakage, embankment overtopping or failure, structural hydraulic malfunction, ground water table, flooding, nondamaging channel capacity (examples), and encroachment. (Some of this information can probably be presented in tabular form.) Plate showing area of encroachment or channel deterioration.

IV - WATERSHED CHARACTERISTICS

4-01. General Characteristics. Total and contributing drainage area; slope, shape, elevation range, vegetation, tributaries; possible damage centers caused by high pool/ backwater.

4-02. Topography

4-03. Geology and Soils

4-04. Sediment. Discussion of erosion and sediment production in watershed.

4-05. Climate. General description of climate over the watershed. Use tables to show extreme and average or 30-year normal values by month. Show watershed average or representative stations. Include paragraphs on temperature, precipitation, snow, evaporation, and wind.

4-06. Storms and Floods. Types (thunderstorms, hurricanes, etc.), time of year, major floods of record, and damages (limit to a few major floods).

4-07. Runoff Characteristics. Runoff related to antecedent rain, initial losses, time of concentration, monthly and annual streamflow distribution at key points, graphical display of record, seasonal variations, low flow, high flow, and tabulation of monthly and annual inflow volume at project for period of record (also monthly inflow frequency curves or tables). If data is available on computer, then cite automation records and how to access.

4-08. Water Quality. Description of water quality characteristics of the watershed and effects on operation of the lake. Describe the effects of agriculture and industry in the basin on water quality of the lake.

4-09. Channel and Floodway Characteristics. Downstream, shape, condition, capacity, improvements, stability, tributaries, encroachments, alignment, water surface profiles, also description of damage centers and key control points, time of water travel (show graphically on plate), overbank, dikes, levees, control structures, and discharge rating curves for key stations.

4-10. Upstream Structures. Drainage area and regulated by whom.

4-11. Downstream Structures. Drainage area and regulated by whom.

4-12. Economic Data. May be tabular with brief descriptions.

a. Population. Include population data for counties and major towns in watershed and valley.

b. Agriculture. Brief description of agriculture in watershed and valley below the project, value and types of agricultural products.

c. Industry. Description and value of industrial activity in watershed and valley below project.

d. Flood Damages. Average annual damages incurred and prevented, stage-damage curves for downstream reaches which are affected by this project (reaches affected by several projects should be shown in master manual). Curves would show stage versus structural damage and stage versus acres flooded.

V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01. Hydrometeorological Stations

a. Facilities. Show locations on map, include U. S. Geological Survey (USGS) or National Weather Service (NWS) station numbers, types of stations (reporting, staff gauge, telemark, etc.), inflow, outflow, water level, precipitation, ground water, evaporation, snowpack, designate key stations, automated/manual status, automatic data processing compatibility, general adequacy of hydrometeorologic information available on a real time basis, reliability, reference chapters regarding hydrologic forecasting, and management.

b. Reporting. Stations reporting directly to office, reporting criteria, method, how reports from other stations are obtained, measurements, summary of activities during normal day-to-day and flood emergencies, reference instructions to damtender in back of manual, hydrologic/meteorologic measurements, and reporting.

c. Maintenance. Arrangements, who to contact for repair, etc.

5-02. Water Quality Stations

a. Facilities. Location, number, and type of stations.

b. Reporting. Same type of information as in paragraph 5-0l.b.

c. Maintenance. Same type of information as in paragraph 5-0l.c.

5-03. Sediment Stations

a. Facilities. Location, number, and type of stations.

b. Reporting. Same type of information as in paragraph 5-0l.b.

c. Maintenance. Same type of information as in paragraph 5-0l.c.

5-04. Recording Hydrologic Data. Method of recording and storing data, length of time to maintain records, forms, records management, and data banks for automated data processing.

5-05. Communication Network. Physical description of main and secondary networks, showing diagram of network standby facilities and reliability. General status, type, and adequacy of data

transmission, emergency warning and remote control, time of interrogation, emergency standby, reliability, and other uses of network.

5-06. Communication With Project

a. Regulating Office With Project Office. Direct or indirect mode normal day-to-day flood warning, emergency regulation, all purposes; power, water supply, water quality, navigation, flood control, other releases; reference Management, chapter IX, and exhibit on Standing Instructions to Damtender. Chart showing direct and indirect lines of communication and authority.

b. Between Project Office and Others. List areas requiring flood warning, type of warning facilities, recreation areas, campsites (upstream/downstream), floodway/plain encroachment, remote control or reregulation, diversion, and related structures of another agency.

5-07. Project Reporting Instructions. Instructions for reporting hydrologic data, items affecting release of water, confirmation of change in releases as instructed, complaints, operating machinery failure, or out-of-service times for maintenance.

5-08. Warnings. Description of responsibility for issuing various types of warnings. Procedures, phone numbers, locations, etc. should be shown in a tabulation. Include instructions for providing warnings of discharge changes.

VI - HYDROLOGIC FORECASTS

6-01. General. Streamflow, lake level, and water quality prediction or forecasting.

a. Role of Corps. Direct/indirect responsibility, prediction capability, District/Division Office, damtender, cooperation with NWS regarding forecasting.

b. Role of Other Agencies. Agency responsibility, prediction capability, short-/long-range assistance by Corps (also see paragraph 9-02).

