CELRH-EC-WM

05 Jan 2010
Schray/5604

Memorandum for Resource Managers and Water Control Manual holders

Subject: Modification of Huntington District Water Control Reporting Procedures.

1. Reference CELRH-EC-WM Memorandum to Kent Browning, dated 20 January 2004, Subject: Modification of Huntington District Water Control Reporting Procedures.

2. The referenced memorandum modifies certain reporting procedures. Since that memorandum was issued, improvements in technology have resulted in the National Weather Service providing detailed snow analyses data in graphical maps via the internet. This data satisfies Water Managements needs, and therefore an additional modification is necessary.

3. Modify Instructions to Dam Tender, Section 2 – Precipitation at Project, sub-section: Snow Depth and Moisture Content:

Replace the section in its entirety with the following:

"Report snow data to Water Management only when directed to do so. Measure and record the water content of the snow at least as often as indicated below.

(1) Each day when rain falls on existing snow cover

(2) Twice a week on Mondays and Thursdays when there is snow cover on the ground if condition (1) does not require more frequent measurement.

4. This change in reporting instructions does not modify the Project's requirement to store this data on site.

5. This memorandum shall be placed in the front of the Water Control Manual to document the change.

Timothy W. Curran, P.E.
Chief, Water Management Section

CELRH-EC-WM

11 June 2007
Schray/5604

Memorandum for Resource Managers and Water Control Manual holders

Subject: Modification of Huntington District Water Control Reporting Procedures.

1. Reference CELRH-EC-WM Memorandum to Kent Browning, dated 20 January 2004, Subject: Modification of Huntington District Water Control Reporting Procedures.

2. The referenced memorandum modifies certain reporting procedures, and this memorandum makes an additional change. Some Water Control Manuals have been revised with the new procedures the "Instructions to Resource Manager" or "Instructions to Dam Tender" section. Manuals that have not been revised should have the referenced memorandum placed in the front of the manual. Make handwritten changes to the memorandum or the Water Control Manual, as appropriate. This memorandum shall be placed in the front of the Water Control Manual to document the change.

3. Modify Instructions to Dam Tender, Section 4 – Regular Reports, sub-section: Weekly Precipitation Report, second and third sentences:

Replace the text "This report must be filled out and transmitted every Monday morning by 0800 hours. If Monday is a holiday, it shall be filled out on the next work day by 0800 hrs." with "This report is no longer required to be completed on a weekly basis. It shall only be filled out and submitted if required by special directive."

Timothy W. Curran, P.E.
Chief, Water Management Section

3/16/04
Clu

CELRH-EC-WM

20 January 2004
Schray/5604

Memorandum for Kent Browning, OR Water Management POC.

Subject: Modification of Huntington District Water Control Reporting Procedures.

1. Please distribute this memorandum to all Huntington District Flood Control Project Managers, direct them to place this memorandum in the front of the Water Control Manual, and make notes in the text which has been superseded.

2. As directed by the QC, EC-WM is implementing the recommendations of the Reservoir Reporting Process Action Team. As such, the following changes shall be made to the water control manuals and the associated processes:

The following sections are modified as noted.

Instructions to Dam Tender, Section 2 - Precipitation at Project, sub-section: Snow Depth and Moisture Content

Measure and report to EC-WM by 0900 hours the water content of the snow at least as often as indicated below.

(1) Each day when rain falls on existing snow cover

(2) Twice a week, on Mondays and Thursdays, when there is snow cover on the ground if condition (1) does not require more frequent measurements.

Instructions to Dam Tender, Section 2 - Precipitation at Ohio River Network Stations

Reports to the National Weather Service are carried out by agreement between the Project and the Weather Service and at their direction. The project is not required to gather or submit any additional data to Water Management beyond what is described previously in section 2 and what is detailed in section 4.

Sub-Sections a, b, and c are therefore no longer relevant except as to describe how to gather and provide data to the National Weather Service.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Weekly Report, ORH 14

This section is rescinded in its entirety and is replaced by sub-section: Historical Files.

Projects are required to maintain a permanent hard copy at the project of all water control data required for daily operation. This data shall be comprised of the information the project has historically gathered using the ORH 14 and 13 reports and shall be gathered at 0730 on days when the project is staffed, at other times as directed by the Schedule for Reading Gages and the Project Manager and when data is requested by Water Management Section. It shall include but not be limited to: Precipitation, Current Weather conditions, Lake Stage Levels, Outflow Stage Levels, Gate Settings, Gate Operations and time performed, Snowfall, Snow on the Ground, Total Moisture Content as directed in Section 2, and all Upstream and Downstream gauge readings which are utilized by project personnel for gate operation decision making.

This information may be maintained either on the historical reports or a new project developed format.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Daily Morning Report

This sub-section is modified to note that: Generation and transmission of the daily morning report (also call the intranet report which replaced the ORH-13 Daily report) is only required when requested by the Water Management Section. Automatic daily transmissions are no longer necessary.

Note: Atwood, Bolivar, Clendening, Piedmont, Tappan, and Tom Jenkins are still required to report all gate operations to EC-WM by phone. Extra emphasis will be placed on these phone calls as Water Management will no longer be able to look up the previous day's gate operations every morning.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Gate Operations Report

This sub-section is modified to note that: Generation and transmission of the gate operations report is only required when requested by the Water Management Section. Neither daily transmissions nor transmissions after every gate operation are necessary any longer.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Weekly Precipitation Report

This sub-section shall be added after the Water Quality Report sub-section.

A fourth report available from the Index Page is the Weekly Precipitation Report. This report must be filled out and transmitted every Monday morning by 0800 hours. If Monday is a holiday, it shall be filled out on the next work day by

0800 hours.

Upon accessing the Weekly Precip Report link on the Index Page, fill in the daily precipitation for the past week. When all data for the week is filled in, save the spread sheet and exit. This record will be saved for the entire year and can be viewed through the link used to modify it.

On days when the project is not staffed, place a "NS" in that day's field and report the combined day's precipitation in the next day when the project is staffed. I.e. If the project does not staff the weekend, place a "NS" in the field for Saturday and Sunday and report the 72 hour precipitation record on Monday morning.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Additional Comments

This sub-section shall be added after the Weekly Precipitation Report sub-section.

A fifth link available on the Index Page is the Additional Comments link. It shall be used when ever the Project has special information or questions that it wants to bring to the immediate attention of the Water Management team. Snow Moisture shall be reported using this link.

Upon accessing the Additional Comments link on the Index page, a blank email to the Water Management Team will be generated. Please note in the subject line, the nature of the issue and then provide supplemental data in the text block of the message. After the email has been completed click on the submit/send button to send the message.

Instructions to Dam Tender, Schedule for Reading Gages

The last sentence of the top paragraph "Stream gages and the precipitation gage (all gages) shall be read at least as often as shown in the table below", shall be replaced with: "Reading and recording of gages shall be carried out as defined under Schedule A except when gage levels/precipitation are such that the Resource Manager or their Acting anticipates that problems may result, at which point the relevant schedule B, C, or D shall be followed for reading and recording of all required gages. Transmission of project gage data will be at the request of EC-WM.

Modify the chart as follows:

SL, SO, and DCO shall be read in all schedules monthly as a check

Modify the footnotes as follows:

(1) When any one of the conditions listed under schedule A, B, C is exceeded and problems are anticipated, place the next higher schedule into effect. When conditions are such that would place schedules C or D into effect, notify by phone one of the Water Control personnel.

Timothy W. Curran, P.E.
Chief, Water Management Section

CF:EC-WH

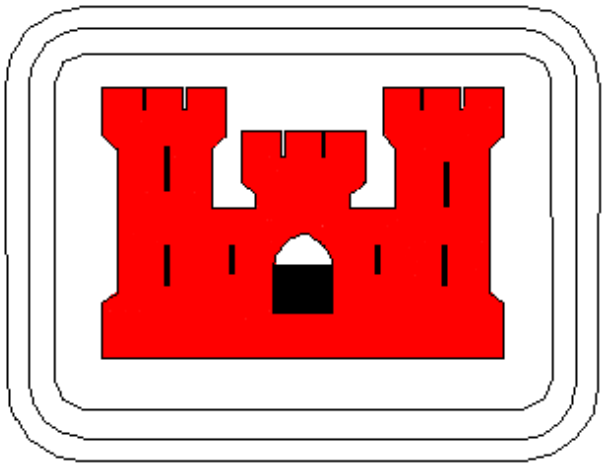
U.S. ARMY ENGINEER DISTRICT, HUNTINGTON

CORPS OF ENGINEERS

HUNTINGTON, WEST VIRGINIA

BIG SANDY RIVER BASIN

KENTUCKY



PROJECT MANUAL

FOR WATER CONTROL MANAGEMENT

FISHTRAP LAKE – LEVISA FORK

JULY 2001

PHOTOGRAPH

FISHTRAP F/C 49-A

VICINITY MAP

50 0 50 100 150

SCALE IN MILES

LEVISA FORK

FISHTRAP LAKE

DAM AND SPILLWAY

PLAN, PROFILE AND SECTIONS

HUNTINGTON DISTRICT, HUNTINGTON, W. VA.

Revised : 30 SEPTEMBER 1978

PREFACE

This manual was developed under a contract between Advanced Technology Systems, Inc. and the U.S. Army Corps of Engineers, Pittsburgh District.

Contract No.: DACW69–00–D–0006

Delivery Order No. 7: Water Control Manual Development for Fishtrap Lake

The manual was developed by:

Advanced Technology Systems, Inc.
639 Alpha Drive
Pittsburgh, PA
Phone:
Fax:

All inquires concerning this manual should be directed to the U.S. Army Corps of Engineers, Huntington District, 502 8th Street, Huntington, WV 25701-2070.

NOTICE TO USERS OF THIS MANUAL

Regulations specify that this water control manual be published in a hard copy binder with loose-leaf form, and only those sections, or parts thereof, requiring changes will be revised and printed. Therefore, this copy should be preserved in good condition so that inserts can be made to keep the manual current. Changes to individual pages will carry the date of revision, which is the Division’s approval date.

REGULATION ASSISTANCE PROCEDURES

In the event that unusual conditions arise during non–duty hours, communications can be achieved by contacting, in the order listed, one of the following personnel.

NOTE: All the listed numbers can be found on the C of E Intranet, including cell phone numbers. Located at [redacted]

Fishtrap Lake Project Office

Fishtrap lake
[redacted]
Project Manager
[redacted]
2204 Fishtrap Road
RR 1, Box 501
Shelbiana, KY 41562-9732

Gate Operating Personnel		***Work Telephone Number***
[redacted]	Commercial Commercial	[redacted]

Water Resources Engineering Branch	***Home Telephone Number***
[redacted]	[redacted]
Chief, Water Control Section	* unlisted
[redacted] Water Control Section	([redacted]
Chief, Water Resources Engineering Branch	* unlisted

Huntington District Office – Water Resources Engineering Branch

Normal Work Hours 0700 to 1600 hrs Monday thru Friday, 0800 to 0900 hrs Saturday, Sunday And Holiday	Additional Extensions	[redacted] [redacted] [redacted]

OTHER AGENCIES

U. S. geological Survey Louisville, KY	Commercial	[redacted]
National Weather Service W. S. Forecast Office Charleston, WV	Commercial Commercial	[redacted]

WATER CONTROL MANUAL

FISHTRAP LAKE – LEVISA FORK

U.S. ARMY CORPS OF ENGINEERS
HUNTINGTON DISTRICT
MAY 2001

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Number

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LIST OF PLATES (continued)

Mean Sea Level Reference Datum

All elevations in this manual use the 1929 National Geodetic Vertical Datum (1929 NGVD) unless otherwise stated.

SI Units (Metric) Equivalents and Conversion

Length:
1 centimeter = 0.394 inches
1 meter = 3.28 feet
1 kilometer = 0.621 miles

Area:
1 square meter = 10.764 square feet
1 square kilometer = 0.386 square miles
1 hectare = 2.471 acres

Volume:
1 cubic meter = 35.31 cubic feet
1 cubic meter = 1.308 cubic yards
1 cubic meter = 0.81×10^{-3} acre feet

Flow:
1 cubic meter per second = 35.31 cubic feet per second

Temperature:
Degree Celsius = (Degree Fahrenheit - 32) x 5/9

BIG SANDY RIVER BASIN
FISHTRAP LAKE, KENTUCKY

LOCATION OF PROJECT: Pike County, Kentucky, on Levisa Fork of Big Sandy River; 103.3 miles above the mouth of Levisa Fork and 130.1 miles above the mouth of the Big Sandy.

DRAINAGE AREA ABOVE DAM: 392 Square Miles.

RESERVOIR: Top of dam (without camber) - 845.3 feet above NGVD
Spillway Crest - 790 feet above NGVD
Total Storage - 164,360 acre-feet or 7.80 inches of runoff
Minimum conservation pool - 569 acres
Seasonal conservation pool - 1131 acres
Maximum Flood Control pool - 2631 acres

DAM: Type - rolled rock dam with impervious core. Maximum height 195′ above streambed, crest length 1100′, top width 32′, maximum base width 990′

SPILLWAY: Controlled by four 57′ x 37′ tainter gates in the left abutment near the dam. Crest elevation is 790.0, length of crest is 228 net feet. The design discharge is 298,200 cfs with a surcharge of 15.3′ and a freeboard of 5.0′.

OUTLET WORKS: Intake structure with three gated sluices 6′ wide by 12′ high conduits controlled by slide gates and discharging into a 15.5′ diameter horseshoe tunnel. The outlet works are provided with three 6′ x 4′ low flow intakes. All three discharge into a common well which in turn discharges into the 3′ x 6′ low flow conduit. Control of low flow discharge is by a 3′ x 6′ hydraulically operated slide gate.

LAND ACQUIRED: 15,785 ACRES--FEE
203 ACRES--EASEMENT

NOTE: Additional pertinent data can be found on Exhibit A

SECTION I – INTRODUCTION

1-01 AUTHORIZATION

This manual is prepared in accordance with ER 1110-2-240, dated 8 October 1982 and ETL 1110-2-251, dated 14 March 1980, which provides for the submission of manuals for reservoir regulation in accordance with instructions contained in "Guide for Preparing Water Control Manuals", as prepared by SWD, dated October 1977.

Fishtrap Lake was authorized by the Flood Control Act of 1938, 75th Congress, 3rd session, for flood control and other purposes. A boundary map of the Huntington District is shown in **Plate 1-1**.

1-02 PURPOSE AND SCOPE

The purpose of this manual is to furnish detailed schedules for regulation of Fishtrap Lake. This manual will function as documentation of the plan for water control and as a reference source for higher authority and for office and field personnel for water control management throughout the life of the project. The manual additionally contains background information necessary for understanding the objectives and application of the water management schedules, as well as results of optimal simulation of project operation for specific purposes and conditions. The guidelines in EM 1110-2-3600 provide for submission of water control manuals that contain regulation schedules in sufficient detail to establish the basic plan of reservoir operations to be followed under current conditions. This manual supplements the report, subject, "Master Manual for Reservoir Regulation – Big Sandy River Basin," in which information required for the coordinated operation of all reservoirs in Big Sandy River Basin is presented.

1-03 RELATED MANUALS AND REPORTS

The following manuals and reports concerning Fishtrap Lake or the Big Sandy River projects have been previously completed.

	Title	Date
1.	Interim Survey Report on Big Sandy River and Tug and Levisa Forks, Kentucky, West Virginia, for Flood Control and Allied Purposes.	December 1957
2.	Interim Survey Report on Big Sandy River and Tug and Levisa Fork, Kentucky, West Virginia, and Virginia, for Flood Control and Allied Purposes, published as House Document No. 184, 86th Congress, First Session.	December 1959
3.	Survey Report, published as House Document No. 246, 89th Congress, First Session	October 1965

4.	Report of the Board of Engineers for Rivers and Harbors, subject, Big Sandy River and Tug and Levisa Forks, Kentucky, West Virginia, and Virginia published in House Document No. 246, 89th Congress, First Session.		April 1965
5.	Design Memoranda:		
	No. 1	Hydrology	July 1960
	No. 2	Chesapeake and Ohio Railroad Relocation	July 1970
	No. 3	Relocations – Highways, Part I, State and Federal	December 1960
	No. 4	Relocations – Highways, Part II, County Roads	February 1961
	No. 5	Geology and Soils	August 1963
	No. 6	General Design Memorandum	November 1960
	No. 7a	Preliminary Master Plan	January 1962
	No. 7b	Master Plan – Site Planning	June 1966
	No. 8	Norfolk and Western Railroad Relocation	May 1965
	No. 9	Real Estate – Phyllis to Kemper Road and Reservoir Land, Part I	August 1961
	No. 10	Real Estate – Route 460 to Grapevine and Reservoir, Part II	March 1962
	No. 11	Real Estate – Supplemental Mineral Report, Parts I and II,	January 1963
	No. 12	Relocations – Schools	August 1963
	No. 13	Concrete Aggregates	February 1964
	No. 14	Real Estate – Reservoir, Part III	May 1963
	No. 15	Dam – Selection of Site and Type	May 1963
	No. 16	Dam, Spillway, Outlet Works and Access Road	April 1964
	No. 17	Relocations – Power and Telephone	January 1965
	No. 18	Relocations – Utilities and Pipelines	November 1964
	No. 19	Real Estate – Reservoir, Part IV	September 1964
	No. 20	Reservoir Clearing	June 1966
	No. 21	Real Estate – Pike County School	May 1964

	No. 22 Fishtrap – Gaging Station, South Williamson	February 1968
	No. 23 Sediment Range Network	April 1976
	No. 24 Fishtrap – Gaging Stations	May 1977
6.	Periodic Inspection Report No. 1	May 1970
	Periodic Inspection Report No. 2	March 1972
	Periodic Inspection Report No. 3	March 1974
	Periodic Inspection Report No. 4	August 1977
	Periodic Inspection Report No. 5	October 1982
	Periodic Inspection Report No. 6	October 1987
7.	Preliminary Project Manual for Water Control Management for Fishtrap Lake	March 1973
8.	Operations and Maintenance Manual	April 1976
9.	Review of Completed Project, Plan of Study	September 1974
10.	Draft Environmental Impact Statement	August 1977
11.	Final Environmental Assessment	March 1980
12.	Supplement No. 1 to D.M. 22, Report on Sedimentation Survey	September 1972
	Supplement No. 2 to D.M. 22, Report on the Second Sedimentation Survey,	June 1974
	Supplement No. 3 to D.M. 22, Report on the 1975 Sedimentation Survey, Sediment Range Layout	July 1976
	Supplement No. 4 to D.M. 22, Report on 1978 Sedimentation Survey	October 1979
	Supplement No. 5 to D.M. 22, Report on 1984 Sedimentation Survey	March 1986

1-04 PROJECT OWNER

The United States Government has full title, ownership, and fee control of all Huntington District, Corps of Engineers reservoir and lake lands, including Fishtrap Lake. The United States Government reimbursed the private property owners of most of the surrounding land and now owns the dam and operating structures.

1-05 OPERATING AGENCY

The Huntington District, Operations Division is responsible for the operation of Fishtrap Lake.

Fishtrap Lake is staffed, all year round between the hours of 0700 and 1530. The Project is monitored during non-duty hours when conditions warrant it and if necessary operations will be made during non-duty hours.

Table 1-1
Project Office Points of Contact

The mailing address is:	**The Damtender (Resource Manager) is:**
Fishtrap Lake	[redacted]
2204 Fishtrap Road	2204 Fishtrap Road
RR 1, Box 501	RR 1, Box 501
Shelbiana, KY 41562-9732	Shelbiana, KY 41562-9732
Telephone No: [redacted]	Fax: [redacted]

1-06 REGULATING AGENCIES

The Huntington District, Water Resources Branch is responsible for regulating the Project as described under the following regulations:

(1) EM 1110-2-3600, 25 May 1959,
Subject: Reservoir Regulation.

(2) ER 1110-2-1400, DAEN-CWE-Y, 24 April 1970,
Subject: Reservoir Control Centers.

(3) ORDR 1110-2-27, 12 January 1976,
Subject: Water Control Management Activities.

(4) ER 1130-2-415, DAEN-CWE-Y, 28 October 1976,
Subject: Water Quality Data Collection, Interpretation, and Application Activities.

(5) DRDR 1110-2-26, 5 February 1979, ORDED-W,
Subject: Water Quality Investigations and Control Activities.

(6) ER 1110-2-240, DAEN-CWE-Y-HW, 8 October 1982,
Subject: Water Control Management.

(7) ER 1110-2-208, DAEN-CWE-Y, 30 July 1979,
Subject: Water Control Management.

SECTION II – DESCRIPTION OF PROJECT

2-01 LOCATION

Fishtrap Lake is located entirely in Pike County on the Levisa Fork of the Big Sandy River near the states of Virginia and West Virginia. The dam is located on Levisa Fork of Big Sandy River, a tributary of the Ohio River, 130.1 miles from its mouth and approximately 7 miles above the City of Pikeville, Kentucky. The dam is also 3.0 miles above the confluence of Russell and Levisa Forks, 103.3 miles upstream from the mouth of Levisa Fork. Fishtrap Dam is about 80 air miles south of Huntington, West Virginia and about 90 air miles southwest of Charleston, West Virginia.

The lake is located in the southeast portion of Kentucky and adjacent portions of Virginia. The Big Sandy River Drainage Basin Map, **Plate 2-1**, shows the location of the project, along with other important features.

2-02 PROJECT PURPOSES

a. General. Fishtrap Lake was authorized for flood control and allied purposes in a comprehensive plan for the Ohio River Basin. The purposes include water conservation for general recreation, and fish and wildlife management. Benefits from specific project purposes serve not only local interests in the Big Sandy River Basin, but are widespread throughout the Ohio River Basin.

2-03 PHYSICAL COMPONENTS

a. Embankment. The layout of the physical components of the project is shown in **Plate 2-2**, General Site Plan. The embankment to the right of the spillway section is founded on bedrock and consists of rock-fill with a central impervious core and required filters and transition zones. The embankment has side slopes of 1 vertical on 2 horizontal. The embankment wraps around the non-overflow section of the concrete spillway with the same slopes. The rock-fill is composed of intermixed siltstone and sandstone with some clay-shale and indurated clay. The impervious core comes from weathered indurated clay and is generally clay with some rock fragments. A cutoff trench and grout curtain extends along the entire axis of the dam.

The embankment to the left of the spillway consists of earth-fill founded on the overburden except for a rock-fill zone on the upstream side adjacent to the concrete section founded on bedrock. A free drained backfill is provided on the downstream side with a transition zone provided for the rock-fill section. The downstream slope of the left embankment is 1 vertical on 2 horizontal and the upstream slope is 1 vertical on 2.5 horizontal. Stone protection is utilized on the upstream slope. The rock fill section slopes are 1 vertical on 1.5 horizontal.

The basic dam dimensions are total Top or Crest length, concrete and earth of 1,100 feet, Maximum Height or elevation above streambed (845.3) 195 feet, Crest Width 32 feet, and Maximum Width at toe of Slope 990 feet. The Embankment plan is shown on **Plate 2-3** and Embankment Section on **Plate 2-4**.

Principal Dimensions of the embankment are as follows:

Total Crest Length	1,100 feet
Maximum Height Above Natural Streambed	195 feet
Crest Width	32 feet
Maximum Width at Toe of Slope	990 feet
Approximate Width at Natural Streambed	95 feet

b. Spillway. The spillway is constructed of concrete with a controlled ogee crest and is located adjacent to left abutment of the dam as shown on **Plate 2-2**. The spillway crest is set at elevation 790 feet NGVD and has a width of 258 feet. Three concrete piers, each ten feet wide, surmount the crest reducing the effective spillway crest width to 207 feet. Control of flow over the spillway is provided by four tainter gates, each 57 feet wide and 37 feet high. Spillway plan and profile views are given on **Plate 2-5**.

c. Outlet Works. The outlet works is located in the left abutment and consists of forebay, intake structure, tunnel transition, tunnel, stilling basin, outlet channel and Service Bridge. The single 15.5 feet diameter horseshoe-shaped tunnel, driven through rock and lined with concrete, serves the operating needs. Regulation is effected through three 6′ x 12′ sluices, controlled by hydraulic slide gates, and housed in a dry well type intake structure. Low flows are passed through a 3′ x 6′ conduit, also controlled by a hydraulic slide gate. Low flow discharge is through multiple high-level inlet ports, to provide control over temperature and oxygen content for downstream water quality. Energy dissipation of the tunnel discharge is accomplished in a conventional jump type stilling basin and the outflow is returned to Levisa Fork via an outlet channel, excavated, for the most part, in rock. The general arrangement of the principal features is shown on **Plate 2-6**.

d. Operating Machinery. Operating Machinery for water control purposes consists of control gates and associated mechanisms.

(1) Crest Gates. The spillway gates are 57 feet wide, conventional, radial, lift-type tainter gates with the trunion set at elevation 811.0 and a nominal radius of 44 feet. Two feet of freeboard, above the flood control pool elevation of 825.0 feet NGVD, are provided by the gate height of 37 feet. The crest gates are raised by a traveling crane with a single trolley having a single hoist. The crane is operated within the control structure and on the Service platform, handled by a portable gantry or by

chain hoist from a monorail. A gate position indicator is provided on the hoist. A spare stand-by generator is stored at the site for emergency use.

(2) Slide Gates. The three 6′ x 12′ high-pressure slide gates are designed structurally to withstand the maximum flood control pool elevation 825 feet NGVD, without exceeding normal design stresses. The 3′ x 6′ slide gate in the low flow system will be designed to withstand maximum pool head at elevation 840.3 feet NGVD. The four gates located in the conduits will be operated from the operating floor at elevation 845.3 feet NGVD, with ancillary controls in the gate control chamber at elevations 706.5 and 697.5 feet NGVD. The hydraulically operated service platform access door is operated only from the interior of the building at elevation 673.0 feet NGVD. Each gate assembly consists of gate frames, gate leaf, seal strips, gate leaf stem and stem extension, hoist cylinder and piston for hydraulic operation, gate bonnet and bonnet cover, remote leaf position indicator, semi-automatic gate hanger and all other accessories that provides a complete installation. A traveling crane with sufficient capacity is used for handling the emergency bulkhead and for servicing the slide gates and stand-by generator. The crane is an in-door, electric motor-operated, overhead traveling crane. The crane is equipped with a single trolley having a single hoist. The machinery and bulkheads outside the operating range of the Service hoist, both within the control structure and on the Service platform, is handled by a portable gantry or chain hoist from a mono-rail provided for that purpose.

(3) Low Flow System. Low flow and selective withdrawal are provided through three 6′ x 4′ low flow intakes at elevations 715.0, 731.0 and 747.0 feet NGVD. Each intake is protected by a trash screen and is controlled by a hydraulically operated unseating type sluice gate. All three intakes discharge into a common well which then discharges into the 3′ x 6′ low flow conduit. Control of low flow discharge is by a 3′ x 6′ hydraulically operated slide gate. The isometric view of the intake structure is shown on **Plate 2-7**. General sections of the intake structure are shown in **Plates 2-8 and 2-9**.

(4) Auxiliary Power Unit. The standby power unit consists of a diesel engine directly connected to an alternating current generator, both mounted on a common base. The engine is a liquid-cooled, cold starting type and is easily started by its battery. The power is sufficient for any conceivable need.

2-04 RELATED CONTROL FACILITIES – N.A.

2-05 REAL ESTATE ACQUISITION

Acquisition policies during the acquisition program were based upon the fee acquisition of a 300-foot minimum horizontal guideline. Minimum requirements included the lower hill slopes that included all improvements. Residual portions of these properties were hill

lands of relatively low value. All roads in the area were also within the minimum acquisition area, which added to the necessity for acquiring these areas. Good real estate practices dictated that entire properties are acquired to preclude demands for access or the payment of severance that would closely equal the land values. The circumstances led to a "blocked out" program that was consistent with established policy.

Access reevaluation studies determined which lands were left without adequate access due to flooding and where provision of such access would cost more than acquisition. In this case they were purchased. The total acquisition of 15,785 acres in fee and 203 acres in easement included all lands required for construction, sites designated for public use, rights-of-way for relocated highways, and the areas cutoff by the lake.

In accordance with the approved plan of coal lands acquisition, the Corps acquired fee to the coal in all project lands. All oil and gas interests for the entire area, except for a few gas wells in the upper end of the basin, were acquired in fee. The gas wells not acquired in fee were subordinated to reservoir operation. After these gas wells were depleted, there were no more mineral exploration or exploitation in the reservoir lands. All existing oil and gas wells on project land were plugged with the last one being finished in 1963.

Relating to subordination of minerals, the broad form deed gives the Government the broadest control as any restrictions apply to the entire tract, while the general form deed only restricts the tract below elevation 830 feet NGVD except for access. The basic intent of the general form subordination, which comprises about 50 percent of the Government’s estate, is only to insure the integrity of the project’s flood control function. It is essentially meaningless in controlling mining. While the broad form deed does provide some additional control, it too has been demonstrated to be inadequate. In Grapevine Creek, for example, where the Government owned broad form subordination of coal, additional surface rights further restricting mining activities had to be acquired to protect the recreation complex.

2-06 RECREATION AND PUBLIC FACILITIES

Recreation development at the project includes four Corps-operated public use areas covering 93 acres and two acres under commercial lease. Recreational development has been limited by physical constraints, environmental degradation and absence of a qualified cost-sharing sponsor. Problems include floating debris, excessive sedimentation, safety problems relating to mining activities and lack of developable areas. Water based recreational activities should be limited by year 2000 and eliminated by about year 2025.

Problems associated with fish and wildlife is related to habitat limitations. Mining has resulted in decreased wildlife habitat.

While fishery habitat has decreased due to loss of storage capacity, angling success remains remarkably good. Progressive loss of winter storage will cause a significant decline in harvestable size game fish and most fisheries will be lost by about year 2020.

As extraordinary amount of sediment has been deposited in Fishtrap Lake since the project became operable in 1968. The sources of sediment are varied, but the major source is the extensive disturbance of land by the coal mining industry, particularly surface mining.

Listed in **Table 2-1**, below are recreational sites in operational condition in the summer of 1985. Any future sites will be constructed as joint funding is arranged with another governmental agency, such as Kentucky Department of Fish and Wildlife Resources. Site locations are shown in Land Use Plan, **Plate 2-10**.

Table 2–1
Recreation Sites at Fishtrap Lake

Name	Status
Tailwater Fishing Area	Complete
Dam Overlook	Complete
Fishtrap Marina and Boat Launching	Complete
Becky Branch Primitive Camping	Complete
Lick Creek Primitive Camping	Complete
Grapevine Creek Area	
Day Use Area	Complete
Overnight Area	Complete

a. Corps Operated Sites. Project personnel operate and maintain the following public use and recreation areas:

(1) Downstream Fishing Area. This area covers about 22 acres on both sides of Levisa Fork below the spillway and stilling basin. The facilities at this site include: a fisherman’s weir, parking facilities for 278 cars, picnic units, a restroom, playground, ball field, drinking fountains, dusk-to-dawn lights, bulletin board, benches, water storage tank and a sewage treatment plant.

(2) Dam Overlook. This area includes the project operations building and equipment. This area has limited parking available. This whole area includes 37 acres.

(3) Fishtrap Launch Site. This is an improved area with a three lane paved launching ramp, 75 paved auto and trailer parking spaces, a picnic table, restroom and water fountain. The site is

just upstream of the dam on the right bank next to the marina and comprises 7 acres.

(4) Grapevine Area. This area also has been improved to include a control station, 28 camp trailer sites, paved parking for 58 cars, two restrooms with showers, water storage tank, 20 picnic units, a bulletin board, two paved launching ramps, four drinking fountains, a sewage treatment plant, a trailer dump station and 13 pieces of playground equipment. This site utilizes 34 acres.

(5) Lick Creek Area. This is a 7-acre primitive tent camping area that also has a boat launching ramp and a limited parking area.

(6) Becky Branch Area. This is an area that provides for primitive camping. This area is accessible by boat only.

b. State Operated Sites. There are no sites operated by the Commonwealth of Kentucky. Kentucky does assist in the management of the fishing resources through a stocking program, water monitoring and law enforcement of state fish and game laws and regulations.

c. Privately Operated Sites. A commercial concession lease consisting of 8 acres provides a concession and bait shop, slips, bank ties, and 33 paved parking spaces. The operator has provided these developments in compliance with an approved plan. The lease expires 31 March 1990.

SECTION III – HISTORY OF PROJECT

3-01 AUTHORIZATION

Fishtrap Lake was authorized for flood control and allied purposes in the Huntington District by the Flood Control Act of 1938, 75th Congress, 3rd session Public Law No. 75-874. The preceding legislation was accompanied by House of Representatives Report No. 2353, which included a previous report titled “Comprehensive Flood Control Plan, Ohio River Basin”, submitted 12 November 1937 by the Ohio River Division Engineer.

Additional legislative authority includes the authorizing act; the Flood Control Act of 1944, PL78-354 as amended; the Fish and Wildlife Coordination Act of 1958, PL85-624; the Federal Water Supply Act of 1958, PL85-500; the Forest Conservation Act as amended; the Federal Water Project Recreation Act; and, the Water Resources Planning Act. The general map of the Corps of Engineers, Huntington District, showing the Levisa Fork River Basin and the Fishtrap Lake project is shown as **Plate 1-1**.

3-02 PLANNING AND DESIGN

During the planning phase, it was concluded that the best plan for comprehensive flood relief in Levisa Fork Basin would consist of a system of four flood control reservoirs to supplement the existing Dewey Lake and Prestonsburg Local Backwater Protection Projects. The four reservoirs were the Fishtrap Lake, the Pound Reservoir (now named John W. Flannagan Reservoir) on Pound River, the Haysi Lake on Russell Fork and the North Fork Lake on the North Fork of Pound River. All except the North Fork Lake had been authorized for flood control, the North Fork Lake being recommended for construction in the report, but not yet acted on by Congress. All four reservoirs were justified economically when considered as a system. When considered on an incremental basis, only Fishtrap Lake, John W. Flannagan Reservoir and North Fork Lake were justified economically. The addition of hydroelectric power facilities was not justified economically in any of the four projects. As proposed for flood control in that report, the Fishtrap Lake comprised a concrete gravity dam on Levisa Fork 103 miles above the mouth, or 2.6 miles above the confluence of Russell and Levisa Forks. The reservoir had a total capacity of 164,360 acre-feet at elevation 825, or 7.8 inches of runoff from the controlled drainage area of 392 square miles.

The recommended size and scope of the Fishtrap Lake Project was determined by maximization, where applicable, of the net benefits of joint operation with the three other authorized reservoir projects in Big Sandy River Basin. Despite the fact that the Haysi Lake Project has become inactive since the time of the project formulation studies, the Fishtrap Lake Project still provides necessary benefits as maximized by the project formulation process.

Conflict between purposes within the project was resolved by economic efficiency criteria.

Investigation of flood control storage requirements was made with a view toward providing sufficient storage capacity to control effectively not only historic floods but also floods that might reasonably be expected to occur in the future. Based on a maximum flood control elevation of 825 feet NGVD, flood storage allocations of 143,300 acre-feet in winter and 88,920 acre-feet in summer will control all known floods in the Fishtrap Lake drainage basin. This amount of storage will limit the outflow from the Standard Project Flood to 62,400 cfs.

Requirement for a storage volume to serve as winter habitat for aquatic communities in the lake and space for accumulation of sediment is met by a minimum pool with surface elevation of 725 NGVD and a volume of 10,530 acre-feet. The minimum pool has a surface area of 569 acres.

The planning phase indicated that the recreation facilities at Fishtrap Lake would supplement the facilities at other areas in or adjacent to the recreation zone of influence, which is the area from which a motorist can reach the lake in a maximum driving time of one hour. Benefits and visitations assumed for economic studies were based on a seasonal pool level of 757 feet NGVD and a surface area of 1,131 acres. Water quality control is not a project purpose, so there is no reduction of benefits due to drawdown of seasonal pool.

During the planning phase, studies were made for purposes of regulating water temperatures for warm-water fish propagation. As suggested by the U.S. Fish and Wildlife Service, three high-level intakes were subsequently established at elevations 715, 731 and 747 feet above NGVD.

The Fish and Wildlife Service originally asked that a seasonal pool be provided to maintain flows of 150 cfs during the months of April and May and 100 cfs from June through November. Studies were made with a view toward maintaining such flows, and the studies concluded that the seasonal pool would need to encroach too greatly on the flood control pool and that there would be frequent years in which the seasonal pool could not be replenished in the spring to provide 100 cfs The U.S. Fish and Wildlife Service subsequently asked that a minimum flow of 100 cfs be provided during the filling period of April and May and that a minimum of 75 cfs be maintained from the time seasonal pool is attained until the first of December and that at least 10 cfs be maintained during the winter months. These flows have been established and adhered to as closely as possible.

3-03 CONSTRUCTION

Construction of the project was initiated in March 1961 with the digging of exploratory trenches in the embankment area. Work on the spillway section, embankment, and appurtenant structures began in

1965, and the work was completed in June 1968, with final acceptance in October 1968.

The road relocation program began in March 1961. In all, 8.1 miles of U.S. 460 were relocated and constructed, 6.3 miles of state highways and 17.5 miles of county roads were also related and constructed. In order to provide power to all project facilities and relocated uses, 30.7 miles of power line were constructed, 31.1 miles of telephone and railway communication lines and 10.8 miles of gas pipelines. There were 30.0 miles of single track of the Chesapeake and Ohio Railway and 4.8 miles of single track of Norfolk and Western Railway, including a 1000-foot long tunnel. There were eleven schools in the project area that were relocated. The relocation program included relocating 2,100 graves from 70 cemeteries in the project area.

The project was placed in operation in October 1968, and closure was made, and the pool was raised to the minimum pool elevation of 725 feet NGVD.

The finished dam cost about $54,297,500 MILLION DOLLARS.

3-04 RELATED PROJECTS

As previously mentioned Fishtrap Lake is part of the flood control system of the entire Ohio River Basin as well as of the Big Sandy River Basin. Fishtrap Lake is one of five authorized and operating flood control reservoirs in the basin, but regulation procedures are correlated with the operation of lakes on other Ohio River tributaries to the fullest extent possible while giving due consideration to local concerns and requirements.

A number of studies have been authorized in the Big Sandy Basin with no current activity. Most of these studies are non-structural in nature, consisting of floodproofing, floodplain evacuation, or floodsafe redevelopment measures.

3-05 MODIFICATIONS TO REGULATIONS

The original channel capacity stages have been maintained since project began operations.

3-07 PRINCIPAL REGULATION PROBLEMS

Excessive sedimentation is the most significant problem in the Fishtrap Lake watershed. Coal mining, particularly augering, both on and off Federal lands, is the primary source of the sediment. Water problems associated with mining include elevated levels of specific electrical conductance, sulfates, chlorides, and iron. Large quantities of floating debris frequently occur on the lake. The main principal downstream regulation problem is a low water bridge downstream of the dam which is covered by water during channel capacity releases.

SECTION IV – WATERSHED CHARACTERISTICS

4-01 GENERAL CHARACTERISTICS

a. Levisa Fork River Basin

The Levisa Fork River Basin lies within the States of Virginia and Kentucky, and extends in a northwesterly direction from its headwaters in Virginia near the Tazewell and Buchanan Counties border to the confluence near Millard, Kentucky, with the Russell Fork. The river then continues on its northwesterly course until the Levisa Fork and Tug Fork Rivers meet near Louisa, Kentucky, to form the Big Sandy River. The river flows a distance of approximately 164 miles and drains an area of 2,320 square miles, which includes the Counties of Pike, Floyd, Johnson, and Lawrence in Kentucky and Buchanan County, Virginia. The drainage basin is roughly triangular in shape; its greatest length is 40 miles; and the maximum width is 17 miles. Flows at the U.S.G.S. gage at Pikeville, 87.6 miles above the mouth, have varied from 1.5 cfs to 85,500 cfs, with a mean runoff of about 1.2 cfs per square mile of drainage area. Drainage areas of the Levisa Fork River and principal tributaries above the dam site are given in **Table 4-1**, below. Streambed profiles of the Levisa Fork River and its principal tributaries above the dam site are on **Plate 4-1**.

TABLE 4-1
Drainage Areas of Levisa Fork and Tributaries

Stream	Point	Area (Sq.Mi.)	Levisa Fork (Miles)
Levisa Fork	At mouth	2,320	0.0
Levisa Fork	At Paintsville, KY	2,143	38.6
Johns Creek	At mouth	225	46.9
Beaver Creek	At mouth	241	65.0
Levisa Fork	At Paintsville, KY[1]	1,233	87.6
Shelby Creek	At mouth	115	93.4
Levisa Fork	Below mouth of Russell Fork	1,080	97.6
Levisa Fork	At Fishtrap dam	386	100.4
Russell Fork	At mouth	680	97.6
Russell Fork	Below mouth of Pound River	528	121.4
Pound River	At mouth	226	121.4

[1] At new gaging station

b. Fishtrap Lake Basin

The lake lies entirely in Pike County, Kentucky. Fishtrap Lake drainage basin is irregularly shaped and is about 44 miles long and 15 miles wide and lies in a general east-west direction. Levisa Fork drainage basin extends into nearby portions of the State of Virginia. Situated in the Kanawha Section of the maturely dissected Appalachian Plateau physiographic province, the basin displays the moderately high hills, steep hillsides and absence of flat land that characterize the province. The lake covers the flood plain over much of the length of the lake up the main stem and lower tributaries.

The lake is dendritic in shape, with a shoreline length of 43 miles at seasonal pool elevation of 757 feet NGVD. At seasonal pool, the lake extends up the mainstem 16.5 miles and up Grapevine Creek 1.5 miles above the mouth. Mean breadth of Fishtrap Lake is 565 feet with a maximum depth of 84 feet and a mean depth of 33.3 feet. The reservoir controls runoff from the drainage area of 392 square miles, controls headwater flooding along Levisa Fork below the dam and gives substantial protection along Big Sandy River.

4-02 TOPOGRAPHY

The Levisa Fork River drainage basin lies within the Cumberland Mountain section of the Appalachian Plateau physiographic province. This physical section is characterized by high, mature plateaus and mountain ridges of moderate to strong relief. Levisa Fork Valley, above the dam site, is a steep-sided entrenchment, with flood plains being narrow or entirely absent. Through most of its length, the stream has carved its channel 600 to 800 feet below the surrounding hilltops. Elevations above mean sea level vary from about 660 feet at the confluence of Russell Fork and Levisa Fork, about 2.7 miles below the dam, to about 3,000 feet on the western slope of the Allegheny Ridges where the stream has its source.

Levisa Fork Valley consists of a narrow flood plain bounded by steep hills, the valley width varying from stream width at the source to 1,100 feet at Pikeville, Kentucky, and averaging 1,300 from Pikeville to the mouth at Louisa, Kentucky. Streambank heights above Pikeville vary from 10 to 25 feet above low water, and downstream from Pikeville the streambanks are generally 40 to 45 feet above low water. Levisa Fork falls approximately 1,878 feet from the source to the mouth, which is an average slope of 11.5 feet per mile. A streambed profile of the Levisa Fork River and its principal tributaries is shown on **Plate 4-1**.

4-03 GEOLOGY AND SOILS

The consolidated rocks now appearing at the surface in Levisa Fork Basin are of Pennsylvanian age, except for a narrow belt of Mississippian, and possibly Devonian rocks, which have been exposed

along Pine Mountain by a thrust fault of major proportions. The structure of the rocks of the region are, generally speaking, a great down-fold or trough extending northeasterly across Eastern Kentucky into West Virginia. The regional dip of the strata is to the northwest or north, and at low angles. This dip is interrupted, however, by a number of broad, low folds. The Pennsylvanian rocks, ranging from Pottsville to Conemaugh in age, measure approximately 3,000 feet of sandstones and shale's containing numerous beds of coal and a few thin beds of limestone and clay. The Conemaugh rocks, the youngest rocks of the area, are confined to the lower or north end of the basin. The Allegheny series of rocks underlies the Conemaugh in the lower portion of the region, whereas in other sections of the basin only thin remnants of this series remain on the higher ridges or they have been entirely removed by erosion. The Pottsville series ranging in thickness from 2,500 to 500 feet comprise most of the exposed rocks throughout the basin. It contains more than 20 coal seams that are of commercial thickness at certain locations.

The unconsolidated materials in the watershed are river-deposited silts clays, and sand and residual materials formed by the disintegration of the country rock. The valley fill materials are generally fine to medium grained and consist of river-deposited sand, silt, clay, and gravel. The higher elevations are blanketed with residual sandy clay, which generally passes into bedrock at a shallow depth.

The Levisa Fork Basin lies wholly within the physiographic province known as the Appalachian Plateaus. All of the rocks that now outcrop in the region are of sedimentary origin that is they were deposited in or by the agency of water. With few exceptions, the beds were accumulated in the sea or in extensive marshes during a period of subsidence or sinking of the area. Following this accumulation, crustal movements caused the area to be slowly lifted above the sea. Erosion agencies then reduced the surface to base level. These processes of uplift and erosion were repeated several times. Although the topography and drainage lines of portions of this province have been modified by continental ice sheets, Levisa Fork watershed was not affected by glaciations. The agencies of erosion are now reducing the area to base level or to a low-lying plain. The present streams generally follow the meandering courses cut by an earlier drainage cycle.

4-04 EROSION AND SEDIMENT YIELD

Over 80 percent of the Fishtrap Lake drainage basin is wooded. There are no major portions that are farmed due to the topography of the area. Logging of the wooded portion of the basin is actively practiced. Coal production in the drainage area is low due to the current economic situation. The immediate prospect for further commercial development of the coal seams is doubtful, even though the area has large areas of coal seams.

In the past, Levisa Fork has appeared to carry a heavy sediment load; however, no actual samples have been taken to determine the amount of sediment carried. A summary of reservoir sediment deposition surveys made in the United States through 1960 was published by the U.S. Department of Agriculture in "Miscellaneous Publication No. 946." The information contained in this publication was used to estimate the amount of sedimentation that might be expected to occur in Fishtrap Lake. Utilizing the data relative to the reservoirs in the Tennessee Valley Authority adjacent to the Levisa Fork River Basin, it appeared that a sedimentation rate of 0.376 acre-foot per square mile of controlled drainage area per year would be a representative value for Fishtrap Lake.

A total of 2,845 acre-feet of storage are provided in the minimum pool area, below elevation 725.0 feet, for fish and wildlife conservation and sedimentation reserve. Assuming that sedimentation occurred at an annual rate of 0.376 acre-foot per square mile of contributing drainage area, or 147 acre feet per year, and all the material were deposited in the minimum pool area, the minimum pool would have a life of about 50 years.

Visual indication that sedimentation problems existed at Fishtrap Lake occurred when the lake was drawn down to minimum pool level in the fall of 1971. A field inspection by representatives of various Federal and Kentucky state agencies was conducted at Fishtrap Lake in January 1972.

Results of the first resurvey of sediment ranges, conducted in 1972 indicated that the accumulation of sediment in Fishtrap Lake was at an excessive rate and a matter of concern in regard to the effective operation and management of the project for authorized purposes. A cooperative sediment-monitoring program between the U.S. Geological Survey and the Huntington District was initiated in 1973 to obtain data concerning the sedimentation problem. Lake sedimentation surveys conducted by the Huntington District in 1974 and 1975 indicated that sedimentation at Fishtrap Lake was continuing at an excessive rate. The lake sedimentation survey conducted by the Huntington District in 1978 indicated that the rate of sedimentation for the period between the 1975 and 1978 resurveys was greater than the rates indicated by the 1974 and 1975 resurveys.

The 1984 sedimentation survey of Fishtrap Lake indicated that the rate of sedimentation for the 5.8-year period between August 1978 and the June 1984 surveys was less than the rates indicated by the 1972, 1974, 1975, and 1978 surveys. The decrease in the sedimentation rate was apparently the result of hydrologic conditions and reduced sediment-producing activities in the basin during the latest period between surveys.

As a result of the 216 Studies, data indicated that during seven years of project operation, 5,833 acre-feet of sediment had been deposited. This represents 55 percent of the minimum pool storage

capacity. The major source of sediment is the disturbance of land by coal mining, particularly surface mining.

Flood control storage capacity remains essentially as originally allocated. At the end of the project's economic life, year 2068, flood control storage capacity would be reduced from 7.3 inches of runoff to 5.7 inches. This loss of flood control storage wasn't anticipated to affect reductions in downstream flood stages for up to a 200-year flood event. Therefore, potential loss of flood control storage was not regarded as a major problem.

Storage capacity and facilities at Fishtrap Lake are adequate for meeting established streamflow regulation requirements. However, streamflow regulation capability will deteriorate significantly by year 2000 and the capability will be lost by year 2030.

Recreation development at the project includes four Corps-operated public use areas covering 93 acres and two acres under commercial lease. Recreational development has been limited by physical constraints, environmental degradation and absence of a qualified cost-sharing sponsor. Problems include floating debris, excessive sedimentation, safety problems relating to mining activities and lack of developable areas. Visitation exceeded 700,000 in 1975 and is expected to continue to rise until project services are lost or severely degraded. Water based recreational activities will be limited by year 2000 and eliminated by year 2025.

Problems associated with fish and wildlife is related to habitat limitations. Mining has taken a toll in decreased wildlife habitat. While fishery habitat has decreased due to loss of storage capacity, angling success remains remarkably good. Progressive loss of winter storage will cause a significant decline in harvestable size game fish and most fishery will be lost by year 2020.

Increasing energy needs and increasing emphasis on coal production to fill those needs could result in future mining in the drainage basin. An increase in sediment-producing activities in the drainage basin above Fishtrap Lake could increase the rate of sedimentation in the lake. The methods used in mining the coal and reclaiming the land after mining will affect the quantities of sediment reaching Fishtrap Lake.

4-05 CLIMATE

a. General. The climate of the Levisa Fork Basin is Humid Continental, typical of the central temperate zone, having highly variable temperatures between the summer and winter seasons. The entire basin is affected by frontal air mass activity, and is subject to both continental polar and maritime tropical air masses. Frequent and rapid changes in weather occur due to the passage of fronts associated with general low-pressure areas. The prevailing wind direction is from the southwest.

Meteorological data used in hydrologic studies for Fishtrap Lake were available from 21 National Weather Service stations within and adjacent to the drainage basin. Average period of record per station was 16.3 years in 1959. Ten of the 21 are in Huntington District and are designed for daily reporting. These ten, plus four stations installed since planning studies and the project itself, provide data for operation.

b. Temperature. Temperatures have been recorded in and near the Levisa Fork River Basin for as many as 60 years. Grundy, Virginia, which is at the headwaters of Levisa Fork, has recorded temperatures ranging from a low of -20°F in December 1984 to a high of 105°F in July 1966. The average annual temperature is about 56°F; the average summer temperature is 74°F. The growing season, or the period between the last killing frosts of spring to the first killing frost of autumn, usually runs from mid-April to mid-October. **Table 4-2**, page T4-1, presents a temperature summary for three representative stations in the Levisa Fork River Basin.

c. Precipitation. The normal annual precipitation of approximately 44.3 inches is nearly uniform over the Levisa Fork River Basin. Average monthly, maximum monthly, minimum monthly, and maximum 24-hour precipitation is listed in **Table 4-3**, page T4-2, for three representative stations. The Levisa Fork River Basin lies directly in the path of extensive meteorological disturbances, which move from the western Gulf of Mexico region northeastward over the lower Mississippi Valley and the Ohio Valley to the Great Lakes Region and North Atlantic Coast. Most of the precipitation over the basin results from these general storms, which vary considerably in frequency and character, producing a wide variation in precipitation for individual months and years. Meteorological conditions likely to produce major flooding in the Levisa Fork Basin develop into two types: (1) the summer type, confined to the period of the year from May to early November, with the greatest probability of occurrence during June or July; and (2) the winter or early spring type, most likely to occur during the month of March.

Summer rains usually result from conventional frontal activity associated with thunderstorms of convectional or orographic origin. They are usually confined to relatively small areas and are of short duration with high intensity rates.

Precipitation of the winter and early spring types generally results from the passage of low-pressure systems over the basin. These storms are less intensive and more evenly distributed with rainfall of longer duration and wider areal extent. These storms are generally caused by cold airmasses, originating in the region of Alaska, which interact with warm airmasses sweeping northward from the Gulf of Mexico and the Atlantic Ocean. Occasional stagnation and stationary development produces prolonged precipitation. Snow Cover, saturated or frozen ground, or combinations thereof, may greatly

increase runoff rates and volumes. The direction of travel of the storm system is usually northeastward.

The Levisa Fork Basin, particularly in the headwater areas, is subject to tropical storms of the hurricane type. The most likely period of occurrence is during the late summer and fall months. These storms originate in the Western Atlantic and Caribbean Sea areas, and in many cases swing inland over the southern and southeastern United States. The intensity of wind forces decreases rapidly as these storms travel overland, but: many of the storms drive large masses of saturated and unstable air inland. Nearly all of the resulting precipitation occurs inland and intense rates of rainfall occur when the storm strikes or crosses the Appalachian Mountains.

Meteorological studies indicate that the summer-type storm has possibilities of producing the maximum flood. However, meteorological records show that winter-type storms occur more frequently and produce more major floods than the summer-type storms.

The average annual snowfall over the basin is about 16 inches and represents only a minor portion of the total annual precipitation. Average monthly and annual snowfall for representative stations are listed in **Table 4-3**, page T4-2.

d. Droughts. The most recent droughts occurred in 1988, 1998 and 1999. The severest drought on record for Levisa Fork Basin occurred in 1930.

e. Evaporation and Wind. Evaporation losses occurring at Fishtrap Lake were calculated from NOAA Technical Report NWS 33, published by the National Weather Service from data obtained jointly by the Weather Service, Corps of Engineers, and other organizations. Average values for monthly, seasonal, and annual evaporation losses from the lake are shown in **Table 4-4**, next page, - Lake Evaporation Losses - Summary. The evaporation records at Clarksburg, West Virginia (1923-1964) were used to determine the maximum seasonal (May-October) evaporation losses.

Annual average wind direction over the Levisa Fork River Basin is southwesterly. Southerly winds, however, prevail from July through October, change to southwesterly during November and December, and become near westerly in January and February. The direction then gradually becomes and remains southwesterly during March, April, May, and June. During the seasonal period of maximum evaporation, the lowest average wind speed, 5 mph, occurs in August and the highest, 8 mph, in May. [1]

[1] Information on wind direction and speed is taken from "Climatic Atlas of the United States," June 1968, published by Environmental Science Services Administration of the U.S. Department of Commerce.

Table 4-4
Lake Evaporation Losses – Summary

Maximum Seasonal Evaporation (1930) – 29.0 Inches*
Average Annual Evaporation – 30.0 Inches*
Average Seasonal Evaporation (may-October) – 24.1 Inches*

Month	Average Inches*	Monthly Evaporation losses Acre-Feet**
May	4.14	389
June	4.62	434
July	6.14	577
August	4.26	400
September	3.48	327
October	1.50	141
Seasonal Total	24.14	2,268

* Vertical distance

** One-inch loss from seasonal (water quality control) pool surface area (elevation 757.0) = 94 acre-feet.

4-06. STORMS AND FLOODS

a. General. Floods in the basin are not limited to any specific month, although winter and spring floods are more frequent than summer floods. The occurrence of summer-type storms over the basin has produced local floods without affecting adjacent areas. The lowermost 1-mile of the Levisa Fork River is subject to backwater flooding from the Ohio River as well as headwater flooding, or a combination of both. Ohio River floods are caused by winter-type storms that occur between December and April; these storms are more widespread and of longer duration.

Large floods in the past, such as the 1937 flood, which occurred before construction of the flood control reservoirs, produced a high stage on the Ohio River at Ashland, Kentucky, that backed water up the Levisa Fork as far as 32 miles. **Table 4-5**, next page shows potential stages at Ashland, backwater distance with low flow in the Levisa Fork, and probable frequency, of occurrence under present-day conditions.

The topography of the basin, consisting of winding, narrow-crested ridges and deep, narrow valleys, is conducive to the rapid concentration of runoff, resulting in fast rises of the stream. Floods on the Levisa Fork above the Fishtrap dam site are generally of relatively short duration and seldom remain above flood stage more than 24 hours. Flooding in the lower reaches of the river can last longer when influenced by Ohio River floods. The flooding characteristics of the basin are illustrated by the list of high water data at Pikeville, Kentucky, presented in **Table 4-6**, page 4-

10. A flow frequency curve for Fishtrap Dam on the Levisa Fork is useful to describe the flooding characteristics of the basin.