6-02. Flood Condition Forecasts

a. Requirements. Time required to compute flow hydrograph, time increment of forecast ordinates, key hydrologic and control point stations, use of data in general interpretation of flood control diagrams, consideration of uncontrolled runoff toward target flow at control stations, and target storage levels in the lake.

b. Methods. Methods and procedures of hydrologic forecasting, upstream/downstream flow, unit hydrograph, Antecedent Precipitation Index (API), stage-discharge relations, nomographs, rainfall-runoff relations, computer applications, relationship with NWS regarding forecasting (include sample of forecast), and sample of computer application program and how to access.

6-03. Conservation Purpose Forecasts

a. Requirements. Hourly/daily/weekly hydropower, mosquito control, fish spawning, special recreation events, water supply/-quality needs, water temperature, dissolved oxygen, other needs.

b. Methods. Methods and procedures for nonflood streamflow synthesis, water release temperature or dissolved oxygen, use of hydrologic data, computer applications, repetitive period for predicting, and sample of computer application program and how to access.

6-04. Long-Range Forecasts

a. Requirements. Long-range streamflow synthesis, joint use or seasonal flood control/conservation storage utilization and reservation, snowpack, runoff, irrigation release scheduling, pool level predictions for recreation, ecological conditions, monthly/seasonal hydropower scheduling, lake turnover, nesting grounds, fishing, water supply/ quality needs, drought conditions regarding water rights, navigation interest, low flow, and other.

b. Methods. Procedures for both flood control and conservation, seasonal outlook/forecast, snowpack surveys, repetitive period for predicting, use of hydrologic data, reliability of predictions, consideration of uncontrolled runoff in target flow at control point, computer applications.

6-05. Drought Forecast

a. Requirements. Similar to information required in paragraph 6-04a.

b. Methods. Similar to information needed in paragraph 6-04.b.

c. Reference Documents. Descriptions, completion dates, and physical locations.

VII - WATER CONTROL PLAN

7-01. General Objectives. Overall and in general terms how the water control plan meets purposes as stated in paragraph 2-02.

7-02. Constraints. Physical (including unremedied malfunctions; gate change limitations; structural and hydraulic design limitations; discharge constraints associated with inoperative gates; low pool level intake and water supply outlet limitations; reservoir area limitations associated with high pool levels such as backwater into upstream structures, leaks in levees, embankment boils, and required movement of facilities), legal, political, social, and major conflicts between purposes. Reference master manual for the system.

7-03. Overall Plan For Water Control. In general terms, consideration and treatment of coordinated system regulation among purposes and with other projects; compatibility among purposes, examples of comprehensive regulation for flood control/-conservation; storage yield limitations, (see following paragraphs in this chapter for details).

7-04. Standing Instructions to Damtender. Reference exhibit in back of manual -- during normal conditions, during communication outage, unforeseen emergency events requiring deviations from prevailing regulation schedules, spillway/outlet works restrictions.

7-05. Flood Control. Include normal and emergency regulations. Detailed explanation of release scheduling procedures during flood emergency, computer applications, role of Corps (reference Management, chapter IX, Section 7 Regulation), relative emphasis upon controlling peak outflow or pool level and backwater, use of seasonal or joint use storage, regulation with respect to storage zones including surcharge, use of streamflow predictions, forecasting total flow downstream, reference exhibits (SDF, SPF, maximum flood of record, other), special concerns for safety, include release schedule or water control diagram (should be table or plate, see EM 1110-2-3600; for Section 7 projects the schedule or diagram will be signed by a duly authorized representative from OCE and the project owner, integration with project components and other projects.

Constraints: Upstream/downstream encroachments, storage age limitations (lack of, surcharge only, joint use, seasonal), inadequate warning facilities, nondamaging channel capacity, low-water crossings, weak channel banks, show allowable rate of release change, physical discharge capability, integrated regulations with other project/purpose, and other.

7-06. Recreation. Special release for whitewater boat racing, canoe racing, and other.

Constraints: droughts, floods, long-term/frequent inundation, rapid pool rise, pool fluctuation for hydro, tertiary objective (incidental accomplishment only), muddy banks, bank erosion, high turbidity, planned seasonal fluctuations, high-velocity downstream, prolonged flood releases, inflow, other.

7-07. Water Quality. Role of Corps (reference chapter IX); short-term release scheduling, long-range release planning, storage utilization in general for water quality, multilevel releasing (reference and discuss sample regulation exhibit). Regulation to meet water quality objectives.

Although water quality control may not be an authorized project purpose, compliance with Public Law 92-500 requires that all Federal facilities be managed, operated, and maintained to protect and enhance the quality of water and land resources through conformance with applicable Federal, State, Interstate, and local substantive standards. Consequently, the manual should present a description of water quality control aspects (environmental impacts) of project regulation. Information should be included on specific regulation activities or techniques which are to be carried on continuously or periodically to assure project compliance with applicable Federal/State water quality standards. Also, special provisions should be noted which may alleviate or respond to emergency conditions, such as fish kills, flow augmentation for pollution abatement or aesthetics.

Constraints: comingled storage, lack of allocated storage, water rights, droughts, floods, and outlet facilities.

7-08. Fish and Wildlife. Accomplishment of fish and wildlife objectives by reregulation for other purposes, fluctuation of pool level for spawning or waterfowl, temperature control, cold water fishery, multilevel releasing, etc.

Constraints: Lack of allocated storage, other project purposes, floods, droughts, undesirable quality, single-level intake, and water rights.