Table 4-5
Ohio River Backwater Effects on Levisa Fork

Peak Elevation at Ashland, Kentucky Feet above NGVD	Distance* (Low water) Miles	Frequency (Present-Day Conditions)** Return Period - Years
575.5	6	100
570.8	4	50
563.7	1	20
560.0	0	10
555.5	0	5
549.8	0	2
546.8	0	1

* Estimated nearest mile

** Considers present operational reservoir system throughout district.

Table 4-6
Levisa Fork at Pikeville, Kentucky – High-Water Data

Date	Natural Gage (Height-Feet **)	Natural Discharge (cfs)*
5 April 1977	76.0	149,760
29 January 1957	60.0	85,500
7 May 1984	55.6	83,500
12 March 1963	55.4	83,000
7 March 1967	54.7	80,000
17 March 1973	48.1	63,100
11 January 1974	47.9	62,750
26 January 1978	47.7	62,000
28 January 1918	47.2	60,300
23 March 1929	47.0	60,000
22 December 1926	46.4	58,300
30 March 1975	45.2	56,000
31 December 1969	44.9	54,640
7 May 1958	44.3	53,900
8 January 1946	43.0	50,300
30 January 1932	42.8	49,800
14 April 1972	42.3	48,500
4 March 1917	42.0	47,500
16 April 1956	40.8	45,200
7 May 1971	40.5	44,600
4 February 1939	40.0	43,600
7 March 1955	39.9	43,100
27 March 1913	39.9	43,000
2 February 1950	39.1	41,700
20 May 1953	38.8	40,900
26 March 1965	38.8	40,800
3 February 1923	38.2	39,900
21 January 1979	38.2	39,800
14 February 1948	38.1	39,400
3 March 1934	37.6	38,000
18 February 1944	35.8	34,800
28 February 1962	35.6	34,600
23 January 1920	35.1	33,600
6 April 1936	34.8	32,600
18 February 1945	33.9	31,200
2 January 1919	33.9	31,200
9 February 1937	33.8	31,000
30 December 1943	33.5	30,500
12 march 1935	33.1	29,700
21 February 1922	33.0	29,600
31 July 1961	32.9	29,200
23 March 1952	32.8	28,900
16 February 1925	32.5	28,100

* Values based on rating or measurements in use at time of event.
** Values reflect gage heights at new gage site.

b. Storm and Flood of February 1862. The flood of February 1862 reached major proportions in Levisa Fork Basin. Climatological data were not collected in the basin at the time, but the storm over Big Sandy Basin apparently was relatively local inasmuch as there is little evidence of a major flood in adjacent drainage areas. The flood on Levisa Fork at Pikeville reached a stage of 51.9 feet, or 0.8 feet lower than the highest flood of record, that of January 1957. At Paintsville the crest stage was 46.6 feet, and at Louisa it was 52.6 feet. It is estimated that the runoff from Levisa Fork amounted to approximately 3.2 inches from the drainage area.

c. Storm and Flood of March 1929. The flood of March 1929 reached major proportions throughout the Levisa Fork watershed. The flood was preceded by periods of unusually high temperatures. The flood was caused by heavy rainfall on the 23rd, with 2.93 inches at Dante, Virginia; 2.00 inches at Gary, West Virginia; and 2.36 inches at Pikeville, Kentucky. The volume of runoff from Levisa Fork watershed above the dam site was approximately 2.20 inches. On Levisa Fork at Fishtrap, an estimated crest flow of 28,000 cfs was reached.

d. Storm and Flood on January 1937. The unprecedented flood of January 1937 in the Ohio Valley resulted from excessive rains during January, which followed moderately heavy rains occurring in the latter part of December over the entire Ohio River watershed. The resulting flood on Levisa Fork did not reach major proportions, but at Louisa the crest was 49.0 feet, 4 feet above flood stage. The estimated runoff from the Levisa Fork drainage area was approximately 5.10 inches.

e. Storm and Flood of February 1939. The flood of February 1939 was caused by two distinct storms. On 30 January the first storm released between 1.0 and 1.5 inches of rain over the basin, which saturated the soil and started the streams to rise. The second storm occurred during the first three days of February and resulted in basin rainfall varying from about 2 inches at the head of Levisa Fork to about 3.5 inches at the dam site. The volume of runoff from the drainage area above the Levisa Fork at Fishtrap was approximately 1.6 inches. A crest flow of 17,900 cfs was attained on Levisa Fork, at Fishtrap.

f. Storm and Flood of January 1946. The flood of January 1946 reached major proportions throughout the Levisa Fork watershed. The flood preceded by unseasonably warm weather and a moderate amount of rain three days prior to the main storm. Almost all the rain contributing to flooding fell oil 7 January, with 2.80 inches recorded at Pikeville, Kentucky; 2.47 inches at Gary, West Virginia; and 2.63 inches at Dante, Virginia. The volume of runoff from Levisa Fork above the dam site was approximately 2.1 inches. On Levisa Fork at Fishtrap, a crest flows of 23,000 cfs was reached.

g. Storm and Flood of February-March 1955. The storm period began on 26 February and was characterized by unseasonable warmth, thunderstorms, and general rains while the area was under the influence of warm air masses. The rainfall averaged approximately 4.0 inches over the basin from 26 February to 1 March. Moderate amounts of rain fell on the 1st, 3rd, and 4th of March, and then nearly 2.25 inches fell on the 6th and 7th of March. The total runoff from 26 February to 7 March was slightly over 6.0 inches. The first period of intense rainfall produced a crest flow of 19,500 cfs at Fishtrap on 27 February. The second intense rainfall period caused a crest flow of 18,700 cfs at Fishtrap on 6 March. The flood on Levisa Fork reached a stage of 39.1 feet at Pikeville and 41.3 feet at Paintsville. The crest stage of the Big Sandy River at Louisa was 52.6 feet.

h. Storm and Flood of January 1957. Frontal activity between strongly contrasting air masses brought excessive rainfall to the southern Appalachian region during the period 27 to 29 January. Rainfall averaged about 4.2 inches over Levisa Fork above the dam site. The streams were at average flows and the ground was saturated from antecedent rainfall at the onset of the storm. The crest flow at Fishtrap was 33,000 cfs. The flood on Levisa Fork reached a stage at Pikeville of 52.7 feet, at Prestonsburg of 48.7 feet, and at Paintsville of 46.0 feet. The Big Sandy River at Louisa reached a crest stage of 50.8 feet. The volume of runoff from the drainage areas of Levisa Fork amounted to approximately 3.4 inches.

i. Storm and Flood of April 1977. The flood was caused by a series of disturbances moving from the southern plains states into the Appalachians on 4 April. Heavy thunderstorms formed ahead of the disturbance in the lower Mississippi Valley and moved northeastward along a stationary front into the southern Appalachians. Three periods of heavy rainfall occurred over the Levisa Fork on 4 April. The first heavy rain fell between midnight and 0500, the next around midday, and the last around sunset. Rainfall amounts for the total storm period averaged about 6.0 inches in the Levisa Fork Basin. Major flooding occurred over the upper reaches of the Levisa Fork. The intense rainfall produced a crest flow of 49,263 cfs at Fishtrap on 5 April. The greatest known flood occurred upstream from Pikeville Kentucky. The crest stage at Pikeville was 51.46, 45.71 feet at Prestonsburg, 42.19 feet at Paintsville, and 45.00 feet on the Big Sandy at Louisa. It was estimated that the regulation of Fishtrap Reservoir resulted in a crest stage reduction of 8.3 feet at Pikeville, Kentucky. The volume of runoff from the drainage areas of Levisa Fork amounted to approximately 4.7 inches.

j. Storm and Flood of May 1984. The flood of May 1984 was characterized by heavy rains, which began on 2 May. Some of the storm totals were: 6.34 inches at Card Knob, 5.35 inches at Dewey Lake, 4.41 inches at Inez, and 6.69 inches at Hurley, Virginia.

These rains came at a period of time when the ground was nearly saturated from previous precipitation. The crest stage at Pikeville was 44.4 feet, 43.9 feet at Prestonsburg, 40.6 feet at Paintsville, and 42.3 feet on the Big Sandy River at Louisa. The regulation of Fishtrap resulted in a crest stage reduction of 9.0 feet at Pikeville, Kentucky. The volume of runoff from the drainage areas of Levisa Fork amounted to approximately 3.3 inches.

4-07 RUNOFF CHARACTERISTICS

The headwater portion of the Levisa Fork River Basin is characterized by narrow valleys with steep sloping sides. Runoff from these slopes is flashy and tends to collect rapidly in the stream channel, resulting in quick rises of the stream. Infiltration losses are lowest during the winter months when storm rainfall may be augmented by snowmelt and frozen or saturated ground is present. Infiltration losses are highest during late summer and early fall when the ground is dry. However, precipitation during these seasons may be quite heavy and have sufficient intensity to more than make up for the higher infiltration rates. It is during the late summer and early fall periods when streamflows in the basin drop to very low levels. **Table 4-7**, below, presents average normal, maximum and minimum runoff for the Fishtrap dam, based on 47 years of record at the U.S.G.S. gage at Fishtrap, Kentucky.

Table 4-7
Monthly Average Runoff - Levisa Fork at Fishtrap Dam
Based on Gage Records: 1938-1984

Month	Normal Avg. Flow		Maximum Avg. Flow		Minimum Avg. Flow	
	(cfs)	Inches	(cfs)	Inches	(cfs)	Inches
January	728.37	2.14	2186.35	6.43	21.92	0.064
February	899.10	2.41	1951.50	5.23	97.96	0.263
March	1099.07	3.23	3102.94	9.13	93.29	0.274
April	738.53	2.10	1787.10	5.09	86.83	0.247
May	583.74	1.72	1854.94	5.46	84.81	0.249
June	289.72	0.82	1454.20	4.14	31.00	0.088
July	212.45	0.63	906.28	2.67	16.41	0.048
August	189.05	0.56	1184.84	3.49	14.13	0.042
September	126.45	0.36	416.43	1.19	2.14	0.006
October	169.39	0.50	854.45	2.51	1.10	0.003
November	12.50	0.04	99.93	0.28	0.24	0.001
December	470.72	1.38	1643.23	4.83	8.04	0.024
Annual	**459.92**	**15.94**	**802.23**	**27.81**	**171.19**	**5.934**

4-08 WATER QUALITY

a. Geology. The Levisa Fork Basin lies within the states of Virginia and Kentucky. Levisa Fork has its headwaters in Buchanan County, Virginia, and flows 164 miles before joining with the Tug Fork River near Louisa Kentucky to form the Big Sandy River. Fishtrap Lake is located on Levisa Fork in Pike County Kentucky. The lake is 100 miles above the mouth of Levisa Fork and about 7 miles from the town of Pikeville. It was authorized for flood control, general recreation, low flow augmentation, and fish and wildlife conservation. The lake is formed by a rolled rock dam with a central impervious core and has a drainage area of 392 square miles. At seasonal pool elevation of 757-ft NGVD the lake extends 16.5 miles up Levisa Fork.

The dam and the lake are within the Cumberland Section of the Appalachian Plateau physiographic province. This section is characterized by a mature plateau with moderate to strong relief. The predominant overburden material found in the upland areas is sandstone and shale. The lithology of the rock found in the lake area reflects a typical Pennsylvania cyclic sequence of shallow water deposited sandstones, interbedded shales containing numerous beds of coal, and a few thin layers of limestone and clay. Geological considerations are most important because rock type in the drainage basin determines, to a great extent, the inorganic composition of inflow and (ultimately) lake water. Most of the watershed is wooded, and a large portion of the basin contains coal. There are active mines throughout the basin and a commercial logging industry exist. High sediment runoff is associated with both industries.

b. Chemical. In terms of major ions and descriptive parameters, inflow water at Fishtrap Lake is classified as a calcium-sulfate type. This represents an unbalanced condition most. A calcium-carbonate type represents a normal condition. Water hardness in the basin is 201 mg/1 Calcium Carbonate which is classified as hard according to USGS classifications.

c. Watershed Indicators. EPA uses an index of watershed indicators (IWI) to asses the health of aquatic resources in the watershed. The index ranges from 1 to 6 with 1 indicating a better water quality and lower vulnerability to stressors such as pollutant loadings and 6 indicating more serious water quality problems and a higher vulnerability to stressors. The most recent IWI score calculated for the Levisa Fork basin was 3 (1999 - upper and lower basins). This implies that the watershed has less serious water quality problems and a lower vulnerability to stressors.

During the majority of the recreation season, the lake is stratified with warmer, oxygenated water in the upper levels (epilimnion) and colder water, devoid of oxygen in the lower levels (hypolimnion).

Water quality data collected by the Corps of Engineers from 1980 to 1999 indicate that water quality in the basin reflects watershed conditions.

4-09 CHANNEL AND FLOODWAY CHARACTERISTICS

The regulation channel capacity, or central flow in the Levisa Fork River below Fishtrap Lake is 8,000 cfs in the winter and 5,000 cfs in summer. Respective winter and summer control flows at the gage at Pikeville, Kentucky, are 26,700 and 13,800 cfs. Control stages at Pikeville, Kentucky, are set at 31.6 feet of stage in winter and 23.0 feet of stage in summer. Flood time of travel of Fishtrap Lake discharge to Pikeville is 3 hours; Prestonsburg, 21 hours; to Paintsville, 29 hours; and to Ashland on the Ohio River, 54 hours.

The Levisa Fork River follows a meandering course over the 161-mile length between the headwater and the mouth. Levisa Fork has generally stable banks and relatively low turbidity except after hard rains. The streambed consists of sand and gravel, medium-size boulders, and occasional rock outcrops. The stream varies in width from about 60 feet at the dam site to 200 feet at the mouth. The valley width gradually increases from around 300 feet at the dam site to 1,500 feet at the mouth. Levisa Fork falls approximately 1,878 feet from the source to the mouth, which is an average slope of 11.5 feet per mile.

4-10 UPSTREAM STRUCTURES – N.A.

4-11 DOWNSTREAM STRUCTURES

Fishtrap Lake is one of five authorized and operating flood control reservoirs in the entire Ohio River Basin as well as of the Big Sandy River Basin. The locations of these reservoirs are shown on **Plate 1-1**. There is also a gage downstream at Pikeville and a municipal water supply at Pikeville 15 miles downstream from the dam.

4-12 ECONOMIC DATA

a. Population. The Levisa Fork River Basin above Fishtrap Dam has an estimated 2000 population of about 39,000 persons in a predominantly rural environment. Population centers are small, most of them numbering less than 4,000 persons. This area, including Pike and Buchanan Counties, has experienced a decline in population in the decade ending in 2000, ranging from –5.3 percent in Pike County to –13.9 percent in Buchanan County.

b. Agriculture. 15 percent of the basin is about two-thirds in pasture and one-third in crops. Some corn and hay are grown for animal feed, but most of the crops are grown for local sale or personal use.

c. Industry. Approximately 85 percent of the basin is wooded and currently supports an active logging industry. A large portion of the basin contains coal lands that have some commercial potential. Presently, mines are operating throughout the basin.

d. Flood Damages. Losses of serious proportions result from inundation of large portions of the towns and agricultural lands along Levisa Fork during major floods. Losses along Big Sandy River are primarily the result of backwater from Ohio River floods. In order to determine average annual natural damages by headwater floods, those damages, which occurred before construction of the various flood control reservoirs, were derived by the frequency-damage curve method. The natural stage-frequency curves and the stage-damage curves were used for plotting the frequency-damage curves. The areas under the frequency-damage curves were then measured to obtain the average annual flood damages. Updated through 2000, and on the basis of 2000 construction costs, flood damages along Levisa Fork Basin up to year 2000 are approximately $538.7 million.

SECTION V – DATA COLLECTION AND COMMUNICATION NETWORKS

5-01 HYDROMETEOROLOGIC STATIONS

a. Facilities. Data Collection Platforms (DCPs) have been installed at stream gaging and precipitation stations. Installations at stations in the Levisa Fork basin are described in **Table Nos. 5-1**, page T5-3 and **5-2**, page T5-5. Early-model stage detection devices, i.e. staff sections and wire weight gages, are now used as primary references for setting modern measuring and recording instruments at the bubbler-type installation. However at the standard well installation, the electric tape is used for primary reference. Strip chart recorders provide a graphical record of stream stage and a backup for Analog-to-Digital Recorder (ADR) devices. Shaft encoders are now being used to digitally record water levels.

Some stream gaging stations have voice DCPs, capable of answering a telephonic call and responding with the current updated information by synthesized voice.

Another type of DCP is now available that has the capability of reporting in response to a telephone query from a computer or terminal. The query can be initiated any time from the Water Control System, project office or home of a selected individual during off-duty hours. The voice synthesizer gives stage as “level” to 0.1 feet when dialed. These DCP’s can also dump to a computer terminal giving several readings over a period of hours. These DCPs are being installed at critical locations such as inflow, lake and outflow stations, along with some control point stations.

Stream Gaging Stations in the Levisa Fork River Basin: Levisa Fork near Big Rock, Fishtrap Lake outflow gage, Levisa Fork River at Pikeville, Levisa Fork River at Prestonburg, and Levisa Fork River at Paintsville. Gage locations are shown in **Plate 5-1**, Hydrologic Network; and pertinent data about them is listed in **Table 5-1**, page T5-3 (Table section), Stream Gage Data.

Nine precipitation stations are located in and near the Levisa Fork Basin. They are located at Virgie, Pilgrim Knob, Grundy, Frescreek, Phelps, Williamson, Fishtrap, Pikeville and Big Rock.

b. Reporting. The DCP platforms store stage and precipitation data and, every four hours, transmit to the LRD computer downlink via the GOES satellite. The Water Resources Engineering Branch Water Control System receives data automatically from the LRD water control system on an hourly basis.

c. Maintenance. Routine daily first level maintenance for all mechanical stream gaging equipment in the Levisa Fork River Basin will be performed by the assigned project personnel. Advanced higher level maintenance, particularly for any electronic equipment

malfunction, will be performed by a Corps trained technician or a U.S.G.S. technician. The Water Control Section should be contacted if a malfunction has occurred. Water Control personnel will then contact the appropriate personnel.

5-02 WATER QUALITY STATIONS

a. Facilities. A network of eighteen water-quality-sampling stations was established at Fishtrap Lake. Primary stations located on the lake are shown in **Plate 5-2**. All primary stations within the basin are described in **Table 5-3**, below.

Table 5-3
Description By Location of Fishtrap Lake
Primary Water Quality Sampling Stations

Station Number	Distance in Miles Above or Below Dam
1FRL0001	0.3 Miles Below
1FRL0002	15.2 Miles Above
1FRL0003	0.1 Miles Above
1FRL0004	1.1 Miles Above
1FRL0005	2.1 Miles Above
1FRL0006	3.0 Miles Above
1FRL0007	4.0 Miles Above
1FRL0008	5.0 Miles Above
1FRL0009	6.0 Miles Above
1FRL0010	7.0 Miles Above
1FRL0011	8.0 Miles Above
1FRL0012	9.0 miles Above
1FRL0013	10.1 Miles Above
1FRL0014	11.1 Miles Above
1FRL0015	12.2 Miles Above
1FRL0016	13.1 Miles Above
1FRL0017	14.1 Miles Above
1FRL0018	15.1 Miles Above

b. Reporting. Water quality data collected at Fishtrap Lake is used to meet such objectives as:

(1) Establish baseline conditions and monitor subsequent changes

(2) Identify water quality environmental problems

(3) Study special problems or develop criteria for such solutions as modification of reservoir regulation procedures aimed at controlling or enhancing environmental conditions and meeting water quality objectives

(4) Provide a database adequate for understanding project conditions and for coordination with state agencies in regard to implementing any needed watershed pollution control.

Parameters measured, frequency of collection, and number of data-collection-stations are determined by specific project conditions. The water quality program design for Fishtrap Lake was structured to describe various factors affecting water quality over the long term. Data collected are used for applications such as identification of trends indicating problem conditions and reporting existing conditions. Basic studies consist of 5 essential components:

(1) In-situ measurements to evaluate distribution of various properties.

(2) Wet chemistry and various types of solids for both immediate and long-term use.

(3) Indirect but rapidly obtainable indicators of productivity such as chlorophyll and carbon.

(4) Benthic organisms to monitor long-term quality of streams.

(5) Other biological measurements such as plankton and seston.

Standard physical/ chemical tests and reasons for testing are presented in **Table 5-4**, next page.

c. Maintenance. Sediment and water samples are collected from Fishtrap Lake once every 5 years. Water samples are also collected every 10 years each month for the months April through September. During emergency or under adverse conditions, water quality samples are collected on an as-needed basis. In all cases data are collected for one or more of the following reasons:

(1) Long term analysis

(2) Problem identification or solution

(3) Cause and effect relationships

(4) Mathematical modeling

(6) Predictive capability

Present sampling programs are oriented toward existing or potential effects and are structured to describe various factors that affect water quality.

Table 5-4 Standard Physical / Chemical Tests	
Type of Test	**Reason for Testing**
Calcium (Ca) Magnesium (Mg) Sodium (Na) Potassium (K)	Major Cations – Ionic Balance, ratios and relationships
Sulfate (SO_4) Chloride (Cl)	Major Anions - Ionic Balance, ratios, and relationships
NITROGEN (N) Nitrate + Nitrite Ammonia Total Kjeldahl	Nutrient
Total Organic carbon (TOC)	Nutrient
Phosphorus (P) Total Filterable	Nutrient
Solids Total Suspended Dissolved	Equivalent Ambient Values, Correlation with optical measurements
Hardness	Evaluate Buffer Capacity and Alkalinity Characteristics
Metals Iron (Fe) Manganese (Mn)	Important for Hypolimnetic and Outflow Evaluations During Stratification
Dissolved Oxygen Temperature pH Specific Conductance	In-situ parameters used to evaluate conditions for project operation

5-03 SEDIMENT STATIONS

a. Facilities. A network of sediment ranges was established at Fishtrap Lake as part of an aerial photography, ground control, and mapping contract during the period February to September 1959. The 32 sediment ranges established at Fishtrap Lake were designated category “A” ranges and they were marked with monuments referenced to the existing triangulation control system or to permanent landmarks. The lake category "A" ranges are shown in **Plate 5-2**. Four downstream sediment ranges were established and designated category “C” ranges. The ground profile of each range was measured at the

time and several years later the sediment range was adopted by the Corps of Engineers. The four sediment ranges were resurveyed as part of the 1984 sedimentation survey. The 1984 profiles indicate scour to varying degrees on the sides of the channel.

b. Reporting. In order to monitor the rate of deposition of sediment in the lake, reconnaissance scope survey of selected ranges are conducted every five years unless an earlier survey is indicated by natural causes, such as a major flood or by increased sediment producing activities in the basin.

The original ground profiles along the original network of sediment ranges at Fishtrap Lake were taken in 1963. The first resurvey of all sediment ranges at Fishtrap Lake was conducted in 1972. The original stream bottom profile for Fishtrap Lake and the upstream tributaries is shown on **Plate 4-1**. The adjusted bottom profile due to accumulated sediment is shown on **Plate 5-3**.

c. Maintenance. Project personnel and the survey party members regularly and periodically check the sediment range markers so the damaged monuments can be replaced and any obscuring undergrowth can be removed.

5-04 RECORDING HYDROLOGIC DATA

All data entered into the water control system are stored in a database. Stream and precipitation data is stored in one hour increments. Project information along with being stored in one hour increments is also processed in one day average values and stored.

The data is stored in water year files and in period of record files for each basin. As the data is useful for historic studies it is for seen to be maintained indefinitely although it is unclear what length of time is required.

5-05 COMMUNICATION NETWORK

Communication between Fishtrap Lake, the Big Sandy Area Office, the District Office, etc., is carried primarily by telephone (FTS). District radio network provides a backup when telephone service is interrupted. Data collection platforms (DCPs) are installed at stream gaging stations and precipitation stations for collection of hydrometerological data. The DCPs transmit data to the satellite and can be accessed by phone. **Plate 5-4** graphically illustrates the communication network of the Huntington District.

5-06 COMMUNICATION WITH PROJECTS

a. Regulating Office With Project Office. Telephone is the primary mode for most communication between the Water Resources Engineering Branch and the field offices. The District Cell Phone is used for secondary backup communication, while mobile radio, State

Police, courier, etc are utilized during an emergency when neither the primary or secondary systems are operational.

The Water Control Section personnel use the telephone to request information and to give operational guidance to the project. Fax machines, e-mails and the inter-and intranets are used by the Water Control section to provide to and to gather from the projects more information. The US Postal Service is utilized for transmission of hard copies and voluminous information.

b. Between the Project Office and Others. The primary method of communication between the project and those interested in project status and operation is the telephone. Inter-project communication may also utilize the district cell phone.

5-07 PROJECT REPORTING INSTRUCTIONS

The project shall report hydrometerologic and water quality data to the Water Resources Engineering Branch as described in Instructions to Damtender, **Exhibit B**, chapter 4. The project shall report any operational problems by telephone to the Water Resources Engineering Branch and the Technical Support Branch of Operations.

5-08 WARNINGS

There are no interests immediately downstream from the dam that are vulnerable to flooding at discharge rates up to the channel capacity. However, in order to advise recreators below the dam of impending increases in outflow, a discharge warning horn is sounded at the outlet works whenever the total gage opening is to be increased. Water Level Warnings at Project Lake Areas, **Table 5-5**, page T5-7, lists communication by project personnel concerning actual or potential high-water situations and filling and drawdown operations.

SECTION VI – HYDROLOGIC FORECASTS

6-01 GENERAL

Hydrologic forecasts, vitally important to water control management, incorporate utilization of the best methods available for optimal regulation for specific project purposes, as well as for basin management. The Water Control Section uses all available hydrologic and meteorologic data in forecasting efforts for Levisa Fork Basin. Forecasts are made and utilized for streamflow above and below the Fishtrap project for low flow, normal flow, and flood conditions.

a. Role of Corps.

(1) District Office. In accordance with ER lll0-2-240, DAEN-CWE-Y-HW, 8 October 1982, subject: Water Control Management Activities, the Water Control Section performs water control management activities for multipurpose projects throughout the District. Included in these activities is the preparation of various forecasts to insure safe and efficient operation of each project within the District. Forecasts include lake inflows, lake levels, project outflows, water quality and outflow temperature, and flows at downstream stations. The river forecasts prepared by the Corps of Engineers are used primarily for the execution of its responsibilities, and are not released to the general public unless the National Weather Service is willing to make the release or agrees to such dissemination.

(2) Division Office. The Water Management Division at the Great Lakes and Ohio River Division Office utilizes 5-day tributary forecasts prepared by the individual districts to derive its 5-day flow forecasts for stations along the Ohio River.

b. Role of Other Agencies. The National Weather Service (NWS) has official statutory responsibility for preparing forecasts of Ohio River stages and flows; issuing river flood warnings and flash flood watches and warnings; and transmitting data, forecasts, watches, and warnings to users and the general public. NWS also collects and evaluates weather information and prepares weather forecasts and outlooks covering various lengths of time, and performs other hydrologic and meteorologic services.

6-02 FLOOD CONDITION FORECASTS

a. Requirements. Whenever “flood threat” conditions approach as defined by the Schedule for Reading Gages, **Plate 3-1** in **Exhibit B**, forecasting effort primarily focuses on area rainfall, downstream flood control points, and the lake elevation. The forecast is computed using one hour data and it normally takes one hour to complete the forecast of the Levisa Fork River Basin. The model is executed repeatedly during the flood event as additional data becomes available. The forecast data is used to predict the

anticipated pool crest, downstream flood crests, necessary storage releases, and probable duration of flood period. The reservoir storage data used in the forecast model program is summarized in **Table 7-2**, page 7-4.

The control stages and flows for the key stations at Levisa Fork and Big Sandy River Basin are summarized in **Table 7-3**, page 7-6. **Plate 6-1** shows the forecast area and reaches for Fishtrap Lake. The detailed drainage areas for Levisa Fork River Basin are listed in **Table 6-1**, below. The basin configuration is shown on **Plate 6-2**.

TABLE 6-1
Drainage Areas of Levisa Fork and Tributaries

Stream	Location	Area (Sq.Mi.)	Levisa Fork (Miles)
Levisa Fork	At mouth	2,320	0.0
Levisa Fork	At Paintsville, KY	2,143	38.6
Johns Creek	At mouth	225	46.9
Beaver Creek	At mouth	241	65.0
Levisa Fork	At Paintsville, KY	1,233	87.6
Shelby Creek	At mouth	115	93.4
Levisa Fork	Below mouth of Russell Fork	1,080	97.6
Levisa Fork	At Fishtrap dam	386	100.4
Russell Fork	At mouth	680	97.6
Russell Fork	Below mouth of Pound River	528	121.4
Pound River	At mouth	226	121.4

A basin forecaster, assigned to the Levisa Fork River Basin, utilizes the Water Control system computer model each day and couples the results from the model with knowledge and experience with the basin to produce the required daily forecasts. The computerized forecast is then made available for distribution to interested parties and groups. A typical sequence of modeling events leading to water control management decisions is described as follows:

1. Satellite data, both stage and precipitation, are received from the LRD downlink, decoded and added to the resident database. Stage data is converted to flow data using stage/ flow rating tables. This is done automatically each hour.

2. Observed precipitation and stage/ flow data are reviewed graphically to insure integrity. Any necessary corrections are made

and any missing data are added when available from supplementary sources.

3. The precipitation-runoff model is executed based on observed data up to the time of forecast. If precipitation is occurring at the time of forecast then future precipitation maybe considered in the model execution by request of division.

4. The small basin hydrograph forecast are then reviewed and modified if necessary. The second part of the model is then executed to route, blend and combine flows. The flows are reviewed, the lake outflows modified if necessary, and the second part of the model is recomputed.

5. Step 3 is repeated to obtain subsequent forecasts that consider any additional precipitation (QPF), special regulation or other hypothetical analyses that may be required.

This real time modeling program makes extensive use of small-area unit hydrographs, infiltration rates, discharge rating tables, routing coefficients, and graphical review of flood hydrographs and profiles. The computer program assimilates the total precipitation over a 3-day time period and analyzes the storm in detail. By using predetermined basin rainfall infiltration rates and runoff percentages the program computes the antecedent rainfall, base flow, and storm runoff.

By applying the computed storm runoff to the appropriate unit-hydrographs a computed hydrograph is developed. The computer then uses routing coefficients with routing and combining methods to rout the flood downstream and through Fishtrap Lake. With this computer program and practical experience the Water Control Section is able to produce a reliable forecast for the Levisa Fork River Basin.

6-03 CONSERVATION PURPOSE FORECASTS

a. Requirements. Conservation forecasts are executed in conjunction with the flood control forecast. They are executed on a daily basis for the next five days and on a weekly basis for the next 30 days. The main focus of the conservation forecast is to maintain seasonal pool at Fishtrap Lake in order to provide fish and wildlife habitat, recreation, and water supply. At the present time, operations for water temperature and quality are based on observations rather than forecast.

b. Methods. The methods and procedures for non-flood streamflow projection are the same as mentioned previously for the flood forecasting except the concern of the modeler is the low-flow analysis. The repetitive process is utilized to operate the reservoir in order to provide downstream low-flow requirements and then to evaluate their impact on the lake pool.

6-04 LONG-RANGE FORECASTS

a. Requirements. Long range forecasts assist the Huntington District and the Great Lakes and Ohio River Division in water control management in the Levisa Fork River Basin. Long range forecast of a dry spring can allow earlier than normal filling during late winter or early spring to reach summer conservation pool levels in time for the beginning of the recreational season. If a drought is projected, conservation pool may be raised to store additional water for later release downstream. Long-range forecasts are required by the Division Headquarters Water Management Branch (WMB) as they utilize it to inform the Mississippi Valley Division (MVD) of probable future conditions and to suggest specific items of water control management to the districts.

b. Methods. The Water Control Section produces a weekly 30-day forecast utilizing the same method as used for flood forecast. This forecast assumes no future rain. Lower than normal precipitation forecasts are produced by the National Weather Service.

6-05 DROUGHT FORECAST

a. Requirements. The Huntington District now uses the drought forecast of the National Weather Service. The Corps summer drought forecast was discontinued in lieu of the regular NWS forecast.

b. Methods. The long range and conservation forecast address all forecasting concerns that would be raised by a drought. No extra forecast activities are planned for this time.

c. Reference Documents. Many of the basic documents for drought forecast are in Water Resources Engineering Branch files for the Huntington District, Huntington, WV. These files contain records prepared by the Kentucky Department of Fish and Wildlife Resources and the Kentucky USGS for past drought periods, Water Availability Studies for the Levisa Fork River basin, and the Ohio River Basin Comprehensive Study, prepared by the Great Lakes and Ohio River Division, Cincinnati, Ohio. The national and state weekly drought forecasts are included with the Palmer Index summaries for the current and preceding drought periods. During a drought period the low-flow records and reference books are used to prepare weekly drought information bulletin for distribution to all concerned groups.

SECTION VII – WATER CONTROL PLAN

7-01 GENERAL OBJECTIVES

In accordance with ER 1110-2-240, "Water Control Management," dated 8 October 1982, and ORDR 1110-2-27, "Water Control Management Activities," dated 12 January 1976, the plan of water control management and regulation as discussed in the subsequent paragraphs reflects optimal consideration of each project purpose, namely flood control, lake and downstream recreation, fish and wildlife conservation. In developing the plan of regulation, the following general requirements were considered and evaluated in relation to the overall effective water control plan for the project, the Levisa Fork and Big Sandy River Basin and the Ohio River Basin:

a. Prevention or reduction of serious flood damages to communities, crops, and properties below the dam along the Levisa Fork and Big Sandy Rivers to the greatest extent consistent with safe operation of the project.

b. Maximum retention of flows that would add to flood crests on the Ohio River at Ashland, Kentucky.

c. Maintenance of a minimum discharge of 100 cfs during reservoir filling, 75 cfs from the time seasonal pool is attained until December, and 10 cfs from December until the end of March, which is designed to be adequate to sustain downstream aquatic populations and improve downstream water quality.

d. Maintenance of minimum pool elevations 725.0 feet, subject to minimum discharges, to support fish populations and provide space for an equivalent volume sediment storage.

e. Maintenance of seasonal pool elevation 757.0 feet NGVD for recreation and fish and wildlife conservation subject to flood control, water-quality control and minimum discharge purposes. The year round overall pool storage and release schedule is shown on the Fishtrap Rule Curve for Pool Regulation as **Plate 7-1**.

f. Establishment of maximum allowable discharge to avoid downstream damage during flood releases.

g. During minor rises when releases are less than downstream channel capacity, limitation of release rate to the maximum flow that would have occurred if the project had not been constructed.

h. Controlling discharge temperature to aid downstream aquatic communities in maintaining normal states of equilibrium.

i. Sensitivity to reasonable requests for operational changes from the public or other agencies.

j. Concern for safety and well being of humans, fish and wildlife, manmade structures and streambanks downstream of dam, which can be affected by discharge control.

k. Concern for safety of humans and property at recreation sites in the lake area.

l. Limitation of the rate of change of stage at the outflow station to a value no greater than that, which would occur naturally.

7-02 MAJOR CONSTRAINTS

The various project purposes may at times strongly conflict, therefore the following priorities have been established. Flood control is the primary project purpose followed by the low-flow, fish and wild life conservation, and recreation.

Operational limitations concerning flood control, recreation, water supply, low-flow and fish and wildlife conservation are listed in **Table 7-1**, below.

Table 7-1
Operational Limitations for Flood Control

	Pool Level Elevation NGVD	**Capacity Acre-feet - Gross**
Streambed		674.0
Minimum pool	725.0	4,356
Winter Water Supply	725.0	153,830
Summer Recreation	757.0	126,640
Maximum Flood Control Pool	825.0	164,360
Maximum Surcharge Level	840.3	
Top of Dam	845.3	

Gate Change Maximum Rate – 1.0 foot per hour on Outflow gage.
Spillway maximum flow - 790 NGVD Outflow – 308,400 cfs
Minimum Outflow Rate - 10 cfs continuous or stage 10 ft on “O” gage
Maximum low-flow system rate - 444 cfs

Winter release rate w/out directive - 3650 cfs, 18.6 ft on “O” gage
Summer release rate w/out directive - 2080 cfs, 15.7 ft on “O” gage
Maximum outflow with a SPECIAL DIRECTIVE from water control section
Winter - 8089 cfs or 25.5 feet on “O” gage.
Summer - 4651 cfs or 20.3 feet on “O” gage

Historically the main constraints encountered at Fishtrap Lake since regulation began were gradual encroachment on the flood plain, construction in the lake and down stream of the project, and operation for the low water dam below the lake. The low water dam is above Fishtrap town and if an emergency occurs when the dam is

releasing high flows the release must be reduced to allow the public access to the bridge.

7-03 OVERALL PLAN FOR WATER CONTROL

Fishtrap Lake operates to reduce flooding on the Levisa Fork and Ohio Rivers, provide consistent low-flow releases, insure the water quality of the releases, provide habitat for fish and wildlife conservation, and provide recreation in and below the lake.

Fishtrap Lake is part of the flood control system of the entire Ohio River Basin as well as of the Levisa Fork Basin. Regulation procedures must therefore be correlated with the operation of reservoirs on other tributaries of the Levisa Fork and Ohio Rivers to the fullest extent possible. Coordination of regulation is toward maintenance of rough equivalence of degree of utilization of flood control storage capacity between the projects to maximize the ability of the reservoir systems to meet potential flood threats in the basin and along the Ohio River.

Historically, flood damages occurring along the Levisa Fork and Big Sandy Rivers to the Ohio River have primarily involved residences, utilities, highways and commercial and extractive industries, with lesser amounts to agriculture. Greatest flood damages in the past have occurred to residences in the communities of Pikeville, Prestonsburg and Paintsville, with flood damages also to individual residences along the rivers. The most valuable agricultural products are from livestock, which sustain only slight damage from flooding.

Most of the conflicting interests and purposes are resolved by practical planning and allocation of the lake storage volume into pools as listed on **Table 7-2**, next page.

The total storage capacity for Fishtrap Lake is estimated to be 164,360 acre-feet. During the detailed project planning phase this storage was divided and allocated for various project purposes based on a maximum efficiency basis. Storage capacity allocation in the lake for minimum pool includes year-round equivalent storage volume for sediment accumulation, provision of minimum flow during an unusually dry winter, and satisfactory winter habitat for the large population of fish. The minimum sedimentation pool was established at elevation 725 feet NGVD, containing 4356 acre-feet of storage and covering 361 acres. The remainder of the allocated pool storage, or the difference between the maximum flood control pool storage, elevation 825.0 feet NGVD, and the sediment pool storage, elevation 725.0 feet NGVD, is 153,830 acre-feet, which is equivalent to 7.30 inches of runoff from the drainage area above the dam. This large volume of storage is divided into year round water supply and low-flow augmentation at elevation 725.0 NGVD, and summer recreation pool at elevation 757.0 NGVD. The remaining storage is used for flood control.

Table 7-2
Fishtrap Lake Elevations and Storages

Pool	Surface Elev. NGVD	Area Acres	Backwater Stream Miles	Storage			
				Acre-feet (Thousands)		Inches Runoff	
				Net	Gross	Net	Gross
Year-Round Storage:							
Minimum	725	569	11.1	10.5	10.5	0.50	0.50
Seasonal Storage (Summer):							
Low Flow Aug./ Recreation	757	1131	16.5	27.2	37.7	1.29	1.79
Flood Control Storage*							
Winter	825	2631	25.3	153.8+	164.4	7.30	7.80
Summer	825	2631	25.3	126.6#	164.4	6.01	7.80
TOTAL	825	2631	25.3	164.4	164.4	7.80	7.80

* At maximum pool elevation
\+ Between elevations 725 and 825
\# Between elevations 757 and 825

7-04 STANDING INSTRUCTIONS TO DAMTENDER

The Fishtrap Lake Damtender (Resource Manager) and staff operate the project in accordance with general instructions found in **Exhibit B** of this manual and Special Directives issued by the Water Control Section.

a. Regulations. The above-mentioned general instructions and Special Directives are written in accordance with the following regulations: EM 1110-2-3600, 25 May 1959, Subject: Reservoir Regulation; ER 1110-2-1400, DAEN-CWE-Y, 24 April 1970, Subject: Reservoir Control Centers; ORDR 1110-2-27, 12 January 1976, Subject: Water Control Management Activities; ER 1130-2-415, DAEN-CWE-Y, 28 October 1976, Subject: Water Quality Data Collection, Interpretation, and Application Activities; DRDR 1110-2-26, 5 February 1979, ORDED-W, Subject: Water Quality Investigations and Control Activities; ER 1110-2-240, DAEN-CWE-Y-HW, 8 October 1982, Subject: Water Control Management; ER 1110-2-208, DAEN-CWE-Y, 30 July 1979, Subject: Water Control Management.

b. General Instructions. The general instructions apply at all times except when superseded by Special Directives that will be applicable for a specific operation or period of time. General instructions provide for routine reservoir regulation including discharge limit at project initiation, details of gate operation techniques, collection and transmission of hydrologic and streamflow data, reservoir regulation at the start of a flood before contact can be made with the District Office, and emergency regulation in the event that all communications fail during a flood. These

instructions are contained in **Exhibit B**, "Instructions to Damtender" along with exhibits and schedules pertaining to their use.

c. Special Directives. Special Directives are issued by telephone and confirmed by mail to record all substantive guidance given the project by Water Control Section pertaining to water control activities not covered by the general instructions. The following list of subjects or purposes of Special Directives is representative of types issued.

(1) Flood Control

(a) Outflow reduction for Big Sandy River Basin streams or Ohio River control.

(b) Release flood storage and adjustments in rate of release.

(c) Above channel capacity discharge when inflow hydrograph is greater than available storage capacity.

(2) Low Flow - Release less than minimum flow to avoid loss of pool in extremely dry weather.

(3) Temperature Control - Inlet gate operations and low flow valve adjustments to maintain downstream temperatures at desired levels.

(4) Special regulations for:

(a) Construction activities downstream affected by flow.
(b) Stream cleanup activities.
(c) Emergency drowning or pollutant spill.
(d) Special pool levels for fish spawning.
(e) Above seasonal pool levels for drought relief in summer and fall.
(f) Stocking tailwaters stable flow 24-48 hours.
(g) Complete closure for inspection on an emergency or periodic basis.

(5) Spring Filling, Fall Drawdown - Beginning and adjustments to discharge rate in order to control rate of rise or fall in lake level.

(6) Begin and terminate temperature - Dissolved oxygen profiles in the lake.

(7) Change in general instructions.

(8) Any and all other pertinent operations as deemed necessary by Water Control Section.

7-05 FLOOD CONTROL

Fishtrap Lake is part of the flood control system of the Levisa Fork, Big Sandy River and Ohio River Basins with regard to Flood Control. The role of the Corps of Engineers is to decrease the peak flood stages if possible below damage or control stage, at gagged stations down stream of Fishtrap Lake Dam. These control stages are shown in **Table 7-3**, below. They were determined through a channel capacity investigation which utilized topographic maps, aerial photos, and field inspections during high flow conditions.

Table 7-3
Control Stages And Flows At Key River Stations

Station	River	Summer (16 Apr – 30 Nov)		Winter (1 Dec – 15 Apr)		Time of Travel (hrs)
		Stage (feet)	Flow (cfs)	Stage (feet)	Flow (cfs)	
Fishtrap Dam	Levisa Fork	20.3	4,651	25.5	8,089	---
Pikeville (2)	Levisa Fork	23.0	12,700	31.6	20,940	5
Prestonsburg	Levisa Fork	21.0	14,800	33.0	28,220	21
Paintsville	Levisa Fork	20.0	15,100	29.0	24,800	29
Louisa (Fullers)	Big Sandy	45.0	*	45.0	*	46
Ashland	Ohio	53.0	*	53.0	*	72 (1)

* Slope station rating
1 Operational time prior to crest stage in excess of 53.0 feet
2 New gaging station

a. Normal Plan. The plan of operation is to gather stream flow, precipitation and lake data from the data collection platform-satellite network and the Fishtrap Lake morning report. Using this data Water Control Section personnel analyze current rainfall, soil and foliage conditions, input it and gagged stream flow and precipitation into the Water Control System. Lake and stage forecasts for downstream control stations listed in **Table 7-3**, above are then prepared using computer driven hydraulic models. These forecasts are supplemented by the forecasts from the NWS River Forecast Center in Wilmington. These forecasts are then used by the Water Control Section to determine lake operation; upon which time special directives are issued.

Lake operations are based on the following rules:

(1) All inflow will be stored, subject to the minimum flow requirement, which would contribute to stages in excess of the designated control stages at the key stations along the Levisa Fork or Big Sandy River as listed in **Table 7-3**, previous page. Exceptions may occur when the lake is being raised or lowered seasonally, or when the Water control Section has directed special operations.

(2) It is desirable to empty the lake of flood storage as quickly as possible, in view of the possibility of a major flood occurring at a time when the lake is partly filled.

(3) All inflow will be stored, subject to the minimum flow requirement and operational time, beginning at time 72 hours in advance of the predicted time of reaching a forecast crest stage in excess of 53.0 feet on the Ohio River at Ashland, Kentucky. After a complete assessment of Ohio River conditions and trends of continued falling stages, releases will be scheduled so as not to add to actual crests above 53.0 feet on the Ohio River at Ashland.

(4) If the river stage at Ashland is not indicative of flooding conditions further downstream along the Ohio River, directives from LRD Water Management Branch may suggest the storage of inflows in order to provide some benefit to these downstream areas. In such special cases, a complete assessment will be made of all current and anticipated hydrologic conditions in the Levisa Fork River Basin to establish an operational scheme that will benefit the downstream Ohio River areas and not prove, detrimental to Levisa Fork River Basin flood control objectives.

(5) Release of accumulated flood storage is based on determinations by the Water Control Section that downstream flows will continue to recede and plateau below control stage at which time Special Directives for release of stored flood waters will be issued.

(6) All inflow is to be released at discharge rates up to that causing a stage at the outflow gage not to exceed 25.5 feet (8,089 cfs) during the period 1 December - 15 April or 20.3 feet (4,651 cfs) during the period 16 April - 30 November; except when the lake level is being raised or lowered seasonally, when critical flood conditions prevail or are predicted at downstream control points, or when the Water Control Section has directed special operations.

(7) Gates will be regulated so that the rate of change of stage at the outflow gage will not exceed 1.0 foot per hour except when closing for flood control.

(8) The water control plan for major floods provides for increases in reservoir outflow when there are indications that the available storage will be insufficient to control the flood completely. Ordinarily, lake regulation will be based on the

forecast inflow hydrograph predicted by the Water Control System from reports of rainfall depths above the dam. After the inflow hydrograph has been predicted, Water Resources Engineering Branch personnel will determine the outflow required to utilize all the storage available. If the required discharge is equal to or greater than the downstream channel capacity, it is imperative that the outflow be increased to the required value as soon as possible in order to avoid the necessity of releasing even greater flows later. If the required discharge is considerably less than channel capacity, it may be desirable to delay releases to avoid synchronization of the outflow with peak flows from uncontrolled areas below the dam.

b. Emergency Plan. In the event that all communications between Fishtrap Lake and the Huntington District Office are disrupted, the Water Control Section will utilize all available data, e.g., satellite platform data, to keep informed of project conditions and to be prepared to resume regulation instructions when communication is restored. The Damtender will assume regulation of the lake during lack of communication, following the measures described in **Exhibit B**, Instruction to Damtender. In addition, the Damtender will immediately and frequently make every effort to reestablish communications with the District Office.

The Instruction to Damtender directs project personnel to use **Plate 1-6**, Emergency Operation Schedule, which contain the rates of rise curves to operate the reservoir when communication with the District Office is disrupted for longer than three hours and the lake is rising. The curves indicate spillway gate openings to be used when the rate of rise in lake levels indicate that the available storage capacity of the project may be inadequate to fully control a given flood.

7-06 RECREATION

No special release have been historically made at Brunsville Lake for recreation. Although lake operation has been slightly modified for fishing tornaments.

The observed recreation uses at the lake have been fishing, and hunting, boating, swimming, picnicking, sightseeing, camping, and hunting. Fishing occurs all year with increased use with lake fill in spring. Boating occurring all year becomes significant with lake fill and camp grounds open on May 1st, **Table 7-4**, next page, list lake visits for these recreation uses for the calendar year 1999.

For all recreation purposes, it is desirable to keep the pool level as close to seasonal as possible. Rapid fluctuation in pool level can result in danger from newly inundated or exposed obstacles and potential snags near shore lines and cove areas, cause difficulty in launching and retrieving boats, render camping and day use areas

useless due to flooding of access roads, sanitary facilities, or grounds. **Table 7-5**, below list the Fishtrap impact elevations.

Table 7-4
Public Use of Recreation Facilities

Type Facility	Activity	Visitor Participation
Campground, Tent, Trailer	Overnight camping	22,026
Day Use Areas	Picnicking	57,336
Boat Launch Marina	Boating, fishing, skiing	110,840
Overlooks, Information center, Group Use Interpretive Center	Sightseeing	558,090
Kentucky Game Preserve, Wildlife Area, Abandoned roads, Nature trails	Hiking, hunting, nature observance	24,837
The Lake	Swimming	18,325

Table 7-5
Fishtrap Impact Elevations

Elevation	**Impact**
Below 725.00	Marina rests on floats
Below 751.00	Launch Ramp at Grapevine is uncovered
Above 758.00	Courtesy Dock upstream of dam is covered
Above 759.00	Parking Lot Access Road at Lick Creek is covered
Above 759.50	Lower Comfort Station at Grapevine is flooded
Above 760.40	Parking Lot Access Road at Grapevine is covered
Above 761.28	Sewage Dump Station at Grapevine is flooded
Above 761.50	Overflow Camping Area at Grapevine is covered
Above 761.88	Camping Area at Grapevine is covered
Above 762.00	Sewage Lift Station at Grapevine is flooded
Above 763.00	Intake structure access- Door to 3rd Floor raking platform flooded Comfort Station flooded
Above 765.00	Sewage/Lift Station electrical control panel
Above 766.00	Electrical Control Panel at Grapevine
Above 768.00	Road covered upstream of dam
Above 768.50	Sand filters- Sewage Control Plant at Grapevine
Above 770.50	Upper Comfort Station at Grapevine flooded
Above 798.50	Water Plant at German begins to flood

Unfortunately, below seasonal pool elevations may occur during dry years due to minimum discharge and above seasonal pool elevations occur regularly due to flood control operation. Project personnel evacuate recreation areas when necessary and indicate increased discharge to down stream recreation users.

7-07 WATER QUALITY

Fishtrap Lake is located in Pike County, Kentucky on Levisa Fork, a tributary of the Big Sandy River. It was authorized for flood control, recreation, low-flow augmentation, and fish and wildlife conservation. A rolled rock dam located on Levisa Fork about 7 miles from the community of Pikeville forms the lake. A spillway controlled by 4 tainter gates with a crest elevation of 790-feet NGVD was built to protect the dam from overtopping. The drainage area above the dam is 392 square miles. At seasonal pool elevation of 757-feet NGVD the lake extends 16.5 miles above the dam and covers a surface area of 1131 acres. The volume of water in the lake at seasonal pool is about 37,700 acre-feet.

The outlet works include a selective withdrawal structure with three 6’X12’ sluice gates for releases over 444 cfs and a low flow system for releases under 444 cfs. The low flow system is a common well with three 6’x 4’ intakes located at invert elevations 715, 731, and 747 feet NGVD or 42, 26, and 10 feet, respectively, below the surface at summer pool. The low flow system was designed to provide a wide range of water temperatures downstream. The lake stratifies during the summer with warm, oxygenated water in the epilimnion and colder water with little or no oxygen in the hypolimnion. By releasing water from a single elevation or a mix of different elevations, regulated downstream temperatures are achieved. Water temperature rule curves for releases from the project were established between the State of Kentucky and the Corps of Engineers. The project is operated to meet those temperature objectives whenever possible. The Outflow Temperature Objective Curve is shown on **Plate 7-2**.

7-08 FISH AND WILDLIFE CONSERVATION

In accordance with State Code, the Kentucky Department of Fish and Wildlife Resources (KDFWR) accepted responsibility for fish and wildlife conservation at Fishtrap Lake. The Department shares the Corps conservation goal of long term well-being of the populations of water and land species of plant and animal life common to the area and the maximum sustained enjoyment of these populations by the public.

KDFWR meets the Conservation requirements in the lake and downstream by: stocking of the lake and downstream; imposing size limits as necessary; monitoring populations, reproductive success, and size distribution within species; providing a conservation officer at the lake to conduct creel surveys and fisherman interviews; and administering licensing regulations for sport fishermen.

The fisheries and wildlife are negatively updated by an unstable pool during spawning and reproduction, loss of pool, poor quality water downstream of the project which may deposit silts or iron hydroxide on the gravel rock bars, and unnatural water temperatures downstream.

In order to assist DFWR and prevent negative impacts, Fishtrap Dam operates the project as described in 7-05b and 7-06, which fosters a stable pool. It should be noted that downstream flooding may require gate closure and consequently a pool rise at any time and that during an extreme drought on other emergency conditions the discharge may be reduced below 75.0 cfs guarantees a year round conservation pool, and an expanded pool during traditionally dry months; operates the project as described in 7-7 which insures a minimum 75.0 cfs of high quality, natural temperature water; provides a stable outflow (no particular flow required) for 24-48 hours after downstream stocking; is willing to hold an intermediate pool elevation during filling for spawning; and provides a higher minimum outflow during filling (between 75-100 cfs).

7-09 WATER SUPPLY

Fishtrap Lake is required to provide water to ensure flowing oxygenated water for downstream fisheries and wildlife.

Therfore, a guaranteed continuous minimum flow is a project purpose required of Fishtrap Lake. The discharge rate for aquatic environment and water supply maintenance of 75.0 cfs in summer and 10 cfs in winter was selected after a study to determine the maximum rate that does not exceed the maximum acceptable drawdown in the driest year. These discharges are to be maintained at all times, even during closure for flood control. Routine release volumes through the low flow gates is shown on **Plate 7-3**.

The summer water supply and recreation pool of 757 feet NGVD was designed to supply 75.0 cfs in summer and 10 cfs in winter even during the driest years.

7-10 HYDROELECTRIC POWER - N.A.

7-11 NAVIGATION - N.A.

7-12 DROUGHT CONTINGENCY PLANS - SEE ANNEX I

7-13 FLOOD EMERGENCY PLANS

Although the Huntington District does not have a specific Flood Emergency Action Plan for Fishtrap Lake, inundation maps have been published for spillway floods and there are standard responses to floods in the District. These responses are dependent on whether or not the integrity of the Dam is threatened.

a. Inundation Mapping. Inundation Maps have been prepared to Fishtrap Lake for the upstream and downstream spillway design flood with and without Dam failure. The maps were prepared in accordance with ER 1130-2-419 and show the time associated with the hypothetical flood wave. The inundation maps can be found in the Dam Safety Emergency Action Plan copies of which are located in OR-E-EC-GD, Fishtrap Lake, and the individual maps are stored in EC-W.

b. Floods Without Dam Integrity Problems. In the course of flood, which does not threaten the integrity of the dam, the lake operations will be governed as described in 7-05. The Emergency Operations Center (EOC) will respond, based on the Commanders initiative, to the situation as described in the Policies contained in Natural Disaster Procedures, ER-500-1-1, 11 March 1991, which can be found in the EOC. The EOC may ask for periodic updates of the river situation from the Water Control Section or this briefing may be carried out during the briefing for the Commander.

c. Floods With Dam Integrity Problems. When a condition occurs which requires the project to operate to protect the integrity of the Dam and has the potential to be or is a significant hazard to life and property, the observing personnel will elevate the awareness of the situation to the appropriate individuals and take the actions as described in 7-05-a-8 or in **Exhibit B** 1-07. Project personnel shall use the Fishtrap Lake Dam Safety Emergency Action Plan to determine what events will initiate this action and which individuals to contact. The Water Control Section will be kept informed of the situation as a result of the reporting requirements as defined in **Exhibit B-Plate 3-1**. Water Control Personnel will contact the Dam Safety Officer when the lake indicates that alert pool will be achieved or exceeded and will keep the National weather service informed of any abnormal operations of the project. The Dam Safety Officer is responsible for convening the Dam Safety Committee who is responsible for convening the Crises Management Team. The Colonel, the head of the Crises Management Team, will open the EOC if he determines it is necessary.

7-14 OTHER PLANS

Emergency drawdown procedures are graphically illustrated on **Plate 7-8**.

Directory of Key Emergency Personnel is located one page before the Table of Contents of this book.

Fishtrap Lake does not require an operational change to handle mosquitoes, debris, ice jams, or the local ground water table. If necessary these and other issues are addressed in 7-15.

7-15 DEVIATION FROM NORMAL REGULATION

The Huntington District Engineer is occasionally requested to deviate from the normal regulation of Fishtrap Lake. Approval and

notification procedures are required when deviations from the normal water control plan are necessary. Prior approval for major deviations is required from the Division Engineer except as noted below. Deviation requests normally fall into the following categories:

a. Definitions

Major deviation: Change the normal operation of the project for a period of time greater than 5 days or and elevation change greater than two feet. A major Deviation is approved at the Branch and Division levels.

Minor Deviation: A change of the normal operation that does not meet the Major Deviation criteria. A minor deviation approved at the Branch level based on the authority of the Division.

b. Types

1. Emergencies. Emergencies may fall under Major or Minor Deviations. Normally they begin as minor deviations and if necessary are elevated to Major Deviations. The most common emergency that can be expected to occur at a project is a downstream drowning; decreased flow may be needed while searching for the victim or increased flow may be needed to dislodge the body. Other common accidents occurring at the project are failure of the operation facilities, chemical spills, treatment plan 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.

2. Minor Deviations. There are instances that create a temporary need for minor deviations from the normal regulation plan, although they are not considered emergencies. The following list contains most of the types of special regulations commonly requested: Legitimate interests, such as family to travel to and from home and burial processions on a road which traverses the Levisa Fork River streambed, may require reduction of flow for safe crossing. Construction work, major or minor, including pipeline changes or repair, boat dock work, or testing of a finished facility may have various and changing flow requirements.

3. Major Deviations. Either increase or decrease in outflow may be requested by other governmental agencies, including State and local, or by higher authority within the Corps of Engineers.

Each condition should be analyzed on its merits. Required data on flood potential, lake and watershed conditions, possible alternative measures, benefits to be expected and probable effects on other authorized and useful purposes, as mentioned above, shall be analyzed and presented by letter, telephone or fax to either the Great Lakes and Ohio River Division office or Huntington Water

Resources Engineering Branch Chief, along with recommendations for review and approval. Except in case of emergency, confirmation is necessary before the Water Control Section may grant a request.

The following list contains the types of major deviations commonly requested; Anticipated drought periods may require maintenance of additional storage in the lake for later release into the river system for downstream benefit; Special pool level for fishery enhancement. Measures, such as holding a specific higher pool level during and after the spawning period to foster recruitment, may be requested by State Fisheries Biologists to benefit populations of certain species or the entire fishery; All requests for special releases from Corps lakes for recreation such as canoeing, whitewater, or, other special releases will be referred to the Huntington District, Water Control Section of the Engineering-Construction Division for evaluation; Slow drawdown from rises during annually designated 2-week to 3-week period in May on behalf of bass spawn, and special lake drawdown in fall for species adjustment:

7-16 RATE OF RELEASE CHANGE

The Fishtrap Lake outflow is to be regulated in such a manner that the rate of release and the resulting stream level does not change more than 1.0 foot per hour on the outflow “O” gage.

7-17 PUBLIC NOTIFICATION AND WARNING

News of impending gate opening operations is transmitted to persons downstream, primarily anglers, by means of the Below-Project Warning System, which consists of a horn. At Fishtrap Lake, the horn is installed on the top of the dam and is audible within a one-mile radius. The horn is remotely controlled from the project office. Important public service messages concerning regulation of the lake are handled by the Public Affairs Office and disseminated via radio and/or television. Warnings of any unusual releases will be transmitted downstream by project personnel in person and by telephone.

Notification of the public of an enormous water release is carried out by the project, the Water Resources Engineering Branch, National Weather Service and by the district Public Affairs Office. These units utilize various types of mass media, telephone, radio, personal visitation, and the Weather Service dissemination system, depending on the type, urgency and target of the information. Information on planned additions to or changes in lake regulation such as for recreation or fishery enhancement are disseminated by the Public Affairs Office from detailed statements by the Water Resources Engineering Branch. Information of interest primarily to anglers, such as water condition of the lake and outflow, are disseminated by the project via an automatic telephone answering machine tape that is updated as necessary by project personnel. Daily reservoir and rainfall data are disseminated to the Weather

Service via the District Water Control System. This information appears along with other weather and stage information provided by the Weather Service to mass media and county, State, and Federal agencies.

The Damtender (Resource Manager) at Fishtrap Lake will keep informed and inform the Water Resources Engineering Branch of all developments upstream and downstream along Fishtrap Lake. Arrangements should be made with the Water Resources Engineering Branch for public notification of water release operations that are of an unusual nature or substantially different from the established release pattern whenever such releases might cause damage to equipment or facilities located downstream. The objective of this program is to afford those likely to be affected an opportunity to take appropriate remedial action in advance of the arrival of the releases to prevent damage to or loss of property. Warnings of any unusual releases will be transmitted downstream by project personnel in person and by telephone.

SECTION VIII – EFFECT OF WATER CONTROL PLAN

8-01 GENERAL

The effects of regulation for the authorized purposes of flood control, recreation, fish and wildlife conservation, and low flow and water quality control are: a reduction of flood damages along the Levisa Fork, Big Sandy and Ohio Rivers: an increase in the minimum observable flow below the project: the development of the tourism and industry around Fishtrap Lake: the increase in recreational activity in the area around Fishtrap Lake.

8-02 FLOOD CONTROL

a. Spillway Design Flood.

The Spillway Design Flood (SDF) is the basis for determining the spillway capacity required to provide for the safety of the dam during the most critical flood over the basin. Estimates of this storm and flood were made in accordance with EM 1110-2-1405 using maximum probable precipitation shown in NWS Hydrometeorological Report No. 33. A 48-hour storm in August was chosen as most critical. Operation for the flood is shown in **Plate 8-1**. The spillway design flood was routed through the reservoir assuming initial reservoir elevations at both 50 and 100% full. The difference in peak lake levels resulting from these routings was minor. A review of historical data indicated that antecedent storms in August that would fill the lake 50% full are rare, and the elevation 791.0 feet NGVD representing 40% full condition was a more representative condition to adequately illustrate the capacity of the spillway in passing flows from the maximum probable storm. At the onset of the storm, the initial lake level would be maintained by passing inflow of 8,000 cfs during the rainfall periods until runoff began and inflow began to increase. The 8,000 cfs discharge would be maintained until hour 13 when the discharge would have been regulated to pass inflow to maintain the pool at spillway elevation until downstream conditions would permit drawdown of pool to seasonal level in accordance with Special Directives from Reservoir Control Section. Due to the rapidly increasing inflow shown in **Plate 8-1**, the Regulation Schedule, shown on **Plate 8-2**, would call for a succession of increases in discharge, which would require full opening of the control gates and incremental equal opening of all crest gates until the lake elevation reached 828.0 feet. At this point the control gates would be closed and the "Induced Surcharge Envelope Curve" of the Damtender’s Emergency Operation Schedule would be used for further opening of crest gates to effect the discharge called for in the schedule. At elevation 832 this curve calls for lifting the crest gates clear of the water surface and fully opening all sluice gates. As shown in **Plate 8-1**, the lake level peaked at elevation 840.3 feet when the inflow decreased to the value of the outflow, which was at the maximum of 308,400 cfs When the lake level receded to maximum flood control level at

elevation 825 feet, the crest gates would be gradually closed and then the control gates adjusted as necessary to pass inflow and maintain the lake level at elevation 825 feet NGVD until operation could be resumed for downstream control.

At the maximum lake level attained (elevation 840.3 feet NGVD), approximately 49818 acre-feet of storage capacity (equivalent to 2.4 inches of runoff) of surcharge would be stored above the maximum flood control elevation, 825 feet NGVD.

Current Corps of Engineers criteria specify that the SPF be based on the runoff from the Probable Maximum Precipitation (PMP), as indicated in Hydrometerological Reports 51 and 52. Additional criteria from the Ohio River and Great Lakes Division requires a preliminary rainfall equal to 37 percent of the basic storm. Probable Maximum Precipitation (PMP) is again defined as the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year. Using the current spillway design flood criteria based on HMR 51 and 52, dated June 1978, the existing Fishtrap Lake spillway is inadequate. Preliminary hydrologic studies have shown the existing spillway to be in capable of passing the Probable Maximum Flood (PMF) with sufficient freeboard to accommodate potential wind and wave conditions. However, the project would not be overtopped during the revised PMF and the hydrologic deficiency is not sufficient for consideration of project modification at this time. After some of the more deficient projects are corrected for hydrologic deficiencies under the Dam Safety Assurance Program, Fishtrap Lake may be approved for further evaluation of remedial actions to correct the spillway deficiency. Additional information will be provided when it becomes available.

b. Standard Project Flood. The standard project flood constitutes a standard for design of structures that will provide a high degree of protection as determined by flood potentialities of the drainage area involved without regard to economic or physical limitations. This theoretical flood would result from a storm probably in July or August designed to equal the worst combination of meteorologic and hydrologic conditions considered reasonably characteristic of the area. It was determined from generalized rainfall criteria and procedures outlined in EM 1110-2-1411. Operation of Fishtrap Lake for the flood is shown in **Plate 8-3**. A review of summer-type storms indicated that a maximum infiltration rate of 0.05 inch per hour might be experienced and this value was adopted in determining the rainfall excess. Based on studies of streamflow records for the Levisa Fork Basin, a baseflow of one cfs per square mile was adopted. At the start of the flood the reservoir would have been regulated to maintain seasonal pool elevation of 757.0 feet NGVD without exceeding the crop season control stage of 17.3 feet on the ‘O’ gate or downstream crop season control stage at Pikeville, 23.0 feet on the relocated gage. By early morning of the second day, when heavy rainfall and rising river stages indicated

that control stages at downstream stations would soon be exceeded, the Hydrology and Hydraulics would direct gate closure to minimum discharge of 75 cfs on a stage of 10.6 feet at the 'O' gage until 1500 hours on the second day, when conditions would require the reservoir to be operated in accordance with either the Office Regulation Schedule or the Resource Manager's Emergency Operation Schedule. The Schedule would then be used to control discharge until the lake level reached the peak elevation of 829.1 feet NGVD and receded to maximum flood control pool elevation 825.0 feet. This lake level would be maintained until downstream conditions would permit the release of channel capacity flow of 5000 cfs (stage of 17.3 feet on the 'O' gage). This discharge would be maintained until the pool receded to elevation 757.0 feet. The maximum pool elevation would be attained at 1800 hours on the second day with full utilization of design flood control storage and 4.1 feet surcharge storage (10,968 acre-feet) equivalent to 0.53 inches of runoff. Maximum discharge would be 62,400 cfs at this time.

Standard Project Flood Series. The standard project flood series (winter type) was developed to provide an estimate of the potential storage requirements during winter seasons when rainfall is usually of lesser intensity but longer duration than in a summer-type storm. Operation of Fishtrap Lake for the standard project flood series is shown in **Plate 8-4**. This flood series was developed to provide an estimate of potential storage requirements during the winter season when the rainfall is usually of lesser intensity but occurs over a substantially longer period than the summer-type storm. The series is composed of the flood of February-March 1955 followed by a winter-type standard project flood for the month of March. The dates of the flood series correspond to those of February-March 1955. The rainfall of the series is comprised of the storm of February-March 1955, as it occurred, through the rainfall period ending 2400 on March 5, and followed by a winter-type standard project storm for March commencing with the rainfall period beginning at 1200 on March 9. The flows of February-March 1955, as they occurred, were used through 1200 on March 9 and the recession and base flow thereafter. The flows resulting from the winter-type standard project storm, using 100 percent runoff, were added to the recession and base flows of February-March 1955, commencing at 1200 on March 9, to complete the standard project flood series.

The winter-type standard project storm and flood were determined from the generalized rainfall criteria and procedure outlined in EM 1llO-2-1411 and Hydrometeorological Report No.29. Slide gates would be closed to minimum discharge, for Ohio River control, throughout the February-March 1955 flood, but would be discharging 2000 cfs when runoff from the standard project began. The pool level would reach flood control pool elevation of 825 feet NGVD and the crest gates would be opened starting spillway discharge at 1200 hours on 10 March. Spillway flow would continue as the pool rose to the maximum elevation, 830.1 feet NGVD and receded again to the flood control pool elevation. Drawdown to winter elevation, 725.0 feet,

would be effected through the slide gates as rapidly, up to channel capacity discharge of 8,000 cfs, as downstream controls would allow. The maximum lake discharge of 100,000 cfs would occur approximately at 1800 hours on 10 March.

c. Other Floods.

(1) General. The historical floods which were selected for illustration of the water control plan are the floods of March 1929, January 1937, February 1939, February-March 1955, January 1957, March 1963 and April 1977. Reductions at gages on Levisa Fork for the storm of February-March 1955 and other selected storms are listed in **Table 8-1**, page T8-8. The effects of Fishtrap regulation on eight selected Ohio River floods are shown in **Table 8-2**, page T8-10.

(2) Storm and Flood of March 1929. The flood of March 1929 reached major proportions throughout the Levisa Fork watershed, paralleling and approximating the 1918 flood along Levisa Fork from the headwaters downstream to Paintsville, but decreasing in relative magnitude when compared with other floods below that point. The flood was preceded by periods of unusually high temperatures. There were three warm spells, the last of which occurred from the 19th to 27th, during which the records of 42 stations in Kentucky gave an average of 52° Fahrenheit (5.7° above normal). Maximum temperature readings at stations surrounding the basin varied from 85° to 92°. A period of low temperatures existed from the 7th to the l0th, reaching a minimum varying from 9° to 16° at stations surrounding the basins. The flood was caused by heavy rainfall on the 23rd with 2.20 inches recorded at Williamson, 2.00 inches at Gary, 3.21 inches at Jenkins, 2.36 inches at Pikeville, and 2.15 inches at Prestonsburg. Light rain fell in the watershed between the 17th and the 22nd and an average of 0.29 inches fell at the above stations on the 24th. The storm and resultant flood was local in character with high stages recorded in the basin and on small tributaries located only short distances outside the Big Sandy watershed. The volume of runoff from Levisa Fork and Tug Fork was approximately 2.0 and 1.5 inches respectively. On Levisa Fork at Pikeville, a crest stage of 45.0 feet was reached at 9:00 P.M. on the 23rd, which is only 0.1 feet below that of January 1918. On Tug Fork, at Williamson, a crest stage of 30.7 feet was reached, 0.7 feet above flood stage. The flood was of short duration, remaining above flood stage at Pikeville only 18 hours. Flood flows from Levisa Fork caused only moderately high stages on the Big Sandy and Ohio Rivers.

(3) Storm and Flood of January 1937. The unprecedented flood of January 1937 in the Ohio Valley resulted from excessive rains during January, which followed moderately heavy rains occurring in the latter part of December over the entire Ohio River watershed. The resulting flood on Levisa Fork and Tug Fork did not exceed flood stages, but at Louisa the crest stage was 49.0 feet, 4.0 feet above flood stage. On the lower 22 miles of Big Sandy

River, the flood of January 1937 was the maximum flood of record, due to backwater from the Ohio River. The Ohio River reached a crest stage of 73.6 feet at Lock No. 29, exceeding the previous flood of record, March 1913, by 3.6 feet. The estimated runoff from Levisa Fork and Tug Fork was approximately 5.1 and 3.5 inches, respectively.

(4) Storm and Flood of February 1939. The flood of February 1939 reached major proportions throughout the Big Sandy Basin, and was caused by two distinct storms. On 30 January, the first storm liberated between 1.0 and 1.5 inches of rainfall over the basin, which saturated the soil and started the rivers on an upward trend. The second storm occurred on 1 to 3 February and resulted in rainfall over the basin varying from 2 to 4 inches. The heavier rainfall occurred over the lower Levisa Fork Basin downstream of Pikeville. The volume of runoff from Levisa Fork and Tug Fork was approximately 2.0 and 1.4 inches, respectively. On Levisa Fork the flood was the tenth highest of record in the vicinity of Pikeville, and fifth highest of record in the lower 36 miles. Three tributaries, namely Paint Creek, Beaver Creek and Shelby Creek experienced the maximum flood of record up to that time. A crest stage of 51.6 feet was reached at Louisa on the 5th at 2:00 A.M. The Ohio River at both Huntington and Cincinnati began rising with the rainfall of 30 January, and the Big Sandy River crest synchronized with the Ohio River crest.

(5) Storm and Flood of February-March 1955. The storm period began on 26 February and was characterized by unseasonable warmth, thunderstorms, and general rains wile the area was under the influence of warm, moist air masses. Extremely heavy rains, averaging 3.0 inches, from the 4th to the 6th of March contributed more runoff to the high waters resulting from the heavy rainfall, which averaged 3.8 inches, during the last three days of February. The flood on Levisa Fork reached a stage of 39.1 feet at Pikeville, thirteenth highest of record, and at Paintsville of 41.3 feet, seventh highest of record. The crest stage of the Big Sandy River at Louisa was 52.6 feet, third highest of record. The Ohio River reached a crest stage of 63.2 feet at Lock No.29. It is estimated that the regulation of Dewey Reservoir resulted in crest stage reduction of 2.5 feet at Paintsville and in conjunction with existing reservoirs above the confluence of Big Sandy and Ohio Rivers, reduced the stage at Louisa 2.5 feet and 3.0 feet at Lock No.29. The volume of runoff from the series of storms amounted to approximately 5.5 inches from each of the Forks. Operation of Fishtrap Reservoir for the flood of February-March 1955 and Pikeville is shown on **Plates 8-5 and 8-6**. At the start of the flood, the reservoir would have been operated to maintain the winter conservation pool at or near elevation 725.0 feet, until the morning of 27 February. The discharge would be reduced to a minimum flow of 10 cfs at 0900 hours on 27 February to reduce flooding on the U.S.G.S. gage at Pikeville, Kentucky. By the morning of 2 March, the reservoir could have been opened in accordance with regulation for

Levisa Fork; however, the Ohio River was rising and special instructions would have been issued to continue releasing 10 cfs, until further instructions were received. By 0900 hours on 4 March, the Ohio River had crested and fallen one foot and continued recession was indicated; therefore, special instructions would be issued by the Huntington District Office to increase the discharge by increments of 1000 cfs per hour until the channel capacity of 8000 cfs was reached and to maintain this discharge until the pool recedes to conservation level of 725.0 feet, or regulation is required for downstream control at key stations. General rains from the 4th to 6th of March contributed more runoff to existing moderately high stages, which had resulted from heavy rains during latter February. Due to the additional rain and rising streams, and a National Weather Service forecast of a crest in excess of 53 feet at Ashland on the Ohio River, special instructions at 1500 hours on 5 March would be issued to a minimum flow of 10 cfs was reached. By the afternoon of 9 March, after the Ohio River had crested, fallen one foot and continued recession was indicated, instructions would be issued to the dam tender to increase the discharge by increments of 1000 cfs per hour until channel capacity of 8000 cfs was reached and to maintain this discharge until the pool recedes to conservation level of 725.0 feet or regulation was required for downstream control at key stations. Channel capacity of 8,000 cfs was released until the morning of 16 March when streams in Big Sandy River basin began to rise again due to additional rainfall. Instructions were again issued to the dam tender to reduce the reservoir discharge to a minimum of 10 cfs at 0900 hours on 16 March. By 2100 hours on 16 March, downstream stations along Levisa Fork had receded below control stages and instructions were issued to increase the discharge to channel capacity of 8000 cfs and to maintain this discharge until the pool level recedes to conservation level of 725.0 feet.

(6) Storm and Flood of January 1957. Frontal activity between strongly contrasting air masses brought excessive rainfall to the southern Appalachian region during the period of 27 to 29 January 1957. Rainfall from 27 January to 1 February averaged 5.0 inches over the basin, varying from 2.8 inches in the lower basin to 7.0 inches in the upper basin. The streams were at average flows and the ground was saturated from antecedent rainfall at the onset of the storm. On upper Levisa Fork and along most of Tug Fork, the flood exceeded the previously known maximum. The flood on Levisa Fork reached a stage of 52.7 feet at Pikeville (0.8 feet higher than the previous maximum of 1862), and of 46.0 feet at Paintsville (0.6 feet lower than the maximum of 1862). The Big Sandy River at Louisa reached a crest stage of 50.8 feet. The Geological Survey furnished peak discharges for all gaging stations based on restricted area computations or extensions of existing rating curves. It is estimated that regulation of Dewey Reservoir resulted in crest stage reductions of 1.3 feet at Paintsville and in conjunction with existing reservoirs above confluence of Big Sandy and Ohio Rivers, 1.9 feet at Louisa. The volume of runoff from the drainage areas of

Levisa Fork and Tug Fork amounted to approximately 3.4 and 3.0 inches, respectively. Operation of Fishtrap Reservoir for the flood of January 1957 and Pikeville is shown on **Plates 8-7 and 8-8**. At the beginning of this flood, the reservoir would have been operated to maintain the pool level at winter conservation level of 725.0 feet. At 0900 hours on the morning of 29 January, the dam tender would have reduced the discharge to the minimum release of 10 cfs to maintain control stage at the U.S.G.S. gage on Levisa Fork at Pikeville, Kentucky. Special instructions would have been issued to the dam tender to keep the reservoir closed and continue to release the minimum flow of 10 cfs until further instructions. By 1500 hours on 31 January, all downstream control stations would have receded below control stages and no additional rain forecasted; therefore, instructions would have been issued to begin releases from Fishtrap Reservoir. Upon receiving instructions from the Huntington District Office, the dam tender at Fishtrap Reservoir would have increased the discharge by increments of 1000 cfs per hour at 1500 hours on 31 January. By 2300 hours on 31 January, the maximum release rate of 8000 cfs would have been reached and this discharge would be maintained until the pool level receded to conservation pool level of 725.0 feet. At this time, operation would be resumed in accordance with standing operation instructions.

(7) Storm and Flood of March 1963. The month of March was unusually warm and wet after three previous months of abnormally cold, dry weather. Precipitation ranged from slightly more than 2 inches above normal in the west to almost 4 inches above normal in the eastern part of Kentucky. The several periods of heavy rainfall were sufficient to cause major flooding in all streams in Kentucky by 10 March. The most serious flooding was in the Cumberland and Big Sandy River Basins. The flood on Levisa Fork reached a stage of 50.0 feet at Pikeville, which is 2.7 feet below the flood of record. The crest stage on Tug Fork at Williamson, was between 44 and 45 feet, which was 0.4 to 1.4 feet higher than the previous flood of record in January 1957. The Big Sandy River at Louisa reached a crest stage of 50.44 feet or 0.4 feet lower than the flood of January 1957. The retarding effect of the partially completed John W. Flannagan Reservoir Project resulted in crest stage reduction of approximately 2.0 feet at Pikeville. It is estimated that regulation of Dewey Reservoir and the retarding effect of the partially completed John W. Flannagan Reservoir resulted in crest stage reductions of 2.1 feet at Paintsville and in conjunction with existing reservoirs above the confluence of Big Sandy and Ohio Rivers, 5.0 feet at Louisa. The volume of runoff from the drainage areas of Levisa Fork and Tug Fork amounted to approximately 3.40 and 3.25 inches, respectively. Operation of Fishtrap Reservoir for the flood of March 1963 and Pikeville is shown on **Plates 8-9 and 8-10**. At the start of the flood, the reservoir would have been operated to maintain the winter conservation level at or near 725.0 feet and to provide the necessary discharges for downstream minimum flow requirements. By 1900 hours on 5 March, the dam tender would have reduced the discharge to the minimum release of 10 cfs due to the rising stages

at the control station on Levisa Fork at Pikeville, Kentucky. On the evening of 5 March, based on forecasts by the National Weather Service for the Ohio River at Ashland, Kentucky, special instructions would have been issued to the dam tender to keep Fishtrap closed for Ohio River flood control until further instructed. Only the minimum flow of 10 cfs would be released until the Ohio River had crested and fallen one foot and continued recession was indicated. Special instructions would have been issued to the dam tender to increase the outflow by increments of 1000 cfs per hour, beginning at 1500 hours on 9 March, until the channel capacity of 8000 cfs would be reached and to maintain this release rate until the pool level recedes to elevation 725.0 feet or additional regulation is necessary for downstream flood conditions. Additional precipitation on the 10th-12th March started rain swollen streams to begin another rise and, based on National Weather Service forecasts for the Ohio River, instructions would have been issued to close the reservoir at 0900 hours on 11 March for Ohio River control. Gates at Fishtrap Dam, for this second and longest rise, would be kept closed and only the minimum flow of 10 cfs would be released, until 1500 hours on 14 March when special instructions would have been issued to begin drawdown procedures by increasing the discharge to 8000 cfs by increments of 1000 cfs per hour. Maximum channel capacity of 8000 cfs would be released until 0700 hours on 17 March, at which time it would become necessary to again close the gates for flood control throughout Big Sandy River Basin. Fishtrap would be kept closed, with a minimum flow of 10 cfs released, until 0700 hours on 18 March. Special instructions would then be given to increase the discharge by increments of 1000 cfs per hour until maximum channel capacity of 8000 cfs was reached. This discharge would be maintained until the morning of 20 March, when special instructions would be issued to reduce the discharge to the minimum flow of 10 cfs based on a National Weather Service forecast of a crest stage above 53 feet being reached on the Ohio River at Ashland, Kentucky. This minimum discharge would be maintained until the morning of 23 March when special instructions would be issued, based on the Oho River at Ashland having crested and fallen one foot and indications of continued recession, to increase the discharge by increments of 1000 cfs per hour until the 8000 cfs channel capacity is reached. This discharge would be maintained until the pool level receded to conservation pool of 725.0 feet.

(8) Storm and Flood of April 1977. The most significant periods of precipitation during the month began on the evening of the 2nd. Although there was an 18-24 hour break in the rainfall on Sunday the 3rd, this set the stage for greater runoff when the rain began again on Sunday evening. A series of disturbances moved from the southern plains states into the Appalachians on Monday, 4 April. Heavy thunderstorms formed ahead of the disturbances in the lower Mississippi Valley and moved rapidly north eastward along a stationary front into the Southern Appalachians. Three bursts of heavy rainfall occurred over Southern West Virginia, Southeastern

Kentucky and Western Virginia during the 4th. The first heavy rain fell between midnight and 5 A.M.; the next around midday; and the last around sunset. Measured rainfall ranged from 1.31 inches at Louisa, Kentucky, to 9.44 inches at Flat Gap, Virginia, in the headwater area of Pound River. High intensity rainfall was also recorded at Tiny, Virginia, in the headwaters of Russell Fork measuring 8.65 inches. Darwin on Cranesnest River recorded 7.32 inches and Hurley on Knox Creek in the Tug Fork basin recorded 6.69 inches. This intense rainfall resulted in a rapid concentration of runoff for many streams in the upper Levisa Fork basin. Storm runoff from the area above Pikeville amounted to 5.8 inches, indicating that basin average rainfall exceeded 6.5 inches. The flood stages that actually occurred during this flood and the reductions effected by the existing reservoir system are given below:

Station	Gage Height	Reduction
Bartlick	27.6	4.2
Elkhorn City	24.8	1.2
Pikeville	51.5	13.6
Prestonsburg	45.7	11.6
Paintsville	42.2	10.8
Louisa	49.8	13.2

Operation of Fishtrap for this flood of record in the upper Big Sandy River Basin and Pikeville is shown on **Plates 8-11 and 8-12**. At the start of the flood, Fishtrap was refilling to seasonal pool level of 757.0 feet. After a series of disturbances moved over this region, it became apparent that Fishtrap would have to close down to minimum flow of 75 cfs At 1900 hours, 4 April special instructions were given to the dam tender to reduce the discharge to minimum flow of 75 cfs due to rapidly rising stages at the control station on Levisa Fork at Pikeville, Kentucky. This discharge would be maintained until 1300 hours 7 April. The crest at Ashland, Kentucky on the Ohio River was just 0.4 of a foot above flood stage of 53 feet; therefore, special instructions were issued to the dam tender to gradually begin opening to the maximum discharge of 5000 cfs at 1300 hours 7 April. This release rate was maintained until Fishtrap lake level had receded to seasonal elevation 757.0 feet.

(9) Storm and Flood of November 1985. As a result of several periods of rainfall throughout the month of November, the ground conditions were nearly saturated near the end of November. The monthly total for November 1985 was around 7.4 inches. Runoff for the flood period was 0.71 inches. The lake crest occurred 1 December 1985 at 749.28 feet NGVD. The percent storage utilized in this flood was 12.3 percent. The reservoir was operated to maintain pool until 27 November. A National Weather Service forecast for a crest stage in excess of 52 feet at Ashland on the Ohio River was given on 27 November. Special instructions were given to hold minimum discharge of 75 cfs. By the afternoon of 1 December,

instructions were given to the Resource Manager to increase the discharge not to exceed one foot per hour on the outflow gage.

(10) Record Pools. On 7 April 1977, a new pool of record was reached with a crest of 807.00 feet NGVD @ 71.7 percent utilization.

d. Benefits. Average annual flood control benefits attributable to Fishtrap Lake when operated in conjunction with the other completed Levisa Fork Basin projects (Fishtrap in "last-added" position) were calculated to be $1,064,000 along Levisa Fork and $984,000 along Ohio River in July 1960. These values were calculated for Interim Survey Report on Big Sandy River and Tug and Levisa Forks of December 1957. The calculations considered only Levisa Fork since, as mentioned in 4-12d, damages along Big Sandy River are primarily due to backwater from Ohio River floods. Benefits shown include two adjustments: one for future growth (2%/year) between March 1957 and the projected beginning of operation by Fishtrap Lake in July 1967; and the other for price escalation between March 1957 and July 1960.

Damages prevented by Fishtrap Lake operation during the large April 1977 flood were $114,640,000 along Levisa Fork and $8,192,000 along Ohio River. Total damages prevented by Fishtrap Lake since beginning operation in October 1968 up to year 2000 were $290,800,000.

8-03 RECREATION

Success of the recreational purpose of the project, as measured by the number of visitors, has been good. Forecasts of initial annual and ultimate annual visitation at the project were 300,000 and 450,000 respectively. **Table 8-3**, next page, shows the actual visitation at Fishtrap Lake for the years 1970 to 2000.

When the Fishtrap Lake project was planned, Senate Document 86 was used in determining the benefit value of $1.00 per visitor-day common during that period. Currently, U.S. Water Resources Council "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies", dated March 1983, may be used to compute and assign benefit values. The Principles and Guidelines gives rec-points of incremental value based on characteristics of basin recreation possibilities in comparison with the ideal and availability of alternative facilities. Points thus determined for Fishtrap Lake indicate $3.50/visitor-day for general recreation and $3.80/day for fishing or hunting. **Table 8-3**, next page, indicates about 860,000 visitors for the year of 1999, with about 765,000 people awarded to general recreation. Therefore, the value of general recreation benefits for calendar year 1999 are estimated as $2,677,500 in general benefits.

Table 8-3 Visitation at Fishtrap Lake	
Years	**Visitations**
1970	372,200
1971	430,000
1972	492,900
1973	409,500
1974	509,700
1975	718,600
1976	429,700
1977	406,500
1978	406,600
1979	453,000
1980	466,900
1981	373,000
1982	640,100
1983	537,200
1984	474,000
1985	539,400
1986	524,900
1987	605,830
1988	608,186
1992	694,700
1993	688,663
1994	653,578
1995	715,831
1996	671,600
1997	644,200
1998	730,769
1999	859,366
2000	715,366

Pool rises due to flood control operations normally do not affect camping or sightseeing except as access roads may be flooded. Picnicking is affected by flooding of Simms Creek and Island Creek access roads, and flooding of other sites at their various elevations. High water levels affect boating by causing difficulty in launching and recovery, which increases as the water level approaches the top of the ramp. Newly inundated obstacles cause anxiety and potential danger to boaters and water skiers. Hiking is not affected by lake levels up to flood control pool elevation.

Some drawdown below elevation 757 feet NGVD will occur in dry years by release of water stored for the purpose of low flow control at Pikeville on Levisa Fork through Paintsville on Levisa Fork. For example, a drawdown of two feet will occur on the average of once in 2.0 years; three feet, once in 2.7 years, and four feet, once in approximately 3.4 years.

Sightseeing, camping, and picnicking are affected by drawdown only to the extent that view of exposed banks and mud flats may disappoint individual participants. Boat launching at the Grapevine Creek is functional down to elevation 751.0 feet and therefore, normally would not be affected by required releases from the project. Lick Creek launch ramp is functional down to elevation 753.0 and very seldom would be affected by drawdown of seasonal pool in dry weather.

8-04 WATER QUALITY

a. Special Problems. Excessive sedimentation is the most significant water quality problem. This is a direct result of current mining practices within the watershed. Water problems associated with mining include elevated levels of specific conductance, sulfates, chlorides, and iron. This creates problems when trying to regulate releases for downstream temperature requirements.

An interdisciplinary approach is used to evaluate the physics, chemistry, and biology of inflow streams, the lake, and the outflow. The following interpretations are based on data collected between 1990 and 1999.

b. Physical/Chemical. The chemical composition of water may be defined by grouping substances, which compose the dissolved solids. Relationships among groups of chemicals determine the type of water. In terms of major ions and descriptive parameters, water in Fishtrap Lake was classified as a Calcium Sulfate type. This represents an unbalanced condition.

Impounded waters are in more or less dynamic states. The governing factor in water quality development is the temporal and spatial behavior of the density of this water. In most fresh water systems, water temperature is the predominant factor in determining density. Temperature variations in water masses are capable of creating strata of water of greatly different characteristics. Such differing characteristics have direct implications with regard to lake-releases. Most lakes in this part of the country remain nearly isothermal during the winter months. In the spring, under normal conditions, they will stratify and remain so until sometime in the fall. At that time the lakes mix and become isothermal again.

c. Temperature. A lake structure will typically cycle from a mixed condition (Temperature same from top to bottom) to a stratified or layered condition (Temperature changes with depth).

This is the result of thermal energy from the atmosphere gained and lost during the year. During spring as air temperatures start to warm, so do surface water temperatures. This creates a surface layer called the epilimnion. Water temperatures near the bottom remain cool because they are not exposed to sunlight or warmer air temperatures. This layer is called the hypolimnion. The layer in the middle is referred to as the metalimnion or transition layer. During fall when air temperatures start to cool the surface water temperature also cools and mixes with water below at the same temperature. This process continues until water temperature in the epilimnion is the same as the hypolimnion and the lake is once again mixed. Fishtrap Lake remains nearly isothermal during the winter months. In the spring the lake stratifies and remains so until November. At that time the lake mixes and becomes isothermal again. The lake has a short average retention time of 23 days, which directly affects the stratification pattern. As shown in **Plate 8-13**, there is strong thermal stratification, with three well-defined layers.

d. Retention. The lake has a short average retention time of 23 days, which directly affects the stratification pattern. Specific conductance does not indicate any density layers in the lake resulting in interflows through the lake during the summer months. Thus water entering the lake remains there, on the average, for less than 1 month before it is released to the downstream area. This is an average number. Water remains in the lake longer in the summer during times of low flow and shorter in the spring during times of high flow.

e. Dissolved Oxygen. Dissolved oxygen levels are extremely important in water quality characterization. They depend on the physical, chemical, and biological activities that occur in water. Dissolved oxygen saturation limits are directly related to temperature. Thermal stratification can result in zones that exhibit greatly different characteristics. In well-mixed epilimnetic waters, relatively high levels of dissolved oxygen occur and water is usually of acceptable quality. Water in the hypolimnion may become void of oxygen as a result of various oxygen demanding processes. Therefore, a concomitant decrease in water quality can occur after stratification becomes established. Concentrations of dissolved oxygen in Fishtrap Lake were constant throughout the water column after fall mixing completed, sometime in November, and remained so until around April when the lake would normally stratify. At that time, dissolved oxygen levels in the hypolimnion declined until anoxic conditions were reached. This meant that about 56% of the lake had oxygen levels above 5 mg/l. Dissolved oxygen is one of the key parameters for fishing and this represents the maximum amount of lake available for fishing during the latter half of the stratification season (August - October). **Plate 8-14** shows typical dissolved oxygen concentrations during the summer months.

Levisa Fork is the major inflow to Fishtrap Lake. Dissolved oxygen concentrations averaged 91% saturation. Average values in the tailwater were 97% saturation. The outflow system was designed to

allow for regulation of the quality of the water during low flow conditions and the data indicated similar conditions between the tail water and headwater areas.

f. Nutrient Load. Concentrations of nutrients in a lake are an indicator of productivity. Low productivity results in fewer littoral plants and low density of phytoplankton, whereas littoral plants and abundant phytoplankton populations characterize highly productive lakes. The amount of productivity is directly related to the lake fishery. Sufficient quantities of phosphorous, nitrogen, and carbon are needed to have a productive lake. Fishtrap Lake is considered moderately productive with phosphorous as the limiting nutrient. Nutrients are transported with sediments. As water enters a lake, its velocity decreases and the sediments settle to the bottom. Because of this phenomenon, it is common to see algal blooms at the upper end of a lake. Phosphorous concentrations averaged 0.07 mg/1 at the inflow and 0.06 mg/1 in the outflow which indicated that there was available phosphorous in the tailwaters.

g. pH. PH is a measure of the hydrogen ion concentration. It can be increased by adding a base or removing carbon dioxide from a solution such as in photosynthetic assimilation. By definition, pH ranges from 1 to 14 and a pH value of 7.0 is considered neutral. Average pH found in the database for headwater stations was 7.7 and at the tailwater station was 7.3. The average numbers indicated near neutral conditions in the headwater and neutral conditions in the tailwater. Long-term trends indicate no significant pattern in pH values over the watershed.

While pH is a measure of concentration, alkalinity is a measure of capacity. The capacity of a solution to neutralize acids or bases is called buffering capacity. Average alkalinity, a factor buffering pH, was around 88 mg/l $CaCO_3$ in the headwaters and 77 mg/1 $CaCO_3$ in the tailwaters. These numbers indicate sufficient buffering capacity in the system.

h. Hardness. Water hardness is the sum of calcium and magnesium concentrations expressed in terms of mg/1 calcium carbonate. It is largely a result of geological formations at the water source. Calcium and magnesium form an insoluble residue with soap and leave deposits on surfaces that come in contact with the water. The ring around a bathtub is a well-known example of these deposits. Detergents were introduced to reduce this problem. High hardness (hard water) results in high soap consumption as well as objectionable scale in heating vessels and pipes. Public acceptance of hardness varies. Many consumers will object to water harder than 150 mg/l calcium carbonate (Water Supply and Pollution control). Average water hardness at the main inflows was 201 mg/1 calcium carbonate and was 198 mg/l calcium carbonate in the tailwater. This range is classified as very hard based on U.S. Geological Survey classifications.

i. Iron Concentration. Iron is an abundant element on the earth, but usually occurs as an insoluble form in water and at low concentrations. Concentrations of iron in the headwaters of Fishtrap

Lake averaged 2223 ug/l. This average decreased to 644 ug/l in the tailwaters, most likely due to the fact, that releases from the lake are regulated for water quality. During the stratification season, iron levels usually remained below 1000 ug/l in the lake (**Plate 8-15**). Long-term trends indicated no significant changes in iron concentrations.

j. Manganese Concentration. Concentrations of manganese in the headwaters were well below a standard of 1000 ug/l, averaging 187 ug/l. During lake stratification, manganese levels in the hypolimnion were also well below the standard (**Plate 8-16**). The average manganese concentration in the tail water area was 248 ug/l. While this represents a small increase over headwater conditions, it is well below the standard. Long-term trends indicated no significant change in manganese concentrations.

k. Biological. In a freshwater community, algae are the primary producers. They serve as the basis of the food chain and are the primary food source for most aquatic animals. The quantity and types of algae present in a stream or lake are dependent upon many factors, such as temperature, oxygen, light, nutrients and flow. All freshwater algae contain the green pigment chlorophyll. Therefore, measuring chlorophyll can monitor the productivity of aquatic habitats. Algal productivity was low in headwater streams with an average chlorophyll concentration of 3.6 ug/l. Productivity on the lake was also considered low with an average chlorophyll concentration of 3.6 ug/l.

Freshwater invertebrates (worms, insects, crayfish, mussels, etc.) serve as a useful tool for evaluating environmental impacts that occur over time. Because of their limited mobility and their relatively long life span, these organisms are subjected to the environmental conditions of their immediate aquatic habitat. Since 1975, benthic macroinvertebrates have been used as an assessment parameter to evaluate the overall water-quality conditions of Levisa Fork at the outflow station 1FRL0001 (located 1300 feet downstream of the stilling basin), and the inflow station 1FRL0002 at the Big Rock (Virginia) stream gauge.

OVERALL QUALITY RATING: The OQR is derived from the BMWP score and the ASPT. The BMWP, Biological Monitoring Working Party, was designed to give a broad indication of the biological condition of rivers and streams. Identification of organisms, from macroinvertebrate samples, is made to the family level. Each family is given a score, between 1 and 10, depending on their susceptibility to pollution and/or other environmental stresses. Taxa least tolerant, such as families of mayflies and stoneflies, are given the highest scores. The BMWP score is the sum of the family scores. The BMWP score is then divided by the number of families to produce the Average Score Per Taxon (ASPT). The calculated BMWP score (X) and ASPT (Y) are then given a rating between 1 and 7, depending on whether the site or station is classed as a habitat-rich riffle or a habitat-poor riffle/pool. The overall quality rating is derived as OQR = X + Y/2.

The macroinvertebrate data (OQR) for 1FRL0001 and 1FRL0002 are presented in **Plate 8-17**. Both stations had a poor OQR rating. The poor rating at 1FRL0001 is due to a combination of conditions caused by impounding Levisa Fork. These primarily include changes in the flow and temperature regimes, and the release of high concentrations of iron and manganese periodically from the sluice gates during summer stratification. The poor rating at 1FRL0002 is due primarily to the heavy sediment load in Levisa Fork. The most desirable substrates of gravel and rubble at 1FRL0002 are often covered or embedded in sediments of fine sand, silt, and coal fines. This reduces the suitability of the substrate to provide habitat for most benthic invertebrates.

The most common groups of macroinvertebrates collected in the benthic samples from 1FRL0001 were caddis flies (24%), midges (33%), and black flies (27%). The common groups collected from 1FRL0002 were aquatic worms (24%), mayflies (15%) and midges (56%). No stoneflies have been collected in any of the macroinvertebrate samples from 1FRL0001 and 1FRL0002, and only a few mayflies have been collected from 1FRL0001. Historically both stations have had stressed benthic communities.

8-05 FISH AND WILDLIFE

Effects of water control management on fish and wildlife are those associated with:

a. Pool level fluctuations. Spawning season, usually from May through the middle of June, is a time when these fluctuations are critical. When the pool level builds up two feet or more during rainfall runoff and is returned to seasonal elevation, 757.0 feet NGVD, from two to five days, spawning success suffers among bass and other species. Fishtrap Lake supports many game fish including: large mouth bass, small mouth bass, white bass, catfish, crappie and tiger muskie. At the downstream area trout can be found. Kentucky Department of Fish and Wildlife Resources provides stocking for Fishtrap. During the summer months, May through October, the Department stocks trout in downstream area once a month. Numbers of young-of-the-year largemouth bass counted are always in rough proportion to the degree of stability of the pool, or in inverse proportion to the amount of variation in pool level. Extensive efforts are made to raise the pool level to summer pool elevation 757.0 feet NGVD by 15 April and then maintain a constant summer pool within a plus or minus six-inch range until the end of the spawning period. In 1986, land was leased to Kentucky Department of Fish and Wildlife Resources to maintain the lake fishery. The Department has provided a number of fish at tractors in the lake area. In the near future the Kentucky Department of Fish and Wildlife will begin a self-stocking program for Fishtrap Lake. The change from a stream fishery to a lake fishery is taking place satisfactorily. Game fish populations continue to have good hatching success and populations are continuing to increase.

The eggs and young of the year of ground-nesting birds, small mammals and reptiles are lost during a rise of 10-15 feet, those closest to the lake during smaller rises. Such a rise also kills the herbaceous vegetation, which is the food source of small mammals; however, losses of these animals are not as critical due to their fecundity. Although these rises do reduce the carrying capacity, there has been little observable adverse effect of flood regulation on wildlife near the pool.

b. Stratification. Stratification effects on the lake fishery stem from the difference between values of temperature and concentration of dissolved oxygen in upper and lower levels in the water column discussed in subsection 7-04. Low temperatures and dissolved oxygen concentrations occur at lower levels and high temperature at upper levels. Fish species seek out the most desirable habitat. During the period of most severe stratification, only the upper layer of the lake contains sufficient oxygen concentration. Then fish migrate up-lake to shallower areas resulting in a temporary lateral displacement of populations within the lake.

c. Minimum Pool. The fish migration mentioned above has been part of fish losses from the lake through outlet works. Many of the loses occur from the minimum pool, which crowds fishes into about 30% of seasonal volume, during cold weather when they are lethargic and more likely to be drawn by a sudden current.

d. Reforestation. Major benefits to wildlife of Corps occupancy of lands purchased, but not submerged or utilized for recreation areas, were claimed for fire control efforts and the vegetation changes occurring during reversion of open lands to forests. The range appears to be healthy for forest animals.

e. Downstream Flow Fluctuations. Extremes of high and low flows downstream from the dam are much less than those during the pre-construction period. The pre-construction one-year natural frequency flow at the dam site from **Table 8-4**, page 8-19 is 8,900 cfs, which displaced fish and disrupted their food. Today, the lesser flushing action of channel capacity discharge, 5000 cfs, for several days while releasing flood storage has similar effects. In either case, temporarily, fish populations are displaced and flood supplies diminished. The continuous minimum discharge supports the downstream fishery against the increased fishing pressure. The major adverse effect of high discharges from the lake may be the frustration of fishermen at the tailwaters because of the fast current pulling their lines downstream too quickly.

There has been negligible effect of drought-caused drawdown on fish and wildlife. Muddy banks cause turbidity in nearby water due to the lapping of water against the bank. Many fishermen believe this decreases the catch because fish have difficulty seeing the bait or lure. A drawdown of 4 feet will likely expose or make too shallow

some littoral zones which are the best fishing grounds. Losses will be sustained among aquatic insects and other members of the fish food chain whose habitat is the shallow buds of these zones. Such a drawdown is likely to force try and young of the year out of thick, normal cover into unprotected areas where they are more easily utilized as food by larger fish. A portion of the food chain may be impaired if mud flats are exposed into which amphibians and invertebrates have burrowed for body temperature control.

f. Downstream Temperature. Temperature of the downstream aquatic habitat has been controlled fairly smoothly along the Outflow Temperature Regulation Curves of **Plate 7-2**. Since the curves were designed to approximate natural temperatures common in area streams, this factor of the habitat has been much more favorable to native species than if temperature control were not practiced and outflow was limited to bottom discharge.

g. Access. The Fish and wildlife Service report projected fisherman use of the downstream reach at 11,000 man/days per year after the project due to more stable water flows and better access. Greater use of downstream reach during Corps ownership can be attributed to better access, trout stocking by the State and the capacity of the fishery to withstand the increased fishing pressure.

8-06 WATER SUPPLY - N.A.

8-07 HYDROELECTRIC POWER - N.A.

8-08 NAVIGATION - N.A.

8-09 DROUGHT CONTINGENCY PLAN

The lake operation does not include plans for drought. However, there may be instances when there is a request to store water in the lake for later release to mitigate drought, such request must first be approved under the deviation from normal regulation procedure.

8-10 FLOOD EMERGENCY ACTION PLANS

The flood emergency operation plan for the Levisa Fork River Basin outlines procedures to be followed under various emergency situations.

8-11 FREQUENCIES

a. Peak Inflow Provability or Natural Discharge Frequency and Duration at the Outflow Gage. The natural discharge-frequency curve for Fishtrap at the Fishtrap Lake outflow gage was developed in accordance with methods outlined in "Statistical Methods in Hydrology," by Leo R. Beard dated January 1962 and Bulletin 17A, “Guidelines for Determining Flood Flow Frequency”, published by the United States Water Resources Council and dated March 1976. A log-

Pearson Type III distribution was fitted to the annual event series at gaging stations in the Levisa Fork Basin. This enabled a generalized relationship to be derived, which relate frequency curve characteristics, mean, standard deviation and skew, to individual basin factors. These data were utilized to make flow frequency estimates for the project drainage area.

The curve derived by plotting probable maximum flow to be expected at the dam site against exceedence interval in years, is shown as **Plate 8-18**. Flow values for certain exceedence intervals from 1 year to 1000 years are given in **Table 8-4**, below, Frequency Summary, Fishtrap at Fishtrap Lake Outflow Gage, All Seasons, Natural. The modified regulated flows at Fishtrap Lake outflow gage are determined by downstream channel capacities and control stages, barring the occurrence of a huge flood or emergency that the reservoir cannot fully control.

Table 8-4
Frequency Summary
Fishtrap Lake at Fishtrap Lake Outflow Gage
All Seasons - Natural

Exceedence Interval (Years)	Natural Stage Flow (cfs)	Natural modified by Fishtrap Lake Stage Flow	
		Feet	cfs
1000	83,000	--	--
500	73,800	--	--
200	61,500	--	--
100	53,000	25.5	8000
50	44,900	25.5	8000
20	35,000	25.5	8000
10	28,100	25.5	8000
5	21,400	25.5	8000
2	13,100	25.5	8000
1	8,900	25.5	8000

b. Pool Elevation Duration and Frequency. All significant flows for the period of record at Fishtrap were tabulated and hydrographs reconstituted for the dam site or obtained by drainage area ratio. The hydrographs were routed through the lake following the approved plan of water control and the peak pool elevation noted. Using the graphical analysis method described in Beard’s work “Statistical methods of hydrology” mentioned above, the pool elevation frequency was estimated and is shown in Frequency of Filling, **Plate 8-19**. Deviation from water quality control pool

elevation, 757 feet NGVD was plotted as pool elevation probability of occurrence on the average once in a number of years, which is the exceedence interval, against the interval. Selected exceedence intervals with the respective maximum pool elevation expected to occur (on the average), once in that interval are listed in **Table 8-5**, below, Frequency Summary, Fishtrap Lake Pool Elevation Deviation.

Table 8-5
Frequency Summary
Fishtrap Lake Pool Elevation Frequency – All Seasons

Exceedence Interval (Years)	Elevation Feet NGVD
50	815.0
20	802.4
10	793.0
5	783.6
2	770.4
1	761.8

Pool elevation hydrographs produced when the above floods were routed through the lake were measured for amplitude (duration in days) at certain specified elevations and these tabulated by elevation. The total number of days tallied for each elevation for all the floods of the period of record was divided by the number of years of record, 49, to obtain average number of days per year at or above the elevation. The "Average" curve in Duration of Filling; **Plate 8-20** was derived by plotting this average number of days values against the respective elevations. Amplitude at specific elevations of the curve with the highest peak was plotted against the elevations to obtain the "Maximum Number of Days for Period of Record."

c. Control Station – Pikeville Kentucky. The natural frequencies of Levisa Fork at Pikeville were estimated using nearly the same methods and techniques of data handling and calculation as were used for Fishtrap at the dam site.

Maximum natural flows expected to occur, on the average, once in a certain period of years, which is the exceedence interval, were plotted against the respective intervals to produce the "Natural" curves of Flow Frequency for the Fishtrap outflow gage, **Plate 8-18**. Flows for selected exceedence intervals from 1 year to 1000 years are included in **Tables 8-4 thru 8-6.**

Table 8-6
Stage and Discharge Frequencies – U.S.G.S. Gage
Levisa Fork at Pikeville, Kentucky
All Seasons

Exceedence Interval (Years)	Natural Stage Flow		Natural Modified by Fishtrap and John W. Flannagan Stage Flow	
	Feet	cfs	Feet	cfs
1000		190,000	62.0	101,000
500	82.0	168,000	57.7	88,000
200	74.0	140,000	51.4	71,600
100	68.2	121,000	47.2	60,900
50	62.5	103,000	43.4	51,100
20	55.0	80,500	38.3	39,900
10	49.0	64,900	34.9	32,700
5	43.0	50,000	31.9	27,360
2	36.1	35,000	28.5	21,600
1	30.5	25,000	26.2	18,100

SECTION IX – WATER CONTROL MANAGEMENT

9-01 RESPONSIBILITIES AND ORGANIZATION

a. Corps of Engineers. General Authorities for allocation and regulation of reservoir storage in projects owned and operated by the Corps of Engineers are contained in legislative authorization Acts and referenced project documents, These public laws and project documents usually contain provisions for development of water control plans, and appropriate revisions thereto, under the discretionary authority of the Chief of Engineers. Some modifications in project operation are permitted under congressional enactments subsequent to original project authorization. Fishtrap Lake is owned and operated by the U.S. Government. The Huntington District Corps of Engineers is the operating agency for the project under administrative control of the Big Sandy Area Office within Operations and Readiness Division.

b. OCE Role in Water Control Activities. OCE will establish policies and guidelines applicable to all field offices and for such actions as are necessary to assure a reasonable degree of consistency in basic policies and practices in all Division areas. Assistance will be provided to field offices during emergencies and upon special request.

c. Great Lakes and Ohio River Division. The Division Engineer has primary responsibility and authority for direct action with respect to ALL PHASES of reservoir regulation, including: (a) basic policies, criteria, and concepts that determine operating plans; (b) technical evaluations; (c) field operation, and (d) review and approval of reservoir regulation plans and manuals and related activities. The Division Office will coordinate water control management activities associated with inter-district, interdivision and interagency water resource needs. As established in accordance with ER 1110- 2-1400, the Great Lakes and Ohio River Division Water Management Branch is responsible for administration of the Division Engineer’s policy for water control management.

d. Huntington District. District Engineers have the primary responsibility for: (a) general management of reservoir regulation activities within their respective areas; (b) technical evaluations and performance of operations associated therewith; and (c) developing plans and manuals required for reservoirs and interrelated systems within their respective district area. The Water Resources Engineering Branch, within Engineering Division, is the responsible element for all water control activities, which include the following reservoir project functions

(1) Flood control.
(2) Regulation of flows for water supply and water quality control.

(3) Navigation - stage regulation.
(4) Recreation.
(5) Fish and wildlife enhancement.
(6) Alleviation of sediment and erosion problems affected by reservoirs.
(7) Hydropower

Water control plans include coordinated reservoir regulation schedules for project/system operation and such additional provisions as may be required to collect, analyze and disseminate basic data, prepare detailed operating instructions, assure project safety and carry out regulation of projects in an appropriate manner. Water control plans will be developed to conform to objectives and specific provisions of project authorizing legislation and applicable Corps of Engineers' projects. They will include any applicable authorities established after project construction. The water control plans will be prepared giving appropriate consideration to all applicable Congressional Acts relating to operation of Federal facilities, i.e., Fish and Wildlife Coordination Act (P.L. 85-624), Federal Water Project Recreation Act - Uniform Policies (P.L. 89-72), National Environmental Policy Act of 1969 (P.L. 91-190), and Clean Water Act of 1977 (P.L. 95-217). Thorough analysis and testing studies will be made as necessary to establish the optimum water control plans possible within prevailing constraints.