7-09. Water Supply. Provide releases to stream or withdrawal from reservoir for municipal/industrial/irrigation usage; reference contract(s), low flow requirements, fish and wildlife, water rights, role of Corps (reference Management chapter IX); short-term release scheduling; long-range release planning, storage utilization (seasonal comingled, joint use). Show storage accounting method for more than one use of conservation storage. Reference and discuss example regulation exhibit.

Constraints: storage space and yield, water rights, other project purposes.

7-10. Hydroelectric Power. (Federal and non-Federal) installed capacity; run-of-river with/without pondage, peaking, load factor, plant factor; relation to system load, minimum requirements for generation; contracts for primary and secondary energy, restrictions during flood periods; see pertinent data, and other. Role of Corps (reference Management, chapter IX, FERC license) short-term generation (hourly, daily, weekly), long-range scheduling, typical hourly/daily/ weekly/ monthly/seasonal or annual generation schedule, use of synthesized streamflow, snowpack surveys, pumpback operation, coordination with reregulation structure, utilization of storage/pondage in general, and seasonal (reference and discuss sample regulation exhibit, interaction with other projects, other). Include rule curves and energy in storage curve for both Federal and non-federal projects, and signed agreements with non-Federal hydropower developers at Corps projects.

Constraints: overload limitation, storage, inflow, flood releases, tailwater, ice jams, head limitation on pool, release fluctuation, absence of reregulation structure, coordination with downstream reregulation, conflict with navigation, pumpback rate, water quality (temperature, oxygen) regulation with other projects, other.

7-11. Navigation. Release scheduling, accomplishment in general, lock filling and emptying procedure, aids to navigation, reference and discuss example regulation exhibit, integration with other projects.

Constraints: release fluctuation for other purposes, critical high/low flow rates, sediment, dredging, lock size, lock filling/emptying time, other project purposes, lack of storage allocation for navigation releases, integrated regulation with other projects, other.

7-12. Drought Contingency Plans. Descriptions, completion dates, and where plans are physically located (can be attached as an addendum to the manual or be a stand-alone document) if properly referenced in manual.

7-13. Flood Emergency Action Plans. Descriptions, completion dates, and physical location of plans (can be attached as an addendum to the manual or be a stand-alone document) if properly referenced in manual.

7-14. Other. Health and welfare, mosquito control, debris control, low flow, ice jams, special or emergency drawdown, upstream/downstream ground water table, releasing to aid construction upstream/downstream, toxic and hazardous spills, other as appropriate.

7-15. Deviation From Normal Regulation. Describe approval and notification procedures required when deviations from the normal

water control plan are necessary. The District Commander is occasionally requested to deviate from normal regulation of the lake. Prior approval for a deviation is required from the Division Engineer except as noted in subparagraph "a" below. Deviation requests usually fall into the following categories:

a. Emergencies. Examples of some emergencies that can be expected to occur at a project are: drowning and other accidents, failure of the operation facilities, chemical spills, treatment plant failures and other temporary pollution problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions. Districts must inform their division office as soon as practicable. Prepare written confirmation of the deviation and description of the cause and furnish it to the division water control manager. Divisions may develop forms to facilitate the reporting of emergency deviations.

b. Unplanned Minor Deviations. There are unplanned instances that create a temporary need for minor deviations from the normal regulation plan, although they are not considered emergencies. Construction accounts for the major portion of these incidents and typical examples include utility stream crossings, bridge work, and major construction contracts. Deviations are sometimes necessary to carry out maintenance and inspection of facilities. Requests for changes in release rates generally involve time periods ranging from a few hours to a few days. Each request is analyzed on its own merits. In evaluating the proposed deviation, consideration must be given to upstream watershed conditions, potential flood threat, condition of the lake, and alternative measures that can be taken. In the interest of maintaining good public relations, requests generally are complied with providing there are no foreseen adverse effects on the overall regulation of the project (or projects) for the authorized purposes. Approval for these minor deviations normally will be obtained from the division office by telephone. Written confirmation explaining the deviation and its cause will be furnished to the division water control manager.

c. Planned Deviations. Each condition should be analyzed on its merits. Sufficient data on flood potential, lake and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes, together with the district recommendation, will be presented by letter or telefacsimile to the division for review and approval.

7-16. Rate of Release Change. Show the normal allowable rate of increase and decrease in releases.

VIII - EFFECT OF WATER CONTROL PLAN

8-01. General. Discuss the overall effects and benefits from the project.

8-02. Flood Control

a. Spillway Design Flood. General description, routing, total volume, stored volume, peak inflow, duration, maximum discharge, and maximum pool (show plate).

b. Standard Project Flood (SPF). General description, routing, Standard Project Storm (SPS), total volume, stored volume, duration, maximum discharge, peak inflow, maximum pool, percent flood storage, or quantity surcharge storage utilized (show plate).

c. Other Floods. General description, routing, total volume, stored volume, comparison with flood of record or SPF, peak inflow/outflow, maximum pool, and surcharge storage utilized.

8-03. Recreation. Discuss effects and benefits.

8-04. Water Quality. Discuss effects and benefits.

8-05. Fish and Wildlife. Discuss effects and benefits.

8-06. Water Supply. Discuss effects and benefits.

8-07. Hydroelectric Power. Discuss effects and benefits.

8-08. Navigation. Discuss effects and benefits.

8-09. Drought Contingency Plans. Discuss effects and benefits.

8-10. Flood Emergency Action Plans. Discuss effects and benefits.

8-11. Frequencies

a. Peak Inflow Probability. Graph showing peak inflow probability.

b. Pool Elevation Duration and Frequency. Above and below top of conservation pool, i.e. include graph (plate) with curves based on top of conservation pool as datum. Show one curve for frequency and one for duration. Plot of pool elevation for period of record. Table of annual peak discharges could be included.

c. Key Control Points. Stage/discharge curves, and frequency/duration curves (show bank-full, damage zones).

8-12. Other Studies

a. Examples of Regulation. Up-to-date studies to develop and test regulation plan, yield analysis, criteria, data utilized, interpretations, integrated system regulation, new projects, seasonal storage investigations, hydrologic forecasting techniques, any model development, and other.

b. Channel and Floodway Improvement. Flood plain management studies and reports, encroachment, increase/decrease in channel capacity, (see Management, chapter IX), and seasonal channel capacity. Reference and discuss sample regulation exhibit, integration with other projects, and other.

IX - WATER CONTROL MANAGEMENT

9-01. Responsibilities and Organization

a. Corps of Engineers. Owner/operator/regulator or combination thereof; specify whether regulatory responsibility is direct (day-to-day regulation), or indirect (interagency agreement, advisory capacity by request); differentiate between regulatory responsibility for various project purposes when applicable; role of Corps when responsibility is indirect for both regulation and hydrologic forecasts (advisory/assistance/consultant); organizational chart, brief explanation of operation and maintenance responsibility; reference instructions to damtender in back of this manual, interagency coordination activities (see paragraph 9-02 and also Communications, chapter V); reporting to higher authority.

b. Other Federal Agencies. Explanation of responsibilities similar to paragraph 9-01.a: e.g. Bureau of Reclamation project but Corps indirectly/ directly prescribes real-time flood control and/or navigation regulation; or Corps project but Bureau indirectly/directly prescribes regulation for irrigation.

c. State and County Agencies. Furnish information similar to that comprised in paragraphs 9-01.a and b; furnish standards for water quality; serve in participating capacity through coordinated activities (see paragraph 9-02).

d. Private Organization. Furnish information similar to that in paragraphs 9-01.a, b, and c; reservoirs containing hydropower/flood control storage; project requiring coordinated regulation with neighboring Federal projects; flood control and/or navigation regulations prescribed by Corps (Secretary of Army, Title 33, Part 208 of Code of Federal Regulations); local protection projects having regulatory outlets (detention storage, bypass channel, and others); regulation/operation is prescribed/ performed by Corps.

9-02. Interagency Coordination. Explanation of coordination with press, community leaders, and other Federal, State, or local agencies concerning water control plan, flood fighting, special events, etc.

a. Local Press and Corps Bulletins. Explanation of coordination with local press for releases of public interest regarding conservation and flood aspects, gate closure, navigation season, reservoir levels, and other. Publication of news release bulletins regarding status of reservoirs concerning navigation, public use, agricultural harvesting, and flood emergency. Must avoid any conflict with NWS responsibilities for public notification as delegated by Congress.

b. National Weather Service. Coordination in data collection and providing forecasts of streamflow, precipitation, runoff, etc. (see paragraph 6-01), real-time and long-range forecasts, and exchange of data.

c. U.S. Geological Survey. Coordination in data collection, gauge maintenance, sampling programs, streamflow measurement, etc.

d. Power Marketing Agency. Release schedules for hydroelectric power generation, monthly meetings or power allocation, etc.

e. Other Federal, State, or Local Agencies. Bureau of Reclamation, Environmental Protection Agency, State, private, other contacts, routine or random. Owners of non-Corps projects which directly affect Corps regulation.

9-03. Interagency Agreements. Formulation or modification of interagency agreements such as Section 7 Regulations; power contracts, field working agreements, memorandums of understanding, and other (reference exhibit).

9-04. Commissions, River Authorities, Compacts, and Committees. Title and concise function of institutional group (officially established) who share interest in river basin water control activities; hydroelectric power marketing; seasonal outlook regarding water supply (municipal, industrial, irrigation); storage utilization in general; Federal/ State/local participating agencies; and other.

9-05. Non-Federal Hydropower. Non-Federal Hydropower facility at Corps project. Furnish information and explanation of responsibilities similar to that comprised in paragraph 9-01.a. Reference all agreement documents (i.e. MOU’s, MOA’s, etc.) that define the Corps responsibilities to real-time flood control regulation at the Corps project.

9-06. Reports. Monthly charts, short-term hydrologic reports, emergency regulation reports, graphical and tabular summaries. Flood situation reports, quarterly, seasonal, or annual reports, including hydrologic forecasts (also postflood reports). Suggest tabulation to show report, when required, form number, regulation requiring report.

TABLES

Disperse tables one page or less in size throughout the text. Include all tabulations over one page in this section to facilitate narrative continuity within the text. Include tables showing elevation versus area and elevation versus capacity in increments of 1 foot or less. These tables should cover elevation ranges from bottom of the lake to maximum pool.