Water Resources Engineering Branch is delegated the responsibility to coordinate the operation of specific projects with Federal and State agencies, local entities, and the general public. The Division Engineer, ATTN: CELRD-EC-W, will be advised, as soon as possible, of any coordination activities which may require a study, public hearing, or revision in operating plans. Districts are required to alert the Division Engineer, ATTN: CELRD-EC-W, of any significant deviations from routine daily regulation plans. The communication mode for the advisory should be commensurate with the urgency of the situation and transmitted before a plan of action is implemented by the district. An organizational chart is shown on **Plate 9-l** for Water Control Management in Big Sandy River Basin. As shown on the chart, the Recreation-Resource Management Branch and the Big Sandy Area Office are responsible for supervision of the operation and maintenance of the lake projects in the basin. The Damtender at Fishtrap Lake will regulate the project in accordance with general instructions and Special Directives issued by the Water Control Section. General instructions are included in Instructions to Damtender, **Exhibit B** of this manual. Special Directives are issued and signed by the Chief, Water Control Section, for dissemination to the Damtender as necessary to efficiently regulate the project for optimal water control management for all project purposes.

During normal operations, the Water Control Section of the Water Resources Engineering Branch are involved in the following activities pertaining to water control management:

(1) Routine regulation of the lakes and dissemination of pertinent data.

(2) Investigations and refinement of regulation procedures such as analysis of past floods, channel investigations, improvement of forecasting, and planning programs with other agencies.

(3) Training personnel in flood control duties with visits to projects and instructing Water Resources Engineering Branch personnel from other sections.

(4) Development and application of mathematical modeling to complex reservoir systems.

(5) Operation of the Branch hydrologic data collection and water control management system, including computers and field equipment.

(6) Develop and conduct effective public information programs to inform and educate the public regarding Corps of Engineers' water control management activities.

(7) Preparing and submitting reports on lake regulations such as daily reports, weekly reports, monthly reports, annual reports, weekly briefings, and post flood reports.

(8) Preparing and updating water control manuals for individual projects and master manuals for basins.

During flood or other emergencies, Water Resources Engineering Branch personnel are responsible for the following activities in regard to water control management:

(1) Evaluation and dissemination of current and forecast hydrologic, hydraulic and meteorological data.

(2) Presentation of storm and flood analysis to the District Engineer and pertinent staff members.

(3) Providing liaison personnel to support Emergency Operation Center when it is operational.

(4) Regulation of all projects and systems in accordance with approved plans.

(5) Furnishing information to others such as reports to higher authority, status to Emergency Operations Center and data to Public Affairs Office.

a. Instruction to Damtender

During a FLOOD EMERGENCY SITUATION **Exhibit B** of the manual describes the responsibilities of the Corps of Engineers on site project personnel. The details and responsibilities of other elements are indicated in the overall district plan in the Emergency Operations Center Plan and ER 500-1-1, ER 500-2-1 and all annexes to these two

ER's. The lines of communication between the various office elements are shown on **Plate 9-2**.

b. Other Federal Agencies. The National Weather Service and the U.S. Geological Survey cooperate and coordinate activities with the Water Resources Engineering Branch in regard to accumulation of rainfall and streamflow data, as well as river forecasts and discharge measurements. The Corps of Engineers is required by the Fish and Wildlife Coordination Act (48 Stat. as amended) to coordinate all plans affecting Fish and Wildlife with the U.S. Fish and Wildlife Service. The Service is required to present the plans to the relevant State agency, in this case, the Kentucky Department of Fish and Wildlife Resources, for their comments and recommendations. The Service then presents a combined report to the Corps including its comments and recommendations and those of the Kentucky Department of Fish and Wildlife Resources.

The Huntington District also works in cooperation with other Federal, State, local and private organizations and agencies, as has been illustrated throughout this report. A summary of the major relationships is shown on **Plate 9-3**.

c. Local and State Agencies. No local or State agency has funding or operational responsibilities in Huntington District multipurpose reservoirs except in leased recreation areas. The Pike County Sheriff, under a contract with the Huntington District, has responsibility for law enforcement on project lands, particularly at recreation areas and on roads. The State Health Department analyzes drinking water samples mailed to them by project personnel and returns results by mail. The State of Kentucky constitutionally holds in trust all wild animal life in the state on both public and private lands, and all aquatic life in public waters. The State Department of Fish and Wildlife Resources, as mandated by State Code, has responsibility for conservation of fish and wildlife and for boating safety at Fishtrap Lake. The Enforcement Division of the Department of Natural Resources does enforce hunting regulations and licenses on the reservoir lands. The State has undertaken fish management at Fishtrap Lake and the Corps cooperates in lake level manipulation and maintenance of downstream temperature and flow requirements to enhance fisheries management. The State operates the Corps-built fish hatchery at the upper end of the lake and stocks Fishtrap Lake and other streams and lakes in the area.

d. Private Organizations. One private company, D. M. Belcher Marina, has contractual responsibilities at the project concerning operation and management of the marina concession at the lakeside boat launch.

9-02 INTERAGENCY COORDINATION AND COOPERATION

a. Press Releases. Huntington District Office and the National Weather Service coordinate in forecasting flood stages. Local press is provided with information of flood forecasts as furnished by the

National Weather Service (officially responsible for issuing flood warnings). This information will be supplemented by the Corps with available information on observed conditions and with technical advice to enable local interests, within the limits of their capabilities, to obtain optimum flood protection and to perform rescue and relief functions.

The District Office releases various other items to the press for public dissemination. Some of these are in the public interest such as drawdown announcements or notification of a change in or opening of a new facility or service at a reservoir. Some releases are to enlist public cooperation and some, such as reports of flood damages saved by regulation of certain reservoirs, are to inform the public of the benefits derived from Corps built projects.

b. National Weather Service. An agreement between NWS and the Corps of Engineers provides for collection and dissemination of current precipitation data for the Ohio River Basin. By joint agreement, NWS installs, maintains and operates all stations in the Ohio River Network, except those operated by Corps of Engineers personnel at flood control and navigation projects. Where there is a mutual need for the data, station costs are shared by both NWS and the Corps of Engineers. Costs of stations that are required only for reservoir regulation are borne entirely by the Corps of Engineers. In either case, an annual transfer of funds from the Corps of Engineers to NWS is made to cover the required expenditures. As briefly described in Sub-section 6-01b, NWS provides a range of weather information and forecasts under the program as well as Ohio River and tributary stage information and forecasts. The Corps reciprocates, providing NWS with all precipitation, snow cover and stage information from reservoir and other reports, pool level and outflow forecasts and depth reports from the District Snow Cover Reconnaissance.

c. U.S. Geological Survey. The Cooperative Stream Gaging Program was established about 1940 through cooperative arrangements between the Corps of Engineers and the U.S. Geological Survey in order that sufficient stream flow data would be available to meet special needs in connection with the Corps water resources responsibilities. This is in keeping with the Chief of Engineers policy of fully utilizing the facilities and services of other Federal agencies in obtaining many types of basic data. Accordingly, arrangements were made for the Geological Survey to operate specific stations for the Corps on an advance of funds basis. Although the COE requires the basic data, other Federal, State and private agencies and individuals are interested in the water data. The data are published by the Survey, which assures maximum availability and use of all data.

The Geological Survey coordination and cooperation with the Corps, described in paragraph 6-02a, provides the Water Resources Engineering Branch with a system for obtaining reliable stage and

flow information, which is necessary for efficient water control management.

The annual program is formulated by the Water Resources Engineering Branch in collaboration with appropriate District Chiefs of the Geological Survey. The Corps of Engineers and the local representative of the U.S. Geological Survey determine the necessary stations to provide the data for publication and the Corps is requested to furnish an estimate of the costs of installing and/ or operating each station. The District Engineer forwards the selected program through the Division Engineer to the Chief of Engineers. Any supplemental instructions of a current nature necessary in connection with preparation of the report are issued annually by the Chief of Engineers.

d. Kentucky Department of Fish and Wildlife Resources. Functional agreements, meetings, and contacts with various divisions of the Department of Fish and Wildlife Resources are discussed below. They are important to the operation of the project in accordance with the project purposes and with the recommendations of the Kentucky Department of Fish and Wildlife Resources and the U.S. Fish and Wildlife Service.

The Kentucky Department of Fish and Wildlife resources (KDFWR) maintains an office of Corps Liaison for the purposes of coordinating special releases from Corps lakes for recreational or other purposes. This office receives all requests for special regulation and, after examining the request and appending to it any KDFWR comments, sends the request to the District Office. Using the Corps based guidance policies and criteria a determination is then made, and this decision is then sent back to the KDFWR to coordinate with the organization making the request.

The Kentucky Division of Forestry, all project lake Corps Personnel, and project lake state park personnel cooperates in fire-fighting activities to suppress fires that threaten or are burning on project lands. Project personnel cooperates by taking training in fire suppression techniques, reporting such fires to the KDFWR District Forester, fighting the fires before State personnel arrive and by assisting their suppression efforts after arrival.

The Parks and Recreations Division will enforce the boating safety and water regulations, while hunting and fishing licensure procedure enforcement is by the Division of Wildlife. There is frequent day-to-day contact between project personnel and KDFWR personnel through much of the year.

e. Other Federal, State, or Local Agencies. The Corps of Engineers receives requests for information, aid or cooperation from many parties. All responsible requests from Federal, State, local or private organizations or from individuals receive appropriate attention and consideration. Accuracy of information transmitted and

responsible character of aid or cooperation given is commanded by District policy. Huntington District reacts quickly in disaster situations, allocating material and man power when needs are in the Corps areas of responsibility and expertise. In certain cases, such as potential downstream flooding concern or emergency complication involving regulation of the Big Sandy River Lakes, the District Emergency Operations Manager coordinates with the Kentucky Disaster Services Agency. Another example of cooperation with a State entity is an occasion when the Corps studies damages and reconstruction costs due to a flood or other disaster for the Office of the Governor to use in applying for Federal assistance.

In accord with the Corps of Engineers statutory responsibility for operation of its reservoirs in the public interest, the Great Lakes and Ohio River Division Engineer organized the Reservoir Operations Coordinating Group for the Ohio River Basin as a vehicle for perceiving, interpreting, and prioritizing that interest. Composed of the twelve basin States, Tennessee Valley Authority, six Federal agencies and two regional commissions which are Ohio River oriented, the Group meets quarterly and provides a mechanism for a two-way communication through various levels of government and among various agencies of government and other organizations, which serve the public. Meetings of the Group have the stated mission of bringing focus to the public's varied interests in reservoir regulation and accordingly perfecting that regulation to the maximum extent possible.

Water Resources Engineering Branch Personnel sends to each meeting a report which summarizes hydrologic and meteorologic situations in the district for the preceding three month or six month period highlighting pertinent events, flood control activity, and special operations by each project.

9-03 INTERAGENCY AGREEMENTS, MEETINGS AND ORGANIZATIONS

Agreements between the Corps of Engineers, U.S. Geological Survey (USGS), National Weather Service (NWS) and Kentucky Department of Fish and Wildlife Resources (KDFWR) are mentioned above and outlined in paragraphs 9-02a, 02b, 02c and 02d.

In the interest of fire protection for visitors, employees, property, and animal and plant life, the District executed a memorandum of understanding covering all Corps reservoir projects in Kentucky with the Kentucky Department of Fish and Wildlife Resources to be administered by its Division of Forestry. The understanding includes cooperative warning and suppression of fires on or threatening Corps owned lands, Kentucky Department of Fish and Wildlife Resources maintenance of a standard cache of fire-fighting tools at the project, and payment by the Corps of extinguishment costs incurred by the Kentucky Department of Fish and Wildlife Resources.

9-04 COMMISSIONS, RIVER AUTHORITIES, COMPACTS, AND COMMITTEES

a. Ohio River Basin Commission (ORBC). This commission has an active interest in the operation of the Fishtrap Lake and acts in a consultative capacity to both governmental and private interests in the basin. The commission consists of Federal and State representatives in Water Resources. Its purpose is to provide a forum for the Ohio River states to study, discuss, and develop regional policies and positions on common interstate issues concerning water and related land issues.

b. Ohio River Valley Water Sanitation Commission (ORSANCO). This commission, which was created in 1948, coordinates the water quality programs of member states, and promulgates regulations to prevent and mitigate water quality problems on the Ohio River and its tributaries. The states of West Virginia, Pennsylvania, Illinois, Indiana, Kentucky, New York, Ohio, and Virginia are represented on this commission.

c. Kentucky department of Fish and Wildlife Resources (KDFWR). This commission has interest in water related issues as they affect fishery resources and boating opportunities in the State.

d. District Drought Monitoring Committee (DDMC). This is an existing committee consisting of Huntington District Corps of Engineers personnel from the Planning, Operation and Readiness, and Engineering and Construction Divisions; the Office of Counsel; and the Public Affairs Office. The purpose of the committee is to review guidelines, develop and implement functional drought contingency plans, and keep the CDMC informed on drought status and drought related topics and issues.

e. Corps Drought Management Committee (CDMC). The CDMC is composed of personnel from the Corps' office. The purpose of the committee is to represent the broad range of Federal interests and to establish and direct the water management policy for the Huntington District during a drought. Where possible, the Chief of the Engineering/Construction Division uses guidance from this committee in developing and justifying deviations from approved water management plans and procedures.

f. Inter-agency Drought Management Committee (IDMC). The IDMC is composed of local, State, and Federal agency heads that have the authority to represent all user water needs within the Levisa Fork River basin. Federal members include the Huntington District Commander who serves as the Chairman, and agency heads or their designees from the Federal Emergency Management Agency, U. S. Fish and Wildlife Service, Environmental Protection Agency, National Weather Service, U. S. Geological Survey, and Soil Conservation Service. State members include department heads or their designees from the Kentucky Department of Environmental Protection and the

Kentucky Emergency Management Agency. Local members include representatives from the area counties. The purpose of the committee is to review the status of the District's lake storage and operations, review drought related water needs and requests, develop proposed action plans for meeting consolidated and coordinated user needs, and set priorities and define actions on these needs.

9-05 NON-FEDERAL HYDROPOWER - N/A

9-06 REPORTS

Table No. 9-1, at the back of this section contains a listing of the various Periodic and Special reports provided by Huntington District Water Control Section.

a. Periodic.

(1) Daily. Districts are required to report current hydrologic data daily as prescribed by the Division Office. During normal workdays, a daily report containing observed data, 3-day forecast of lake and outflow for all reservoir projects and 5-day flow forecasts for Ohio River tributary gage points, is automatically generated by the water control system. Subsequent to final modeling and certification, the report is transmitted to the Division Office Water Management Branch via leased line. During weekends and holidays, the report contains only observed district data. The reported items are prepared in accordance with ORDER 1110-2-20, CHORD-ED-W lt, 10 Jul 1969, CHORD-ED-W lt, 23 Jan 1967, and ORDER 1110-2-17.

Daily or more frequent briefings of the District Engineer and Chief Engineer containing pertinent hydrologic and meteorologic information are made during flood or other emergencies.

(2) Weekly. Each week a list of 24-hour reservoir effects at tributary gage points is transmitted to LRD. The list, which gives flows in cfs held out from or added to the natural flow, shows the data for the current week. All of the key gage points are reported for Branchland, West Virginia, for the Guyandotte Basin; Charleston for the Kanawha Basin; Palestine, West Virginia, for the Little Kanawha Basin; McConnelsville, Ohio, for the Muskingum Basin; Athens, Ohio, for the Hocking Basin; Higby, Ohio, for the Scioto Basin; Grayson, Kentucky, for the Little Sandy Basin; Louisa, Kentucky, for the Big Sandy Basin; and Wayne, West Virginia, for the Twelvepole Basin.

(3) Monthly. Engineer Regulation No. 1110-2-240, dated 8 October 1982 requires that a monthly record of reservoirs operated by the District be promptly prepared by Water Control Section according to 33 CFR 208.11 and maintained in tabular form readily available for transmittal to the Chief of Engineers or others on request.

(4) Quarterly Reservoir Operations. Each District provides a quarterly review of meteorological influences and water control management activities to each of the four yearly meetings of the Reservoir Operations Coordinating Group. Huntington District personnel of the Water Control Section summarize and compare weather experienced with long-term normals and actual streamflows to mean annual values. They describe seasonal features of operation such as spring filling, summer outflow temperature control or fall drawdown, frozen lakes and effect of river ice on navigation, in addition to any significant flood control operations and damages prevented.

(5) Annual. The Division Engineer is required by ORDR 1110-2-27 and CEORD-ED-W Ltr, 30 Sep l977 to submit to OCE for approval an annual report on reservoir regulation activities of significance during the fiscal year ending and programs proposed for the year following. This report summarizes the water control activities throughout the Ohio River Basin. Therefore district input is mandatory. The following documentation of district programs and activities is requested by 1 November of each year:

(a) A brief summary highlighting the significant accomplishments attributed to each reservoir during the preceding fiscal year.

(b) Water Control Manual submission schedule.

(c) Concise reports on major accomplishments concerning personnel, training, model application, ADP use, data reporting and analysis, and general improvements in reservoir regulation activities.

By Executive Order 12088, the President ordered that the head of each Executive Agency to be responsible for ensuring that all necessary actions are taken for prevention, control, and abatement of environmental pollution with respect to Federal facilities and activities under control of the agency. Annual Division Water Quality reports are required by ORDR-2-26. The report is submitted in two parts. The first part addresses the division Water Quality management plans while the second part presents specific project information. A major objective of this report is to summarize information pertinent to overall water management responsibilities. Generally, the Annual Division Water Quality Report will be submitted as part of the Annual Report on Water Control/Management activities required by ER 1110-1-1400. An Annual Water Quality Report by Districts to LRD includes narrative and tabular summaries of water quality activities and conditions in the Districts. The 1986 Huntington District report by the Water Quality Section of Water Resources Engineering Branch contains a synopsis of activities, specific cases of interest, improvements during the year, and plans for future emphasis in the narrative portion of the report. The tabular portion includes an overview of water quality activities, an overview of water quality conditions, specific water quality control actions in coordination with the Water Control

Section, special studies aimed at identification or solution of problems and problems requiring special studies with schedule for executing the studies. The annual Water Quality Report is to be submitted by 1 December of each year.

b. Special Reports.

(1) Reports on Reservoir Operations During Flood Emergencies. Information on reservoir operations to be included in reports submitted to the Chief of Engineers during flood emergencies in accordance with ER 500-1-1 include rate of inflow and outflow in cfs reservoir levels, predicted maximum level and anticipated date, and percent of flood control storage utilized to date. Maximum use should be made of computerized communication facilities in reporting project status to DAEN-CWO-E/CWE-HY in accordance with the requirements of ER 500-1-1.

(2) Post-Flood Report. Information on the operation of the affected reservoirs is gathered in accordance with ER 500-1-1. This report provides details on antecedent meteorologic and hydrologic conditions, description of the performance of the dam and appurtenant works, detailed analysis of the operating procedures, and effects of reservoir operation on Levisa Fork, Big Sandy River, and the Ohio River. Reservoir effects include evaluation of the stage reductions at key stations and estimates of damages prevented. Conclusions are discussed with regard to adequacy of operating technique, performance of structures, and benefits derived from operations during the flood. The outline of a typical post flood report is given below.

I - Authority, Purpose And Scope

II - Basin Description
Impact of Flood

III - General Precipitation
Storms and Reservoirs

IV - Damages and Flooding

V - Antecedent Rainfall
Storm Rainfall and Runoff

VI - General Method of Operation
Emergency and Standing Instructions
Flood Control Operations during Storms
Special Operations
Operations during Release Period
Results of Operation
Flood Damages Eliminated

(3) Fiscal year budget requests. Fiscal year budget requests for water control management activities will be prepared and submitted to the Office of the Chief of Engineers in accordance with requirements established in Engineer Circular on Annual Budget Requests for Civil Works Activities. The total annual costs of all activities and facilities that support the water control functions, (excluding physical operation of projects, but including flood control and regulation of navigation projects subject to .33 CFR 208.11) are to be reported. Information on Water Control Data Systems and associated Communications Category of the Plant Replacement and Improvement Program will be submitted with the annual budget. Reporting will be in accordance with an Engineer Regulation and the annual Engineer Circular on Civil Works Operations and Maintenance, General Program.

(4) The Chief of Engineers. The Chief of Engineers and staff require information to respond to inquiries from members of Congress and others regarding runoff potentials. Therefore, the Division Engineer will submit a snowmelt runoff and flood potential letter report covering the snow accumulation and runoff period, beginning generally in February and continuing monthly, until the potential no longer exists. Dispatch of supplemental reports will be deter- mined by the urgencies of situations as they occur. The reports will be forwarded as soon as hydrologic data are available, but not later than the l0th of the month. For further information on reporting refer to ER 500-1-1.

(5) Major Drought Situations. During major drought situations or low-flow conditions, narrative summaries of the situation should be furnished to alert the Chief of Engineers regarding the possibility of serious runoff deficiencies that are likely to call for actions associated with Corps of Engineers reservoirs.

(6) Master Plans. Master plans for water control data systems and significant revisions thereto will be prepared by Division water control managers and submitted to HQDA (DAEN-CWE-HY) WASH DC 20314 for review and approval of engineering aspects. Engineering approval does not constitute funding approval. After engineering approval is obtained, equipment in the master plan is eligible for consideration in the funding processes described in ER 1125-2-301 and Engineering Circulars on the Annual Budget Request for Civil Works Activities. Master plans are maintained current and will be updated as necessary to meet needs.

Modified master plans are submitted by 1 February if revisions are required to include equipment not previously approved or for changes in scope or approach. Submittal by the February date allows adequate time for OCE review and approval prior to annual budget submittals.

(7) Miscellaneous. Any additional or pertinent reports required from higher authority will be promptly compiled and transmitted.

Table 9-1

Huntington District Reports By Water Resources Engineering Branch

Periodic Reports

Frequency	Report
Daily	ORH Form 2347A - Morning reservoir pool elevation and discharge.
	ORD Form 85 – 24-hour rainfall, morning stage, flow and five-day flow forecast at Ohio River tributary gage points.
	ORH Form 2347B – Three-day pool and outflow forecast.
Weekly	Reservoir effects at Ohio River tributary gage points. Oral presentation of current reservoir and stream information and current and forecast weather information applicable to water control management.
Monthly	Record of District reservoirs available on request.
Quarterly	Review of meteorological influences on water control management activities to Reservoir Operations Coordinating Group.
Annually	Summary of significant reservoir regulation activities for the year and of programs proposed for the following year.
Special Reports	
Daily or more frequent briefing of District Engineer and Chief Engineer during flood or other emergencies containing hydrologic, meteorologic, and operational information.	
Information relevant to flooded area or situation to the Emergency Operations Center (when functioning) such as pertinent data about the area, copies of reservoir morning and extra reports, relay of any verbal reports, and relevant NWS Weather Wire zone forecasts and special bulletins.	
Reports on reservoir operations to OCE during flood emergencies including inflow, outflow, pool elevation, predicted crest, and maximum storage utilization to date.	
Post-flood report.	
Budget requests for water control management activities to OCE.	
Snowmelt runoff and flood potential letter report to OCE.	
Narrative summaries of major drought or low-flow conditions likely to call for regulations of District reservoirs.	
Narrative plans for water control data systems and significant revisions thereto are submitted to HQDA (DEAN-CWE-HY) Washington, DC 20314, for review and approval of engineering.	

TABLE 4-2

Temperature Summary – Levisa Fork River Basin

Station	Years of Record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average Monthly and Annual Temperature, Degrees Fahrenheit														
Gary, WV	61	35.5	37.3	43.2	53.7	62.8	70.2	73.6	72.7	67.3	55.7	44.7	36.9	54.4
Pikeville, KY	43	38.4	40.9	48.3	58.2	66.8	74.3	77.4	76.7	70.7	59.9	47.1	39.0	58.2
Williamson, WV	80	36.3	38.2	46.3	55.9	65.6	73.4	76.7	75.7	70.0	58.4	46.0	37.8	57.1
Maximum Average Monthly and Annual Temperature, Degrees Fahrenheit														
Gary, WV	61	46.2	48.7	55.0	67.1	75.8	82.6	85.2	82.4	80.2	69.9	57.1	47.7	66.5
Pikeville, KY	43	48.0	51.8	60.4	72.1	80.6	86.9	89.3	88.7	83.8	73.4	57.8	48.9	70.4
Williamson, WV	79	46.7	49.1	58.4	69.2	78.8	85.3	87.9	86.9	82.1	71.2	57.2	47.8	68.4
Minimum Average Monthly and Annual Temperature, Degrees Fahrenheit														
Gary, WV	61	24.9	26.0	31.1	40.3	49.4	58.1	62.0	61.0	54.4	41.7	31.7	25.8	42.2
Pikeville, KY	43	27.3	30.5	34.6	44.4	50.9	61.5	65.6	62.0	57.6	44.4	26.7	29.2	45.8
Williamson, WV	80	26.7	27.2	34.2	42.5	52.4	61.4	64.3	64.2	64.2	46.2	34.3	28.2	45.0

TABLE 4-3

Precipitation Summary – Levisa Fork River Basin

Station	Years of Record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Maximum Monthly and Annual Precipitation, Inches														
Gary, WV	63	7.44	6.48	9.87	5.37	7.73	7.43	11.9	9.66	7.48	8.4	4.47	8.5	54.60
Pikeville, KY	74	8.39	8.96	10.4	7.17	9.62	11.5	12.5	10.8	8.54	9.3	9.81	7.0	57.00
Williamson, WV	79	7.98	8.28	11.8	9.12	9.45	10.4	11.0	10.3	8.97	7.4	7.40	8.2	68.12
Minimum Monthly and Annual Precipitation, Inches														
Gary, WV	63	1.06	1.16	1.48	0.67	1.07	1.32	2.04	1.34	0.59	0.3	0.87	1.2	27.48
Pikeville, KY	74	0.48	0.73	1.44	0.61	0.44	1.22	1.16	0.87	0.80	0.2	0.50	0.9	33.57
Williamson, WV	79	1.08	0.93	1.52	0.92	0.90	0.80	1.24	1.13	0.53	0.4	0.62	0.9	31.67
Average Monthly and Annual Precipitation, Inches														
Gary, WV	63	3.35	3.42	3.97	3.38	3.95	4.28	4.85	4.23	2.87	2.6	2.42	3.2	42.58
Pikeville, KY	74	3.80	3.69	4.31	3.65	3.79	4.29	4.76	3.93	3.02	2.4	2.82	3.2	43.76
Williamson, WV	79	3.80	3.38	4.43	3.76	4.03	4.44	4.80	4.01	2.79	2.5	2.90	3.5	44.39
Average Monthly and Annual Snowfall														
Gary, WV	18	7.0	6.4	3.1	.2							.8	3.8	21.3
Pikeville, KY	46	4.2	4.9	2.7	.1							.8	3.3	16.0

Table 5-1
Levisa Fork River Basin
Stream Gaging Network – Pertinent Data

Stream and Station	Zero Gage Elevation Feet NGVD	Drainage Area Sq. Mi.	Date Established Month/Year	Existing Station Facilities	Method of Obtaining Data
Levisa Fork near Big Rock	886.37	297	09/67	Analog –to-digital recorder, (ADR), electric tape (T), incremental shaft encoder (E), Data collection platform (DCP); with voice capability (voice). Tipping bucket precipitation gage	Project personnel call voice and include in regular and extra reports. Voice transmits to ORD downlink via GOES satellite; data retrieved by ORD Water Control System (WCS) and disseminated hourly to H&H Branch (H&HB) WCS.
Levisa Fork at Fishtrap Lake	NGVD	392	09/72	Stevens continuous recorder (strip chart), T, E, voice, and staff gage. Lake elevation remoted into office.	Project personnel view readout and include in regular and extra reports. Voice transmits to ORD downlink via GOES satellite; data retrieved by ORD WCS and disseminated hourly to H&HB WCS
Levisa Fork below Fishtrap Lake	660.00	392	09/72	Strip chart, T, E, Staff gage and manometer, weighing-type 8-inch precipitation gage, and DCP. Stage remoted into office.	Project personnel view stage readouts in office for inclusion in regular and extra reports. DCP transmits via GOES satellite; data retrieved by ORD WCS and disseminated hourly to H&HB WCS.
Levisa Fork at Pikeville	631.98	1,232	09/79	Strip chart, voice, wires weight staff gage, manometer ADR, tipping bucket precipitation gage, and DCP.	Project personnel call voice and include in regular and extra reports. Voice transmits to ORD downlink via GOES satellite; data retrieved by ORD WCS and disseminated hourly to H&HB WCS.

Table 5-1 (Cont'd)
Levisa Fork River Basin
Stream Gaging Network – Pertinent Data

Stream and Station	Zero Gage Elevation Feet NGVD	Drainage Area Sq. Mi.	Date Established Month/Year	Existing Station Facilities	Method of Obtaining Data
Levisa Fork at Prestonburg	636.91	1,702	03/60	Strip chart, voice, wire weight staff gage, manometer ADR and DCP.	Project personnel call voice and include in regular and extra reports. Voice transmits to ORD downlink via GOES satellite; data retrieved by ORD Water Control System (WCS) and disseminated hourly to H&H Branch (H&HB) WCS.
Levisa Fork at Paintsville	566.84	392	12/28	Strip chart, T, ADR, outside staff gage, stilling well, voice, and DCP.	Project personnel call voice and include in regular and extra reports. Voice transmits to ORD downlink via GOES satellite; data retrieved by ORD Water Control System (WCS) and disseminated hourly to H&HB WCS.
Big Sandy River at Fullers	568.02	3,870	11/51	Strip chart, ADR, outside staff gage, stilling well, voice.	Project personnel call voice and include in regular and extra reports. Voice transmits to ORD downlink via GOES satellite; data retrieved by ORD WCS and disseminated hourly to H&HB WCS.

Table 5-2
Precipitation Stations In and Near Levisa Fork Basin – Pertinent Data

Record From	Station	Equipment	Method of Obtaining Data	Reporting Criteria
1978 8/88	Virgie (1) (2)	8-inch Rain Gage Tipping bucket gage w/heater and data collection platform	Observer calls Louisville WSFO at 0700 plus follow-ups as needed. DCP transmits via GOES satellite to downlink very 4 hours. Data retrieved by ORD WCS and disseminated hourly to H&HB WCS.	0.01 at 0700, 24-hr precipitation. Extra report at 1330 and/or 1930 if 0.5 inch or more collected after 0730.
7/88	Pilgrim Knob, VA. (2)	Tipping bucket gage w/heater and data collection platform	DCP transmits via GOES satellite to downlink every 4 hours. Data retrieved by ORD WCS and disseminated hourly to H&HB WCS.	Data collection interval 60 minutes
1951	Grundy, VA, (1)	8-inch Rain Gage	Observer calls Louisville WSFO at 0700, and additional calls as necessary.	0.01 at 0700, 24-hr precipitation. Extra report at 1330 and/or 1930 if 0.5 inch or more collected after 0730.
1977	Fedscreek (1)	8-inch Rain Gage	Observer calls FRL at 0700, and additional calls as necessary.	0.01 at 0700, 24-hr precipitation. Extra report at 1330 and/or 1930 if 0.5 inch or more collected after 0730.
2/89	Phelps (1) (2)	8-inch Rain Gage	Observer calls Louisville WSFO at 0700, and additional calls as necessary.	0.01 at 0700, 24-hr precipitation. Extra report at 1330 and/or 1930 if 0.5 inch or more collected after 0730.

(1) Ohio River Network, cooperative with National Weather Service.
(2) Installation, maintenance, and ownership by Corps of Engineers.

Table 5-2 (Continued)
Precipitation Stations In and Near Levisa Fork Basin – Pertinent Data

Record From	Station	Equipment	Method of Obtaining Data	Reporting Criteria
3/84	Williamson (2)	Tipping Bucket gage w/heater and data collection platform.	DCP transmit via GOES satellite to downlink every 4 hrs. Data is retrieved by ORD WCS and disseminated hourly to H&HB WCS.	Data collection interval 60 minutes
1969 6/82	Fishtrap lake (1) (2)	8-inch Rain gage tipping bucket	Project personnel gage collector and include reading in morning report. DCP transmits via GOES satellite to downlink every 4 hrs. Data is retrieved by ORD WCS and disseminated hourly to H&HB WCS.	Daily at 0730, 24-hr precipitation. Extra report at 1330 if 0.5 inch or more collected after 0730. Data collection interval 60 minutes.
1981	Pikeville (3) (2)	8-inch rain gage tipping bucket gage w/heater and data collection platform.	Observer calls WSFO at 0700 plus follow-ups are necessary. DCP transmits via GOES satellite to downlink every 4 hrs. Data is retrieved by ORD WCS and disseminated hourly to H&HB WCS.	0.01 at 0700, 24-hr precipitation. Extra report at 1330 and/or 1930 if 0.5 inch or more collected after 0730. Data collection interval 60 minutes.
	Big Rock, VA (2)	Tipping bucket	DCP transmits via GOES satellite to downlink every 4 hrs. Data is retrieved by ORD WCS and disseminated hourly to H&HB WCS.	DATA COLLECTION INTERVAL 60 MINUTES

(1) Ohio River Network, cooperative with National Weather Service.
(2) Installation, maintenance, and ownership by Corps of Engineers.
(3) Non-network.

Table 5-5
High Water Notification

Area	Party Warned	Manner of Issuance	Criterion	Action Taken	Telephone Number
Any work site	Person in charge	In Person	Special directives from H&HB or other indication of probable change in lake level affecting work.	Advise person in charge to take necessary action in planning or executing work.	N/A
Marina	Marina operator	Telephone	Special Directive from H&HB to begin spring filling, fall drawdown, or after regulation affecting lake level. Critical elevation 765.00.	Advise operator to take necessary precaution; Operates cable and winches.	606-432-8638
Grapevine Creek	Marina operator	In Person	Indication of pool rise to critical elevation 758.00.	Advise operator to take necessary precaution; operates cable and winches.	N/A
Downstream	Public	Radio and Telephone	Unusual releases made from dam.	Advise campers and recreation areas.	606-437-4057

Table 8-1
Reductions Effected During Selected Floods on Levisa Fork at Key Stations

Flood	Natural Stage (feet)	Modified Stage due to Dewey Reservoir (feet)	Modified Stage due to Dewey Plus John W. Flannagan Reservoirs (feet)	Modified Stage due to Dewey plus John W. Flannagan plus Fishtrap Reservoir (feet)	Reduction attributed to Fishtrap Reservoir (feet)
March 1929					
Pikeville (1)	44.6	--	41.4	33.9	7.5
Prestonsburg (1)	44.5	--	40.5	34.8	5.7
Paintsville	41.0	39.4	34.9	31.0	3.9
February 1939					
Pikeville (1)	39.9	--	36.4	27.9	8.5
Prestonsburg (1)	42.9	--	40.4	36.2	4.2
Paintsville	42.1	39.4	37.3	34.5	2.8
February 1948					
Pikeville (1)	36.3	--	33.4	28.2	5.2
Prestonsburg (1)	37.8	--	35.8	32.8	3.0
Paintsville	39.2	35.9	34.4	32.4	2.0
March 1955					
Pikeville (1)	39.1	--	36.0	30.3	5.7
Prestonsburg (1)	41.4	--	39.1	34.3	4.7
Paintsville	45.0	41.3	38.6	33.1	5.5

Table 8-1 (Cont'd)
Reductions Effected During Selected Floods on Levisa Fork at Key Stations

Flood	Natural Stage (feet)	Modified Stage due to Dewey Reservoir (feet)	Modified Stage due to Dewey Plus John W. Flannagan Reservoirs (feet)	Modified Stage due to Dewey plus John W. Flannagan plus Fishtrap Reservoir (feet)	Reduction attributed to Fishtrap Reservoir (feet)
January 1957					
Pikeville (1)	52.7	--	48.6	40.6	8.0
Prestonsburg (1)	48.7	--	42.4	34.5	7.9
Paintsville	48.1	46.0	40.3	33.5	6.8
March 1963					
Pikeville (1)	52.0	--	46.2	35.6	10.6
Prestonsburg (1)	48.8	--	42.0	35.2	6.8
Paintsville	44.9	44.2	40.4	35.4	5.0
April 1977					
Pikeville (1)	65.5	--	61.3	56.8	9.2
Prestonsburg (1)	57.5	--	53.9	50.5	7.7
Paintsville	53.0	51.9	50.4	48.0	6.2

(1) Not affected by Dewey Reservoir.

Table 8-2

Flood Stage Reductions Effected During Selected Floods on the Ohio River at Ashland, Kentucky

Flood	Natural Stage 1/ (feet)	Modified Stage due to John W. Flannagan Reservoir (feet)	Modified Stage due to John W. Flannagan and Fishtrap Reservoir (feet)	Reduction attributed to Fishtrap Reservoir (feet)
January 1937	73.3	73.1	72.9	0.2
February 1939	60.5	60.3	59.6	0.7
December 1942	63.4	63.3	63.1	0.2
March 1945	63.0	62.8	62.5	0.3
February 1948	54.6	54.3	53.9	0.4
April 1948	65.2	65.1	64.9	0.2
December 1950	56.7	56.5	56.3	0.2
March 1955	63.2	62.7	61.9	0.8

1/ Natural as modified by existing reservoirs at time of flood and Dewey Reservoir.

BIG SANDY RIVER BASIN

KENTUCKY

PERTINENT DATA

LOCATION OF PROJECT

Fishtrap Lake is located on Levisa Fork of Big Sandy River in Pike County, Kentucky. The dam site is 103.3 miles above the mouth of Levisa fork and 130.1 miles above the mouth of the Big Sandy River, Kentucky.

TYPE OF PROJECT

Flood Control, Water Quality Control, Low-flow augmentation, Recreation, fish and Wildlife Conservation.

AUTHORITY

Flood Control Act of 1938, H. R. 10618, Public Law No. 75-7611, 75th Congress, third session.

PURPOSES

For reduction of flood damages on Levisa Fork, Big Sandy, and Ohio Rivers; provide water quality control for low-flow augmentation in stream below dam, and provide water conservation for recreation and conservation of fish and wildlife.

DRAINAGE AREAS	**(Square Miles)**
Levisa Fork at Big Rock, Virginia (inflow)	297
Levisa Fork at Fishtrap dam site	392
Russell Fork at Elkhorn City U.S.G.S. gage	554
Russell Fork at mouth	680
Levisa Fork at junction with Russell Fork	400
Levisa Fork at Pikeville U.S.G.S. gage	1237
Levisa Fork at Paintsville U.S.G.S. gage	2143
Levisa Fork at Prestonsburg U.S.G.S. gage	1701
Big Sandy River at Louisa U.S.G.S. gage	3892
Big Sandy River at mouth	4290

FISHTRAP LAKE DAM

PERTINENT DATA (Cont'd)

STREAMFLOW DATA	**(Cubic feet per second)**
Average annual flow at Fishtrap, Kentucky	444
Maximum peak discharge, January 1957	33,000
Minimum discharge	0.1

RESERVOIR DATA	**Elevations (Feet above NGVD)**
Top of dam (without camber)	845.3
Maximum water surface (spillway design flood)	840.3
Guide taking line	830
Top of flood control pool	825
Spillway Crest	790
Seasonal conservation pool	757
Minimum conservation pool	725
Stream channel at dam site	673

Capacities	**Acre Feet**	**Inches Runoff**
Minimum conservation storage	10,530	0.50
Seasonal conservation storage	37,720	1.79
Flood Control Storage		
Seasonal	126,640	6.01
Winter	153,830	7.30
Total Storage	164,360	7.80

	Surface Areas (Acres)
Minimum conservation pool	569
Seasonal conservation pool	1131
Maximum Flood Control pool	2631

FISHTRAP LAKE DAM

PERTINENT DATA (Cont'd)

DAM

Type - Rolled rockfill dam with Central impervious core	
Maximum height, feet above bottom of channel	195
Top length, feet	1100
Top Width, feet	32
Maximum base width, feet	990

SPILLWAY

Type – Concrete with a controlled ogee crest	
Crest Width, feet	258
Crest length, feet	228
Crest elevation, feet above NGVD	790

Spillway design flood

Maximum natural flow in cfs	320,000
Maximum inflow in cfs	362,400
Maximum outflow in cfs	308,400
Maximum surcharge in feet	15.3
Tainter gates, number	4
Tainter gates, size	57' wide by 37' high

OUTLET WORKS

Type - intake structure with tunnel transition and stilling basin	
Shape of tunnel - Horseshoes tunnel	
Size of tunnel, diameter in feet	15.50
Length of tunnel, feet	775
Number of slide gates	3
Size of slide gates, feet	6x12
Invert elevation, sluice gates, feet above m.s.l.	682
Capacity of sluice gates at spillway elevation 825 feet above NGVD, cfs	13,800
Number of low-flow inlets	3

FISHTRAP LAKE DAM

PERTINENT DATA (Cont'd)

Size of low-flow intake in feet	6x4
Invert elevations, low-flow inlets, ft above NGVD	715, 731, & 747
Number of low-flow slide gates	1
Size of low-flow conduit, diameter in inches	3x6
Capacity of low-flow slide gate at minimum pool elevation 725 feet above NGVD, cfs	408
Type of stilling basin	conventional jump

DATES

Construction of project initiated	Mar 1961
Construction of project outlet works initiated	Apr 1964
Construction of dam initiated	Mar 1965
Construction of outlet works completed	Sep 1965
Construction of spillway initiated	Mar 1966
Dam closure	Oct 1968
Dam placed in operation	Oct 1968
Construction of spillway completed	Nov 1968
Construction of dam completed	Feb 1969
Construction of project completed	1/

1/ Major construction complete

STATUS

Dam and spillway were completed during February 1969. Concrete hang-on walls were added to the outlet works channel on the left side and gravity walls were added on the right side completed in 1985.

COST

Construction Cost	$54,297,500
Estimated Recreation (code 711) funds	$362,600
Expended through 30 Sept 1981	$362,600
Estimated Recreation (code 713) funds	$10,000
Operation and Maintenance through 30 Sept 1988	$7,658,519

U.S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
HUNTINGTON, WEST VIRGINIA

BIG SANDY RIVER BASIN
KENTUCKY, VIRGINIA, AND WEST VIRGINIA

PROJECT MANUAL
FOR
WATER CONTROL MANAGEMENT
FISHTRAP LAKE – LEVISA FORK, KENTUCKY

INSTRUCTIONS TO DAMTENDER
FISHTRAP LAKE
2001

EXHIBIT B

INSTRUCTIONS TO DAMTENDER

FISTRAP LAKE – LEVISA FORK, KENTUCKY

U.S. ARMY CORPS OF ENGINEERS
HUNTINGTON DISTRICT
JULY 2001

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SECTION I - GENERAL OPERATION INSTRUCTIONS

1-01 GENERAL

The instructions given in this section shall be followed at all times, except when other operations are required by Special Directives issued by the Water Control Section of the Huntington District Office.

a. Instructions contained in Special Directives will be applicable for a specific operation or for a stated period of time. After the instructions specified have been executed, resume operations in accordance with the following general instructions.

1-02 GATE REGULATION TECHNIQUE

a. General. Facilities provided for water control include 3 sluice gates for normal and most flood flows in a dry well type intake structure, a low flow system with three intakes at different levels for water quality and temperature control, and a four-gated spillway for extreme floods. Speed of movement of the gates is controlled by the mechanism in all cases. Sequence and manner of operation, where applicable, appear in subsequent paragraphs. Under normal conditions, including filling, drawdown, and routine flood control operations the gates are to be operated in such a manner as to limit the maximum change in stage at the Outflow "O" gage of 1.0 foot per hour. This rate of change in stage is equivalent to the natural rate and is not to be exceeded except under Special Directive from the Water Control Section or, in emergency conditions, or under provisions of sub-section 1-06 and 1-07. In order to support downstream aquatic environment, minimum outflows of 10 cfs (10.0 feet on the outflow gage) from 1 December through 31 March; or 100 cfs (10.8 feet on the outflow gage) from 1 April through 30 November will be maintained including closures for flood control.

During the period of lake stratification, usually May through October, all releases are to be made through the low flow system except during rises. During rises, some outflow temperature control can be effected by mixing the warmer water from upper levels in the lake with colder bottom water through a sluice gate. However, when the lake level is above elevation 763 feet, no discharges may be made from the low flow system. This is to prevent damage to internal mechanisms by possible rupture of a grating in the service platform should it become clogged with debris. Special instructions will be provided by Water Control Section for all outflow temperature regulation.

b. Sluice Gates. Fishtrap Lake has three 6′ x 12′ sluice openings with hydraulically operated high pressure slide gates. They are designated SL, SC & SR for sluice left, center and right facing downstream. **Plates 1-1, 1-2 and 1-3** at the end of this section show tabulations of the approximate flows and stages at 'O' gage which will occur for various conditions of lake level and gate openings. Using these tables as a guide, the approximate gate openings

required to maintain a designated control stage at the ‘O’ gage can be determined. When the flow at the ‘O’ gage has stabilized, after making the gate settings as determined by the table, only a minor adjustment of the gates should be necessary to establish the desired stage.

c. Low Flow Control System. Intake gates are in the upstream face of the intake structure with inverts at elevations 747, 731 and 715 feet above mean sea level. The gates are 6’ x 4’ hydraulically operated, unseating-type slide gates and may be utilized singly or jointly but only in fully open or fully closed position. They are designated according to depth below MIANO (mid-April through November) pool elevation, 757 feet. Thus the intake with invert at 747 feet is designated 110, that at 731, 126 and the one at 715, 142. The intakes open into a common well which is emptied by a horizontal 3’ x 6’ conduit containing the low flow control gate, LFC. LFC is a 3’ x 6’ hydraulically-operated slide gate with invert at elevation 685 feet.

"Low Flow Control Gate Rating - Single Intake," **Plate 1-4** at the end of this section, is a tabulation of approximate discharge from the low flow system with one intake open at a time. The flow and stage values shown for various openings of LFC at certain lake elevations can be expected as long as the lake elevation is at least 1 foot higher than the top of the particular intake gate being used. Since the gates are 4 feet tall, the lake elevation must be at least 5 feet higher than the invert elevation of the gate for the table flow values to be most nearly accurate. One caution must be observed when operating on single intake; that is never to open LFC more than 1.6 feet. This is to avoid the possibility of high velocity damage to the intake mechanism.

"Low Flow Control Gate Rating - Multiple Intakes," **Plate 1-5** is provided for use when more than one intake is open.

d. Spillway Tainter Gates. The four spillway gates provided are radial lift type tainter gates, 57’ x 35’ each. They open upward from the spillway crest at 790 feet elevation and are designated T1 through T4 from left to right facing downstream. Aside from test procedures or Operation by Special Directive, they are operated only when called for by "Emergency Operation Schedule", **Plate 1-6**, and then simultaneously, maintaining equal openings as far as possible.

1-03 ROUTINE OPERATION

Rule Curves for Regulation, **Plate 1-7** which appears at the end of this section, shows the two basic elevations, to operate Fishtrap Lake. During the approximate period 1 December through 31 March the pool is held at elevation 725 feet NGVD, and during 15 April through 31 October the pool is maintained at elevation 757 feet NGVD.

Regulation for maintaining pool levels under routine conditions and release of minor storage accumulations may be determined by the Damtender. Minor storage accumulations are defined as impoundments up to two feet above designated pool elevation. The maximum release rates for the lake without any directives are 2080 cfs, 15.7 feet on

the “O” gage, or 3650 cfs, 18.6 feet on the “O” gage, during MIANO* or DEMIA* respectively, unless under specifical directive or under conditions of 1-06 or 1-07 below. Special instructions will be issued about 1 April for raising the pool to summer water supply level of 757.0 feet NGVD.

Lowering of the lake level to winter water supply level of 725.0 feet NGVD will begin after Labor Day. The Water Control Section will assess current and anticipated hydrologic conditions and determine the optimal usage for impounded seasonal storage during the drawdown period.

Seasonal Pool may be retained beyond Labor Day to accommodate recreational interests or possibly drawn down to provide beneficial downstream usage during less than normal conditions.

1-04 REGULATION FOR OUTFLOW TEMPERATURE AND DOWNSTREAM WATER QUALITY CONTROL

One of the aims of water control management is maintenance of natural water temperature conditions downstream. To this end and specifically to avoid thermal shock to downstream aquatic communities outflow temperature is regulated within a ± 2°F band around the natural stream temperature. "Outflow Temperature Objective" (**Plate 7-2** in the Fishtrap Lake Water Control Manual) is a year long graph of this band of desired outflow temperature by calendar day and Julian day and is to be found in the front part of the manual.

During the period of lake stratification, approximately mid-April through mid-October, project personnel take weekly temperature and dissolved oxygen data in the lake and send it to Water Resources Engineering Branch where they are are computer-plotted into Water Quality Profiles. Branch personnel, considering the depths of low-flow intakes in the lake, use the latest profile in conjunction with the target temperature for the day from **Plate 7-2** (middle curve, main text), and hourly outflow temperature readings to devise an acceptable scheme of regulation. Then a Special Directive is telephoned to the Project providing details of gate operation. Any and all gate changes for temperature control purposes require a Special Directive from the Water Control Section.

1-05 REGULATION FOR DOWNSTREAM FLOOD CONTROL

During reservoir regulation activity for flood control, outflow corresponding to a stage during MIANO season of 20.3 feet on the “O” gage, 4650 cfs or to a stage during DEMIA season of 25.5 feet 8090 cfs can be maintained without causing appreciable damage along Levisa Fork downstream to the Pikeville gage under conditions of light rainfall. However, these higher channel capacity discharges, or any discharge above 15.7 feet MIANO or 18.6 feet DEMIA on the “O” gage must be authorized by Special Directive from the Water Control

* Acronyms for “1 December to Mid-April” and “mid-April through November”

Section. Special Directives will be issued by Water Control Section to avoid exceeding control stages listed in **Table 1-1**, below.

Table 1-1

Control Stages And Travel Times

Station	River	Summer (16 Apr – 30 Nov)		Winter (1 Dec – 15 Apr)		Time of Travel (hrs)
		Stage (feet)	Flow (cfs)	Stage (feet)	Flow (cfs)	
Fishtrap Dam	Levisa Fork	20.3	4,651	25.5	8,089	---
Pikeville (2)	Levisa Fork	23.0	12,700	31.6	20,940	5
Prestonsburg	Levisa Fork	21.0	14,800	33.0	28,220	21
Paintsville	Levisa Fork	20.0	15,100	29.0	24,800	29
Louisa (Fullers)	Big Sandy	45.0	*	45.0	*	46
Ashland	Ohio	53.0	*	53.0	*	72 (1)

* Slope station rating
1 Operational time prior to crest stage in excess of 53.0 feet
2 New gaging station

If the outflow stages of 20.3 feet MIANO and 25.5 feet DEMIA were maintained when there was significant rainfall and/ or snowmelt over the uncontrolled drainage areas, the combined flows might cause flooding downstream.

Operation for Pikeville is based on stages at the USGS gage there and the approximate 5-hour time of water travel from the project to the gage. MIANO control stage is 23.5 feet and DEMIA 32.4 feet.

The National Weather Service forecast is used for the Operation for the Ohio River at Ashland and the travel time is noted as operation time. Releases are timed so as not to add to the crest at Ashland, Kentucky, or at other stations downstream along the Ohio River.

1-06 OPERATION DURING COMMUNICATIONS FAILURE

During flood periods, every effort shall be made to contact personnel of the Water Control Section. If both radio and telephone facilities fail, solicit the cooperation of local radio and TV stations, amateur and citizens band radio operators, or the State Police. The emergency procedure outlined below shall be followed during periods when the Water Control Section cannot be contacted.

a. If a Special Directive was in effect prior to communications failure, follow the operating instructions contained in the Special Directive until:

(1) The specific operation given in the Directive has been completed, or

(2) Twenty-four hours have elapsed since last contact with the Water Control Section either through the Area Office or otherwise, or

(3) Sufficient rainfall or snowmelt occurs which causes the lake and/or streams in the vicinity to rise rapidly.

b. Whenever any of the foregoing conditions occur, follow the operating instructions contained in sub-sections 1-03, 1-04, 1-05 or 1-07, whichever is applicable.

1-07 EMERGENCY OPERATION

a. General. The rate of rise curves on **Plate 1-6**, Emergency Operation Schedule, shall be used to operate the reservoir in cases where the rate of rise in the lake levels indicate that the available storage capacity of the project may be insufficient to completely control a given flood.

Whenever the lake level is above elevation 788.0 feet NGVD and rising, a constant check shall be made on the rate of rise of the lake level. The lake gage shall be read every hour, on the hour, and the rise in lake level computed for the previous hour. Enter the "Emergency Operation Schedule" **Plate 1-6** with the current lake level and the computed rate-of-rise in feet per hour to obtain the required tainter gate openings.

Should the required tainter gate settings differ from the current gate settings, contact the Water Control Section immediately for operating instructions. In the event of failure of normal means of communication (radio and telephone), continuous and vigorous effort shall be made to contact the Water Control section as described in sub-section 1-06.

b. Communication Failure. Authorization is hereby given to operate the project in accordance with the "Emergency Operation Schedule" (**Plate 1-6**) when there is a greater delay than three hours, in establishing contact with the Water Control Section, from the time that the curves indicate gate settings greater than those being maintained in accordance with other instructions. In such emergency operation, follow the procedures described below.

(1) Emergency operation shall be based on the last readings taken and no attempt shall be made to make up for any missed operation steps. The required sluice gate settings shall be executed as soon as they are determined from the "Emergency Operation Schedule", **Plate 1-6**.

(2) One hour after the previous reading, the lake gage shall be read again, the new rate of rise computed and the required gate settings executed as determined from "Emergency Operation Schedule".

(3) When lake level is below elevation 825.0, use the lower set of curves. If and when the pool level first reaches 825.0, close all sluices and raise all tainter gates as uniformly as possible to the opening indicated by the upper set of curves. If the pool

continues to rise such that the tainter gates are raised clear of the water, open the sluice gates fully to increase the discharge.

(4) If the pool level crests at or below elevation 825.0, hold the pool at that level until ordered by Special Directive to begin drawdown. If the pool level crests above elevation 825.0, maintain current gate settings until pool recedes to 825.0 closing tainter gates as necessary to maintain 825.0 until instructed by Special Directive to drawdown.

(5) If the lake level is at or above 825.0 and a second rise occurs, follow instructions outlined in paragraph b. below.

c. Induced Surcharge Curve Operation. The “Curve for Induced Surcharge Operation” which is shown as the upper limiting curve of "Emergency Operation Schedule" (**Plate 1-6**) provides for utilizing about seven feet of additional storage above maximum flood control elevation of 825.0 feet NGVD when required to regulate outflow to safe rates of increase during emergencies. During periods when the lake level is at or above elevation 825.0 feet NGVD and a second rise occurs, the instructions outlined below shall be followed.

(1) The operation required by the “Curve for Induced Surcharge Operation” **Plate 1-6**, shall be executed without delay and as often as necessary to conform to the induced surcharge curve.

If a second rise occurs while the crest gate setting is greater than 1.0 foot, maintain the setting of the four tainter gates until the pool level rises to the elevation corresponding to that gate setting on the "Curve for Induced Surcharge Operation." Follow this curve until the pool crests and then operate in accordance with subparagraph 1-07a.(4) above.

(2) If a second rise occurs when tainter gate settings are less than 1.0 foot, increase setting to one which intersects the current lake elevation below the Curve for Induced Surcharge Operation. Maintain that setting until the pool rises to the "Curve for Induced Surcharge Operation" and proceed as in (1) just above. If the pool does not rise that far, proceed as in 1-07a(4) above.

1-08 PUBLIC NOTIFICATION OF UNUSUAL RELEASES

Operation of reservoir projects during major floods has, on occassion, resulted in water releases being made which damaged privately owned equipment or facilities located downstream and caused claims or damage suits to be filed against the Government. To minimize the possibility of such claims or suits, Fishtrap Lake Project Supervisor and the Area Resource Manager must stay informed and inform Water Resources Engineering Branch of all developments along Levisa Fork between the dam and the Pikeville gage.

If required by unusual release patterns, obtain directions through the Area Office, from Water Control Section, who will coordinate the release with Public Affairs Office for public notification procedures. Unusual release patterns include closure for flood control, maintenance, inspection, or construction purposes, and

emergency, above channel capacity discharges. Notification of large releases is to afford those likely to be affected an opportunity to take remedial measures in advance of the release so as to prevent damage to or loss of their property.