EXHIBITS

NOTE: Label the following items as exhibits instead of appendices, reserving the latter term to tie individual manuals with master manuals. The number of exhibits will vary from project to project. "Standing Instructions to Damtenders" should be the last exhibit.

a. Supplementary Pertinent Data. May be extensive, but should be limited to aspects pertinent to water control (see Sample Exhibit A).

b. Formal Agreements. Examples are:

- Water Supply Contracts
- Power License Contracts
- Memorandums of Understanding (see Sample Exhibit B)
- Field Working Agreement
- Section 7 Flood Control Regulations
- Letters from other agencies or minutes of requesting commissions acknowledging or concurring in important or unusual aspects of the water control plan.
- Non-Federal Hydropower MOU/MOA’s

To conserve space it may be desirable to show only the portion of the contract pertinent to water control, e.g., omit payment schedules.

c. Standing Instructions to Damtenders. Instructions may pertain to part or all of the following aspects: conservation regulation, normal flood regulation, emergency regulation; instructions during loss of communication for flood and nonflood conditions; public flood warning; data collection and reporting of data and regulation (print in color or with a special border).

SAMPLE
EXHIBIT A

SUPPLEMENTARY PERTINENT DATA

NOTE: Several pertinent items are worthy of inclusion in this portion of the manual as it provides a compact ready reference source and facilitates quick orientation of important aspects relative to water control. Most information on the following pages may be better presented in the "text" of the manual. However, the contrary is also true, i.e. pertinent data should be used to document many aspects related to water control that do not warrant narration to expedite compilation and to avoid unnecessary wordiness of the text.

A few items which constitute brief tables in themselves may be more suitable dispersed within the text to accompany related discussions. However, abbreviated repetition of many items in the text is acceptable, since this exhibit will provide an overview of the project. Suggest all pages of the exhibit be of a different color than remainder of the manual.

SUPPLEMENTARY PERTINENT DATA

GENERAL INFORMATION

Item	Description or Quantity & Units
Other names of project	In addition to that on cover
Location	Basin, stream, river mile, state
Type of project	Dam and reservoir, detention dam, natural lake with gated outlet, hurricane barrier, control structure downstream of main dam, reregulation, diversion, flood closure, other.
Objectives of regulation	Project authorized for single/ multipurpose, list primary, secondary, and tertiary (incidental) purposes.
Project owner	Agency name
Operating agency	Physical operation, on sites/ remote operation, working hours of operation (weekdays, weekends, nights, normal/flood emergency conditions).
Regulating agency	Agency directly responsible for hydrologic forecasts, streamflow prediction and/or day-to-day release selection; also specify when Corps is indirectly responsible, by interagency agreement, for regulation regarding certain project purposes.
Code of Federal Regulations, Title 33 (applies to Section 7 projects)	Part 208, date of publication in Federal Register
Federal Power Commission License	License number, date of contract
Water supply contracts	Contract number, agency, storage, rates, date of contract

Item	Description or Quantity & Units
Other formal agreements	Titles of compacts, commissions, committees
Water rights	Riparian, appropriator, state code, abandoned, none, other
Project cost	
Closure date	When project became functional
Special project features	Attendant control facilities; e.g. fish ladder, fish hatchery regulation structure, pumpback facility, unique aspects, and other.

RESERVOIR LAKE OR POOL

Table of pertinent elements with corresponding incremental storage (acre-feet and inches), cumulative capacity, and area corresponding to:	Top of dam, maximum design pool, top-induced surcharge, top flood control pool, top conservation pool, inactive pool, top dead storage, when applicable, indicating cumulative capacity and whether the above apply to navigation, power, water supply, water quality, irrigation, sediment, joint use flood control/ conservation or comingled conservation storage.
Real Estate taking line for fee title	Elevation; purchased real estate
Real Estate taking line for easement	Elevation
Range of clearing	Upper and lower elevations
Pool elevation corresponding to discharge capability of maximum nondamaging flow rate downstream	State discharge and name or location of damage center (see following pertinent data re: channel).
Reservoir length at top conservation pool	Miles/kilometers

Item	Description or Quantity & Units
Shoreline length at top conservation pool	Miles/kilometers
Safety aspects, possibly requiring warning	Low lying recreational areas and camp sites, in reservoir and area downstream with pool guide criteria and limiting discharge criteria for islands, peninsulas, high-ways, bridges; morning glory spillways, vicinity of energy dissipators, power outlet, downstream channel; wave action, debris, ice, back-water, none, other.
Emergency drawdown	Provision for storage evacua-tion, invert elevation and type of lowest outlet usable for drawdown, minimum time required to empty, quantity of storage impossible to evacuate without pumping, siphoning, or evaporation.
Project Area Data	
Reservoir area	Table showing elevation ver-sus facilities, structures, lands, parks, docks, game and fish, and vegetation affected by high or low pool levels.
Downstream area	Table showing discharge ver-sus facilities, structures, lands, and vegetation af-fected by outflow.

HYDROLOGY

Drainage area	Total contributing

Item	Description or Quantity & Units
Table with data for probable maximum, standard project and other design floods showing:	Maximum water surface elevation, peak inflow, total storm runoff, stored flood volume, maximum outflow of flood, seasonal distinction, and distribution of precipitation/storm type.
Climate	Arid, semiarid, moderate, humid, temperate
1-inch runoff equals acre-feet	
Storm types	Cloudburst, hurricane, tropical rain, snow, and other
Flood season	Time of year
Low flow season	Time of year
Minimum daily flow and date of occurrence	Project inflow at damsite, considering pre- and postproject hydrologic records (show years of record in parentheses).
Minimum monthly flow and date	Same as above
Minimum annual flow and year	Same as above
Average annual flow	Same as above
Maximum annual flow and year	Same as above
Maximum monthly flow and date	Same as above
Maximum daily flow and date	Same as above
Maximum instantaneous flow and date	Same as above
Maximum flood volume and date	Same as above

Item	Description or Quantity & Units
Name and location of key streamflow stations	Upstream and downstream of dam site to facilitate release determination.
Type of hydrometeorologic data recorded at dam site	Manual and automatic, also including pool, tailwater, climatic and water quality data.
Number of precipitation stations used in hydrologic forecasting	Differentiate between manual and automatic recording/ reporting.
Number of snow courses	Normal date of maximum snowpack
Number of sediment ranges	Upstream and downstream of dam site, annual basis or other.

EMBANKMENTS, DIKES, LEVEES, AND TIDAL BARRIERS

Location	All structures associated with the project except those downstream of dam site (see following pertinent data tables for the latter).
Purpose	Protection of agriculture, community, structures, and against loss of life, other.
Type	Overflow/nonoverflow, embankment, levee, dike, flood barrier, other.
Type of fill	Including core
Slope protection	Riprap, grassed, upstream/ downstream, face, channel, toe protection, none.
Height	
Length	
Top elevation	

Item	Description or Quantity & Units
Percent exceedance frequency flood which will overtop structure	When less than 1 percent, state that flood magnitude/ inflow volume is ___ times larger than the 1 percent exceedance frequency flood.
Design flood	Frequency, discharge
Freeboard	Minimum residual
Flood closure structure	Location, elevation/stage at lowest level and at top of added protection (sandbagging, stoplogs), recurrence interval for both.
Method of Activation	Automatic, manual, and by whom
Critical swellhead	Maximum head without failure if overflow type, and corresponding recurrence interval.
Fuse plug	Critical pool elevation and recurrence interval to activate
Associate pumping/ siphon station	Location
Seepage rate at design pool	
Used for roadway	
Elevation of toe	
Other	

SPILLWAY

Location	All structures associated with project except those downstream of dam site; part of main dam left/right bank, saddle, other (see following pertinent data table for control structure downstream).

Item	Description or Quantity & Units
Type	Controlled, uncontrolled, chute, ogee, board-crested, notch, emergency, concrete, rock, perched saddle, other.
Crest elevation	
Net overflow length	
Number and size of gates	
Type of gates	Tainter, drum, stoplogs
Top of gate elevation	In closed position
Induced surcharge	Feet above top of flood control pool
Design head	
Maximum discharge capacity	
Bridge deck elevation	Top
Type energy dissipator	Stilling basin, flip bucket
Time required to open/ close all gates	Considering downstream conditions
Type emergency closure and time requirement	
Recurrence interval of pool attaining crest elevation	When crest is within the range of allocated flood control storage
Spillway activation	Number of postproject (actual) overflow events and dates

OUTLET FACILITIES

Location	All structures associated with project except those downstream of dam site (see following pertinent data for reregulation or other structures downstream).

Item	Description or Quantity & Units
Purpose	Flood control, hurricane, water supply, irrigation, low flow, other.
Type outlet	Circular, rectangular, horse-shoe, bypass, gate in a gate, pipe, partially/entirely uncontrolled, floodwall open-ing, other.
Size of outlet	
Type of service gate or valve	
Number and size of gates and valves	
Entrance invert elevation	
Multilevel intake elevations	
Discharge at pertinent elevations	Bottom and top conservation pools, top flood control pool.
Minimum pool elevation when inoperative	When gate closure required
Minimum time required to open/close service gates	Considering downstream conditions
Type emergency closure and time requirement	
Type energy dissipator	

HYDROELECTRIC POWER FACILITIES
(list separately both Federal and Non-Federal)

Location	
Type	Storage, peaking, run-of-river pumpback, other.
Installed capacity	
Number/type and capacity of units	Design and overload, reversible
Power-on-line date	By units

Item	Description or Quantity & Units
Provision for future	Date of installation (if known) capacity, number of bays anticipated.
Plant factor	
Load factor	Normal plan for generation, seasonal if applicable
Number and size penstocks	
Turbine discharge	Rated capacity at design head for each unit, at top of power pool, at top of flood pool.
Design head	
Maximum gross head for power	
Average net head	
Minimum flow required for generation	By months if variable
Drawdown	Minimum elevation and head
Minimum head	Head below units which are inoperative
Critical drawdown	Hydrologic streamflow record
Minimum peaking capability	Include time on line
Dependable capacity	
Average annual energy	
Annual firm energy	
Specific hydroelectric power storage or pondage	Volume, feet of pondage, none
Comingled, joint use, or seasonal storage	Show in time table if variable
Critical tailwater elevation	Above or below units which are inoperative

Item	Description or Quantity & Units
Discharge at pertinent elevations	Regarding hydropower and flood control
Pumpback capability	Maximum rate and volume per normal pumping cycle
Type of emergency closure and time required	Maximum rate and volume per normal pumping cycle
Type of energy dissipator	
Constraints	Downstream channel capacity Minimum time "on line" plant Minimum time "on line" one unit Normal time "on line" Maximum fluctuation downstream Maximum rate of pool drawdown ft/day Surge wave height (ft) Surge rate (ft/hr)