FISHTRAP LAKE

SLUICE GATE RATING – ONE GATE PARTIAL OPENINGS

Discharge cfs	Stage at 'O' Gage	Gate Opening in Feet and Tenths at Lake Elevation												
		720	730	740	750	760	770	780	790	800	810	820	830	840
0	9.50	0	0	0	0	0	0	0	0	0	0	0	0	0
100	10.81	0.5	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
200	11.25	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5
300	11.59	1.4	1.3	1.2	1.1	1.0	1.0	0.9	0.8	0.8	0.8	0.7	0.7	0.7
400	11.88	1.9	1.7	1.5	1.4	1.3	1.2	1.2	1.1	1.1	1.0	1.0	1.0	0.9
500	12.16	2.4	2.2	1.9	1.7	1.6	1.5	1.4	1.4	1.3	1.3	1.2	1.2	1.1
600	12.43	2.8	2.5	2.3	2.1	2.0	1.9	1.7	1.7	1.6	1.5	1.5	1.4	1.4
700	12.68	3.4	3.0	2.7	2.5	2.3	2.2	2.1	1.9	1.9	1.8	1.7	1.7	1.6
800	12.93	3.8	3.4	3.1	2.8	2.6	2.5	2.3	2.2	2.1	2.0	2.0	1.9	1.8
900	13.17	4.3	3.8	3.4	3.2	3.0	2.8	2.6	2.5	2.4	2.3	2.2	2.1	2.1
1000	13.41	4.8	4.3	3.8	3.5	3.3	3.1	2.9	2.8	2.6	2.5	2.4	2.3	2.3
1100	13.64	5.3	4.7	4.2	3.8	3.6	3.4	3.2	3.1	2.9	2.8	2.6	2.6	2.5
1200	13.87	5.9	5.1	4.6	4.2	3.9	3.7	3.5	3.3	3.2	3.0	2.9	2.8	2.7
1300	14.09	6.2	5.6	5.0	4.6	4.3	4.0	3.8	3.6	3.4	3.3	3.2	3.1	2.9
1400	14.30	6.8	6.0	5.4	4.9	4.6	4.3	4.1	3.8	3.7	3.5	3.4	3.3	3.1
1500	14.50	7.3	6.4	5.8	5.3	4.9	4.6	4.4	4.2	4.0	3.8	3.6	3.5	3.4
1600	14.71	7.7	6.9	6.1	5.7	5.3	4.9	4.7	4.5	4.3	4.1	3.9	3.7	3.6
1700	14.92	8.3	7.2	6.6	6.0	5.6	5.2	5.0	4.7	4.5	4.3	4.1	4.0	3.8
1800	15.13	8.8	7.7	6.9	6.3	5.9	5.5	5.3	5.0	4.7	4.6	4.4	4.2	4.1
1900	15.34	9.4	8.1	7.3	6.7	6.2	5.9	5.5	5.3	5.0	4.8	4.6	4.5	4.3
2000	15.54	9.7	8.5	7.7	7.0	6.6	6.1	5.8	5.5	5.3	5.0	4.9	4.7	4.5
2100	15.74	10.2	8.9	8.1	7.3	6.9	6.4	6.1	5.8	5.6	5.3	5.1	4.9	4.8

PLATE NO. 1-1

FISHTRAP LAKE

SLUICE GATE RATING – ONE GATE PARTIAL OPENINGS

Discharge cfs	Stage at 'O' Gage	Gate Opening in Feet and Tenths at Lake Elevation												
		720	730	740	750	760	770	780	790	800	810	820	830	840
2200	15.94	10.8	9.3	8.4	7.7	7.2	6.7	6.4	6.0	5.8	5.6	5.3	5.2	5.0
2300	16.14	11.3	9.7	8.7	8.0	7.4	7.0	6.7	6.3	6.0	5.8	5.6	5.4	5.2
2400	16.34	11.9	10.2	9.2	8.4	7.8	7.3	6.9	6.6	6.3	6.0	5.8	5.6	5.4
2500	16.53	OPEN	10.6	9.5	8.7	8.1	7.6	7.2	6.9	6.6	6.3	6.0	5.8	5.6
2600	16.72		11.01	9.8	9.0	8.4	7.9	7.5	7.1	6.8	6.5	6.2	6.0	5.9
2700	16.91		11.52	10.2	9.4	8.7	8.2	7.8	7.3	7.0	6.8	6.5	6.3	6.1
2800	17.09		11.8	10.6	9.6	9.0	8.4	8.0	7.6	7.3	7.0	6.7	6.5	6.3
2900	17.28		OPEN	10.9	10.0	9.3	8.7	8.3	7.9	7.5	7.2	6.9	6.7	6.5
3000	17.46			11.3	10.3	9.5	9.0	8.5	8.1	7.7	7.4	7.1	6.9	6.7
3100	17.64			11.7	10.7	9.8	9.3	8.8	8.3	8.0	7.7	7.3	7.1	6.9
3200	17.82			OPEN	10.9	10.1	9.5	9.0	8.5	8.2	7.9	7.6	7.3	7.1
3300	18.00				11.2	10.4	9.7	9.3	8.8	8.4	8.1	7.8	7.5	7.3
3400	18.17				11.6	10.7	10.0	9.5	9.0	8.6	8.3	8.0	7.7	7.5
3500	18.34				11.9	11.0	10.3	9.6	9.3	8.9	8.5	8.2	7.9	7.7
3600	18.51				OPEN	11.3	10.6	9.9	9.5	9.1	8.7	8.4	8.2	7.9
3700	18.68					11.7	10.8	10.2	9.7	9.3	8.9	8.6	8.4	8.1
3800	18.85					OPEN	11.2	10.6	10.0	9.5	9.1	8.8	8.6	8.3
3900	19.02						11.5	10.8	10.2	9.7	9.4	9.0	8.8	8.5
4000	19.19						11.8	11.2	10.5	10.0	9.6	9.2	9.0	8.8
4100	19.32						OPEN	11.5	10.7	10.3	9.8	9.5	9.3	9.0
4200	19.54							11.8	11.0	10.5	10.1	9.7	9.5	9.2
4300	19.71							OPEN	11.2	10.8	10.4	9.9	9.7	9.4

PLATE NO. 1-1

FISHTRAP LAKE

SLUICE GATE RATING – ONE GATE PARTIAL OPENINGS

Discharge cfs	Stage at 'O' Gage	Gate Opening in Feet and Tenths at Lake Elevation												
		720	730	740	750	760	770	780	790	800	810	820	830	840
4400	19.88								11.5	11.0	10.6	10.2	9.9	9.6
4500	20.05								11.8	11.3	10.8	10.5	10.1	9.8
4600	20.22								OPEN	11.5	11.0	10.7	10.3	10.0
4700	20.38									11.8	11.3	10.9	10.5	10.2
4800	20.55									OPEN	11.5	11.0	10.7	10.4
4900	20.71										11.8	11.3	10.9	10.6
5000	20.87										OPEN	11.5	11.1	10.8
5100	21.04											11.7	11.3	10.9
5200	21.20											11.9	11.5	11.1
5300	21.36											OPEN	11.7	11.3
5400	21.52												11.9	11.5
5500	21.67												OPEN	11.7
5600	21.83													11.9
5700	21.99													OPEN

PLATE NO. 1-1

SHEET 3 of 3

FISHTRAP LAKE

SLUICE GATE MULTIPLE RATING – ONE GATE FULLY OPEN, SECOND GATE PARTIAL

Discharge cfs	Stage at 'O' Gage	Gate Opening in Feet and Tenths at Lake Elevation												
		720	730	740	750	760	770	780	790	800	810	820	830	840
2500	16.53	0.1												
2600	16.72	0.6												
2700	16.91	1.2												
2800	17.09	1.6												
2900	17.28	2.3	0.4											
3000	17.46	2.6	0.7											
3100	17.64	3.0	1.2											
3200	17.82	3.6	1.7	0.2										
3300	18.00	4.1	2.0	0.6										
3400	18.17	4.8	2.4	1.0										
3500	18.34	5.0	2.9	1.3										
3600	18.51	5.4	3.2	1.8	0.6									
3700	18.68	5.9	3.6	2.2	0.9									
3800	18.85	6.4	4.2	2.5	1.2	0.3								
3900	19.02	7.1	4.6	2.9	1.7	0.6								
4000	19.19	7.4	4.8	3.2	2.0	1.1								
4100	19.32	7.8	5.3	3.6	2.4	1.3	0.5							
4200	19.54	8.4	5.8	4.0	2.6	1.7	0.8							
4300	19.71	9.0	6.1	4.3	3.0	1.9	1.2	0.4						
4400	19.88	9.6	6.6	4.8	3.4	2.3	1.3	0.6						
4500	20.05	10.1	7.0	5.0	3.6	2.5	1.7	1.0						
4600	20.22	10.6	7.3	5.4	4.0	2.8	2.0	1.2	0.6					

PLATE NO. 1-2

FISHTRAP LAKE

SLUICE GATE MULTIPLE RATING – ONE GATE FULLY OPEN, SECOND GATE PARTIAL

Discharge cfs	Stage at 'O' Gage	Gate Opening in Feet and Tenths at Lake Elevation												
		720	730	740	750	760	770	780	790	800	810	820	830	840
4700	20.38	11.0	7.8	5.8	4.3	3.2	2.3	1.6	0.8					
4800	20.55	11.8	8.2	6.1	4.7	3.6	2.5	1.8	1.2	0.5				
4900	20.71	11.9	8.5	6.6	4.9	3.8	2.8	2.1	1.4	0.8				
5000	20.87	OPEN	9.0	6.9	5.3	4.2	3.2	2.4	1.7	1.1	0.5			
5100	21.04		9.5	7.2	5.5	4.4	3.5	2.6	1.9	1.3	0.7			
5200	21.20		9.7	7.6	6.0	4.8	3.7	2.9	2.2	1.6	1.1			
5300	21.36		10.1	7.8	6.1	4.9	4.0	3.1	2.4	1.8	1.3	0.7		
5400	21.52		10.7	8.3	6.6	5.3	4.3	3.4	2.7	2.1	1.5	1.0		
5500	21.67		11.1	8.6	6.9	5.6	4.6	3.6	2.9	2.4	1.8	1.2	0.8	
5600	21.83		11.5	9.0	7.0	6.0	4.8	3.8	3.1	2.5	1.9	1.4	1.0	
5700	21.99		11.9	9.4	7.4	6.2	5.2	4.2	3.4	2.8	2.2	1.7	1.2	0.7
5800	22.14		OPEN	9.6	7.8	6.5	5.4	4.4	3.6	3.0	2.4	1.9	1.4	1.0
5900	22.30			10.0	8.2	6.8	5.8	4.8	4.0	3.3	2.7	2.2	1.7	1.2
6000	22.45			10.3	8.4	7.1	5.9	5.0	4.2	3.6	2.9	2.4	1.9	1.4
6100	22.61			10.8	8.8	7.3	6.2	5.2	4.4	3.7	3.1	2.6	2.1	1.6
6200	22.76			11.0	9.1	7.7	6.5	5.5	4.7	4.0	3.4	2.8	2.3	1.8
6300	22.91			11.4	9.5	7.9	6.8	5.8	4.9	4.2	3.6	3.0	2.5	2.0
6400	23.06			11.8	9.6	8.3	7.0	6.0	5.2	4.5	3.8	3.3	2.7	2.3
6500	23.21			OPEN	10.1	8.5	7.3	6.2	5.4	4.7	4.1	3.5	2.9	2.5
6600	23.36				10.4	8.8	7.6	6.6	5.6	4.9	4.3	3.7	3.1	2.7
6700	23.51				10.8	9.1	7.8	6.8	6.0	5.2	4.5	4.0	3.4	2.9
6800	23.65				10.9	9.5	8.1	7.1	6.1	5.4	4.8	4.2	3.6	3.1

PLATE NO. 1-2

FISHTRAP LAKE

SLUICE GATE MULTIPLE RATING – ONE GATE FULLY OPEN, SECOND GATE PARTIAL

Discharge cfs	Stage at 'O' Gage	Gate Opening in Feet and Tenths at Lake Elevation												
		720	730	740	750	760	770	780	790	800	810	820	830	840
6900	23.80				11.4	9.7	8.4	7.3	6.5	5.6	5.0	4.4	3.8	3.4
7000	23.95				11.6	10.0	8.8	7.6	6.7	5.9	5.2	4.6	4.1	3.6
7100	24.09				OPEN	10.2	9.0	7.8	6.9	6.3	5.4	4.8	4.3	3.8
7200	24.24					10.7	9.2	8.2	7.2	6.4	5.6	5.0	4.5	4.0
7300	24.38					10.8	9.5	8.4	7.3	6.6	5.8	5.2	4.8	4.2
7400	24.53					11.0	9.7	8.6	7.7	6.8	6.0	5.4	4.9	4.4
7500	24.67					11.5	10.0	8.9	7.8	7.0	6.2	5.6	5.1	4.7
7600	24.81					11.8	10.2	9.1	8.2	7.2	6.5	5.8	5.3	4.9
7700	24.95					OPEN	10.6	9.4	8.4	7.4	6.7	6.1	5.5	5.1
7800	25.09						10.8	9.6	8.5	7.7	6.9	6.3	5.8	5.2
7900	25.09						11.1	9.8	8.8	7.9	7.2	6.5	5.9	5.4
8000	25.24						11.4	10.1	9.1	8.2	7.4	6.8	6.1	5.6
8100	25.38						11.6	10.3	9.3	8.4	7.6	7.0	6.2	5.8
8200	25.52						11.9	10.6	9.6	8.6	7.8	7.1	6.5	6.0
8300	25.65						OPEN	10.8	9.7	8.9	8.0	7.3	6.7	6.2
8400	25.79							11.0	10.0	9.1	8.2	7.6	7.0	6.3
8500	25.93							11.4	10.2	9.3	8.4	7.8	7.1	6.6
8600								11.5	10.4	9.6	8.7	7.9	7.3	6.8
8700								11.8	10.7	9.7	8.9	8.2	7.5	7.0
8800								OPEN	10.9	10.0	9.1	8.4	7.7	7.1
8900									11.2	10.2	9.4	8.6	7.8	73.
9000									11.4	10.5	9.6	8.8	8.1	7.5
9100									11.6	10.7	9.8	9.0	8.3	7.7

PLATE NO. 1-2

FISHTRAP LAKE

SLUICE GATE MULTIPLE RATING – ONE GATE FULLY OPEN, SECOND GATE PARTIAL

Discharge cfs	Stage at 'O' Gage	Gate Opening in Feet and Tenths at Lake Elevation												
		720	730	740	750	760	770	780	790	800	810	820	830	840
9200									11.9	10.8	10.0	9.2	8.4	7.8
9300									OPEN	11.0	10.2	9.4	8.6	8.0
9400										11.4	10.4	9.6	8.9	8.2
9500										11.5	10.6	9.8	9.1	8.4
9600										11.7	10.8	10.0	9.3	8.6
9700										11.9	11.0	10.2	9.5	8.8
9800										OPEN	11.3	10.4	9.7	9.0
9900											11.5	10.7	9.8	9.2
10000											11.7	10.8	10.1	9.4
10100											11.9	11.0	10.2	9.6
10200											OPEN	11.3	10.5	9.7
10300												11.5	10.6	9.9
10400												11.7	10.8	10.1
10500												11.8	11.0	10.4
10600												OPEN	11.2	10.6
10700													11.4	10.7
10800													11.6	10.9
10900													11.8	11.0
11000													OPEN	11.2
11100														11.4
11200														11.6
11300														11.8
11400														OPEN

PLATE NO. 1-2

SHEET 4 of 4

FISHTRAP LAKE

SLUICE GATE MULTIPLE RATING – TWO GATES FULLY OPEN, THIRD GATE PARTIAL

Discharge cfs	Stage at 'O' Gage	Gate Opening in Feet and Tenths at Lake Elevation												
		720	730	740	750	760	770	780	790	800	810	820	830	840
5000	20.87	0.1												
5100	21.04	0.8												
5200	21.20	1.2												
5300	21.36	1.6												
5400	21.52	2.1												
5500	21.67	2.8												
5600	21.83	3.2												
5700	21.99	3.9												
5800	22.14	4.6	0.5											
5900	22.30	5.0	0.8											
6000	22.45	5.7	1.2											
6100	22.61	6.6	1.6											
6200	22.76	7.7	2.1											
6300	22.91	8.8	2.6											
6400	23.06	11.6	3.0											
6500	23.21	OPEN	3.4											
6600	23.36		3.7	1.0										
6700	23.51		4.3	1.4										
6800	23.65		4.6	1.7										
6900	23.80		4.8	2.1										
7000	23.95		5.7	2.5										
7100	24.09		6.6	2.7	0.7									

PLATE NO. 1-3

FISHTRAP LAKE

SLUICE GATE MULTIPLE RATING – TWO GATES FULLY OPEN, THIRD GATE PARTIAL

Discharge cfs	Stage at 'O' Gage	Gate Opening in Feet and Tenths at Lake Elevation												
		720	730	740	750	760	770	780	790	800	810	820	830	840
7200	24.24		7.5	3.0	1.0									
7300	24.38		8.0	3.4	1.2									
7400	24.53		9.3	3.9	1.5									
7500	24.67		OPEN	4.3	1.8									
7600	24.81			4.5	2.1									
7700	24.95			4.8	2.6	0.8								
7800	25.09			5.5	2.9	1.0								
7900	25.24			6.4	3.1	1.2								
8000	25.38			6.8	3.5	1.5								
8100	25.52			7.5	3.8	1.9								
8200	25.65			8.3	4.1	2.1								
8300	25.79			9.7	4.5	2.4	0.9							
8400	25.93			OPEN	4.8	2.8	1.2							
8500					5.2	3.1	1.4							
8600					5.9	3.4	1.7							
8700					6.6	3.7	2.1							
8800					7.0	4.0	2.3	0.9						
8900					7.9	4.3	2.6	1.2						
9000					8.4	4.6	2.9	1.4						
9100					9.8	4.8	3.1	1.7						
9200					OPEN	5.3	3.5	1.9						
9300						5.8	3.7	2.3	1.0					

PLATE NO. 1-3

SHEET 2 of 5

FISHTRAP LAKE

SLUICE GATE MULTIPLE RATING – TWO GATES FULLY OPEN, THIRD GATE PARTIAL

Discharge cfs	Stage at 'O' Gage	Gate Opening in Feet and Tenths at Lake Elevation												
		720	730	740	750	760	770	780	790	800	810	820	830	840
9400						6.5	4.0	2.6	1.2					
9500						7.0	4.2	2.8	1.4					
9600						7.5	4.7	3.0	1.7					
9700						8.1	4.8	3.3	1.9					
9800						9.1	5.1	3.5	2.1	1.1				
9900						11.3	5.7	3.9	2.5	1.3				
10000						OPEN	6.2	4.1	2.7	1.6				
10100							6.6	4.4	3.0	1.8				
10200							7.3	4.6	3.3	2.0	1.0			
10300							7.6	4.8	3.5	2.3	1.2			
10400							8.2	5.2	3.7	2.5	1.5			
10500							9.1	5.6	4.0	2.7	1.7			
10600							11.1	6.1	4.3	3.0	1.9	0.9		
10700							OPEN	6.6	4.5	3.2	2.2	1.2		
10800								7.0	4.7	3.4	2.4	1.4		
10900								7.7	4.9	3.7	2.6	1.6		
11000								8.0	5.3	3.9	2.9	1.8	1.1	
11100								8.4	5.7	4.2	3.0	2.0	1.3	
11200								10.2	6.2	4.4	3.3	2.2	1.4	
11300								OPEN	6.6	4.7	3.4	2.5	1.6	
11400									7.0	4.8	3.7	2.7	1.8	1.1
11500									7.6	5.2	3.9	2.9	2.0	1.3

PLATE NO. 1-3

SHEET 3 of 5

FISHTRAP LAKE

SLUICE GATE MULTIPLE RATING – TWO GATES FULLY OPEN, THIRD GATE PARTIAL

Discharge cfs	Stage at 'O' Gage	Gate Opening in Feet and Tenths at Lake Elevation												
		720	730	740	750	760	770	780	790	800	810	820	830	840
11600									8.0	5.5	4.1	3.1	2.3	1.5
11700									8.8	6.1	4.4	3.4	2.5	1.7
11800									10.2	6.6	4.6	3.5	2.7	1.9
11900									11.9	7.0	4.8	3.7	2.9	2.1
12000									OPEN	7.4	5.2	4.0	3.0	2.3
12100										8.0	5.5	4.2	3.3	2.5
12200										8.4	5.9	4.4	3.4	2.7
12300										9.2	6.4	4.7	3.6	2.9
12400										10.9	6.9	4.8	3.8	3.0
12500										OPEN	7.3	5.2	4.0	3.3
12600											7.7	5.6	4.3	3.4
12700											8.2	6.0	4.5	3.6
12800											8.8	6.4	4.7	3.8
12900											10.2	6.9	5.0	4.1
13000											11.7	7.2	5.3	4.3
13100											OPEN	7.7	5.6	4.4
13200												8.0	6.1	4.6
13300												8.4	6.5	4.8
13400												9.8	6.9	5.2
13500												11.1	7.2	5.5
13600												OPEN	7.7	5.9
13700													8.0	6.2

PLATE NO. 1-3

FISHTRAP LAKE

SLUICE GATE MULTIPLE RATING – TWO GATES FULLY OPEN, THIRD GATE PARTIAL

Discharge cfs	Stage at 'O' Gage	Gate Opening in Feet and Tenths at Lake Elevation												
		720	730	740	750	760	770	780	790	800	810	820	830	840
13800													8.4	6.5
13900													9.5	6.9
14000													10.8	7.2
14100													OPEN	7.6
14200														8.0
14300														8.4
14400														9.3
14500														10.6
14600														11.6
14700														OPEN

PLATE NO. 1-3

SHEET 5 of 5

FISHTRAP LAKE
LOW FLOW CONTROL GATE RATING – SINGLE INTAKE

Discharge cfs	'O' Gage ft.	Gate Openings in Feet and Hundredths at Lake Elevation					
		725	750	754	757	760	763
10	10.00	0.08	0.07	0.06	0.06	0.06	0.06
20	10.16	0.18	0.14	0.13	0.13	0.13	0.13
30	10.29	0.27	0.21	0.20	0.20	0.20	0.20
40	10.40	0.38	0.28	0.27	0.27	0.27	0.27
50	10.49	0.47	0.36	0.34	0.34	0.33	0.33
60	10.57	0.57	0.43	0.42	0.41	0.39	0.39
70	10.64	0.66	0.50	0.48	0.48	0.46	0.45
80	10.71	0.75	0.57	0.55	0.54	0.53	0.51
90	10.76	0.84	0.64	0.62	0.61	0.59	0.58
100	10.81	0.93	0.71	0.69	0.68	0.65	0.64
110	10.86	1.01	0.79	0.76	0.75	0.72	0.71
120	10.90	1.10	0.86	0.83	0.82	0.79	0.77
130	10.95	1.19	0.93	0.90	0.89	0.86	0.84
140	11.00	1.28	1.00	0.97	0.95	0.93	0.91
150	11.05	1.38	1.07	1.04	1.02	1.00	0.98
160	11.09	1.49	1.14	1.11	1.09	1.07	1.05
170	11.13	1.59	1.21	1.18	1.16	1.14	1.11
180	11.18		1.28	1.25	1.23	1.20	1.18
190	11.21		1.36	1.32	1.30	1.27	1.24
200	11.25		1.43	1.39	1.36	1.34	1.31
210	11.29		1.51	1.46	1.43	1.40	1.37
220	11.33		1.59	1.53	1.50	1.47	1.44
230	11.36			1.60	1.57	1.53	1.50
240	11.39					1.59	1.57

PLATE NO. 1-4

FISHTRAP LAKE
LOW FLOW CONTROL GATE RATING – MULTIPLE INTAKES
I 26 AND I 10

Discharge cfs	'O' Gage ft.	Gate Openings in Feet and Hundredths at Lake Elevation				
		751	754	757	760	763
75	10.68	0.54	0.53	0.51	0.49	0.48
100	10.81	0.72	0.69	0.67	0.65	0.64
125	10.92	0.89	0.86	0.85	0.84	0.82
150	11.05	1.06	1.04	1.02	1.00	0.98
175	11.15	1.24	1.20	1.18	1.16	1.15
200	11.25	1.42	1.38	1.35	1.33	1.31
250	11.43	1.78	1.74	1.69	1.67	1.64
300	11.59	2.16	2.08	2.04	2.00	1.97
350	11.74	2.55	2.47	2.42	2.36	2.28
400	11.88	2.95	2.83	2.75	2.69	2.64
500	12.16	3.75	3.57	3.47	3.39	3.31
600	12.43	4.49	4.38	4.26	4.13	4.00
700	12.68	5.29	5.07	4.89	4.83	4.70
800	12.93	---	5.88	5.77	5.60	5.40

PLATE NO. 1-5

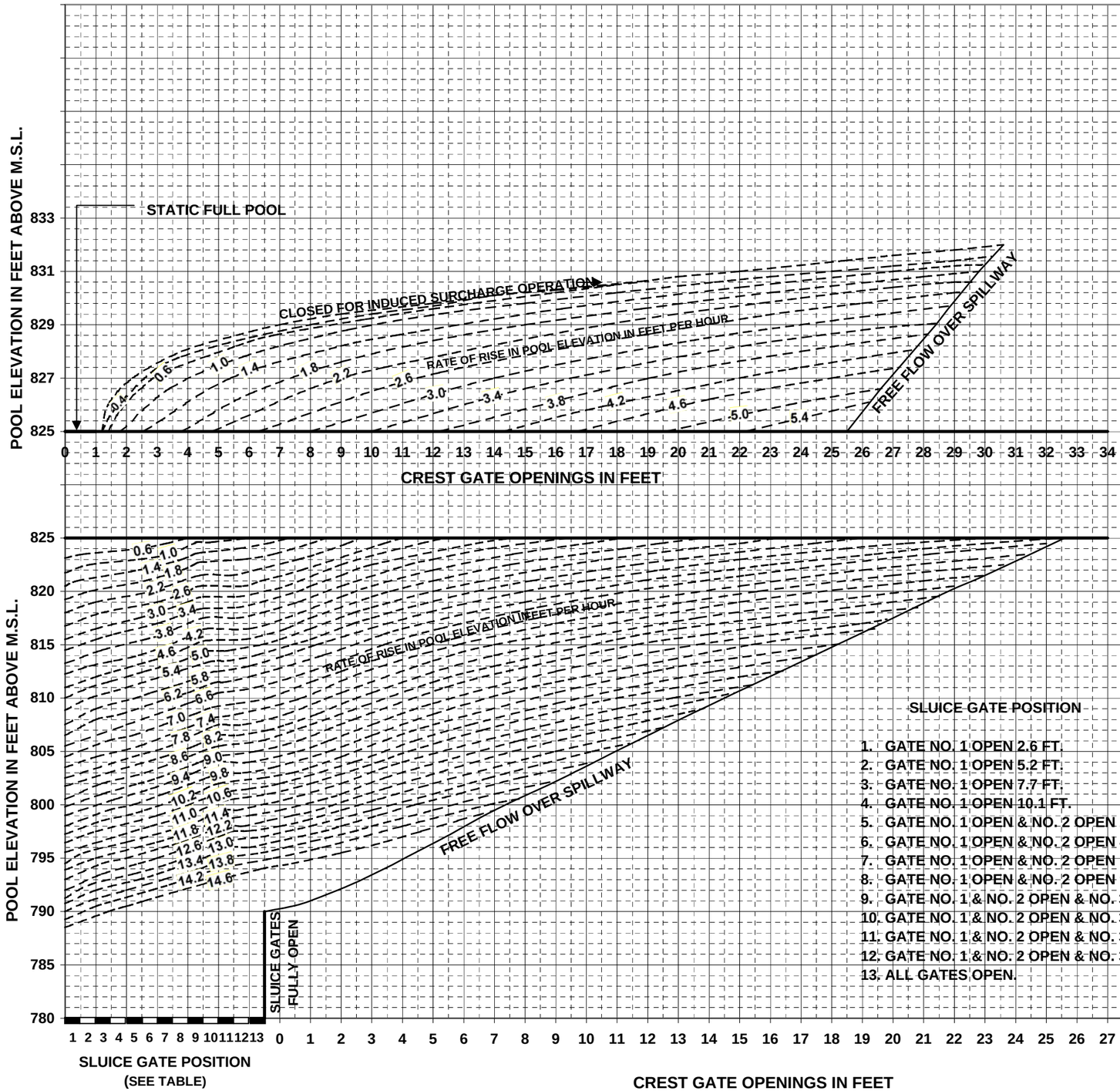
SHEET 1 of 2

FISHTRAP LAKE
LOW FLOW CONTROL GATE RATING – MULTIPLE INTAKES
I 42 AND I 26

Discharge cfs	'O' Gage ft.	Gate Openings in Feet and Hundredths at Lake Elevation				
		751	754	757	760	763
75	10.68	0.54	0.53	0.51	0.49	0.48
100	10.81	0.72	0.69	0.67	0.65	0.64
125	10.92	0.89	0.86	0.85	0.84	0.82
150	11.05	1.06	1.04	1.02	1.00	0.98
175	11.15	1.24	1.20	1.18	1.16	1.15
200	11.25	1.42	1.38	1.35	1.33	1.31
250	11.43	1.78	1.74	1.69	1.67	1.64
300	11.59	2.14	2.09	2.03	2.00	1.97
350	11.74	2.52	2.45	2.40	2.36	2.28
400	11.88	2.92	2.81	2.73	2.69	2.64
500	12.16	3.63	3.54	3.46	3.38	3.31
600	12.43	4.38	4.30	4.19	4.08	4.00
700	12.68	5.17	5.07	4.89	4.80	4.70
800	12.93	---	5.88	5.77	5.60	5.40

PLATE NO. 1-5

SHEET 2 of 2



SLUICE GATE POSITION

1. GATE NO. 1 OPEN 2.6 FT.
2. GATE NO. 1 OPEN 5.2 FT.
3. GATE NO. 1 OPEN 7.7 FT.
4. GATE NO. 1 OPEN 10.1 FT.
5. GATE NO. 1 OPEN & NO. 2 OPEN 2.6 FT.
6. GATE NO. 1 OPEN & NO. 2 OPEN 4.8 FT.
7. GATE NO. 1 OPEN & NO. 2 OPEN 7.3 FT.
8. GATE NO. 1 OPEN & NO. 2 OPEN 9.7 FT.
9. GATE NO. 1 & NO. 2 OPEN & NO. 3 OPEN 1.6 FT.
10. GATE NO. 1 & NO. 2 OPEN & NO. 3 OPEN 4.3 FT.
11. GATE NO. 1 & NO. 2 OPEN & NO. 3 OPEN 6.8 FT.
12. GATE NO. 1 & NO. 2 OPEN & NO. 3 OPEN 9.3 FT.
13. ALL GATES OPEN.

OPERATION INSTRUCTIONS

1. SEE SEPARATE INSTRUCTIONS AS TO WHEN RESERVOIR MAY BE OPERATED WITHOUT SPECIFIC INSTRUCTIONS FROM THE DISTRICT OFFICE.

2. READ THE "LAKE GAGE" EVERY HOUR AND COMPUTE THE RATE OF RISE IN POOL ELEVATION DURING THE PRECEDING HOUR.

3. ADJUST THE GATE SETTINGS EACH HOUR ON THE BASIS OF THE RATE OF RISE AND THE CURRENT POOL ELEVATION AS INDICATED BY THE CURVES.

4. WHEN THE CURRENT POOL ELEVATION IS BELOW 825.0, USE THE LOWER SET OF CURVES. WHEN THE HOURLY POOL ELEVATION READING FIRST EXCEEDS ELEVATION 825.0, CLOSE ALL SLUICES AND RAISE ALL CREST GATES AS UNIFORMLY AS POSSIBLE TO THE OPENING INDICATED BY THE UPPER SET OF CURVES. OPEN THE SLUICE GATES WHEN THE CREST GATES HAVE BEEN LIFTED CLEAR OF THE WATER SURFACE.

5. AFTER THE POOL LEVEL STARTS TO FALL, MAINTAIN THE CURRENT GATE SETTING UNTIL THE POOL LEVEL RECEDES TO ELEVATION 825.0, THEN, CLOSE THE SLUICE GATES, IF THEY ARE OPEN, AND CLOSE THE CREST GATES AS REQUIRED TO MAINTAIN POOL ELEVATION.

6. HOLD THE POOL AT ELEVATION 825.0 OR AT MAXIMUM LEVEL ATTAINED, IF BELOW 825.0, UNTIL ORDERED BY SPECIAL DIRECTIVE TO BEGIN DRAWDOWN OPERATION.

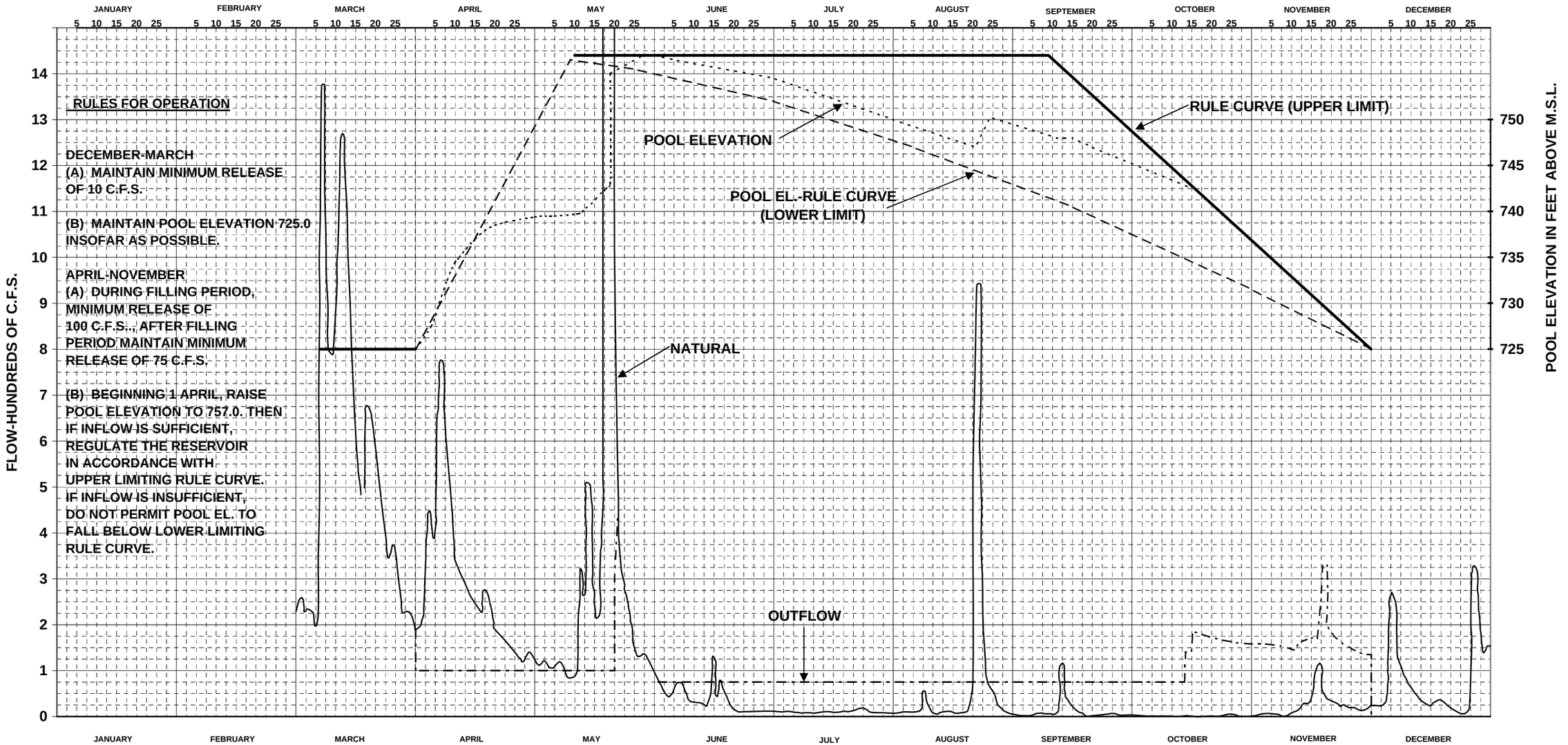
7. IF A SECOND RISE OCCURS WHILE THE POOL IS BEING HELD AT ELEVATION 825.0, FOLLOW THE "CURVE FOR INDUCED SURCHARGE OPERATION". IF THE CREST GATES ARE OPEN MORE THAN 1.0 FEET WHEN THE SECOND RISE OCCURS, MAINTAIN THE CURRENT GATE SETTINGS UNTIL THE POOL LEVEL RISES TO THE ELEVATION CORRESPONDING TO THE GATE SETTING ON THE "CURVE FOR INDUCED SURCHARGE OPERATION". THEN, FOLLOW THIS CURVE UNTIL THE POOL CEASES TO RISE. WHEN THE POOL LEVEL STARTS TO FALL, OPERATE IN ACCORDANCE WITH INSTRUCTION NO. 5, ABOVE.

BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

EMERGENCY OPERATION SCHEDULE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001



1930

BIG SANDY RIVER
LEVISA FORK KY, W. VA. & VA.

FISHTRAP LAKE PROJECT

RULE CURVE
LOW FLOW REGULATION

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.VA. REDRAWN JULY 2001

Plate 1-7

SECTION II - COLLECTION OF HYDROMETEOROLOGIC DATA

2-01 PRECIPITATION AT FISHTRAP LAKE

a. General. Obtain precipitation data by direct observation of the rain gage at the damsite. Instructions for preparation and transmission of hydrologic reports are contained in Section IV.

b. Official Precipitation Gage. The standard National Weather Service (non-recording) rain gage at the damsite is designated as the gage for official use.

c. Regular Readings. Measure and discard precipitation contained in the standard gage about 0700 hours or 0730 hours daily. Observe and record the times of beginning and ending of precipitation. The times of beginning and ending may be read from the recorder chart of the recording precipitation gage when "unknown" or "during night." Instructions for the preparation and transmission of precipitation reports are contained in Section IV. These instructions are for Corps of Engineers purposes and are not to be considered as superseding observation instructions received from the National Weather Service.

d. Recording Precipitation Gage. Check the recording precipitation gage at about 0730 hours daily. Wind the clock and change the chart each Monday morning at about 0800 hours. Along with the chart change, empty the catch bucket and mark the charts appropriately with time of installation and time of removal. As soon as practical after removal, mail the chart to the Huntington District Office, attention Water Resources Engineering Branch.

e. Extra and Special Readings. Take special readings of the precipitation gage when requested by Water Control Section or extra readings whenever required by the Schedule for Reading Gages, **Plate 3-1**. When taking these readings, do not empty the gage at any time except the regular time. Report the total which has fallen since the regular time of reading even though a portion of it may have been reported in a previous extra reading. The regular reading on the morning following any extra readings should always include the amounts reported in the extra readings. Instructions pertaining to the transmission of extra and special precipitation readings are contained in Section IV.

f. Satellite Platform Stations. Data collection platforms (DCPs) and tipping bucket rain gages have been installed at the lake station and at 9 other precipitation stations in or near the drainage area, see **Table 2-1**, next page. The platforms collect, store, and transmit the precipitation data via the Geostationary Operational Environmental Satellite to the LRD downlink in Cincinnati, Ohio.

LRD Water Control System retrieves the data and automatically transmits it hourly to the District Water Control System, located in

Water Resources Engineering Branch, for use in water control management and dissemination.

Several platforms are equipped with voice modems. This allows one to obtain the most recent data value by simply calling the station and listening to a synthesized voice, see **Table 2-1** below.

Reporting information on satellite precipitation stations in and near the Levisa Fork River Basin is listed on the below.

Table 2-1

Precipitation Platform Communication Information

Lovation/ Gage	Equip	Voice	Channel No.	Update Interval	Data Transmitted	Frequency of Transmission
Virgie, KY	1/				P	4 Hours
Pilgrim Knob, VA.	1/			60 min	P	4 hours
Grundy, VA		v			P	4 Hours
Fedscreek, KY					P	4 Hours
Phelps, KY					P	4 Hours
Williamson	1/			60min	P	4 Hours
Hurley, VA					P	4 Hours
Pikeville, KY	1/	v		60 min	P	4 Hours
Fishtrap Lake				60 min	P, S	4 Hours
Big Rock, VA.		v		60 min	P	4 Hours

1/ Precipitation equipment same at all platform reported stations: Tipping-bucket gage and platform.

P Precipitation in inches
E Elevation in feet NGVD
S Stream stage in feet above gage zero
T Temperature in degrees Fahrenheit
V "Voice platform answers telephone query with synthesized voice in addition to transmitting via satellite

g. Snow Depth and Moisture Content. During the winter, make regular measurement of snowfall and snow depth about 0700 or 0730 hours daily. Measurements of the water content of the snow on the ground are required in order to determine the amount of water which may run off during a warm spell or with any wind and rainfall which may occur.

To determine the water content of the snow, obtain a representative snow sample at an undisturbed location by forcing the outside container of the rain gage through the snow to the ground surface. Then, using a shovel or thin sheet of metal to hold the snow cover within the container, remove the container from the ground. The water content of the sample can be measured by placing the outside

container in a vessel of warm water, and then pouring the melted snow into the inside container of the gage for a reading with the measuring stick. On no account should the vessel containing the snow be exposed to extreme heat because of the possibility of loss by evaporation. Measure water content of the snow at least as often as indicated below.

(1) Each day when any new snowfall occurs.

(2) Each day when rain falls on existing snow cover.

(3) Twice a week when there is snow cover if neither condition (1) nor (2) requires more frequent measurements.

Instructions for the preparation and transmission of reports pertaining to snowfall, snow depth, and moisture content of snow cover are contained in Section IV.

2-02 PRECIPITATION FOR NATIONAL WEATHER SERVICE

At the end of every month, the project at the request of the National Weather Service, faxes the daily precipitation reports for the project.

SECTION III - COLLECTION OF STREAMFLOW DATA

3-01 GENERAL.

Obtain river and lake stage data by observing in the project office readouts of the lake and outflow gages and by interrogating surrounding voice gages. The necessary frequency for reading the gages at the project and for obtaining reports from the gaging stations is set forth in the "Schedule for Reading Gages," **Plate 3-1**, which appears at the end of this section. Instructions regarding the transmission of regular, extra and special reports of gage readings are contained in Section IV.

3-02 GAGES PERTINENT TO REGULATION OF FISHTRAP LAKE.

a. Gage Listings. Information about gages of importance to operation of the project appears in **Table 3-1**, below.

b. Reading and Recording Gage Heights. All gage readings must be listed in the records in order that complete data on the effect of the lake on natural flows will be available. Record lake gage readings in terms of elevation above mean sea level but record all other gage readings in stage. The necessary frequency for reading gages is set forth in the "Schedule for Reading Gages," **Plate 3-1** which is located at the end of this section. Gage data are listed in the **Table 3-1**.

TABLE 3-1

PERTINENT GAGE DATA

Gage	Location	Code Symbol	Eqpt	Reference Gages		Recorder	Visual Indicator	Datum of Gage[1/]
				Staff	Other			
Lake	Intake Structure	L	V	SL	TL	RL	VIL	NGVD
Outflow	0.4 mi below Dam,	O	DCP	SO	TO	RO	V10	660.00
Inflow	Levisa Fork at Big Rock	BRLP4	V	SB	TB	*RB		886.37
Downstream Control	Levisa Fork at Pikeville	PKVP3	V	SP	WWP	*RP		631.98

1/ Feet above Mean Sea Level
S Staff
T Electric tape
* ADR (analog-to-digital recorder)
E Encoder
DCP Standard platform
V Voice platform
VI Visual indicator in office
WW Wire weight gage

3-03 TELEPHONE GAGES

In order to facilitate collection of stage information, data collection platforms with voice modules capable of responding to

telephone calls were installed at the project "Lake" gage and at the Big Rock and Pikeville gages on Levisa Fork. The lake and outflow gages are remoted into the project office. After a few seconds of high pitched tone, the voice module repeats its identification number by synthesized voice. Then it repeats the latest reading of each parameter reported such as stage/elevation and precipitation. The voice calls stage or elevation "level" and precipitation, "rain." Time of each reading is given and the message ends with battery voltage and time. One should note that the time given is Greenwich Mean Time (GMT). To convert to Eastern Daylight or Eastern Standard Time, subtract four or five hours, respectively.

The telephone numbers of these gages are classified as "Restricted" in order to avoid indiscriminate calls by unauthorized persons. The necessary frequency for obtaining reports from these gages is set forth in "Schedule for Reading Gages," **Plate 3-1**, at the end of this section. Instructions pertaining to transmission of regular, extra and special reports of gage readings are contained in Section IV. Telephone numbers and code symbols assigned to these gages to be called by project personnel appear in **Table 3-2.**

TABLE 3-2

STREAM GAGE TELEPHONE NUMBERS

Gage	Symbol	Exchange	Telephone Number
Lake	FRLP4	Paintsville	[redacted]
Levisa Fork at Pikeville	PKVP3	Pikeville	[redacted]
Levisa Fork at Big Rock	BRLP4	Grundy	[redacted]

3-04 DATA COLLECTION.

Project personnel view readouts in the Project Office and use telephone to query telephonic gages. This data is recorded as specified in section iv.

Electronic gaging equipment also reports gage heights to the Water Control Data base via satellite once every 4 hours where it is shared in hourly format.

3-05 OUTFLOW TEMPERATURE AND TEMPERATURE-DISSOLVED OXYGEN PROFILES

Weekly temperature and dissolved oxygen profiles are to be taken in the lake on Monday during periods of stratification. The Weather Control Section will issue Special Directives each year concerning the location and the time periods for the profiles. Project personnel have been provided with instrumentation necessary and Water Quality field personnel have been given instruction in the use of the equipment.

In addition to the collection of the aforementioned data, water temperature is being collected at Fishtrap outflow, via satellite platform station.

SCHEDULE FOR READING GAGES
FISHTRAP LAKE

Always read and record the regular stream gages, VIL, VL RL, TL, or SL and VIO, RO, TO, or SO, immediately before each gate operation except when they have been read in the last hour with no intervening gate operation. Also read them one hour after completion of any operation. However, when operating the gates almost continuously, the gages need not be read before and after each individual operation, but readings at one-hour intervals, including the readings before the first and after the last gate operation, will be sufficient. If the recorders are operating properly, the above- mentioned gage heights may be read from the charts at the time of the next reading. Read all gages at least as often as shown in the following table.

	SCHEDULE A(l)		SCHEDULE B(l)		SCHEDULE C(l)		SCHEDULE D (1)	
	Normal Conditions		Flood Threat		Flood Condition		Major Flood Condition	
COMDITIONS	**MIANO***	**DEMIA****	**MIANO***	**DEMIA****	**MIANO***	**DEMIA****	**MIANO***	**DEMIA****
Lake gage elevation	Below 736.0	Below 762.0	736.0-816.0	762.0-816.0(4)	816.0-825(4)	816.0-825(4)	Above 825.0(4)	Above 825.0(4)
Stage at 'O' gage	Below 15.70(6)	Below 18.60(6)	15.70-18.1(6)	18.60-22.20(6)	18.10-20.3(6)	22.20-25.5(6)	Above 20.30(6)	Above 25.50(6)
Precipitation within								
24 hours (6)	Less than 0.75	Less than 0.50	0.75-1.25	0.50-1.00	1.25-2.50	1.00-2.50	Above 2.50	Above 2.50
Big Rock voice	Below 6.00	Below 6.60	6.00-11.60	6.60-11.60	11.60-14.90	11.60-14.90	Above 14.90	Above 14.90
Pikeville voice	Below 13.90	Below 16.80	13.90-18.90	16.80-26.00	18.90-23.50	26.00-32.40	Above 23.50	Above 32.40

READ GAGES

VL and VO (2)	At 0730 & 1330(3)	At 0730 & 1330	At 0730, 1330, 1930 & 0130	At 3 hour intervals (4)
Outflow Temperature	Daily at 0730	Daily at 0730	Daily at 0730	Daily at 0730
Big Rock voice	Daily at 0730	At 0730 & 1330	At 0730, 1330, 1930 & 0130	At 3 hour intervals
Pikeville voice	Daily at 0730	At 0730 & 1330	At 0730, 1330, 1930 & 0130	At 3 hour intervals
SL, TL, SO and TO	Twice Weekly(as check)	Twice weekly(as check)	Twice weekly(as check)	Twice weekly(as check)
Precipitation Gage	Daily at 0730	Daily at 0730 & 1330	At 0730, 1330, 1930 & 0130	At 3 hour intervals

(1) When any one of the conditions listed under schedule A, B or C is exceeded, place the next higher schedule into effect immediately and notify by person-to-person telephone call one of the Water Resources Engineering Branch personnel listed In paragraph 4-03c.

(2) When the visual indicators are not operating properly, read voice, recorder, tape, or staff gages.

(3) Take readings on weekdays regularly and on weekends and holidays by special arrangement.

(4) Whenever the reservoir level is between elevation 820 and 825 and rising, or at elevation 825 or above, read the lake gage and stream gages hourly.

(5) The 1330, 1930, and 0130 readings on weekdays and all readings for weekends and Holidays may be obtained from the recorder charts at the time of the next scheduled reading of visual gages. If necessary to obtain the readings desired, roll the chart back and, after taking readings, return to the proper position-all according to Instructions contained in **Plate 3-2**.

(6) All releases above a stage of 15.70 feet in MIANO and 18.60 feet in DEMIA are to be covered by Special Directive.

(7) If precipitation has occurred since the morning reading and amounted to 0.20" in winter or 0.50" in summer, or if snowmelt has occurred sufficiently to cause a rise in lake or outflow, read the lake gage, outflow gage, and rain gage at 1330 hours and transmit the readings and rainfall amount to Water Resources Engineering Branch by computer or by telephone if necessary.

Once a particular schedule is in effect, follow that schedule for a minimum of 24 hours before placing a lower schedule into effect or until such time that conditions require the use of a higher schedule. The foregoing table lists the minimum number of gage readings required. Record all gage readings made in addition to those required by the foregoing table.

*MIANO - 16 April through 30 November **DEMIA - 1 December through 15 April

CHART HANDLING INSTRUCTIONS
Obtaining Weekend and Holiday Readings
From Stevens Strip Chart Recorders

STEVENS TYPE AP, TYPE A-71 OR A-35 RECORDER

1. First lift the lid or remove dust cover.
2. Lift pan from chart and secure pen in bolder off paper position.
3. Facing Stevens recorder grasp knurled knob on the take up roll located in the rear of the recorder and to the left of the recorder paper. Turn knurled knob clockwise until enough paper is showing to obtain sufficient readings being careful paper does not come in ‘contact with pen.
4. Record weekend and Holiday readings.
5. After sufficient readings have been obtained, grasp knurled knob, turn counterclockwise until slack is out of paper. Lower pen back on chart. If pen is off more than I hour, reset for correct time. To-raset, grasp the knurled disc which is located on the right-hand side of the recorder just beneath the knurled knob of the supply cylinder. Pull the disc out to the right and rotate it until the paper is free. Advance paper until chart shows the correct time. Rotate the knurled disc to its normal location and push back in place to the left.
6. If you reset for time, make notation on chart.

STEVENS PAV-C OR CAV-C RECORDER

1. Face recorder and open recorder door.
2. Remove pen from chart by turning pen arm positioning screw clockwise.
3. Run the chart upward by moving and turning the knurled disk on the right end of the take up roller, upward, until enough record is showing to obtain readings. Be careful paper doesn’t come in contact with pen.
4. Record weekend and Holiday readings.
5. After readings are obtained,run the chart downward by turning the knurled disk on the right end of the take up roll, downward, until paper slack is removed and pen time is correct. Hold the chart in place; at the same time place a finger mder the spiral spring belt, lift outward from the wall slig htly stretching the belt, then release. Paper will stay taut.
6. Place pen back on the chart by turning pen arm positioning screw counterclockwise
7. If pen is off more than 1 hour, reset for time. To reset, run chart downward until Den shows correct time on the chart. Holding chart in place lift outward spiral Spring belt, stretching slightly, then release belt.
8. If you reset for time, make a notation on chart. Include in notation time, date, stage from counter, etc.

SECTION IV - INSTRUCTIONS FOR COMPLETION AND TRANSMISSION OF REPORTS

4-01 REGULAR REPORTS

a. Weekly Report, ORH Form 14. To reduce the probability of error in transcribing data from other forms, enter gage readings through the week on a copy of Form 14. Lake and outflow gage readings will be obtained every six hours (0130, 0730, 1330 and 1930) during periods when the project is attended and recorded on the form.

The Schedule for Reading Gages, **Plate 3-1**, defines conditions for taking more frequent readings of gages. After each time of entering readings on the form, check the correctness of the readings as recorded. If doubt arises, investigate to the extent necessary to be certain of the readings. During normal conditions, if the 1930 and 0130 readings have not been recorded on the form, take them from the recorder charts at the time of taking the 0730 readings. After any period when the project was not attended, obtain all missed readings from the recorder charts and record on Form 14. If it is necessary to turn the charts back in order to obtain readings, use instructions contained in **Plate 3-2** for doing so and resetting properly after recording readings. On Monday morning, or Tuesday if the project was not attended on Monday, after recording any missed readings and the 0730 readings, type the data on a fresh Form 14 and keep a copy for project files. Check the data on the typed original to be the same as on the handwritten form and mail to the District Office marked "Attention Water Resources Engineering Branch." Begin a new Form 14. A sample Form 14, **Plate 4-1**, is included at the end of this section.

b. Daily Morning Report. Use of ORH-13 is discontinued. A new recording/ reporting program was installed at the dam in May 1998. It is a fully computerized three page, menu-driven master data sheet, with a convenient auto-prompt feature which are easily completed by filling the empty data boxes. It uses the district internet to submit the data to EC-WW. It shall be used to record the regular morning readings at the project.

These readings shall include precipitation, readings of the lake “L” gage, outflow “O” gage, gate positions, river stages and gate operations shall be recorded each day.

After recording, the data will be transmitted via the internet to the District INTRANET System for the Water Resources Engineering Branch by approximately 0800 hours on each day in which the project is attended.

An example of this report can be found at the end of this section in **Plate 4-2**. Instructions relative to recording and transmission of the report are found in Intranet reporting System Instructions, **Plate 4-5**.

After submittal, this report can be accessed through the Fishtrap Lake web page at (http://wcds-a./dbases/frl/reports).

Transmit reports for Saturdays, Sundays, and Holidays on which the project is attended as on regular work days. Transmit reports for unattended days after transmission of the current report for the first working day which follows. In each regular or extra Daily Morning Report, also include any telephonic readings made since the previous Project Information report.

If conditions are such that the daily report cannot be transmitted to the District Intranet System by 0830 hours, transmit the report by telephone or fax to Water Resources Engineering Branch, then enter the data into the computerized report form when it becomes available.

c. Water Quality Report. During periods of lake stratification the temperature-dissolved oxygen profile and water quality data are measured and reported on a regular basis. Monitoring begins when a special directive is sent by Water Control Section at the request of Water Quality Section. Report Water Quality data in accordance with the special directive. Monitoring ends when the lake is no longer stratified at which point Water Quality Section will request Water Control Section issue a special directive ending monitoring when it is no longer necessary.

The Intranet reporting system should be used to submit all reports. An example of the report in this system can be found at the end of this section in **Plate 4-3**. Instructions relative to recording and transmission of the report are found in Intranet Reporting System Instructions, **Plate 4-5**.

After submittal, this report can be accessed through the Fishtrap Lake web page at (http://wcds-a./dbases/frl/reports).

d. Gage Operations Report. All gate operations shall be reported either individually at the time it occurs or the next morning when all gage valve operations since the previous report will be submitted. The Intranet reporting system should be used to submit all reports. An example of the report in this system can be found at the recording and transmission of the report are found in Intranet Reporting System Instructions, **Plate 4-5**.

After submittal, this report can be accessed through the Fishtrap Lake web page at (http://wcds-a./dbases/frl/reports).

4-02 EXTRA REPORTS

Extra reports, as indicated by the Schedule for Reading gages, **Plate 3-1**, should be transmitted via INTRANET over the project computer terminal in the same way as the regular Project Information report. If project personnel are unable to transmit the report over the computer terminal, telephone the report in to Water Control Section. Failing this attempt, telephone the report to one of the Water Resources Engineering Branch personnel in the order listed below in paragraph 4-03c.