LOCK

Location
Elevations (feet above NGVD)
- Upper pool normal
- Upper pool minimum
- Upper pool (max. navigation)
- Lower pool (normal - no flow)
- Lower pool (max. navigation condition)
- Top of lock wall, upper guide and guard walls
- Top of lower guide and guard walls
- Upper sill
- Lower sill
- Chamber floor
- Miter gate (and top girder)
- Approach channel upstream
- Approach channel downstream

Dimensions (in feet)
- Chamber width
- Chamber length (usable)
- Chamber length (between pintles)
- Lift normal
- Depth above lower sill (min.)
- Height of upper gate

Item	Description or Quantity & Units
Height of lower gate	
Minimum cushion depth in chamber	
Guide wall length (up and downstream)	
Guard wall length (up and downstream)	
Width top of guide and guard walls	
Width top of chamber wall	
Culvert size	
Type and dimensions of culvert valves	
Minimum submergence of culvert valves	
Lock filling time	For top navigation pool levels, other
Lock emptying time	For top navigation pool levels, other
Average annual tows/ tonnage	
Minimum monthly tows/ tonnage or record and date	
Maximum elevation permitting navigation	
Freeboard on lower guide wall when lock becomes inoperative	
Number of inoperative incidents due to high flow and date of most recent event (also low flow events)	
Type of emergency closure and time required	
Leakage rate at normal pool	

Item	Description or Quantity & Units
CONTROL POINTS/RIVER REACHES	
Location	Downstream of dam site only, name, river mile, nearby community, highway bridge (see following separate pertinent data for control structures located downstream).
Purpose of control	Potential damage center, water quality, low flow, water rights, municipal, industrial, irrigation, fish, navigation, other.
Channel/floodway description	Main channel, diversion chanel, flood relief bypass, acres easement/purchased land, high/low velocity, riprap, bed/bank stability, well-/ill-defined, bed transmissibility.
Uncontrolled drainage area	Total/contributing to control point
Treatment of uncontrolled target flow	Contributes/does not contribute to flood control/conservation runoff.
Target flow rate(s)	Seasonal if applicable, flood control and conservation purposes
Time of water travel	From dam site to control point, through reaches between control points
Table showing discharge stage and recurrence interval for:	(1) top of banks, (2) maximum nondamaging stage, (3) minor damage stage, (4) significant damage stage, (5) regulating discharge(s) (restrictive stage or flow rate applicable during integrated system regulation), (6) maximum, (7) minimum stage/discharge of

Item	Description or Quantity & Units
	record based on project conditions, (8) regulating discharge(s) (target flows) for flood control use during project formulation of authorized plan, and (9) flowage easement/fee.
Monitoring provisions	Type of data obtained and used, communication with regulating office, with damtender (automatic reporting/reporting, manually operated).
Channel usage	Navigation, canoe racing, common water contact sports, fishing, spawning beds, other.
Safety aspects possibly requiring warning	Bank sloughing, high-velocity flow, backwater, debris, encroachments, campsites, low water crossing highways, rapid rise after turbines on lines, other.
Dikes or levees downstream	Overflow/nonoverflow type, design flow rate, (furnish pertinent information similar to that required for embankments).
Related control structures	Type of structure (reregulation diversion, overflow weir, flood closure, other) associated with channel or floodway.
Location	All control structures downstream of main project associated with channel or floodway.
Purpose	Reregulation, diversion, overflow weir, flood closure, or other control structure.
Type	Brief description, number and size of gates, weir, culvert, siphon opening in dike/levee, ungated.

Item	Description or Quantity & Units
Flow passage	Elevation and height above streambed, weir crest elevation
Pertinent discharge capacity	Design rate, other
Regulation	Reference regulatory instructions which should be included with this manual as an appendix (or exhibit), or compiled under separate cover.
Regulating agency	Office responsible for release selection and recommended flow passage in general; telephone and address if non-Corps.
Operation	Agency responsible for physical operation of gates, stoplogs, sandbags, pumping facilities, other manual remote operation; name, address, and phone number of damtender.
Other pertinent information	

SAMPLE
EXHIBIT B

LETTER OF UNDERSTANDING

PUEBLO DAM AND RESERVOIR, ARKANSAS RIVER
PUEBLO COUNTY, COLORADO

WHEREAS, Pueblo Dam and Reservoir, Arkansas River, Pueblo County, Colorado, was authorized as part of the Fryingpan-Arkansas Project, Colorado (Public Law 87-390). The project is owned and was constructed essentially as authorized with 27,000 acre-feet of exclusive flood control storage and 66,000 acre-feet of joint use storage which will be operated in accordance with Section 7 of the 1944 Flood Control Act.

WHEREAS, Section 7 of the Flood Control Act of 1944 (Section 7, Public Law 78-534, 58 Stat. 890, 33 U.S.C. 709) directs the Secretary of the Army to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with Federal funds.

WHEREAS, paragraph 208.11, Title 33 of the Code of Federal Regulations (41 FR 20401, May 18, 1976) further prescribes the policy and procedure for regulating the use of storage allocated for flood control or navigation purposes at all reservoirs capable of such regulation and constructed wholly or in part with Federal funds provided on the basis of such purposes.

THEREFORE, this Letter of Understanding shall consummate the provisions of Section 7 of the 1944 Flood Control Act for Pueblo Dam and Reservoir, Arkansas River, Pueblo County, Colorado. In addition to the responsibilities of the project owner and the Corps of Engineers spelled out in paragraph 208.11, 33 CFR, it is agreed that:

a. The Bureau of Reclamation (hereinafter called the Bureau), as owner of the project, shall accept the responsibility for the operation and maintenance of the flood control facilities.

b. The Bureau shall perform the physical operation of the flood control facilities for the purpose of regulating stored floodwaters as directed by the Corps of Engineers (hereinafter called the Corps).

c. The Corps shall direct the regulation of the project for storage and release of floodwaters in the flood storage pool. The Bureau shall be responsible for directing storage and release of floodwaters when below or above the flood storage pool.

d. The Bureau shall be responsible for providing adequate warnings to downstream interests when changes in release of stored floodwaters are made.

e. The Water Control Manual for Pueblo Dam and Reservoir will contain the Water Control Agreement (release schedule in tabular and/or graphical form). In addition to documenting the Water Control Agreement, the manual will provide instructions for reporting and communicating between the project and the Corps. The manual will serve as a guide to personnel involved in the flood control regulation of Pueblo Dam and Reservoir during the life of the project. Portions of this manual may be updated from time to time as conditions warrant. Revisions will be in accordance with the provisions of 208.11(d)(10),33 CFR.

_____	_____
Regional Director Lower Missouri Region Bureau of Reclamation Authorized Representative of the Commissioner	Division Engineer Southwestern Division Corps of Engineers Authorized Representative of the Chief of Engineers
DATE_____	DATE_____

NOTE: Additional items should be included in the Letter of Understanding as appropriate.

PLATES

NOTE: As appropriate, considering utility (need, clarity, conciseness) and avoiding repetition, preferably in the order of treatment in the manual.

A list of plates is included for use as a check in preparing plates. The list should be adjusted by adding or deleting plates, according to need, covering all features of the project pertinent to water control.

Chapter II

Location and Vicinity Map
General Plan and Sections
Sediment Ranges
Embankment
Outlet works
Spillway
Hydroelectric Power Facilities
Water Supply Facilities
Facilities for Water Quality or Temperature Control
Related Control Facilities
Real Estate Map
Backwater Curves
Public Use Sites

Chapter III

Neighboring Projects
Areas of Encroachment

Chapter IV

Stream Profiles
Inflow Frequency - (Volume by Month)
Flow Duration Curves
Inflow Hydrographs
Crest Travel Time
Stage Damage Curves - Structural and Acres

Chapter V

Hydrologic Network
Communication Network
Lines of Communication
Organization Chart
Forms and Reporting Instructions (As Needed)

Chapter VI

- Unit Hydrographs
- Rainfall - Runoff Relation Curves (API)
- Sample API Printout
- Sample Runoff Printout
- Forecasting Reaches
- Routing Template or Curves
- Recession Curves
- Soil Moisture Curves
- Index Area

Chapter VII

- Release Schedule or Water Control Diagram
  (Transitional Pool or Seasonal Pool Guide)
- Emergency Release Schedule
- Spillway Gate Regulation (Surcharge) Curves, Inflow vs Outflow
- Area-Capacity Curves
- Evaporation Curves
- Outlet Rating Curves - Full and Partial Gate Openings
  - Conduits
  - Spillway
  - Low Flow
- Tailwater Rating Curve
- Intake Sluices - Rating Curve
- Pool Elevation vs Time (Yearly Regulation)
- Objective Temperature Curve
- Fish Spawn - Growing Calendar - Elevation
- Turbine Performance Curves - Gross Head vs KW vs Discharge
  (Show Outer Limits)
- Hydroelectric Power Rule Curve Energy in Storage
- Hydrographs of Critical Period Indicating Firm Yield
- Navigation Charts

Chapter VIII

- Spillway Design Flood Routing (Normal and Emergency)
- Standard Project Flood Routing (Normal and Emergency)
- Other Major Floods
- Peak Inflow Frequency
- Volume Inflow Frequency
- Pool Elevation Probability
- Duration Curve (Pool Elevation)
- Pool Elevation - Period of Record Routing and Actual Since Beginning of Operation
- Frequency Curves at Key Index Stations
- Stage Discharge Curves for Control Key Index Stations

PART B
OUTLINE FOR PREPARING MASTER WATER CONTROL MANUALS

OUTLINE

TITLE PAGE

PHOTOGRAPHS OF PROJECTS

NOTICE TO USERS OF THIS MANUAL

REGULATION ASSISTANCE PROCEDURES

TABLE OF CONTENTS

I - INTRODUCTION

II - BASIN DESCRIPTION AND CHARACTERISTICS

III - GENERAL HISTORY OF BASIN

IV - DESCRIPTION OF PROJECTS

V - DATA COLLECTION AND COMMUNICATION NETWORKS

VI - SYSTEM HYDROLOGIC FORECASTS

VII - SYSTEM WATER CONTROL PLAN

VIII - EFFECT OF SYSTEM WATER CONTROL PLAN

IX - SYSTEM WATER CONTROL MANAGEMENT

PERTINENT DATA FOR BASIN

TEXT OF MANUAL (See Note)

NOTE: This outline is intended for preparation of Master Water Control Manuals. The format and content as presented in Part A, Preparation of Water Control Manuals, should be used for guidelines. The chapter titles above should always be used; however, additional chapters may be added as required. Discretion may be employed in the selection of topics and subtopics within the chapter headings as they relate to the basin/watershed.