4-03 SPECIAL REPORTS

a. Reporting Criteria. Special reports include any report not regularly scheduled or called for by the Schedule for Reading Gages. A special report should be made when an event occurs concerning the project that Water Resources Engineering Branch should have knowledge of or when requested by the Branch.

b. Special Report Data. The following types of occurrences or information are examples of occasions for or subjects of special reports.

(1) Extraordinary meteorological event such as a tornado or blizzard, or heavy precipitation after 0730 hours.

(2) Gate positions and/or operations.

(3) Flooding upstream or downstream.

(4) Request for special operation.

(5) Catastrophe such as drowning.

(6) Unusual or abnormal water quality condition in the lake, inflow streams or downstream a reasonable distance from the dam.

(7) Moisture content of snow.

(8) Outflow temperature and/or air temperature at time other than 0730 hours.

(9) Local weather forecast.

c. Transmission of Special Report. All special reports should be made at any time of day or night, including weekends and holidays, or when requested by Water Resources Engineering Branch. During office hours, submit them by telephone; however, if it is impossible by telephone, utilize the cell phone, email or fax.

When making telephone calls after hours or during weekends or holidays, unless advised that the Water Resources Engineering Branch will be on duty, place a person-to-person call to one of the following Water Resources Engineering Branch personnel, in the order listed on **Table 4-1**, next page.

TABLE NO. 4-1

DIRECTORY OF KEY PERSONNEL

Party	Telephone		Radio
DISTRICT PERSONNEL	OFFICE	RESIDENCE	CALL LETTERS
Water Resources Engineering Branch			WUE4
Chief, Water Control Section	[redacted]	[redacted]	
Water Control Section	[redacted]	[redacted]	
Water Control Section	[redacted]	[redacted]	
Chief, Water Resources Engineering Branch	[redacted]	[redacted]	

Huntington District Office, Water Resources Engineering Branch

Normal Work Hours, Nights, Weekends, and Holidays — Additional Extensions

NOTE: All the above numbers can be found on the C of E Intranet, including cell phone numbers. Located at [redacted]

Pertinent telephone numbers, which may be of value during flood emergency, are listed below:

Fishtrap Lake Project Office	Telephone No.
Commercial	[redacted]
Home	[redacted]

Gate Operating Personnel	Telephone No.
	[redacted]
	[redacted]

Other Agencies		
U. S. Geological Survey Louisville, KY Nights, weekends, Holidays	Commercial Commercial Commercial	[redacted] [redacted]
National Weather Service Forecast Office, Hydrology Charleston, WV	Commercial Commercial from HDQ	[redacted] [redacted]

4-04 CELL PHONE AS STANDBY COMMUNICATION

Keep the cell phone turned on at all times when anyone is on duty at the project office, including overtime periods, since a District Office operator is sometimes on duty outside of regular office

hours. Also, messages may be relayed through other projects. When there is difficulty in transmitting reports via INTRANET, telephone, or fax, attempt to call on cell phone either direct to the District Office or by relay through another project which has contact with the District Office.

4-05 LETTER REPORTS

a. General. All letter reports pertaining to water control management will be addressed to the District Engineer, Attention: Water Resources Engineering Branch (CELRH-EC-W).

b. Downstream Channel Conditions. At the request of the Water Control Section, inspection of critical areas downstream from the dam will be made for conditions listed below to observe encroachment on the channel, indiscreet utilization of low-lying areas, and flooding conditions, as follows:

(1) During flood periods when maintaining the maximum allowable outflow stage on the "O" gage, inspections will be made down Levisa Fork to the Pikeville gage.

(2) Inspections will be made downstream to Russell Fork during or immediately after periods of unusual storage releases.

(3) If complaints of flooding are received, notify the Water Control Section immediately; then make an inspection of the specific area as soon as practicable.

(4) At any other times, as requested by the Water Control Section, and under (3) above, the essential items to note and report are: (a) persons or communities involved, (b) nature of complaint, and (c) extent and depth of flooding. Make a letter report, containing pictures, cross sections or sketches of the findings as soon as practicable. If immediate action appears necessary, make a brief initial report via telephone to the Water Resources Engineering Branch.

c. Lake Area Conditions. During periods of lake storage above seasonal pool elevation, inspections shall be made within the lake area. Essential items to look for and observe are bank slippage and effects of wind and wave erosion.

d. Low Flow Releases. During periods of low flow release, downstream observations shall be made of stream depth, fish and wildlife, water odor, and discoloration, if any, as directed by the Water Control Section. Stream gages, rain gages and temperature equipment shall be periodically checked for proper functioning and performance or when directed by the Water Control Section. During periods of stratification, outflow temperature requirements will be maintained according to directives issued by the Water Control section.

e. Functioning of the Dam. Functioning of the dam shall be observed at all times, including performance of gates, valves, machinery and outlet structure and the presence of any leakage.

During flood storage periods when the lake level reaches or exceeds the Alert Elevation, 800.0 feet NGVD for Fishtrap Lake, daily observations are made and reported under provisions of the Dam Operations Management Policy in addition to the normal weekly observations made under the policy. At these or other times requested by Water Control Section for a particular use, forward a copy of such observations as soon as practicable to Water Resources Engineering Branch as a letter report.

f. Water Quality Reports. Any unusual water conditions should be reported to the Water Control Section, particularly:

(1) Floating debris, oil, scum and other floating materials from municipal, industrial, or other discharges such as from agricultural practices in such amounts that they are unsightly or detrimental to wildlife or public health.

(2) Unusual color, odor or other conditions in such degree as to be a nuisance.

(3) Any fish kills, plankton blooms or insects to the degree that they are a nuisance should be reported.

(4) The Water Control Section should be informed concerning application of chemicals to the water or to surrounding land. This includes fertilizers or pesticides.

RESERVOIR WEEKLY REPORT

REPORTS CONTROL SYMBOL ORHED – H-2

STATION Fishtrap lake

WEEK ENDING @ 0730 25 May 87

GAGE RECORDS

DATE	TIME		GAGES			GATE NO.	*AMT. OF OPENING		PURPOSE
	START	END	'L'	'O'	PKVP3		INITIAL	FINAL	
20 Feb	1330		72730	67405	MM				
	1827	1830	72663	67399	1147	S-1	060	040	TO CONTROL POOL
	1930		72663	67399					
21 Feb	0130		72664	67317					
	0727	0730	72664	67317	1171	S-1	040	060	TO CONTROL POOL
	1330		72667	67402	1429				
	1457	1500	72674	67405	1523	S-2	000	010	TO CONTROL POOL
	1930		72679	67474					
22 Feb	0130		72931	67474					
	0727	0730	73072	67474	1794	S-2	010	030	TO CONTROL POOL
	0827	0830	73097	67547	1779	S-2	030	050	TO CONTROL POOL
	0927	0930	73107	67627	1776	S-3	000	020	TO CONTROL POOL
	1330		73111	67223	1821				
	1358	1400	73114	67723	1828	S-1	060	040	TO CONTROL POOL
	1930		73147	67633					
23 Feb	0130		73183	67633					
	0727	0730	73220	67633	1689	S-1	040	060	TO CONTROL POOL
	0827	0830	73214	67700	1681	S-3	020	040	TO CONTROL POOL
	1330		73107	67777	1707				
	1542	1545	73055	67773	1706	S-1	060	040	TO CONTROL POOL
	1930		72949	67670					
24 Feb	0130		72791	67670					
	0727	0730	72631	67670	1552	S-3	040	020	TO CONTROL POOL
	0827	0830	72575	67579	1544	S-3	020	000	TO CONTROL POOL
	0927	0930	72573	67496	1539	S-2	050	030	TO CONTROL POOL
	1157	1200	72570	67441	1472	S-2	030	020	TO CONTROL POOL
	1330		72570	67403	1415				
	1427	1430	72573	67402	1376	S-2	020		

CHECK READINGS

FINAL POSITION OF GATES

SIGNATURE

PLATE NO. 4-1 (1 of 2)

RESERVOIR WEEKLY REPORT

REPORTS CONTROL SYMBOL ORHED – H-2

STATION Fishtrap lake

WEEK ENDING @ 0730 25 May 87

GAGE RECORDS

DATE	TIME START	TIME END	GAGES 'L'	GAGES 'O'	PKVP3
24 Feb	1527	1530	72584	67239	1366
	1930		72610	67365	
25 feb	0130		72630	67365	
	0730		72630	67365	MM
	1330		72615	67365	MM
	1928	1930	72576	67365	1062
26 Feb	0130		72605	67276	
	0730		72640	67276	MM
	1330		72668	67276	MM
	1930		72691	67276	
27 Feb	0130		72710	67276	
	0727	0730	72721	67276	0975

GATE OPERATING RECORD

GATE NO.	*AMT. OF OPENING INITIAL	*AMT. OF OPENING FINAL	PURPOSE
S-2	000	010	TO CONTROL POOL
S-1	040	020	TO CONTROL POOL
S-1	020	040	TO CONTROL POOL

CHECK READINGS

DATE	TIME	SL	RL	VL
23 Feb	0730	73220	73220	73220
27 Feb	0730	72721	72721	72721
DATE	TIME	SO	RO	VO
23 Feb	0730	67633	67633	67633
27 Feb	0730	67276	67276	67276

FINAL POSITION OF GATES

S-1 OPEN 040, S-2 OPEN 010, S-3 CLOSED

H-1, H-2, and H-3 all closed

LFSG closed

SIGNATURE

PLATE NO. 4-1 (2 of 2)

FISHTRAP LAKE

PROJECT INFORMATION

USE THE MOUSE OR TAB TO MOVE BETWEEN FIELDS
ENTER WILL SUBMIT THE FORM

This file is a New submission.

DATE	TIME
10 Jul 2001	0730

CURRENT PROJECT INFO

COE ID	PRECIP (IN)	POOL ELEV (FT-MSL)	TAIL WATER STAGE (FT)	FLOW (KCFS)	SNOW DEPTH (IN)	WATER EQUIVILENT (IN)	WEA CONDI
FRLP4	0	725	675	0	0.0	0.0	0 Unchanged

CURRENT GATE SETTINGS

GATE	SL	SC	SR	I10	I26	I42	LFC
SETTING	.00	.00	.00	OPEN	OPEN	OPEN	.00

ADDITIONAL STATION INFORMATION

COE ID	PRECIP (IN)	STAGE (FT)
BRLP4	0	0.0
PKVP3	0	0.0
WMSO4	0	0.0

ADDITIONAL COMMENTS

PLATE NO. 4-2

FISHTRAP LAKE

GATE OPERATIONS

This file is a New submission.

GATE ID	VALUE		DATE	TIME	
	Start	End		Start	End
SL	0.0	0.0	10 Jul 2001	0700	0705

ADDITIONAL COMMENTS

PLEASE ENTER THE FISHTRAP PASSWORD:

Submit These Gate Operations

Clear Form

CLICK HERE TO RETURN TO FISHTRAP LAKE HOME PAGE (WILL NOT SAVE DATA)

PLATE NO. 4-2

FISHTRAP LAKE

Lake Quality Report

USE THE MOUSE OR TAB TO MOVE BETWEEN FIELDS
THE ENTER KEY WILL SUBMIT THE DATA

This file is a New submission.

DATE	TIME	LAKE ELEV (FT)	WEATHER
10 Jul 2001	0730	750.0	0 Unchanged

DEPTH (M)	TEMP (C)	D.O.	COND	TURB	pH
OUTFLOW					

DEPTH (M)	TEMP (C)	D.O.	COND	TURB	pH
0.0					
1.0					
2.0					
3.0					
4.0					
5.0					
6.0					
7.0					
8.0					
9.0					

PLATE NO. 4-3

10.0					
12.0					
14.0					
16.0					
18.0					
20.0					

ADDITIONAL COMMENTS

PLEASE ENTER THE FISHTRAP PASSWORD:

SUBMIT DATA

CLEAR FORM

CLICK HERE TO RETURN TO FISHTRAP LAKE HOME PAGE (WILL NOT SAVE DATA)

The POC for this page:

[redacted] *CELRH-EC-WW*
Huntington, WV
Send Email to Water Resources

Date last modified: 23 Apr 99 at 0924

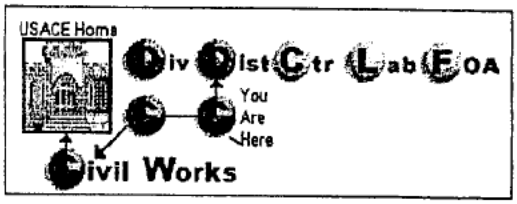


PLATE NO. 4-3

LAKE PROFILE

FISHTRAP LAKE

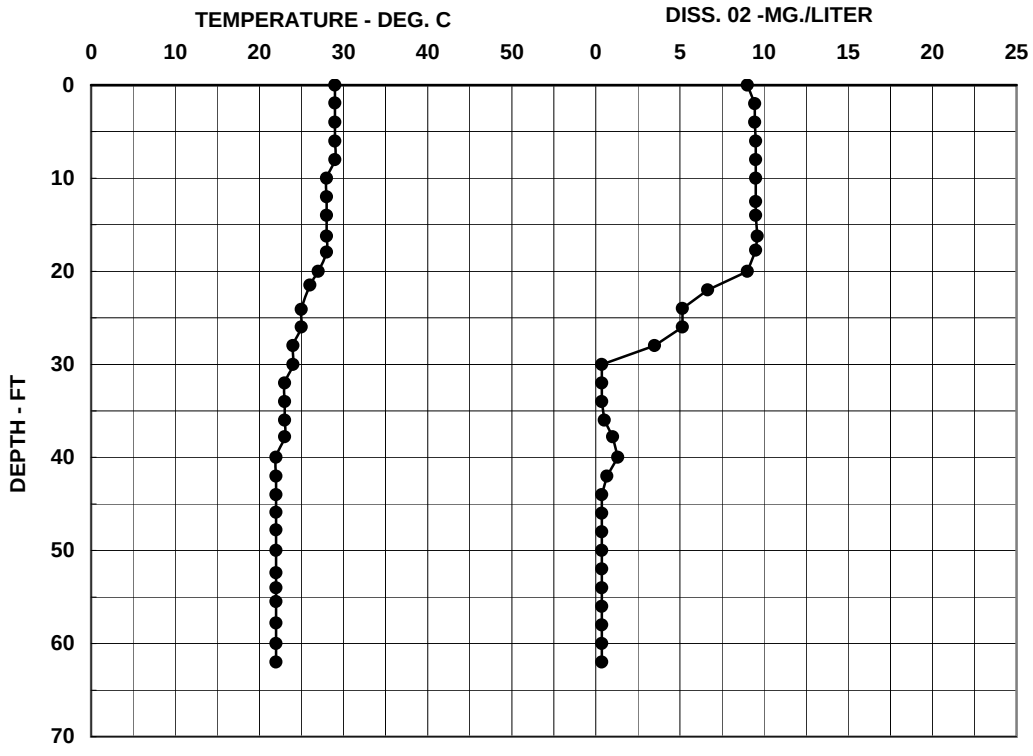
PERTINENT INFORMATION

SEASONAL POOL ELEV. (MSL)…757.00
CURRENT LAKE ELEVATION……757.95
OBJECTIVE OUTFLOW TEMP…….22.20
CURRENT OUTFLOW TEMP…….21.40

LOW FLOW INTAKES: 1 @ 747,
1 @ 731, AND 1 @ 715
SLUICE GATES INTAKES: 3 @ 682

WATER QUALITY ASSESSMENT

LOCATION OF MEASUREMENT	CONDITION OF WATER	QUALITY CONSIDERATIONS CURRENT	POTENTIAL
0-26	GOOD		
26-44	FAIR		
44-BOTTOM	POOR		ANOXIA
OUTFLOW	GOOD		



COMMENTS:

1. WEAK THERMOCLINE ESTABLISHED AT ABOUT 18 FT.

2. 00 GOOD. >5MG/L IN UPPER 26 FT.

BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

LAKE WATER QUALITY PROFILE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN MAY 2001

PLATE NO. 4-4

INTRANET REPORTING SYSTEM INSTRUCTIONS

LOGGING ON. Open the web browser (Microsoft Internet Explorer or Netscape Navigator) to the following address: This Index Page contains links to information pertaining to Fishtrap Lake. The Data Submission Reports vary for each project, and report forms for one project cannot be substituted for another project. When submitting data for
gate operations follow the link for Gate Operations.

PASSWORD.

SUBMISSION. After all the project information has been recorded, click on the 'Submit' button to send the report or 'Clear Form' to clear all the information out of the form and start over. If the password was correct, a SHEF compatible report will be sent back to the computer terminal. Information can be checked before the final submission. If there is any incorrect data on the report, use the browser's 'back button' to return to the Project Report Page to correct the information.

If the report was correct, click on the 'Correct' button at the top of the page, the SHEF confirmation screen will be transmitted back to the terminal. The information will be entered into a permanent record. If this password is missing or incorrect, attempts to submit the Project Report will be unsuccessful.

REPORTS. Tree reports can be accessed from the Index Page: The Daily Project Report (also called the Morning Report), the Gate Operations Report, and the Water Quality Report. Click on the picture or on the Report name to access a report.

DAILY PROJECT REPORT (MORNING REPORT)

When the Daily Project Report Page has been accessed, indicate if this is a new or a revised report. Check the date/time group.

CURRENT PROJECT INFO. The first table is used to record general information about the project at the time of the report.

Column 1 - Station Abbreviation. This column identifies the lake station. The first three letters comprise the abbreviation of the station name and the last letter and figure are a key to its location on the District Isohyetal Map. This five-digit group (FRLP4) constitutes the abbreviation for the station and should always be used.

These station names have been coded into the web page and cannot be changed at the project. If there are any difficulties in relation to this, please contact the Water Control Section.

Column 2 - Precipitation. Record the amount of precipitation (to the nearest 1/100 inch) since the last report.

Column 3 - Lake Elevation. Use this column for reporting the lake "L" gage, in feet above NGVD, to the nearest hundredth foot. Please include decimal points.

Column 4 - Outflow Stage. Use this column for reporting the stage at the "O" gage, to the nearest hundredth foot. This is the stage reading of the gage.

Column 5 - Flow. This column can be used to record the outflow if it becomes necessary. At this point, this field is not available.

Columns 6 and 7 - Snow and Water Equivalent. Report the depth of snow cover and its water content in these columns. Where a station does not make this report or no precipitation has been reported, send 0.00. Record the snow depth in inches to the nearest hundredth. Indicate a trace by OOT. Report the figures for snowfall and snow cover since the previous report.

Columns 8 - Weather Description. The drop down menu in this column is used to report the weather conditions at the time of the Project Report observation, in accordance with the following code:

0 - Unchanged	6 - Drizzle	12 - Snow Flurries
1 - Clear	7 - Light Rain	13 - Light Snow
2 - Partly cloudy	8 - Moderate Rain	14 - Moderate Snow
3 - Cloudy	9 - Heavy Rain	15 - Heavy Snow
4 - Light Fog or Mist	10 - Sleet, Freezing Rain	16 - Missing
5 - Heavy Fog or Mist	11 - Hail	

When there has been no precipitation to report use 1, 2, or 3.

CURRENT GATE SETTING. The second table is used to record gate settings at the time of the report. The table is a two row-eight section box with 7 gate entries. The top row begin with GATE and identify the gates. The second row lists the gate settings or gate opening below the gate ID number.

Top row-Gate Identifications: SL, SC, SR, I10, I26, I42 and LFC. Second Row-Gate Settings: Column 2, 3, and 4 are used for recording the openings of the slide gates. Column 2 is used for the left side gate SL, column 3 is used for the middle slide gate SC, and column 4 is used to report the right slide gate, SR. Column 5, 6 and 7 are used to report open or closed positions of the three low-flow intake gates, I10, I26, and I42. Column 8 is used for reporting the amount of opening, in inches of the low-flow valve, LFC. Each gate opening is reported to the nearest tenth of a foot. Transmission of the openings for each gate shall consist of a 3-digit number, and if the gate is closed, 0.0 is reported.

ADDITIONAL STATION INFORMATION. The third table is used to make any additional comments regarding precipitation and stage for Fishtrap Lake. These fields are unlimited. The five-digit group (FRLP4) constitutes the abbreviation for the station and should always be

used in the SHEF box. Report the precipitation in inches to the nearest hundredths and the stage in feet to the nearest hundredths for the gages at Big Rock (BRLP4), Pikeville (PKVP3) and Williamson (WMSO4).

ADDITIONAL COMMENTS. The forth table is used for supplementary data and comments. Additional data and comments should be reported in message form at the end of the INTRANET report. Include any or all of the following in such messages:

(a) Moisture content of snow cover.

(b) Precipitation at the dam during the past 24 hours, when greater than one (1) inch, by 6-hour periods.

(c) Comments.

GATE OPERATONS REPORT

When the Gate Operations Report Page has been accessed, indicate if this is a new or a revised report. Check the date/time group. This report is used to record information about gate operations. If several gate operations have been performed since the last report, up to 6 (six) gate operations may be reported on a single form. Enter the data on the report in the following manner with the first entry for a new report.

In the first table, Gate Operations, choose the gate ID from a drop down menu. Use column one through six, successively for gate designation, initial gate opening, final gate opening, date, beginning time, and ending time.

In the second table, Additional Comments, an unlimited field is provided to record any comments relevant to the Gate Operations Report which have not been covered previously.

WATER QUALITY REPORT

When the Water Quality Report Page has been accessed, indicate if this is a new or a revised report. Check the date/time group.

The first table in the Water Quality Report has fields referring to conditions at the time the water quality sampling was performed. Record the date and time, the lake elevation in feet to the nearest hundredth, and the weather conditions.

The second table is used to record water quality data at the outflow gage on the surface. Record the water temperature in degrees Celsius, the Dissolved Oxygen (D.O.) content in mg/ml, the water condition, turbidity in n.tu and pH.

The third table is used to record water quality at various depths. The first column records the depth water depth, from the surface, in meters. This field is populated for the convenience of the data transcriber, but can be changed if conditions warrant. The second column records the water temperature in degrees Celsius. The third column records the Dissolve Oxygen (D.O.) content in mg/ml. The

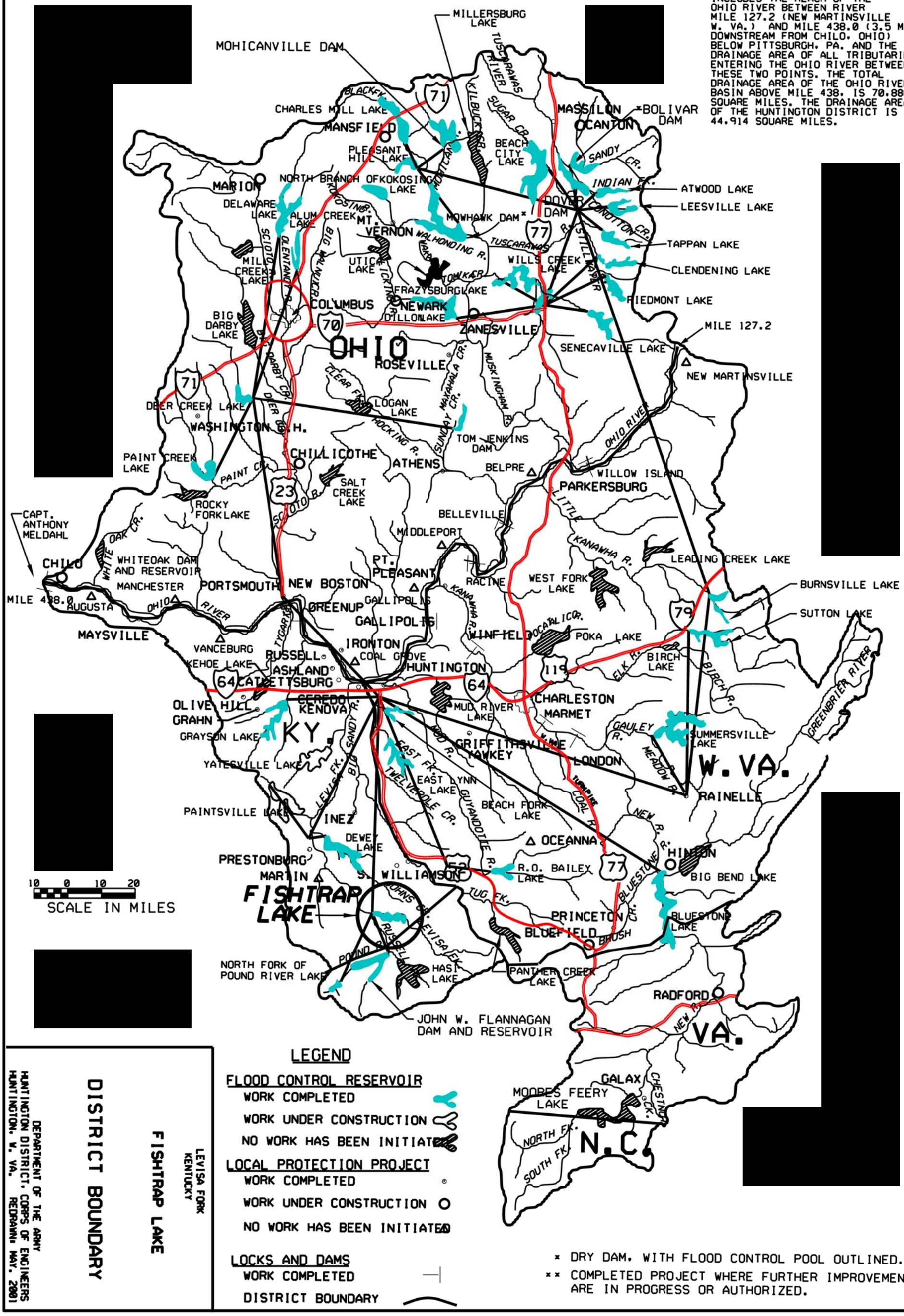
fourth column records the water condition. The fifth column records turbidity in n.tu. The sixth column records the pH. Not all of these readings will be taken at every recording session at every depth.

Below the table recording the water conditions, there is an unlimited field to provide additional comments

UPON APPROVAL OF NEPA DOCUMENTATION, THE DROUGHT CONTINGENCY PLAN WILL BE FURNISHED FOR ENCLOSURE IN THE WATER CONTROL MANUALS.

[redacted]

THE HUNTINGTON DISTRICT INCLUDES THE REACH OF THE OHIO RIVER BETWEEN RIVER MILE 127.2 (NEW MARTINSVILLE W. VA.) AND MILE 438.0 (3.5 MILES DOWNSTREAM FROM CHILO, OHIO) BELOW PITTSBURGH, PA. AND THE DRAINAGE AREA OF ALL TRIBUTARIES ENTERING THE OHIO RIVER BETWEEN THESE TWO POINTS. THE TOTAL DRAINAGE AREA OF THE OHIO RIVER BASIN ABOVE MILE 438. IS 70,880 SQUARE MILES. THE DRAINAGE AREA OF THE HUNTINGTON DISTRICT IS 44,914 SQUARE MILES.



LEGEND

FLOOD CONTROL RESERVOIR
- WORK COMPLETED
- WORK UNDER CONSTRUCTION
- NO WORK HAS BEEN INITIATED

LOCAL PROTECTION PROJECT
- WORK COMPLETED
- WORK UNDER CONSTRUCTION
- NO WORK HAS BEEN INITIATED

LOCKS AND DAMS
- WORK COMPLETED
- DISTRICT BOUNDARY

* DRY DAM, WITH FLOOD CONTROL POOL OUTLINED.

** COMPLETED PROJECT WHERE FURTHER IMPROVEMENTS ARE IN PROGRESS OR AUTHORIZED.

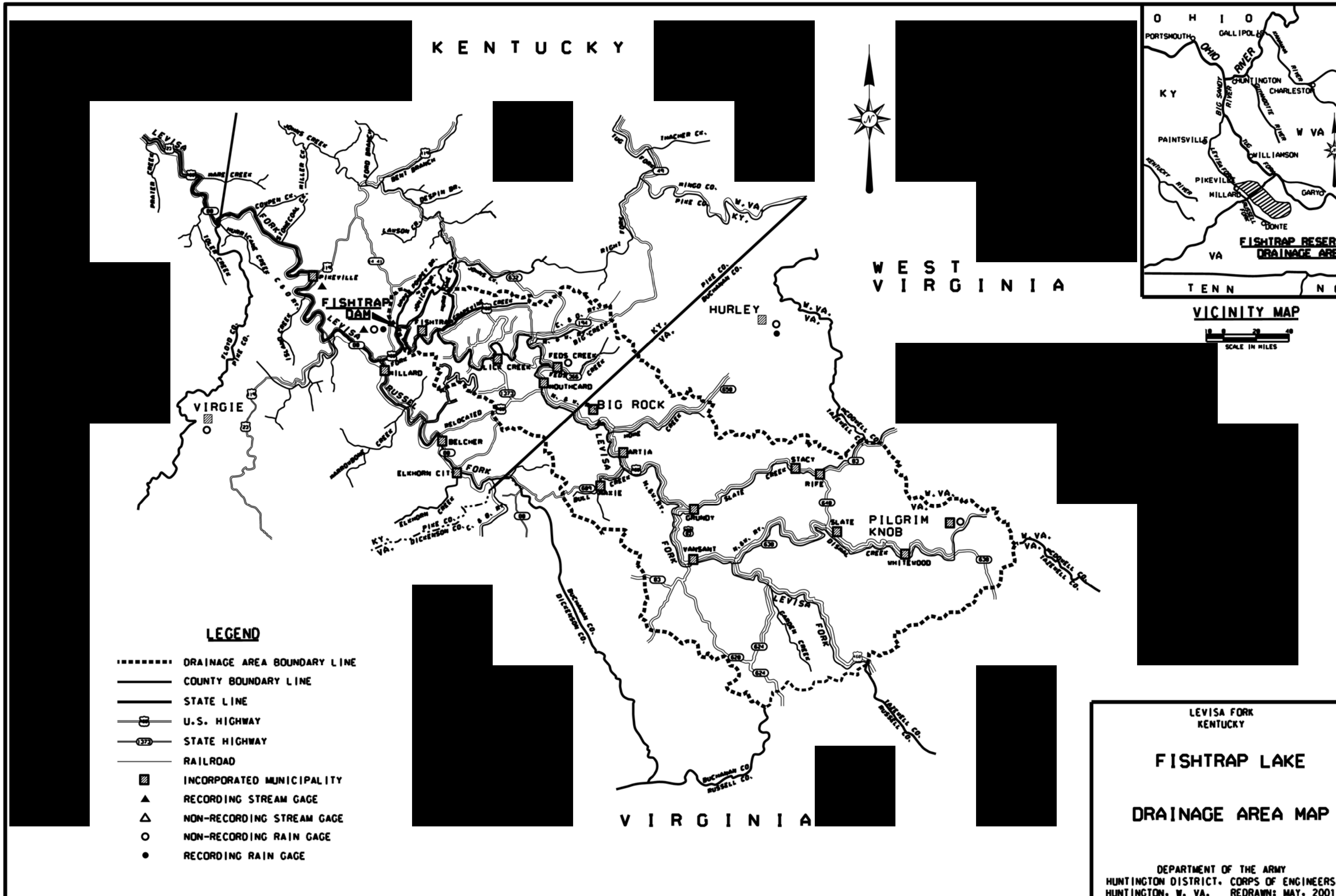
LEVISA FORK KENTUCKY

FISHTRAP LAKE

DISTRICT BOUNDARY

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: MAY, 2001

PLATE NO. 1-1



LEVISA FORK
KENTUCKY

FISHTRAP LAKE

DRAINAGE AREA MAP

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: MAY, 2001

PLATE NO. 2-1

LEVISA FORK
KENTUCKY

FISHTRAP LAKE
DAM AND APPURTENANT WORKS

GENERAL PROJECT PLAN

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT. CORPS OF ENGINEERS
HUNTINGTON. W. VA. REDRAWN: MAY. 2001

PLATE NO. 2-2

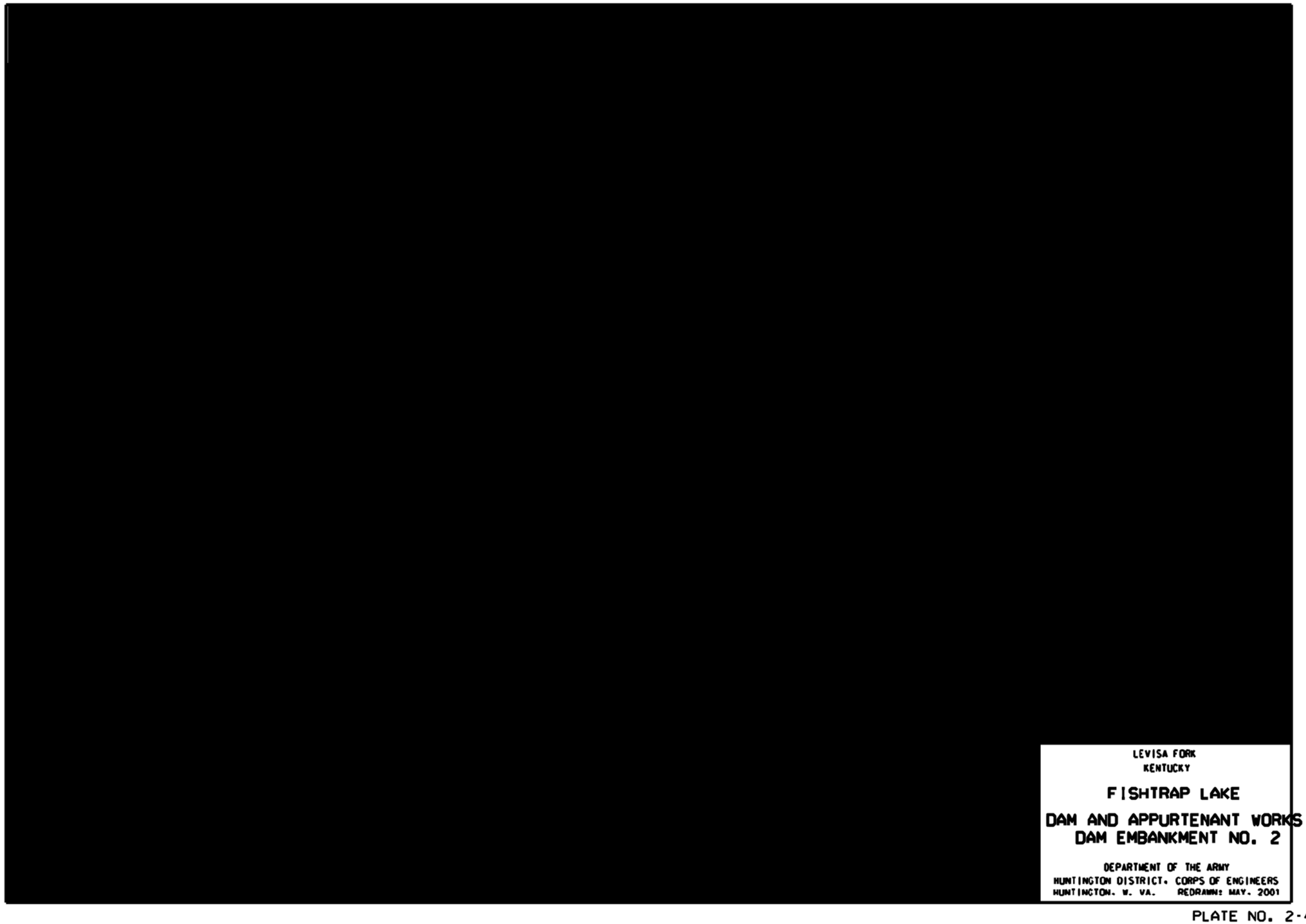
LEVISA FORK
KENTUCKY

FISHTRAP LAKE
DAM AND APPURTENANT WORKS

DAM
EMBANKMENT - NO. 1

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: MAY, 2001

PLATE NO. 2-3



LEVISA FORK
KENTUCKY

FISHTRAP LAKE

DAM AND APPURTENANT WORKS
DAM EMBANKMENT NO. 2

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: MAY, 2001

PLATE NO. 2-4

LEVISA FORK
KENTUCKY

FISHTRAP LAKE
DAM AND APPURTENANT WORKS

SPILLWAY GATE STRUCTURE
GENERAL ARRANGEMEMT

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: MAY. 2001

PLATE NO. 2-5

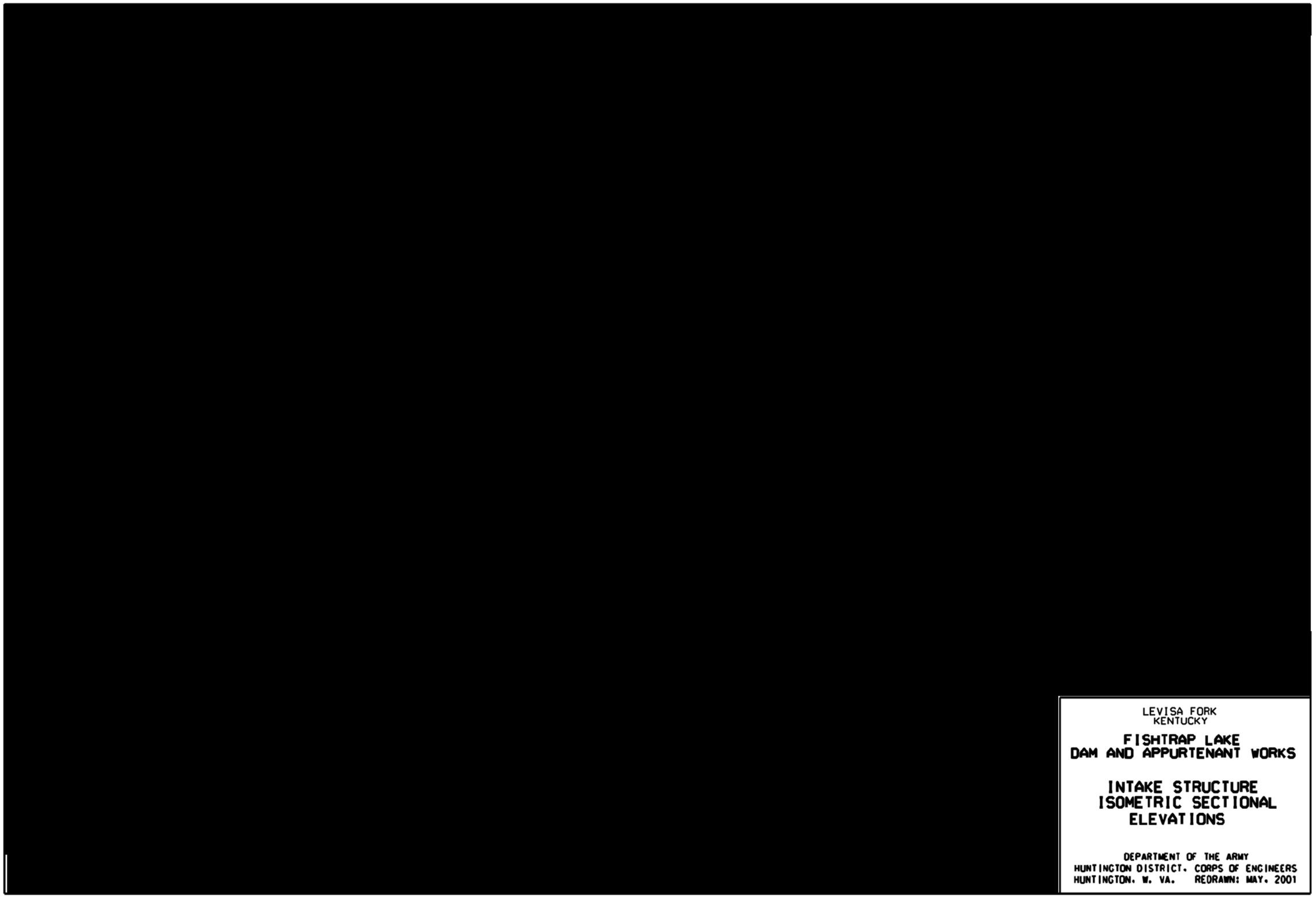
LEVISA FORK
KENTUCKY

FISHTRAP LAKE
DAM AND APPURTENANT WORKS

OUTLET WORKS
PLAN AND PROFILE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: MAY, 2001

PLATE NO. 2-6



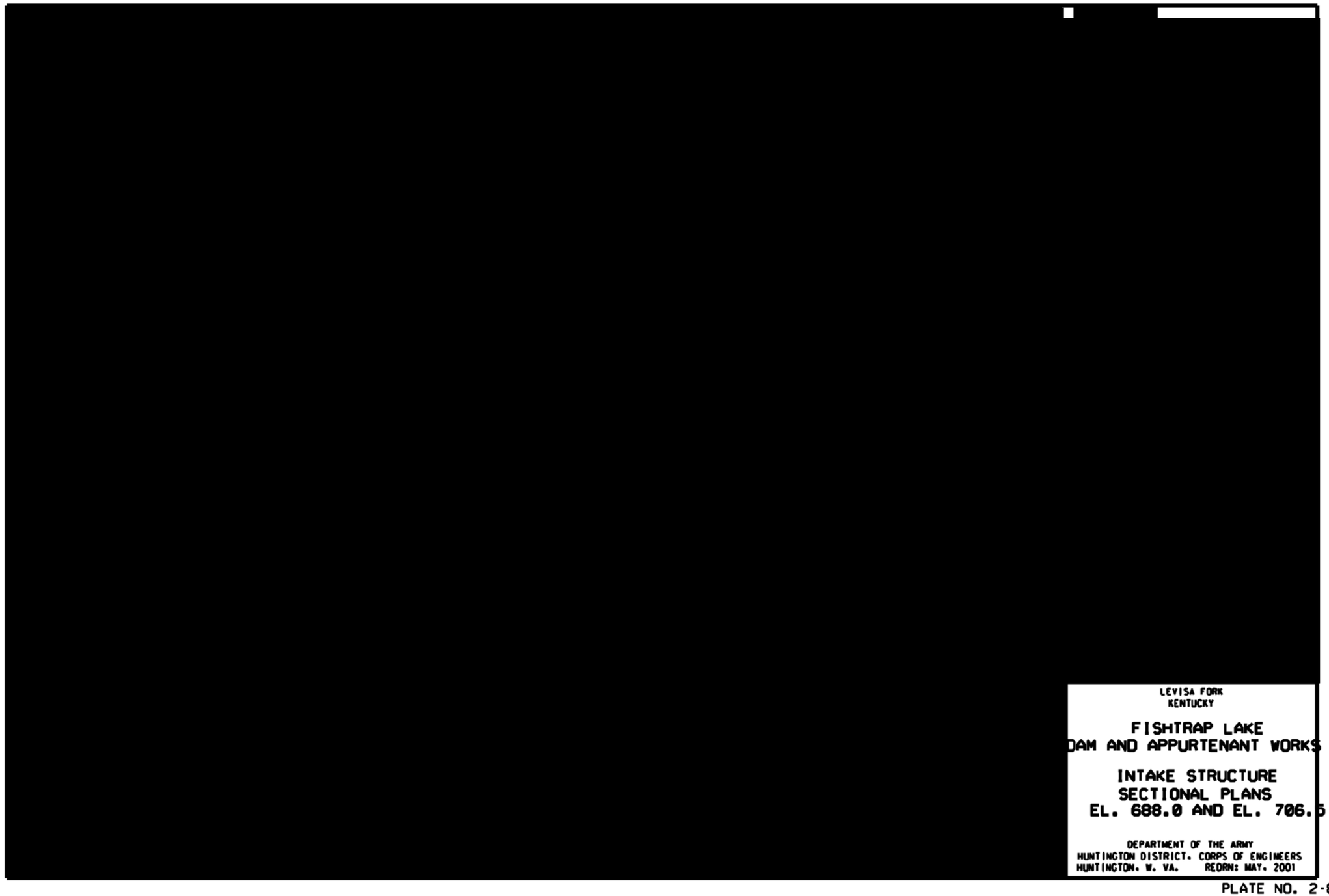
LEVISA FORK
KENTUCKY

FISHTRAP LAKE
DAM AND APPURTENANT WORKS

INTAKE STRUCTURE
ISOMETRIC SECTIONAL
ELEVATIONS

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: MAY, 2001

EXHIBIT NO. 2-7



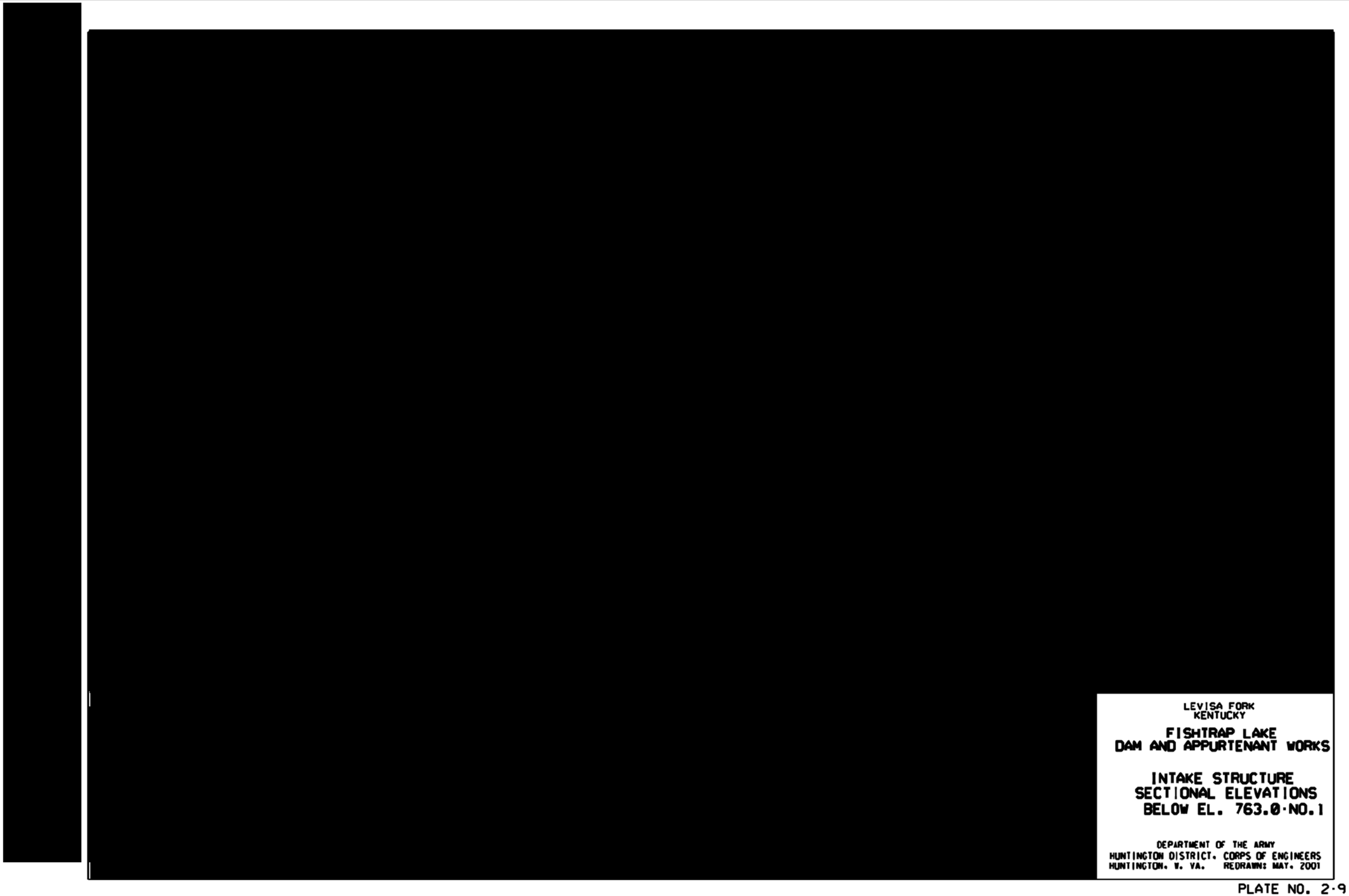
LEVISA FORK
KENTUCKY

FISHTRAP LAKE
DAM AND APPURTENANT WORKS

INTAKE STRUCTURE
SECTIONAL PLANS
EL. 688.0 AND EL. 706.5

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT. CORPS OF ENGINEERS
HUNTINGTON. W. VA. REDRN: MAY. 2001

PLATE NO. 2-8



LEVISA FORK
KENTUCKY

FISHTRAP LAKE
DAM AND APPURTENANT WORKS

INTAKE STRUCTURE
SECTIONAL ELEVATIONS
BELOW EL. 763.0-NO.1

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT. CORPS OF ENGINEERS
HUNTINGTON. W. VA. REDRAWN: MAY. 2001

PLATE NO. 2-9

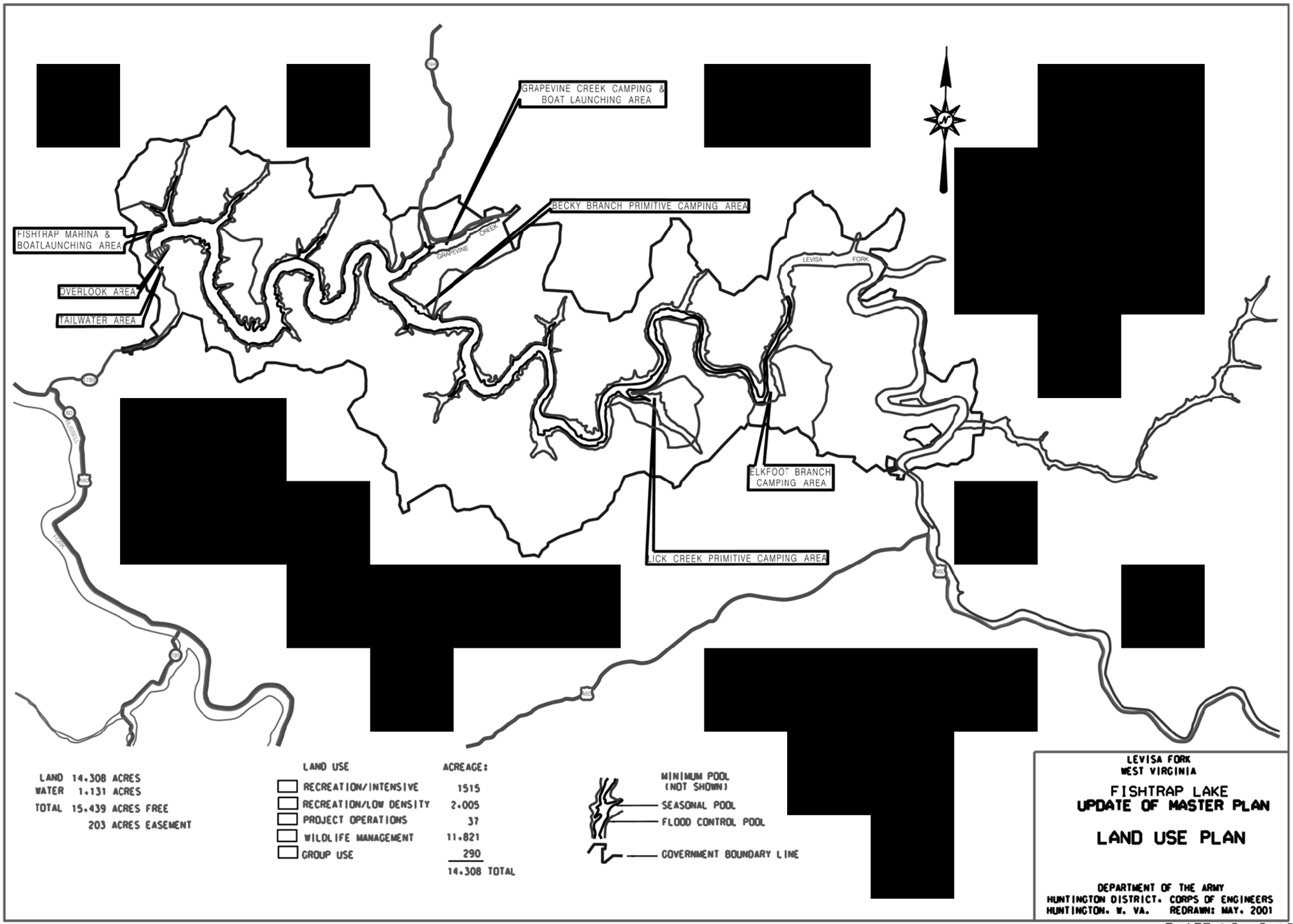

GRAPEVINE CREEK CAMPING & BOAT LAUNCHING AREA
BECKY BRANCH PRIMITIVE CAMPING AREA
FISHTRAP MARINA & BOATLAUNCHING AREA
OVERLOOK AREA
TAILWATER AREA
GRAPEVINE CREEK
LEVISA FORK
ELKFOOT BRANCH CAMPING AREA
LICK CREEK PRIMITIVE CAMPING AREA
LAND 14,308 ACRES
WATER 1,131 ACRES
TOTAL 15,439 ACRES FEE
203 ACRES EASEMENT
LAND USE
ACREAGE:
RECREATION/INTENSIVE 1515
RECREATION/LOW DENSITY 2,005
PROJECT OPERATIONS 37
WILDLIFE MANAGEMENT 11,821
GROUP USE 290
14,308 TOTAL
MINIMUM POOL (NOT SHOWN)
SEASONAL POOL
FLOOD CONTROL POOL
GOVERNMENT BOUNDARY LINE
LEVISA FORK
WEST VIRGINIA
FISHTRAP LAKE
UPDATE OF MASTER PLAN
LAND USE PLAN
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: MAY, 2001

PLATE NO. 2-10

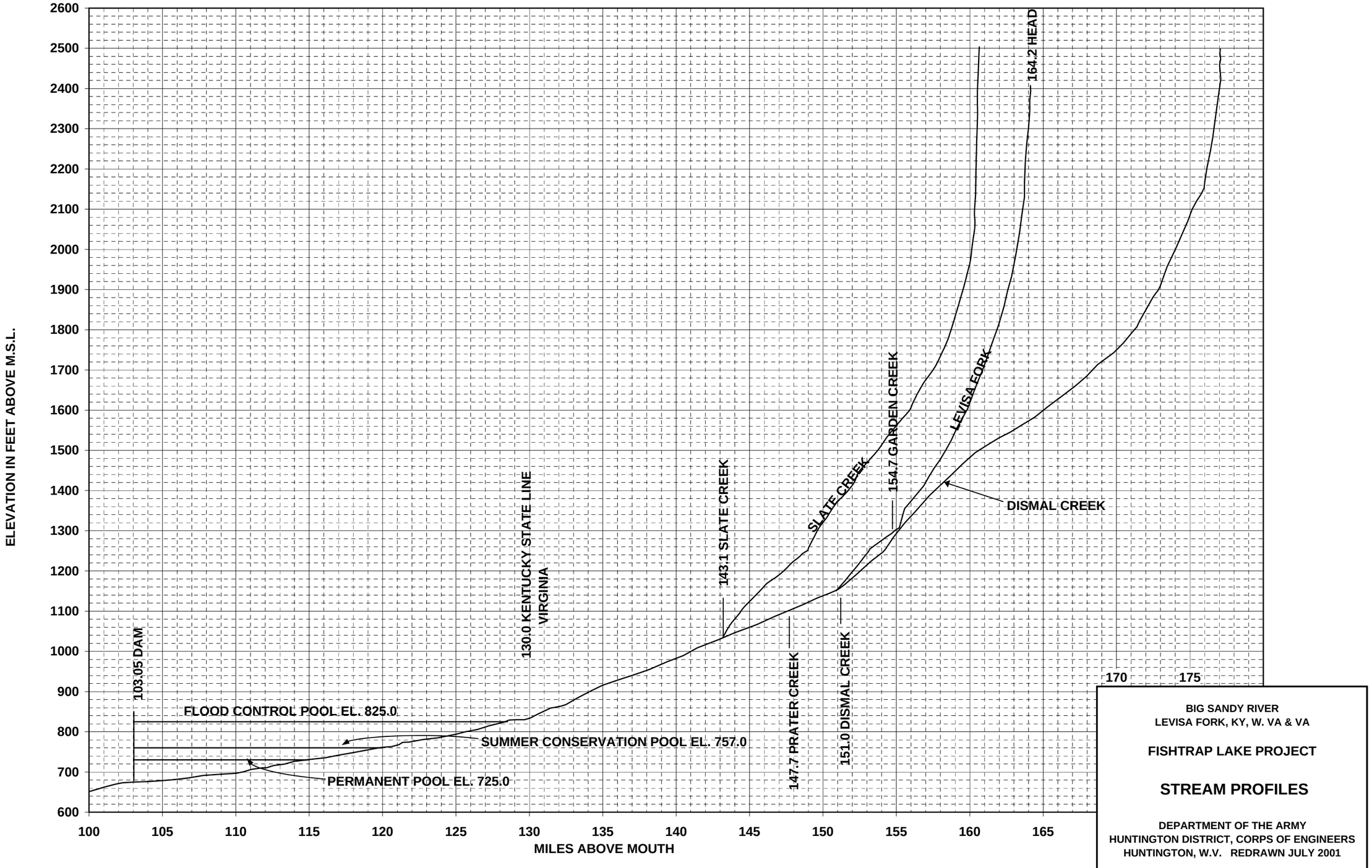
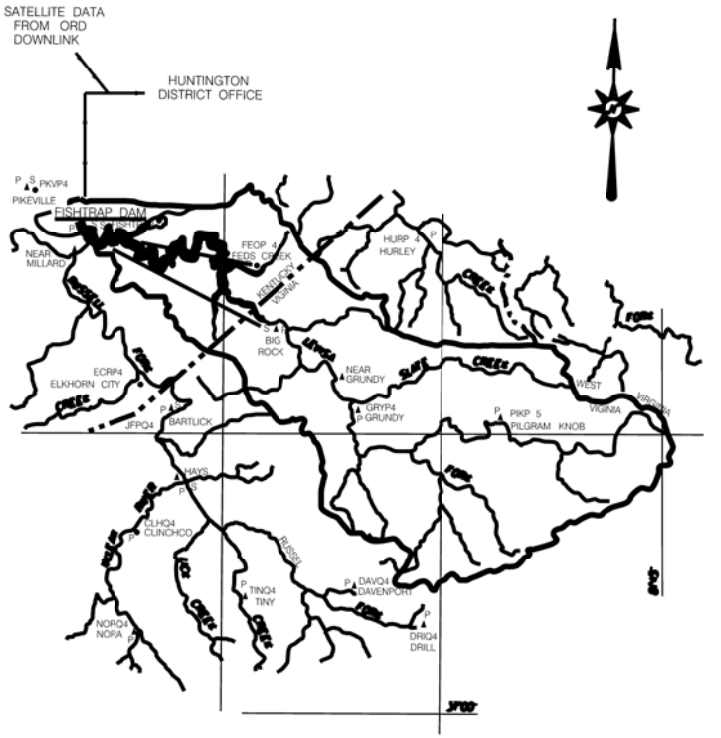

ELEVATION IN FEET ABOVE M.S.L.
MILES ABOVE MOUTH
103.05 DAM
130.0 KENTUCKY STATE LINE
VIRGINIA
143.1 SLATE CREEK
147.7 PRATER CREEK
151.0 DISMAL CREEK
154.7 GARDEN CREEK
164.2 HEAD
SLATE CREEK
LEVISA FORK
DISMAL CREEK
FLOOD CONTROL POOL EL. 825.0
SUMMER CONSERVATION POOL EL. 757.0
PERMANENT POOL EL. 725.0
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA
FISHTRAP LAKE PROJECT
STREAM PROFILES
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

Plate 4-1



LEGEND

- RESERVOIR
- REPORTING PRECIPATION STATION
- P PRECIPATION
- S STAGE
- ▲ SATELLITE DATA PLATFORM

[redacted]

LEVISA FORK
KENTUCKY

FISHTRAP LAKE

HYDROLOGIC NETWORK

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. RECORDED MAY, 2001

PLATE NO. 5-1

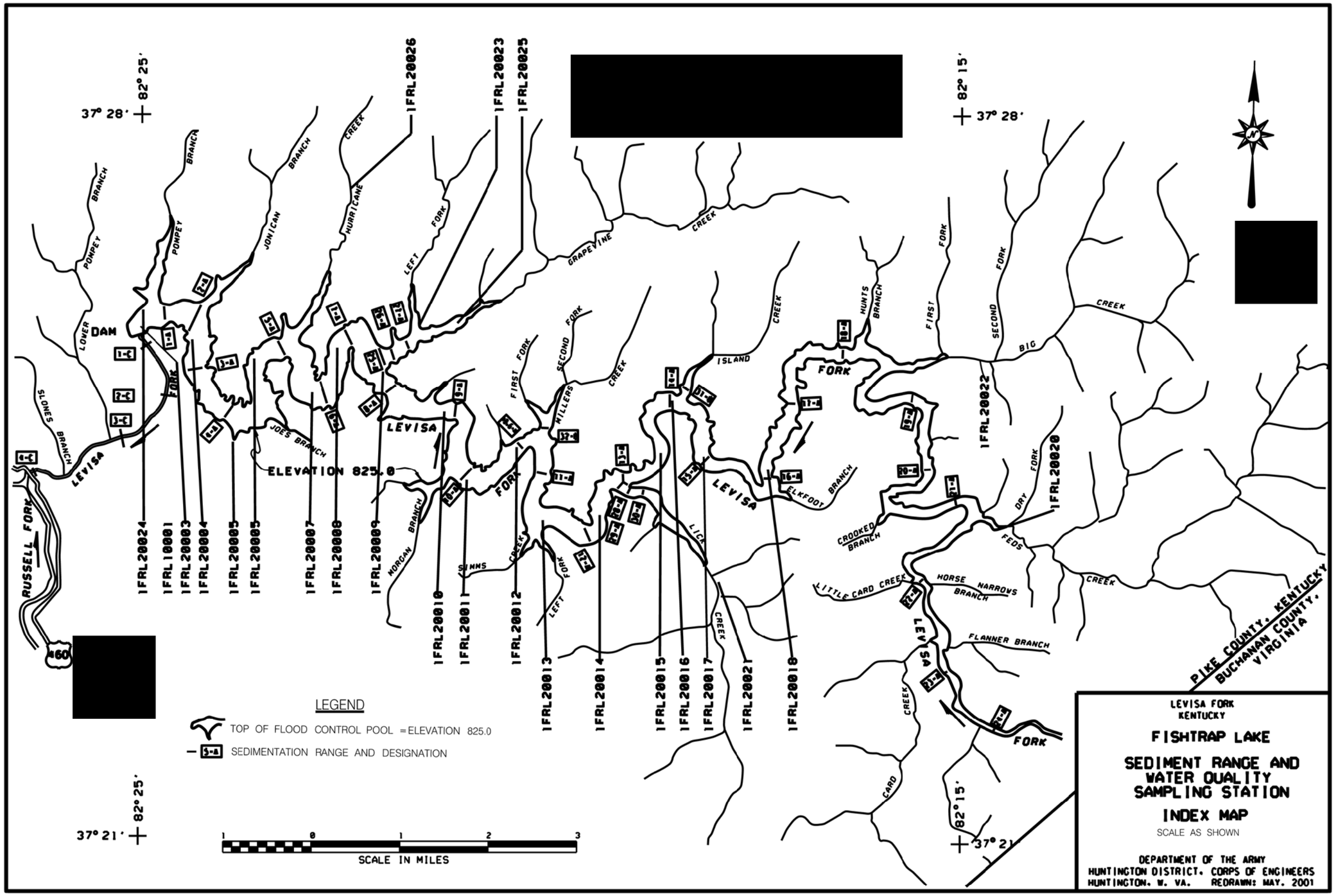
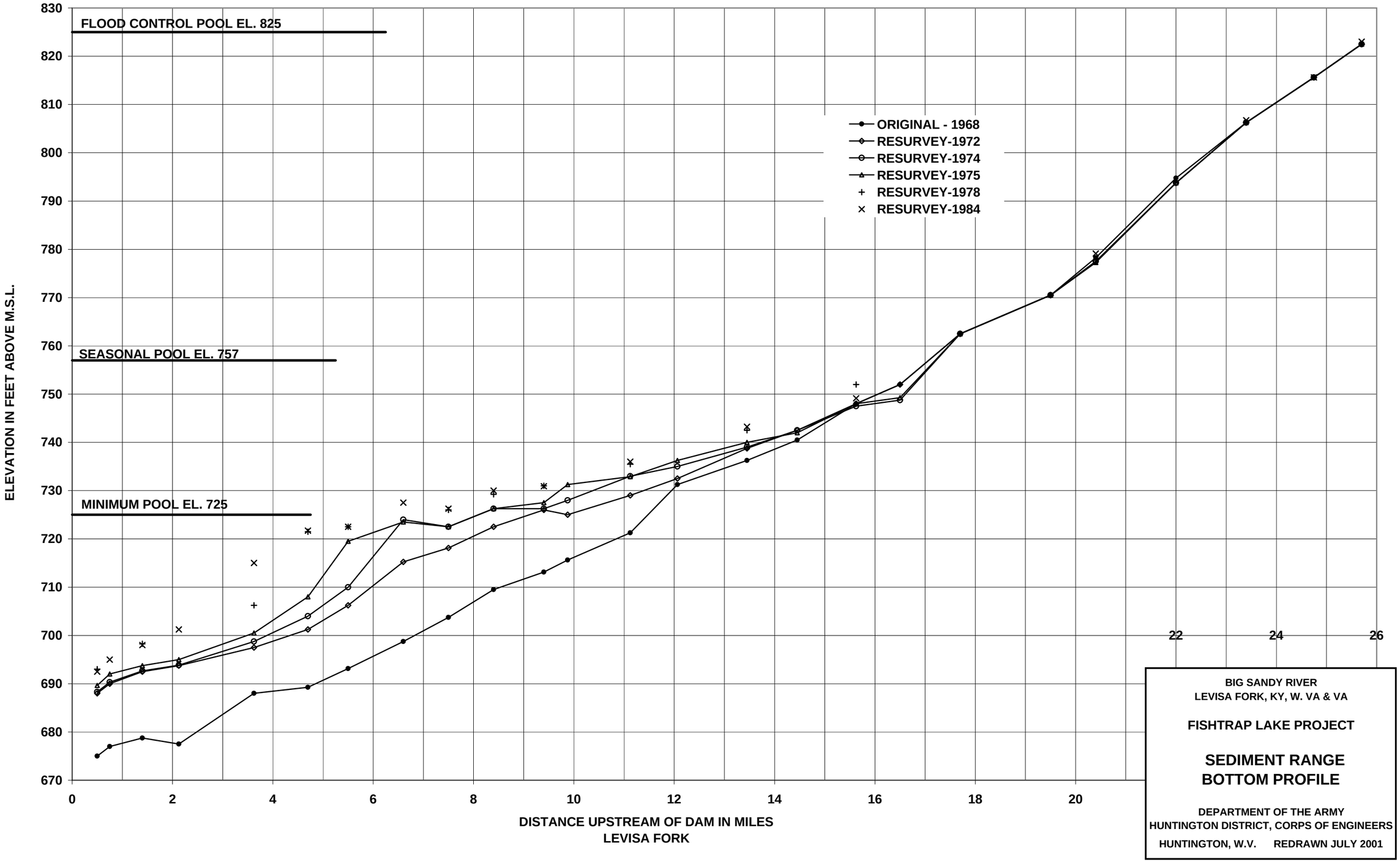

37° 28'
82° 25'
82° 15'
37° 21'
LOWER POMPEY BRANCH
POMPEY BRANCH
JONICAN BRANCH
HURRICANE CREEK
LEFT FORK
GRAPEVINE CREEK
FIRST FORK
SECOND FORK
MILLERS CREEK
ISLAND CREEK
HUNTS BRANCH
FIRST FORK
SECOND FORK
BIG CREEK
DAM
SLONES BRANCH
LEVISA FORK
JOES BRANCH
ELEVATION 825.0
LEVISA FORK
MORGAN BRANCH
SIMMS CREEK
LEFT FORK
LICK CREEK
LEVISA FORK
ELKFOOT BRANCH
CROOKED BRANCH
DRY FORK
FEDS CREEK
LITTLE CARD CREEK
HORSE NARROWS BRANCH
FLANNER BRANCH
LEVISA FORK
CARD CREEK
RUSSELL FORK
460
FRL20024
FRL10001
FRL20003
FRL20004
FRL20005
FRL20006
FRL20007
FRL20008
FRL20009
FRL20010
FRL20011
FRL20012
FRL20013
FRL20014
FRL20015
FRL20016
FRL20017
FRL20021
FRL20018
FRL20026
FRL20023
FRL20025
FRL20022
FRL20020
PIKE COUNTY, KENTUCKY
BUCHANAN COUNTY, VIRGINIA
LEGEND
TOP OF FLOOD CONTROL POOL = ELEVATION 825.0
SEDIMENTATION RANGE AND DESIGNATION
SCALE IN MILES
1 0 1 2 3
LEVISA FORK
KENTUCKY
FISHTRAP LAKE
SEDIMENT RANGE AND
WATER QUALITY
SAMPLING STATION
INDEX MAP
SCALE AS SHOWN
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: MAY, 2001

PLATE NO. 5-2



BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

SEDIMENT RANGE BOTTOM PROFILE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

Plate 5-3 (1 of 2)

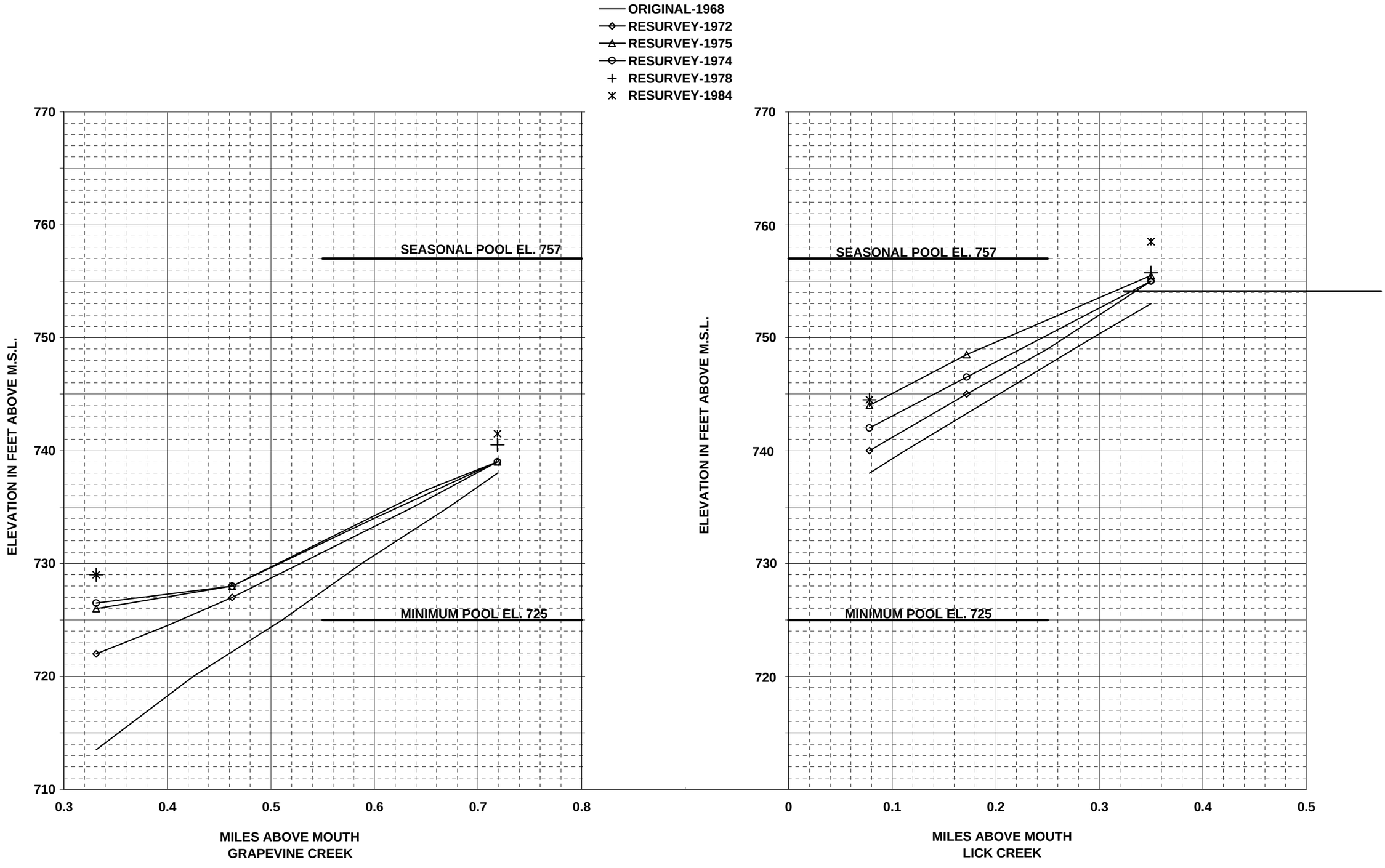
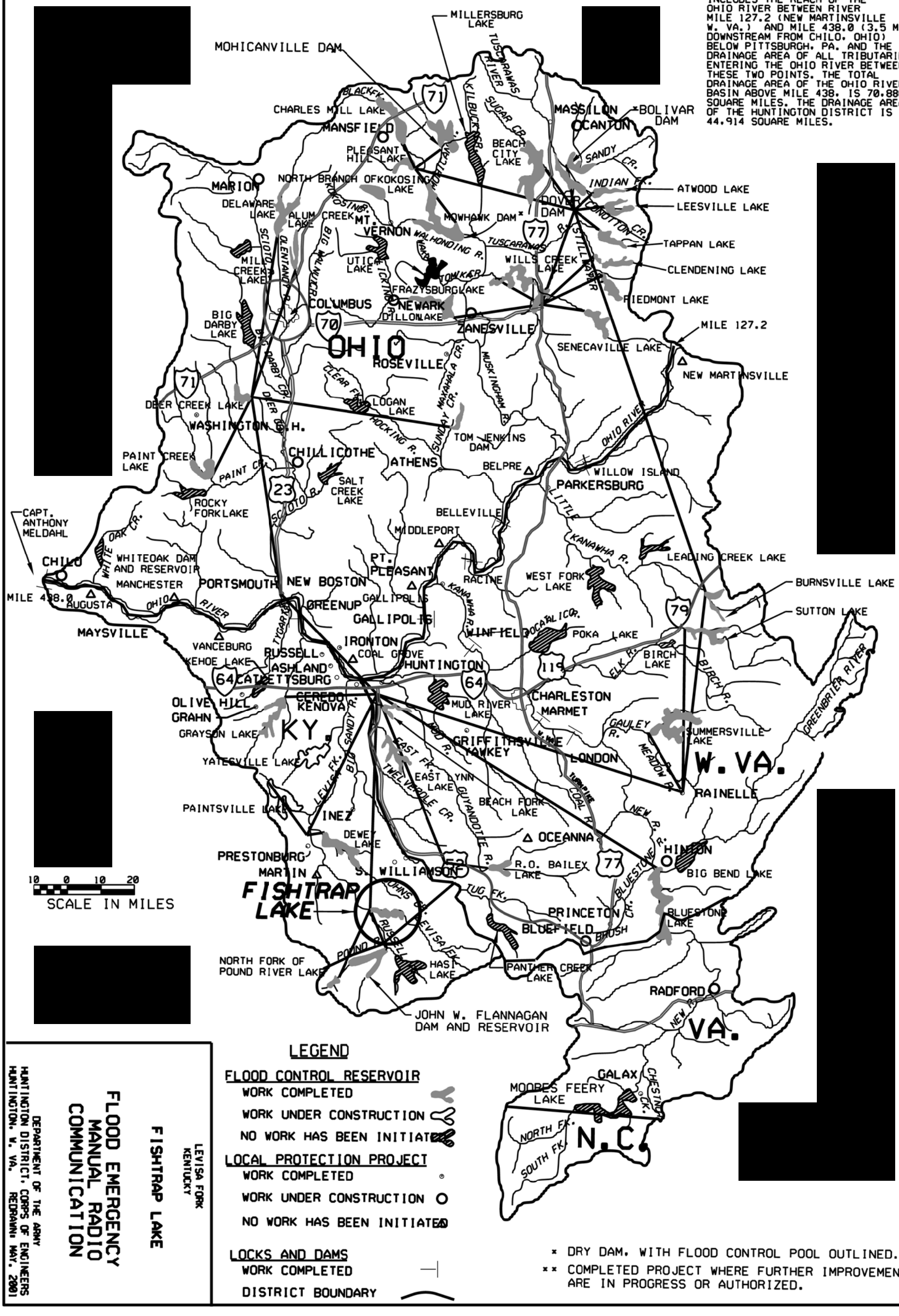


Plate 5-3 (2 of 2)

THE HUNTINGTON DISTRICT INCLUDES THE REACH OF THE OHIO RIVER BETWEEN RIVER MILE 127.2 (NEW MARTINSVILLE W. VA.) AND MILE 438.0 (3.5 MILES DOWNSTREAM FROM CHILO, OHIO) BELOW PITTSBURGH, PA. AND THE DRAINAGE AREA OF ALL TRIBUTARIES ENTERING THE OHIO RIVER BETWEEN THESE TWO POINTS. THE TOTAL DRAINAGE AREA OF THE OHIO RIVER BASIN ABOVE MILE 438. IS 70,880 SQUARE MILES. THE DRAINAGE AREA OF THE HUNTINGTON DISTRICT IS 44,914 SQUARE MILES.



LEGEND

FLOOD CONTROL RESERVOIR
- WORK COMPLETED
- WORK UNDER CONSTRUCTION
- NO WORK HAS BEEN INITIATED

LOCAL PROTECTION PROJECT
- WORK COMPLETED
- WORK UNDER CONSTRUCTION
- NO WORK HAS BEEN INITIATED

LOCKS AND DAMS
- WORK COMPLETED
- DISTRICT BOUNDARY

* DRY DAM, WITH FLOOD CONTROL POOL OUTLINED.

** COMPLETED PROJECT WHERE FURTHER IMPROVEMENTS ARE IN PROGRESS OR AUTHORIZED.

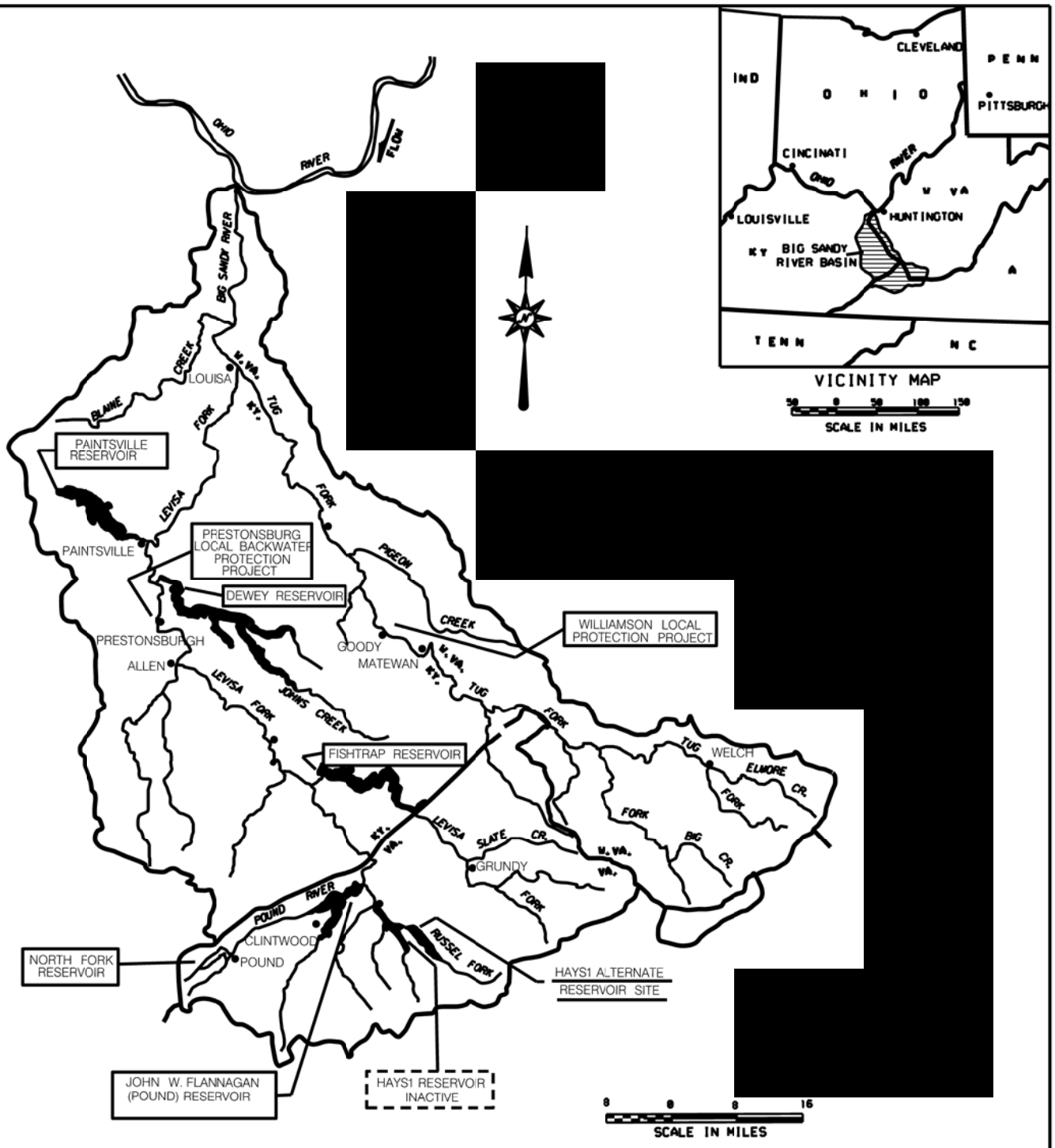
FLOOD EMERGENCY MANUAL RADIO COMMUNICATION

FISHTRAP LAKE

LEVISA FORK KENTUCKY

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: MAY, 2001

PLATE NO. 5-4



LEGEND

- EXISTING RESERVOIR
- COMPLETED PROJECTS
- PROPOSED PROJECTS
- AUTHORIZED PROJECTS

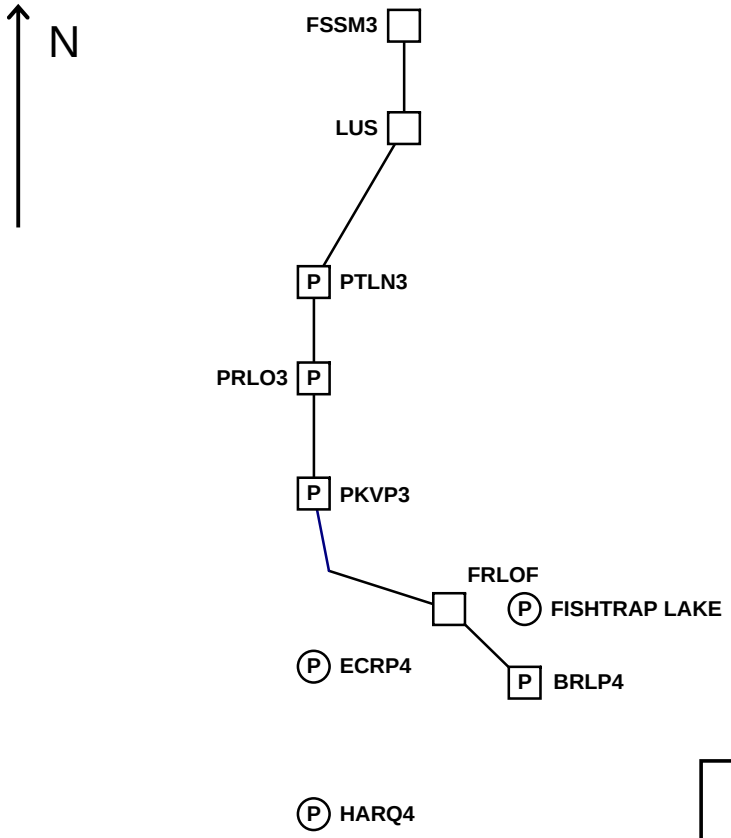
LEVISA FORK
KENTUCKY

FISHTRAP LAKE

FORECAST AREA AND REACHES

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: MAY. 2001

PLATE NO. 6-1



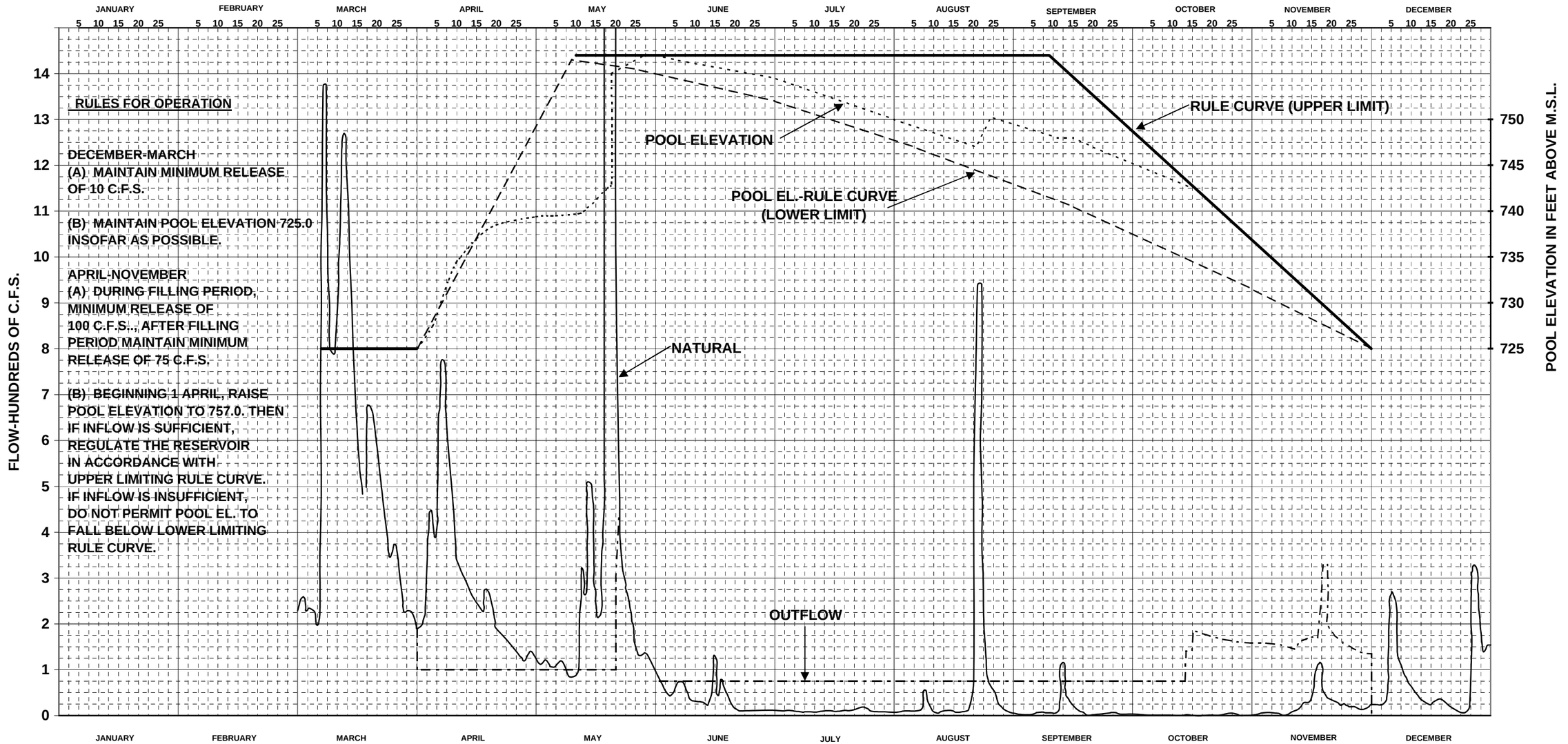
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

BASIN NETWORK CONFIGURATION

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE 6-2



1930

BIG SANDY RIVER
LEVISA FORK KY, W. VA. & VA.

FISHTRAP LAKE PROJECT

RULE CURVE
LOW FLOW REGULATION

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.VA. REDRAWN JULY 2001

Plate 7-1

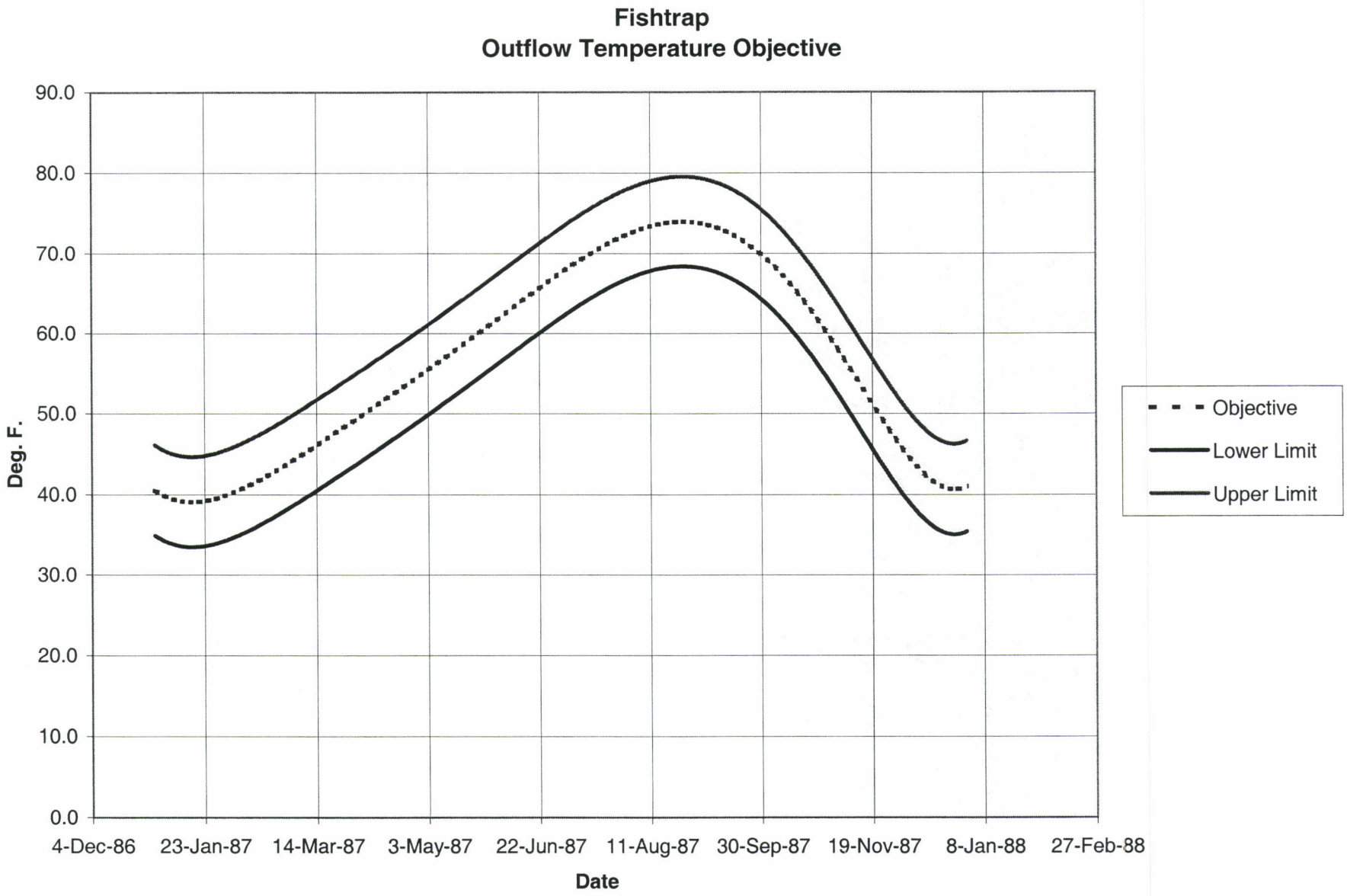

Fishtrap
Outflow Temperature Objective
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Deg. F.
4-Dec-86
23-Jan-87
14-Mar-87
3-May-87
22-Jun-87
11-Aug-87
30-Sep-87
19-Nov-87
8-Jan-88
27-Feb-88
Date
Objective
Lower Limit
Upper Limit

Plate Do 7-29

Fishtrap
Temperature Objective Evaluation

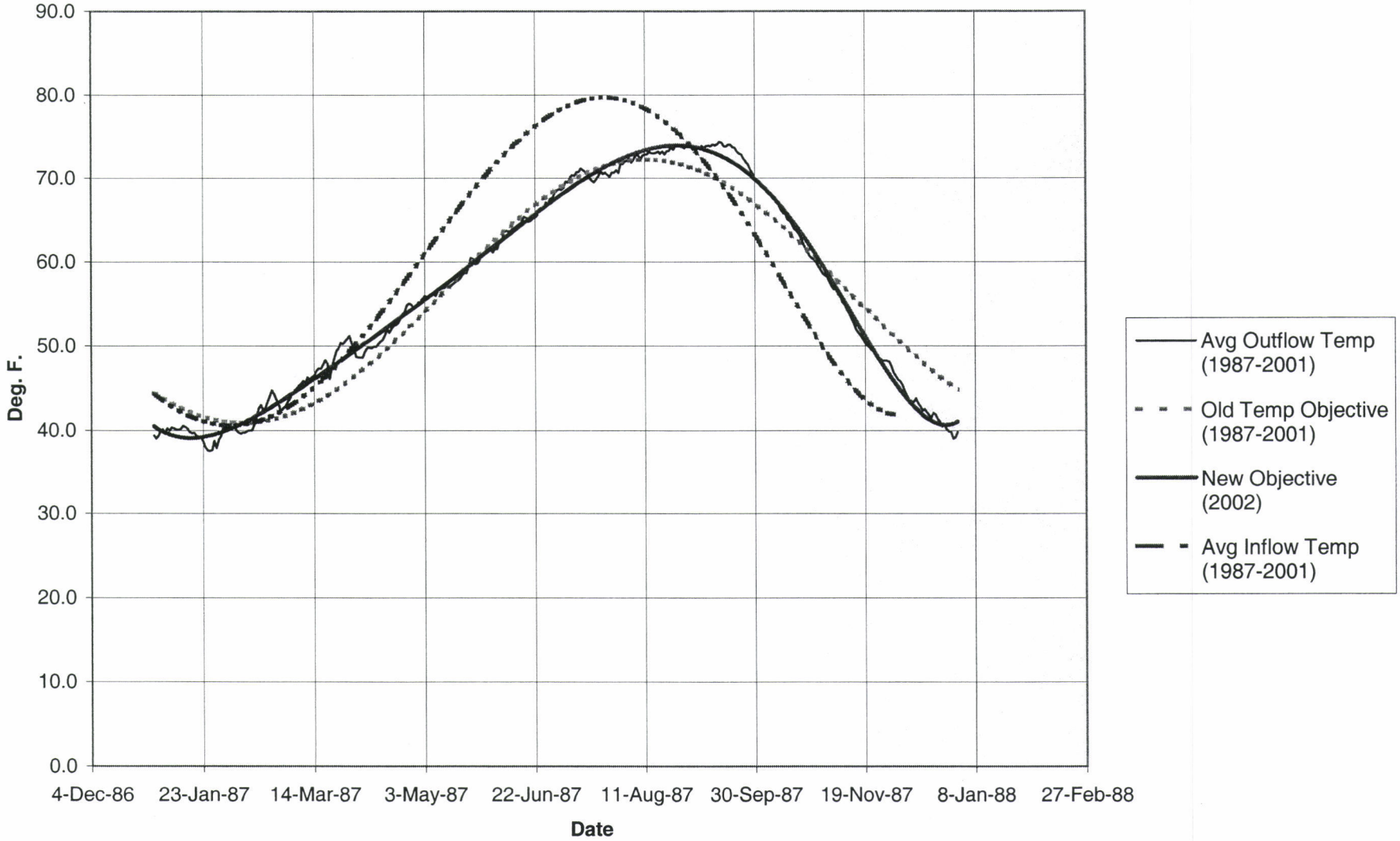
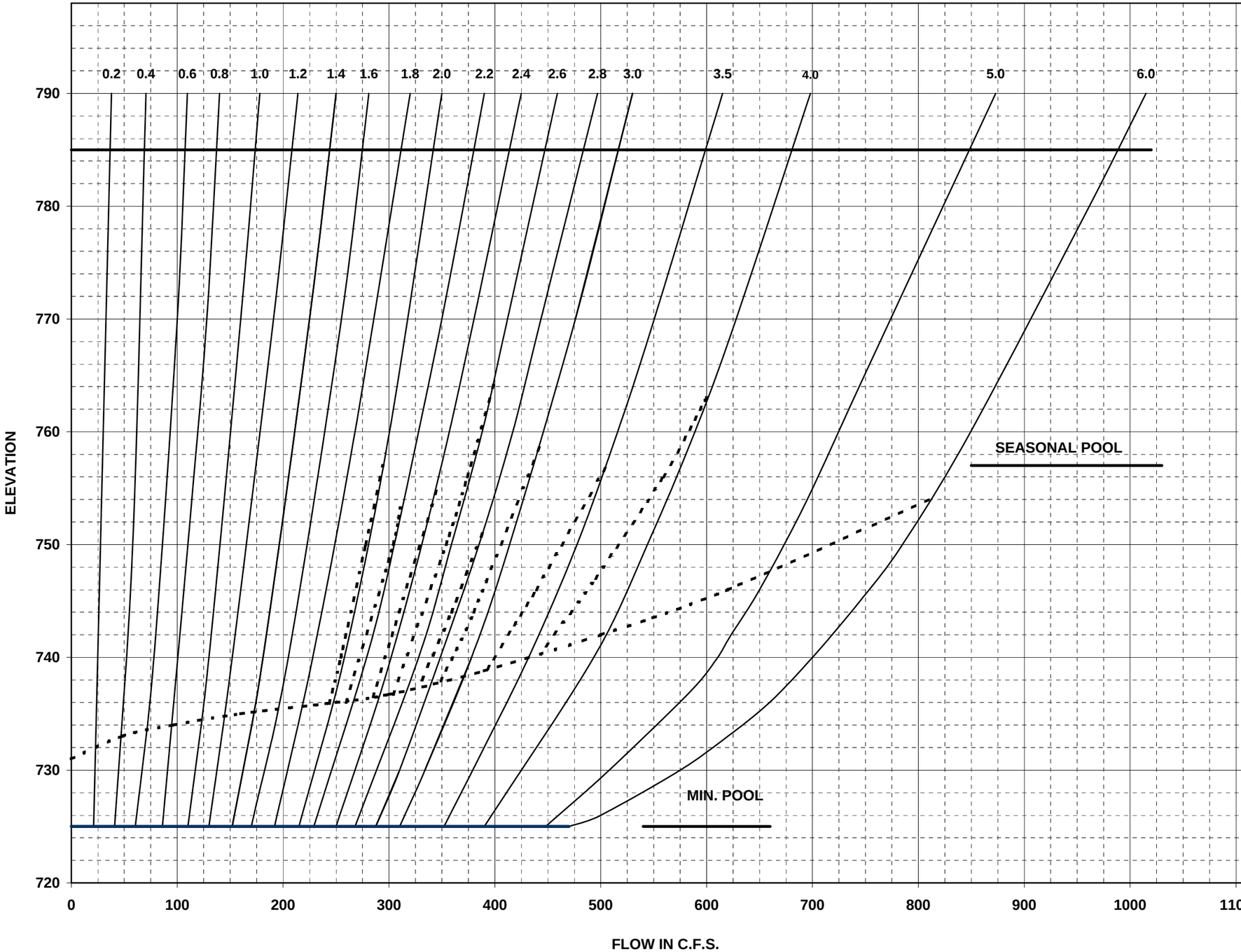


Plate No 7-26



NOTES

1. LOW-FLOW SYSTEM CONSISTS OF ONE 3 FT. X 6 FT. SLUICE AND A 3 FT. X 6 FT. SLIDE-TYPE CONTROL GATE, LFC, WITH INVERT ELEVATION AT 685 FT. AND THREE 6 FT. WIDE X 4 FT. HIGH INTAKE GATES WITH INVERT ELEVATIONS AT 715, 731, AND 747 FT. THE CURVES GIVE OPENINGS OF LFC TO RELEASE INDICATED FLOWS AT INDICATED ELEVATIONS AS AFFECTED BY SELECTION OF INTAKE GATES.

2. THE SOLID CURVES ARE FOR TWO INTAKES FULLY OPEN AT ELEVATIONS 715 AND 731; ALSO FOR 731 AND 747 EXCEPT WHERE ACCOMPANIED BY DASHED CURVES.

3. THE DASHED CURVES ARE FOR TWO INTAKES FULLY OPEN AT ELEVATIONS 731 AND 747.

4. LFC IS NOT TO BE OPENED MORE THAN 1.6 FT. WITH SINGLE INTAKE TO AVOID HIGH VELOCITY DAMAGE TO THE INTAKE MECHANISM. SOLID CURVES OF LFC OPENINGS 1.6 FT. AND SMALLER ARE APPLICABLE WITH ONE OR MORE INTAKES OPEN.

BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

LOW FLOW CONTROL GATE RATING CURVES

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 7-3

FISHTRAP LAKE, LEVISA FORK

AREA AND CAPACITY TABLES

DRAINAGE:
NET DRAINAGE AREA = 395 SQ.MI. 1 INCHE OF RUNOFF = 21,067 AC. FT.

POOL ELEV.	CAPACITY		AREA IN ACRES	POOL ELEV.	CAPACITY		AREA IN ACRES
	AC. FT.	INCHES			AC. FT.	INCHES	
674	0.1	0	0	712	4732.1	.22	322
675	2.1	0	4	713	5063.1	.24	339
676	8.1	0	9	714	5412.1	.26	358
677	20.1	0	15	715	5779.1	.27	377
678	38.1	0	21	716	6166.1	.29	397
679	62.1	0	27	717	6572.1	.31	417
680	92.1	0	33	718	6999.1	.33	437
681	127.1	.01	38	719	7446.1	.35	457
682	168.1	.01	43	720	7912.1	.38	476
683	213.1	.01	48	721	8398.1	.40	495
684	263.1	.01	53	722	8902.1	.42	514
685	318.1	.02	58	723	9425.1	.45	532
686	378.1	.02	62	724	9967.1	.47	551
687	443.1	.02	67	725	10527.1	.50	~~569~~ 174 2003 REVISED
688	513.1	.02	72	726	11106.1	.53	588
689	588.1	.03	78	727	11703	.56	606
690	669.1	.03	84	728	12318	.58	624
691	756.1	.04	90	729	12951	.61	642
692	850.1	.04	97	730	13601	.65	659
693	951.1	.05	105	731	14269	.68	676
694	1059.1	.05	112	732	14954	.71	693
695	1176.1	.06	121	733	15656	.74	710
696	1301.1	.06	129	734	16374	.78	727
697	1434.1	.07	138	735	17110	.81	~~144~~ 489 2003 REVISED
698	1578.1	.07	148	736	17862	.85	760
699	1730.1	.08	158	737	18630	.88	777
700	1893.1	.09	167	738	19416	.92	794
701	2065.1	.10	177	739	20218	.96	811
702	2248.1	.11	188	740	21037	1.00	828
703	2440.1	.12	198	741	21874	1.04	846
704	2644.1	.13	209	742	22729	1.08	864
705	2859.1	.14	220	743	23602	1.12	882
706	3086.1	.15	233	744	24493	1.16	900
707	3325.1	.16	245	745	25403	1.21	~~919~~ 841 2003 REVISED
708	3577.1	.17	258	746	26331	1.25	937
709	3843.1	.18	273	747	27277	1.29	956
710	4123.1	.20	288	748	28243	1.34	974
711	4419.1	.21	304	749	29226	1.39	993

FISHTRAP LAKE, LEVISA FORK

AREA AND CAPACITY TABLES

DRAINAGE:
NET DRAINAGE AREA = 395 SQ.MI. **1 INCHE OF RUNOFF = 21,067 AC. FT.**

POOL ELEV.	CAPACITY		AREA IN ACRES	POOL ELEV.	CAPACITY		AREA IN ACRES
	AC. FT.	INCHES			AC. FT.	INCHES	
750	30227	1.43	1010	788	82855	3.93	1780
751	31246	1.48	1028	789	84645	4.02	1801
752	32282	1.53	1045	790	86457	4.10	1823
753	33336	1.58	1062	791	88292	4.19	1847
754	34406	1.63	1079	792	90151	4.28	1870
755	35493	1.68	1096	793	92033	4.37	1895
756	36598	1.74	1113	794	93940	4.46	1919
757	37720	1.79	~~1131~~ 1145	795	95871	4.55	1944
758	38860	1.84	1148	796	97828	4.64	1969
759	40017	1.90	1167	797	99809	4.74	1994
760	41194	1.96	1186	798	101816	4.83	2019
761	42391	2.01	1207	799	103847	4.93	2043
762	43607	2.07	1227	800	105901	5.03	2066
763	44845	2.13	1248	801	107978	5.13	2088
764	46104	2.19	1270	802	110076	5.23	2109
765	47385	2.25	1292	803	112195	5.33	2130
766	48687	2.31	1314	804	114335	5.43	2151
767	50013	2.37	1336	805	116496	5.53	2171
768	51360	2.44	1359	806	118678	5.63	2191
769	52730	2.50	1381	807	120879	5.74	2211
770	54123	2.57	1404	808	123101	5.84	2232
771	5537	2.64	1426	809	125343	5.95	2253
772	56974	2.70	1448	810	127607	6.06	2275
773	58433	2.77	1470	811	129893	6.17	2297
774	59914	2.84	1492	812	132201	6.28	2319
775	61416	2.92	1514	813	134532	6.39	2342
776	62941	2.99	1535	814	136886	6.50	2366
777	64487	3.06	1557	815	139263	6.61	2389
778	66055	3.14	1579	816	141664	6.72	2413
779	67644	3.21	1600	817	144094	6.84	2437
780	69254	3.29	1620	818	146539	6.96	2461
781	70884	3.36	1640	819	149013	7.07	2486
782	72535	3.44	1660	820	151510	7.19	2510
783	74205	3.52	1680	821	154032	7.31	2534
784	75895	3.60	1700	822	156578	7.43	2558
785	77605	3.68	1720	823	159148	7.55	2582
786	79335	3.77	1740	824	161743	7.68	2607
787	81085	3.85	1759	825	164362	7.80	2631

PLATE NO. 7-4 (2 of 3)

FISHTRAP LAKE, LEVISA FORK

AREA AND CAPACITY TABLES

DRAINAGE:
NET DRAINAGE AREA = 395 SQ.MI. 1 INCHE OF RUNOFF = 21,067 AC. FT.

POOL ELEV.	CAPACITY		AREA IN ACRES	POOL ELEV.	CAPACITY		AREA IN ACRES
	AC. FT.	INCHES			AC. FT.	INCHES	
826	167006	7.93	2656				
827	169674	8.05	2681				
828	172367	8.18	2705				
829	175085	8.31	2730				
830	177827	8.44	2755				
831	180594	8.57	2780				
832	183387	8.70	2805				
833	186205	8.84	2830				
834	189048	8.97	2856				
835	191916	9.11	2881				
836	194809	9.25	2906				
837	197728	9.39	2931				
838	200671	9.53	2957				
839	203642	9.67	2984				
840	206640	9.81	3015				
841	209672	9.95	3047				
842	212736	10.10	3080				
843	215832	10.25	3111				
844	218958	10.39	3140				
845	222110	10.54	3164				
845.3	223059.9	10.59	3170				

PLATE NO. 7-4 (3 of 3)

FISHTRAP

PERCENT STORAGE UTILIZATION - WINTER

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
725	0.00	0.04	0.07	0.11	0.15	0.19	0.22	0.26	0.30	0.34
726	0.38	0.41	0.45	0.49	0.53	0.57	0.61	0.65	0.69	0.73
727	0.76	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12
728	1.16	1.20	1.25	1.29	1.33	1.37	1.41	1.45	1.49	1.53
729	1.58	1.62	1.66	1.70	1.74	1.79	1.83	1.87	1.91	1.96
730	2.00	2.04	2.08	2.13	2.17	2.21	2.26	2.30	2.34	2.39
731	2.43	2.48	2.52	2.56	2.61	2.65	2.70	2.74	2.79	2.83
732	2.88	2.92	2.97	3.01	3.06	3.10	3.15	3.20	3.24	3.29
733	3.33	3.38	3.43	3.47	3.52	3.57	3.61	3.66	3.71	3.75
734	3.80	3.85	3.90	3.94	3.99	4.04	4.09	4.13	4.18	4.23
735	4.28	4.33	4.38	4.42	4.47	4.52	4.57	4.62	4.67	4.72
736	4.77	4.82	4.87	4.92	4.97	5.02	5.07	5.12	5.17	5.22
737	5.27	5.32	5.37	5.42	5.47	5.52	5.57	5.62	5.68	5.73
738	5.78	5.83	5.88	5.93	5.99	6.04	6.09	6.14	6.19	6.25
739	6.30	6.35	6.41	6.46	6.51	6.56	6.62	6.67	6.72	6.78
740	6.83	6.89	6.94	6.99	7.05	7.10	7.16	7.21	7.27	7.32
741	7.38	7.43	7.49	7.54	7.60	7.65	7.71	7.76	7.82	7.88
742	7.93	7.99	8.04	8.10	8.16	8.21	8.27	8.33	8.39	8.44
743	8.50	8.56	8.61	8.67	8.73	8.79	8.85	8.90	8.96	9.02
744	9.08	9.14	9.20	9.26	9.31	9.37	9.43	9.49	9.55	9.61
745	9.67	9.73	9.79	9.85	9.91	9.97	10.03	10.09	10.15	10.21
746	10.27	10.33	10.40	10.46	10.52	10.58	10.64	10.70	10.76	10.83
747	10.89	10.95	11.01	11.08	11.14	11.20	11.26	11.33	11.39	11.45
748	11.52	11.58	11.64	11.71	11.77	11.83	11.90	11.96	12.03	12.09
749	12.16	12.22	12.28	12.35	12.41	12.48	12.54	12.61	12.68	12.74
750	12.81	12.87	12.94	13.00	13.07	13.14	13.20	13.27	13.34	13.40
751	13.47	13.54	13.60	13.67	13.74	13.80	13.87	13.94	14.01	14.07
752	14.14	14.21	14.28	14.35	14.42	14.48	14.55	14.62	14.69	14.76
753	14.83	14.90	14.97	15.03	15.10	15.17	15.24	15.31	15.38	15.45
754	15.52	15.59	15.66	15.73	15.80	15.87	15.95	16.02	16.09	16.16
755	16.23	16.30	16.37	16.44	16.52	16.59	16.66	16.73	16.80	16.88
756	16.95	17.02	17.09	17.17	17.24	17.31	17.38	17.46	17.53	17.60
757	17.68	17.75	17.82	17.90	17.97	18.05	18.12	18.19	18.27	18.34
758	18.42	18.49	18.57	18.64	18.72	18.79	18.87	18.94	19.02	19.09
759	19.17	19.25	19.32	19.40	19.48	19.55	19.63	19.70	19.78	19.86
760	19.94	20.01	20.09	20.17	20.25	20.32	20.40	20.48	20.56	20.64
761	20.71	20.79	20.87	20.95	21.03	21.11	21.19	21.27	21.35	21.42
762	21.50	21.58	21.66	21.74	21.82	21.91	21.99	22.07	22.15	22.23
763	22.31	22.39	22.47	22.55	22.63	22.72	22.80	22.88	22.96	23.05
764	23.13	23.21	23.29	23.38	23.46	23.54	23.63	23.71	23.79	23.88
765	23.96	24.04	24.13	24.21	24.30	24.38	24.47	24.55	24.64	24.72

PLATE NO. 7-5 (1 OF 5)

FISHTRAP

PERCENT STORAGE UTILIZATION - WINTER

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
766	24.81	24.89	24.98	25.06	25.15	25.24	25.32	25.41	25.50	25.58
767	25.67	25.76	25.84	25.93	26.02	26.10	26.19	26.28	26.37	26.46
768	26.54	26.63	26.72	26.81	26.90	26.99	27.08	27.17	27.26	27.35
769	27.43	27.52	27.61	27.71	27.80	27.89	27.98	28.07	28.16	28.25
770	28.34	28.43	28.52	28.61	28.71	28.80	28.89	28.98	29.07	29.17
771	29.26	29.35	29.45	29.54	29.63	29.73	29.82	29.91	30.01	30.10
772	30.19	30.29	30.38	30.48	30.57	30.67	30.76	30.86	30.95	31.05
773	31.14	31.24	31.33	31.43	31.53	31.62	31.72	31.81	31.91	32.01
774	32.11	32.20	32.30	32.40	32.49	32.59	32.69	32.79	32.89	32.98
775	33.08	33.18	33.28	33.38	33.48	33.58	33.67	33.77	33.87	33.97
776	34.07	34.17	34.27	34.37	34.47	34.57	34.67	34.77	34.88	34.98
777	35.08	35.18	35.28	35.38	35.48	35.59	35.69	35.79	35.89	35.99
778	36.10	36.20	36.30	36.41	36.51	36.61	36.72	36.82	36.92	37.03
779	37.13	37.23	37.34	37.44	37.55	37.65	37.76	37.86	37.97	38.07
780	38.18	38.28	38.39	38.49	38.60	38.70	38.81	38.92	39.02	39.13
781	39.24	39.34	39.45	39.56	39.66	39.77	39.88	39.99	40.09	40.20
782	40.31	40.42	40.53	40.63	40.74	40.85	40.96	41.07	41.18	41.29
783	41.40	41.50	41.61	41.72	41.83	41.94	42.05	42.16	42.27	42.38
784	42.49	42.60	42.72	42.83	42.94	43.05	43.16	43.27	43.38	43.49
785	43.61	43.72	43.83	43.94	44.05	44.17	44.28	44.39	44.50	44.62
786	44.73	44.84	44.96	45.07	45.18	45.30	45.41	45.53	45.64	45.75
787	45.87	45.98	46.10	46.21	46.33	46.44	46.56	46.67	46.79	46.90
788	47.02	47.13	47.25	47.37	47.48	47.60	47.71	47.83	47.95	48.07
789	48.18	48.30	48.42	48.53	48.65	48.77	48.89	49.01	49.12	49.24
790	49.36	49.48	49.60	49.72	49.84	49.95	50.07	50.19	50.31	50.43
791	50.55	50.67	50.79	50.91	51.03	51.16	51.28	51.40	51.52	51.64
792	51.76	51.88	52.00	52.13	52.25	52.37	52.49	52.62	52.74	52.86
793	52.98	53.11	53.23	53.36	53.48	53.60	53.73	53.85	53.98	54.10
794	54.22	54.35	54.47	54.60	54.72	54.85	54.98	55.10	55.23	55.35
795	55.48	55.61	55.73	55.86	55.99	56.11	56.24	56.37	56.50	56.62
796	56.75	56.88	57.01	57.14	57.27	57.39	57.52	57.65	57.78	57.91
797	58.04	58.17	58.30	58.43	58.56	58.69	58.82	58.95	59.08	59.21
798	59.34	59.48	59.61	59.74	59.87	60.00	60.13	60.27	60.40	60.53
799	60.66	60.80	60.93	61.06	61.20	61.33	61.46	61.60	61.73	61.87
800	62.00	62.13	62.27	62.40	62.54	62.67	62.81	62.94	63.08	63.21
801	63.35	63.49	63.62	63.76	63.89	64.03	64.17	64.30	64.44	64.58
802	64.71	64.85	64.99	65.13	65.26	65.40	65.54	65.68	65.81	65.95
803	66.09	66.23	66.37	66.51	66.65	66.79	66.92	67.06	67.20	67.34
804	67.48	67.62	67.76	67.90	68.04	68.18	68.32	68.46	68.61	68.75
805	68.89	69.03	69.17	69.31	69.45	69.60	69.74	69.88	70.02	70.16

PLATE NO. 7-5 (2 OF 5)

FISHTRAP

PERCENT STORAGE UTILIZATION - WINTER

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
806	70.31	70.45	70.59	70.73	70.88	71.02	71.16	71.31	71.45	71.59
807	71.74	71.88	72.02	72.17	72.31	72.46	72.60	72.75	72.89	73.04
808	73.18	73.33	73.47	73.62	73.76	73.91	74.05	74.20	74.35	74.49
809	74.64	74.79	74.93	75.08	75.23	75.37	75.52	75.67	75.81	75.96
810	76.11	76.26	76.41	76.55	76.70	76.85	77.00	77.15	77.30	77.45
811	77.60	77.75	77.90	78.05	78.19	78.34	78.49	78.65	78.80	78.95
812	79.10	79.25	79.40	79.55	79.70	79.85	80.00	80.16	80.31	80.46
813	80.61	80.76	80.92	81.07	81.22	81.38	81.53	81.68	81.84	81.99
814	82.14	82.30	82.45	82.60	82.76	82.91	83.07	83.22	83.38	83.53
815	83.69	83.84	84.00	84.15	84.31	84.47	84.62	84.78	84.94	85.09
816	85.25	85.41	85.56	85.72	85.88	86.04	86.19	86.35	86.51	86.67
817	86.83	86.98	87.14	87.30	87.46	87.62	87.78	87.94	88.10	88.26
818	88.42	88.58	88.74	88.90	89.06	89.22	89.38	89.54	89.70	89.86
819	90.03	90.19	90.35	90.51	90.67	90.84	91.00	91.16	91.32	91.49
820	91.65	91.81	91.98	92.14	92.30	92.47	92.63	92.80	92.96	93.12
821	93.29	93.45	93.62	93.78	93.95	94.11	94.28	94.45	94.61	94.78
822	94.94	95.11	95.28	95.44	95.61	95.78	95.94	96.11	96.28	96.45
823	96.61	96.78	96.95	97.12	97.29	97.46	97.62	97.79	97.96	98.13
824	98.30	98.47	98.64	98.81	98.98	99.15	99.32	99.49	99.66	99.83
825	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PLATE NO. 7-5 (3 OF 5)

FISHTRAP

PERCENT STORAGE UTILIZATION - SUMMER

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
757	0.00	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72	0.81
758	0.90	0.99	1.08	1.17	1.26	1.36	1.45	1.54	1.63	1.72
759	1.81	1.91	2.00	2.09	2.18	2.28	2.37	2.46	2.56	2.65
760	2.74	2.84	2.93	3.03	3.12	3.21	3.31	3.40	3.50	3.59
761	3.69	3.78	3.88	3.97	4.07	4.17	4.26	4.36	4.46	4.55
762	4.65	4.75	4.84	4.94	5.04	5.14	5.23	5.33	5.43	5.53
763	5.63	5.72	5.82	5.92	6.02	6.12	6.22	6.32	6.42	6.52
764	6.62	6.72	6.82	6.92	7.02	7.12	7.23	7.33	7.43	7.53
765	7.63	7.73	7.84	7.94	8.04	8.14	8.25	8.35	8.45	8.56
766	8.66	8.76	8.87	8.97	9.08	9.18	9.29	9.39	9.50	9.60
767	9.71	9.81	9.92	10.02	10.13	10.24	10.34	10.45	10.56	10.66
768	10.77	10.88	10.99	11.09	11.20	11.31	11.42	11.53	11.63	11.74
769	11.85	11.96	12.07	12.18	12.29	12.40	12.51	12.62	12.73	12.84
770	12.95	13.06	13.17	13.29	13.40	13.51	13.62	13.73	13.84	13.96
771	14.07	14.18	14.29	14.41	14.52	14.63	14.75	14.86	14.98	15.09
772	15.20	15.32	15.43	15.55	15.66	15.78	15.89	16.01	16.12	16.24
773	16.36	16.47	16.59	16.70	16.82	16.94	17.06	17.17	17.29	17.41
774	17.53	17.64	17.76	17.88	18.00	18.12	18.23	18.35	18.47	18.59
775	18.71	18.83	18.95	19.07	19.19	19.31	19.43	19.55	19.67	19.79
776	19.92	20.04	20.16	20.28	20.40	20.52	20.65	20.77	20.89	21.01
777	21.14	21.26	21.38	21.51	21.63	21.75	21.88	22.00	22.13	22.25
778	22.37	22.50	22.62	22.75	22.87	23.00	23.13	23.25	23.38	23.50
779	23.63	23.76	23.88	24.01	24.14	24.26	24.39	24.52	24.65	24.77
780	24.90	25.03	25.16	25.29	25.41	25.54	25.67	25.80	25.93	26.06
781	26.19	26.32	26.45	26.58	26.71	26.84	26.97	27.10	27.23	27.36
782	27.49	27.62	27.75	27.89	28.02	28.15	28.28	28.41	28.55	28.68
783	28.81	28.94	29.08	29.21	29.34	29.48	29.61	29.74	29.88	30.01
784	30.14	30.28	30.41	30.55	30.68	30.82	30.95	31.09	31.22	31.36
785	31.49	31.63	31.77	31.90	32.04	32.18	32.31	32.45	32.59	32.72
786	32.86	33.00	33.14	33.27	33.41	33.55	33.69	33.83	33.97	34.10
787	34.24	34.38	34.52	34.66	34.80	34.94	35.08	35.22	35.36	35.50
788	35.64	35.78	35.92	36.06	36.20	36.35	36.49	36.63	36.77	36.91
789	37.05	37.20	37.34	37.48	37.62	37.77	37.91	38.05	38.20	38.34
790	38.48	38.63	38.77	38.92	39.06	39.21	39.35	39.50	39.64	39.79
791	39.93	40.08	40.23	40.37	40.52	40.67	40.81	40.96	41.11	41.25
792	41.40	41.55	41.70	41.85	41.99	42.14	42.29	42.44	42.59	42.74
793	42.89	43.04	43.19	43.34	43.49	43.64	43.79	43.94	44.09	44.24
794	44.39	44.55	44.70	44.85	45.00	45.15	45.31	45.46	45.61	45.77
795	45.92	46.07	46.23	46.38	46.53	46.69	46.84	47.00	47.15	47.31

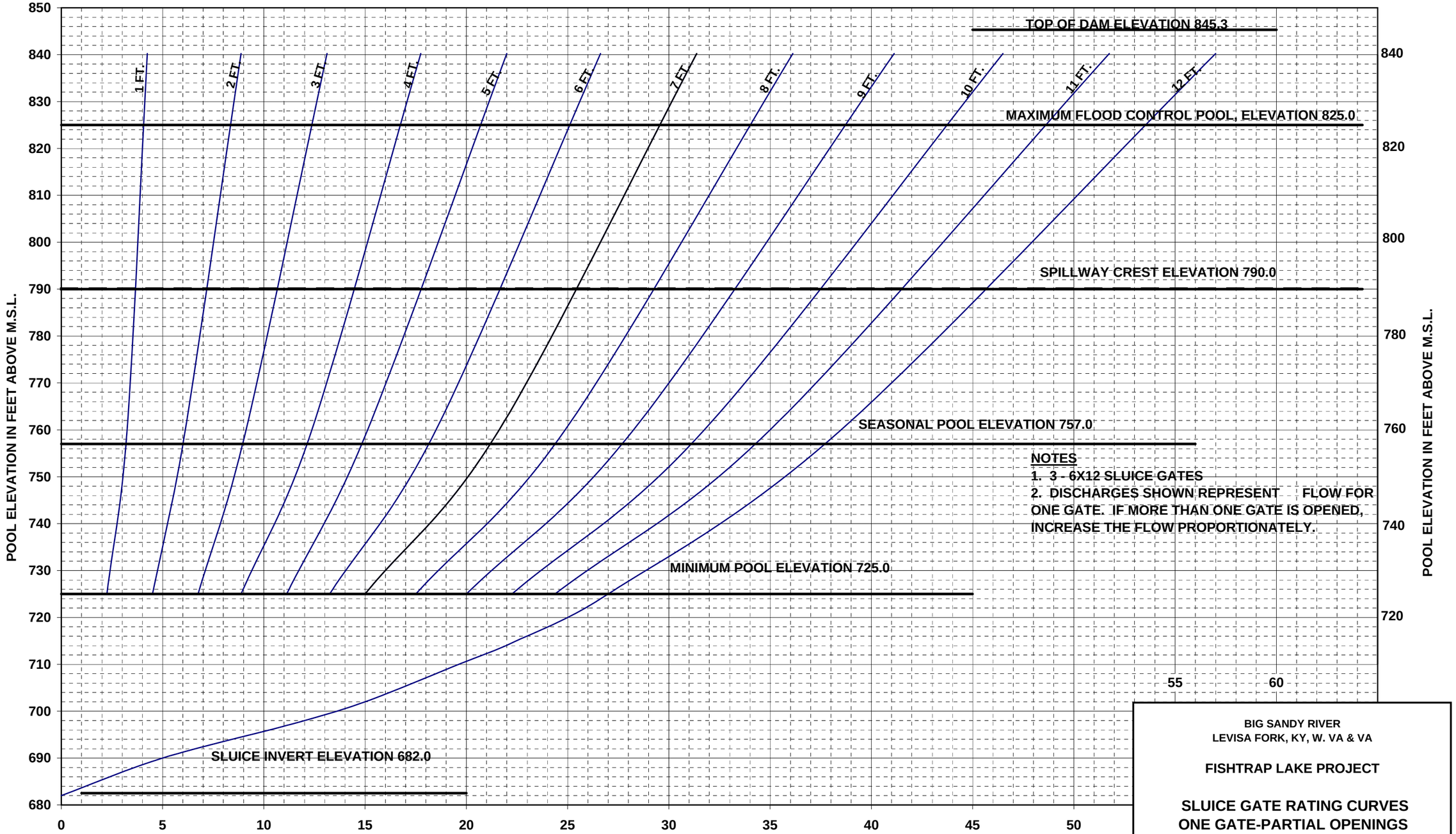
PLATE NO. 7-5 (4 OF 5)

FISHTRAP

PERCENT STORAGE UTILIZATION - SUMMER

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
796	47.46	47.62	47.78	47.93	48.09	48.24	48.40	48.56	48.71	48.87
797	49.03	49.19	49.34	49.50	49.66	49.82	49.98	50.14	50.29	50.45
798	50.61	50.77	50.93	51.09	51.25	51.41	51.57	51.73	51.89	52.06
799	52.22	52.38	52.54	52.70	52.86	53.03	53.19	53.35	53.51	53.68
800	53.84	54.00	54.17	54.33	54.49	54.66	54.82	54.99	55.15	55.31
801	55.48	55.64	55.81	55.97	56.14	56.31	56.47	56.64	56.80	56.97
802	57.14	57.30	57.47	57.64	57.80	57.97	58.14	58.31	58.47	58.64
803	58.81	58.98	59.15	59.31	59.48	59.65	59.82	59.99	60.16	60.33
804	60.50	60.67	60.84	61.01	61.18	61.35	61.52	61.69	61.86	62.03
805	62.20	62.38	62.55	62.72	62.89	63.06	63.24	63.41	63.58	63.76
806	63.93	64.10	64.27	64.45	64.62	64.79	64.97	65.14	65.32	65.49
807	65.67	65.84	66.02	66.19	66.37	66.54	66.72	66.89	67.07	67.24
808	67.42	67.60	67.77	67.95	68.13	68.30	68.48	68.66	68.84	69.01
809	69.19	69.37	69.55	69.73	69.90	70.08	70.26	70.44	70.62	70.80
810	70.98	71.16	71.34	71.52	71.70	71.88	72.06	72.24	72.42	72.60
811	72.78	72.97	73.15	73.33	73.51	73.69	73.88	74.06	74.24	74.42
812	74.61	74.79	74.97	75.16	75.34	75.52	75.71	75.89	76.08	76.26
813	76.45	76.63	76.82	77.00	77.19	77.37	77.56	77.75	77.93	78.12
814	78.31	78.49	78.68	78.87	79.05	79.24	79.43	79.62	79.81	79.99
815	80.18	80.37	80.56	80.75	80.94	81.13	81.32	81.51	81.70	81.89
816	82.08	82.27	82.46	82.65	82.84	83.03	83.23	83.42	83.61	83.80
817	83.99	84.19	84.38	84.57	84.77	84.96	85.15	85.35	85.54	85.73
818	85.93	86.12	86.32	86.51	86.71	86.90	87.10	87.29	87.49	87.69
819	87.88	88.08	88.27	88.47	88.67	88.87	89.06	89.26	89.46	89.66
820	89.85	90.05	90.25	90.45	90.65	90.85	91.05	91.25	91.45	91.65
821	91.85	92.05	92.25	92.45	92.65	92.85	93.05	93.25	93.45	93.65
822	93.86	94.06	94.26	94.46	94.66	94.87	95.07	95.27	95.48	95.68
823	95.88	96.09	96.29	96.50	96.70	96.91	97.11	97.32	97.52	97.73
824	97.93	98.14	98.35	98.55	98.76	98.97	99.17	99.38	99.59	99.79
825	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PLATE NO. 7-5 (5 OF 5)



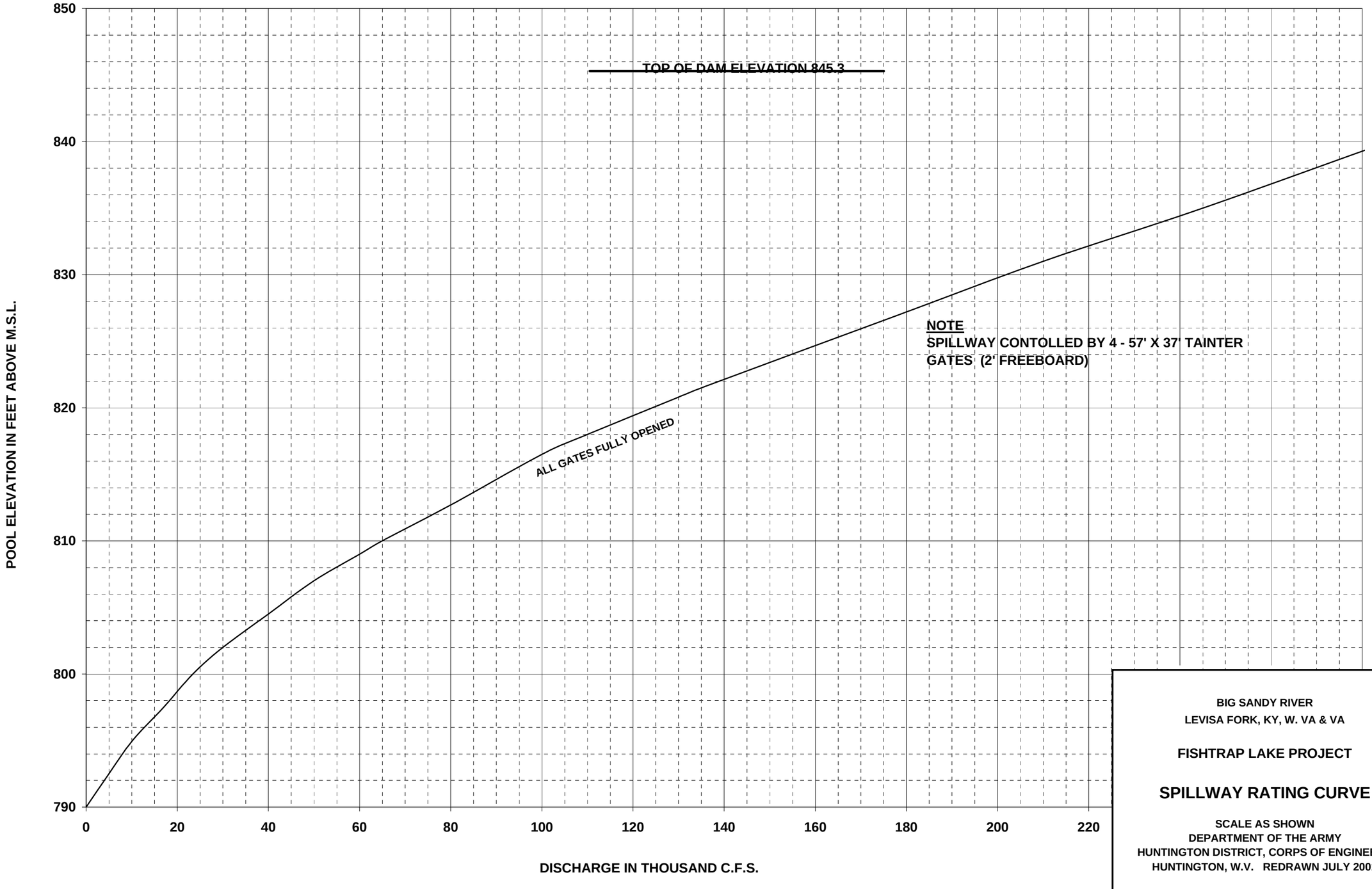
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

SLUICE GATE RATING CURVES
ONE GATE-PARTIAL OPENINGS

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 7-6



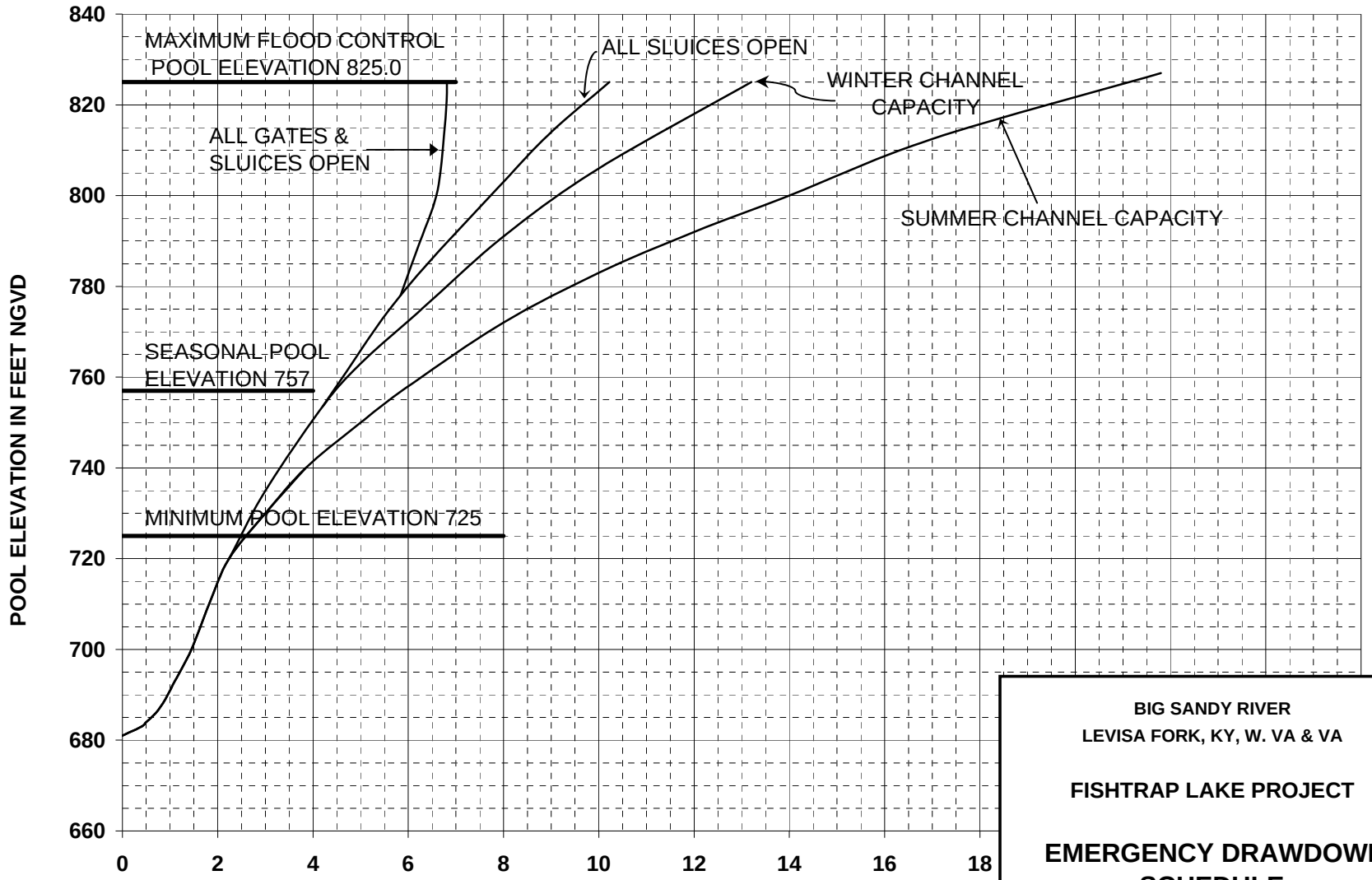
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

SPILLWAY RATING CURVE

SCALE AS SHOWN
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 7-7



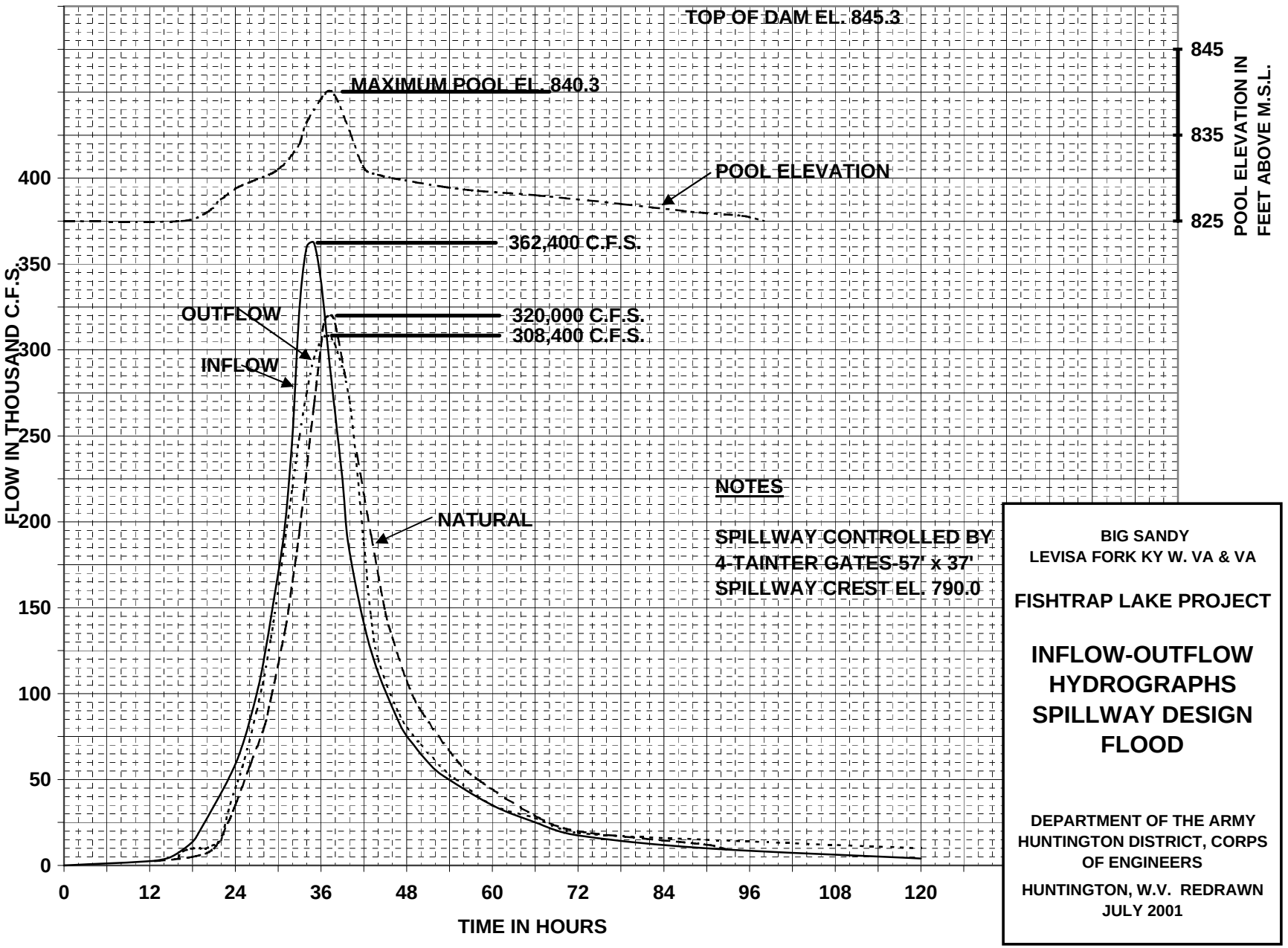
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

EMERGENCY DRAWDOWN SCHEDULE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 7-8



BIG SANDY
LEVISA FORK KY W. VA & VA

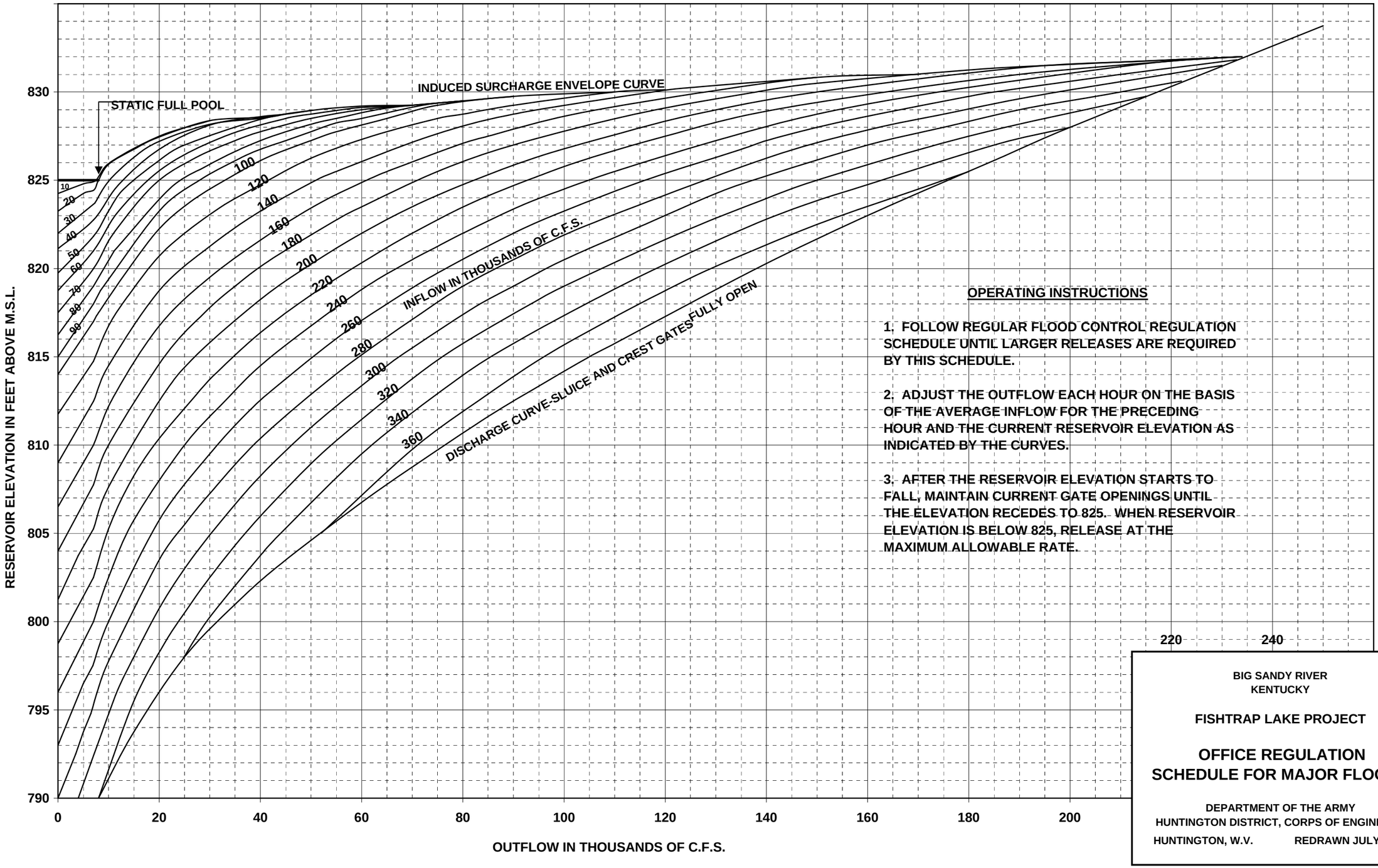
FISHTRAP LAKE PROJECT

INFLOW-OUTFLOW HYDROGRAPHS SPILLWAY DESIGN FLOOD

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 8-1



OPERATING INSTRUCTIONS

1. FOLLOW REGULAR FLOOD CONTROL REGULATION SCHEDULE UNTIL LARGER RELEASES ARE REQUIRED BY THIS SCHEDULE.

2. ADJUST THE OUTFLOW EACH HOUR ON THE BASIS OF THE AVERAGE INFLOW FOR THE PRECEDING HOUR AND THE CURRENT RESERVOIR ELEVATION AS INDICATED BY THE CURVES.

3. AFTER THE RESERVOIR ELEVATION STARTS TO FALL, MAINTAIN CURRENT GATE OPENINGS UNTIL THE ELEVATION RECEDES TO 825. WHEN RESERVOIR ELEVATION IS BELOW 825, RELEASE AT THE MAXIMUM ALLOWABLE RATE.

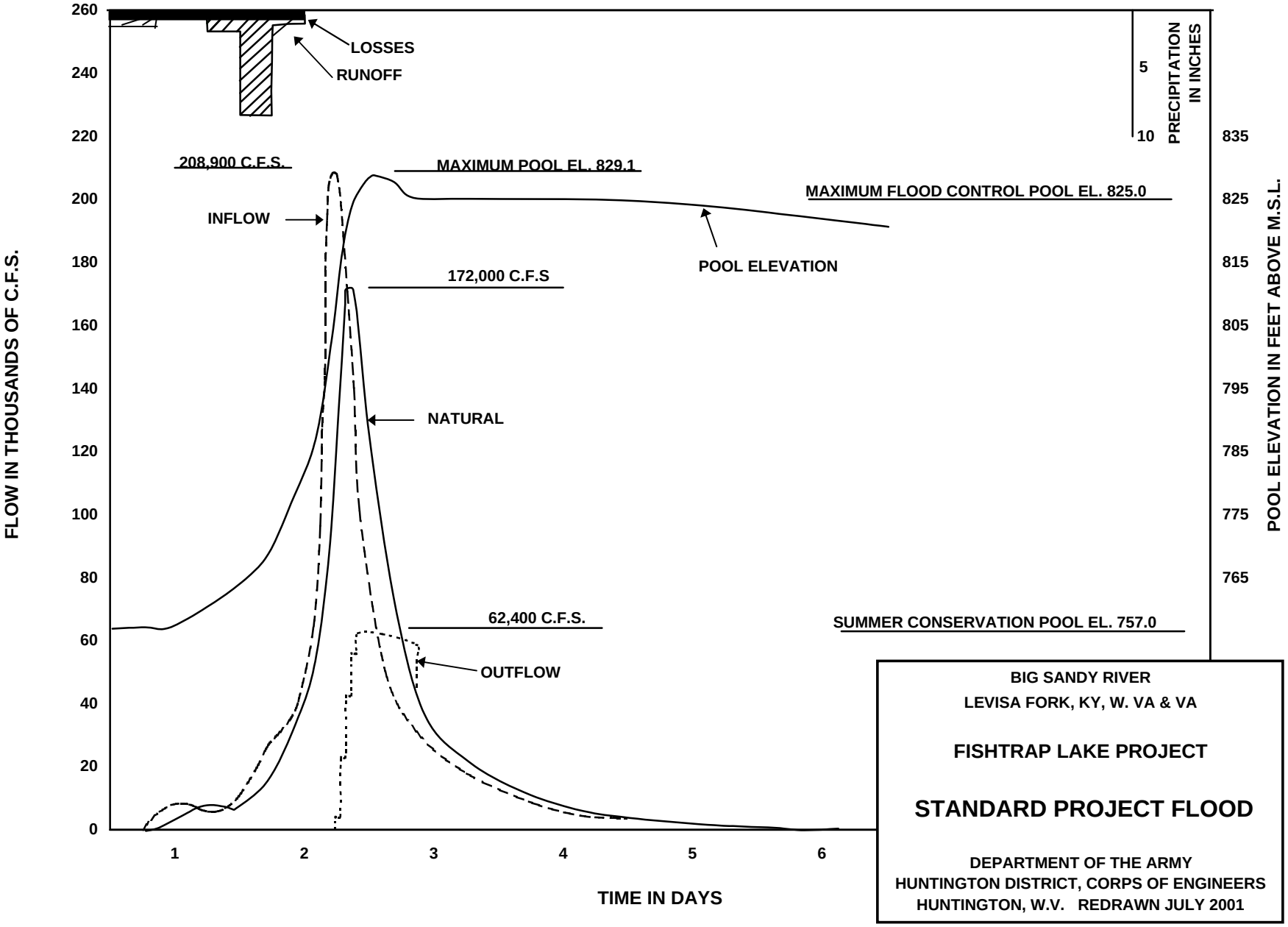
BIG SANDY RIVER
KENTUCKY

FISHTRAP LAKE PROJECT

OFFICE REGULATION SCHEDULE FOR MAJOR FLOODS

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE 8-2



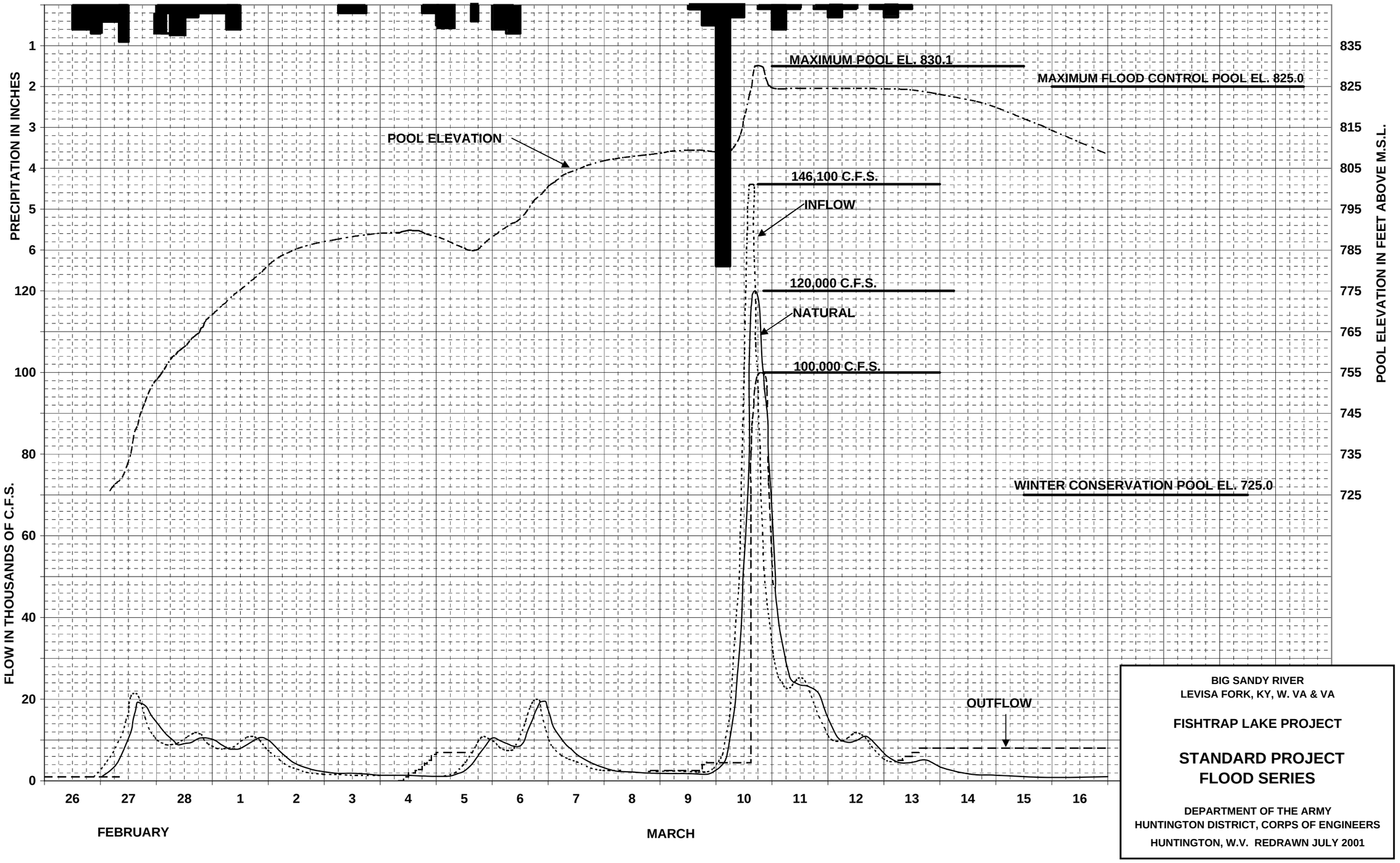
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

STANDARD PROJECT FLOOD

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 8-3



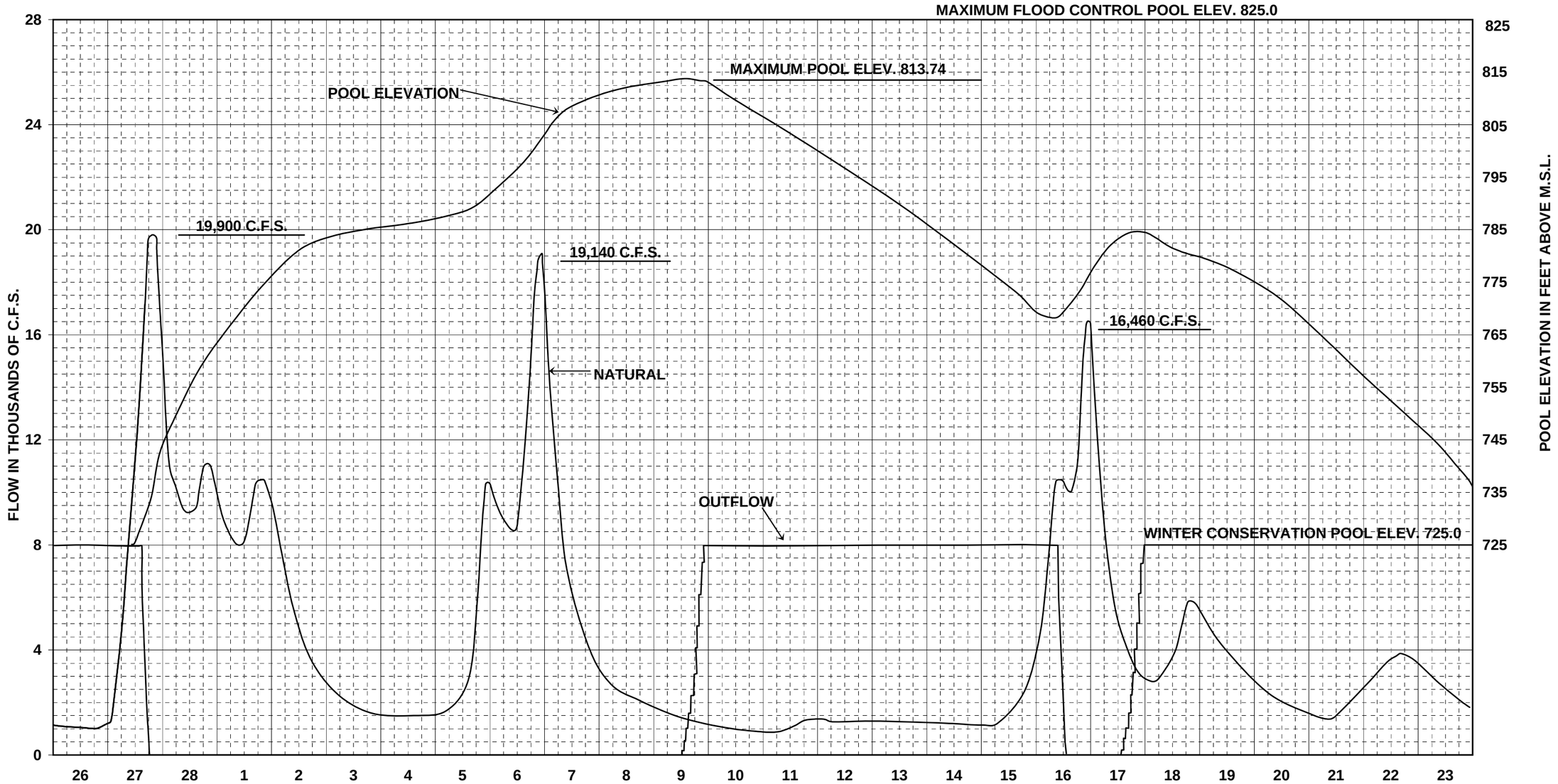
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

STANDARD PROJECT FLOOD SERIES

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 8-4



BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

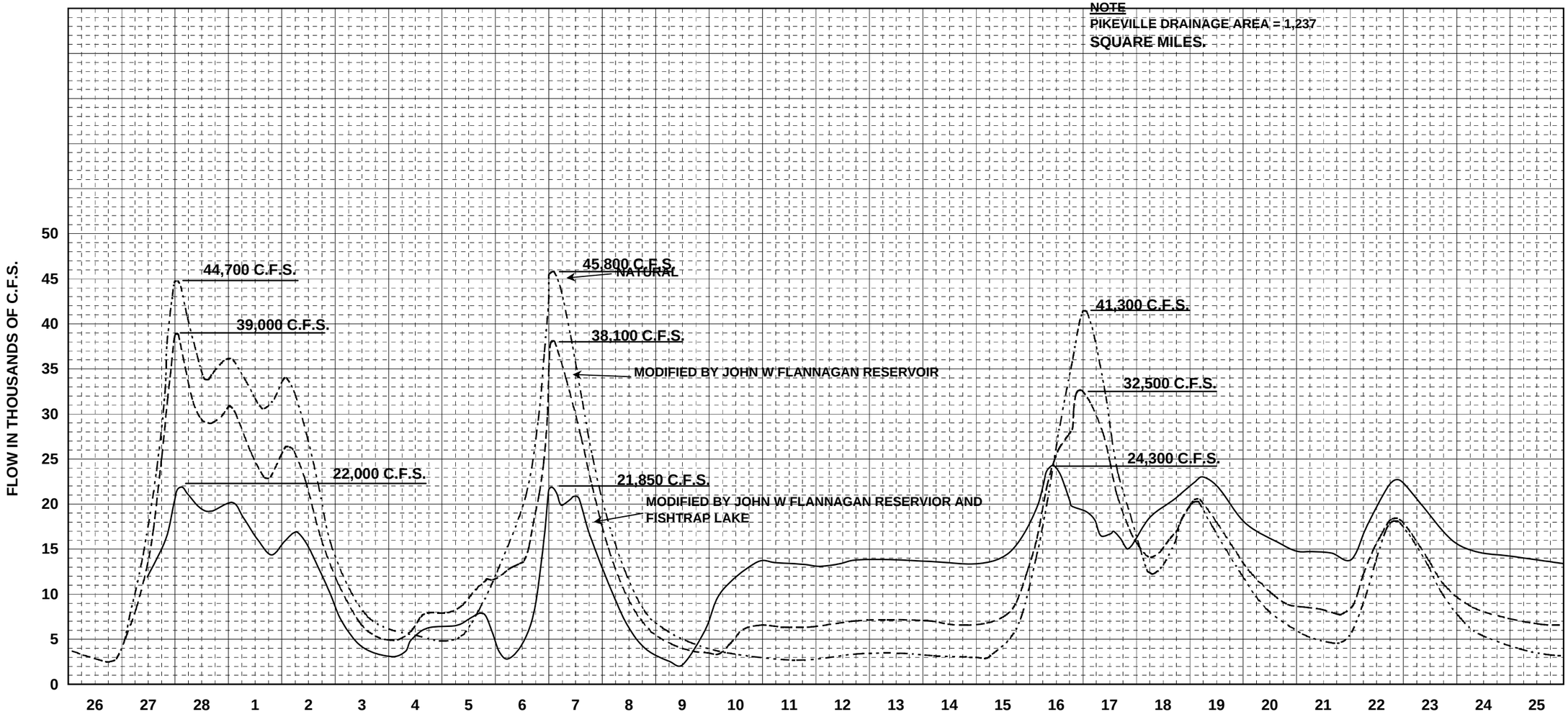
FISHTRAP LAKE PROJECT

FLOOD OF FEBRUARY - MARCH 1955

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 8-5

NOTE
PIKEVILLE DRAINAGE AREA = 1,237 SQUARE MILES.



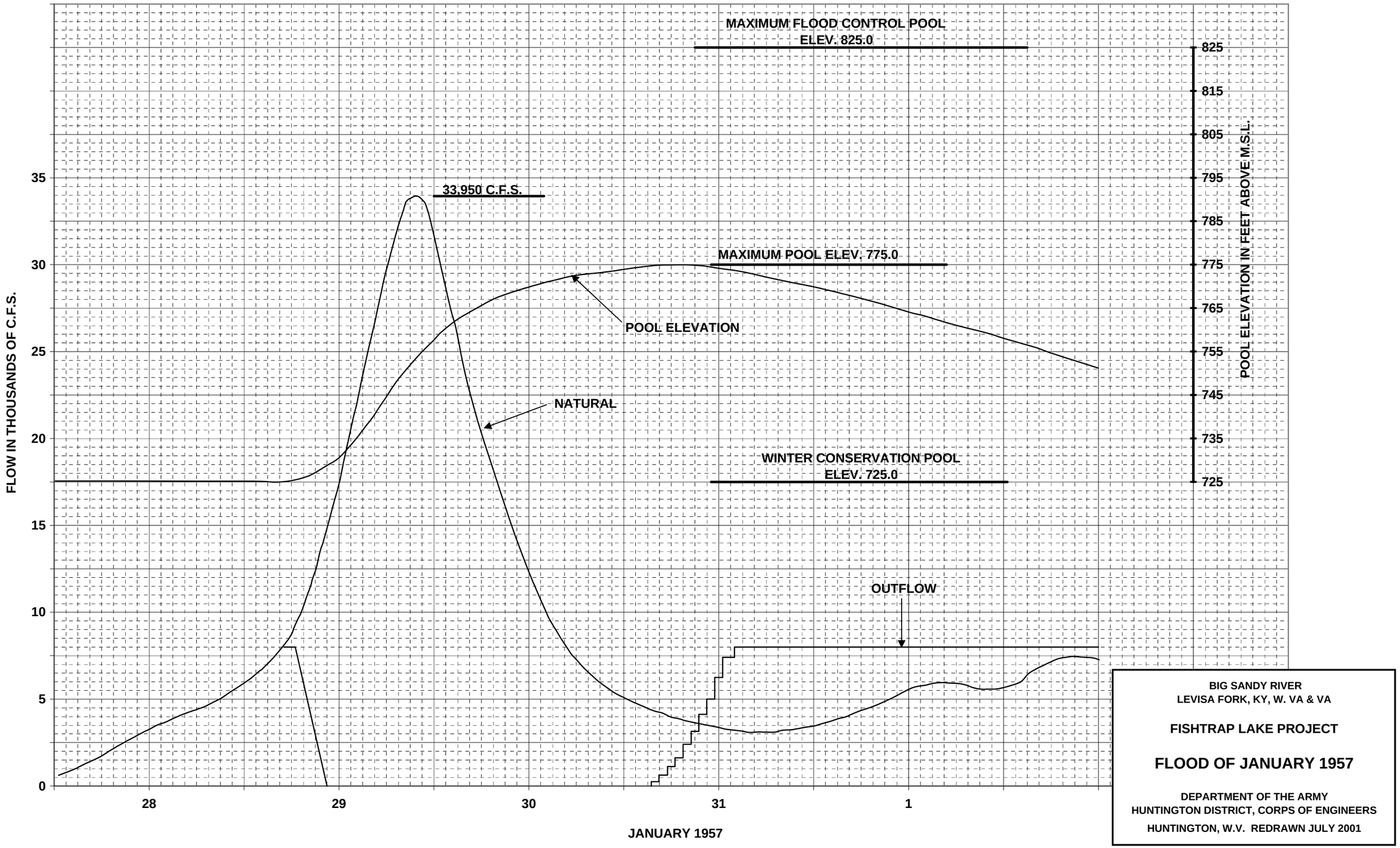
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

FLOOD OF FEBRUARY - MARCH 1955
PIKEVILLE, KENTUCKY

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 8-6



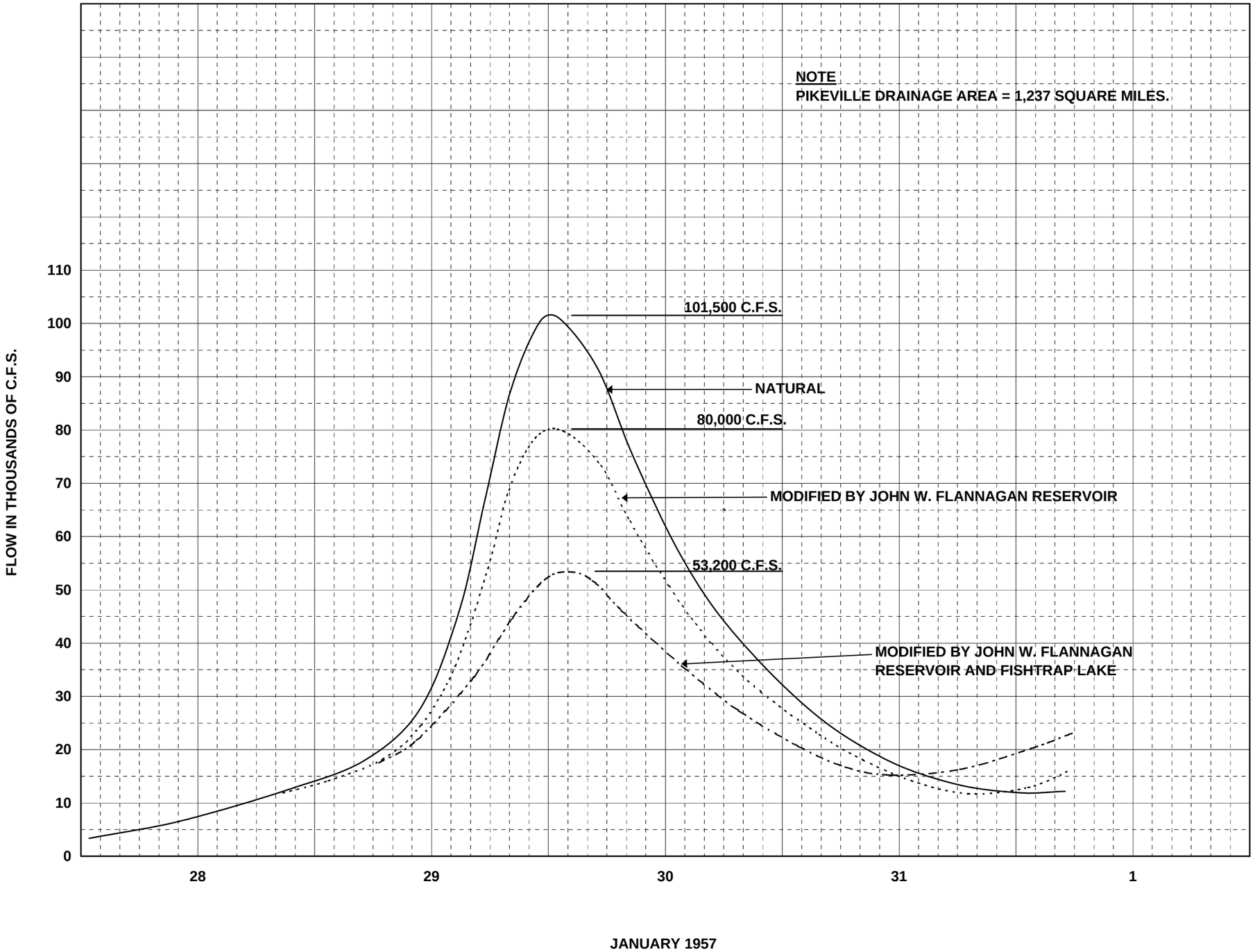
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

FLOOD OF JANUARY 1957

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 8-7

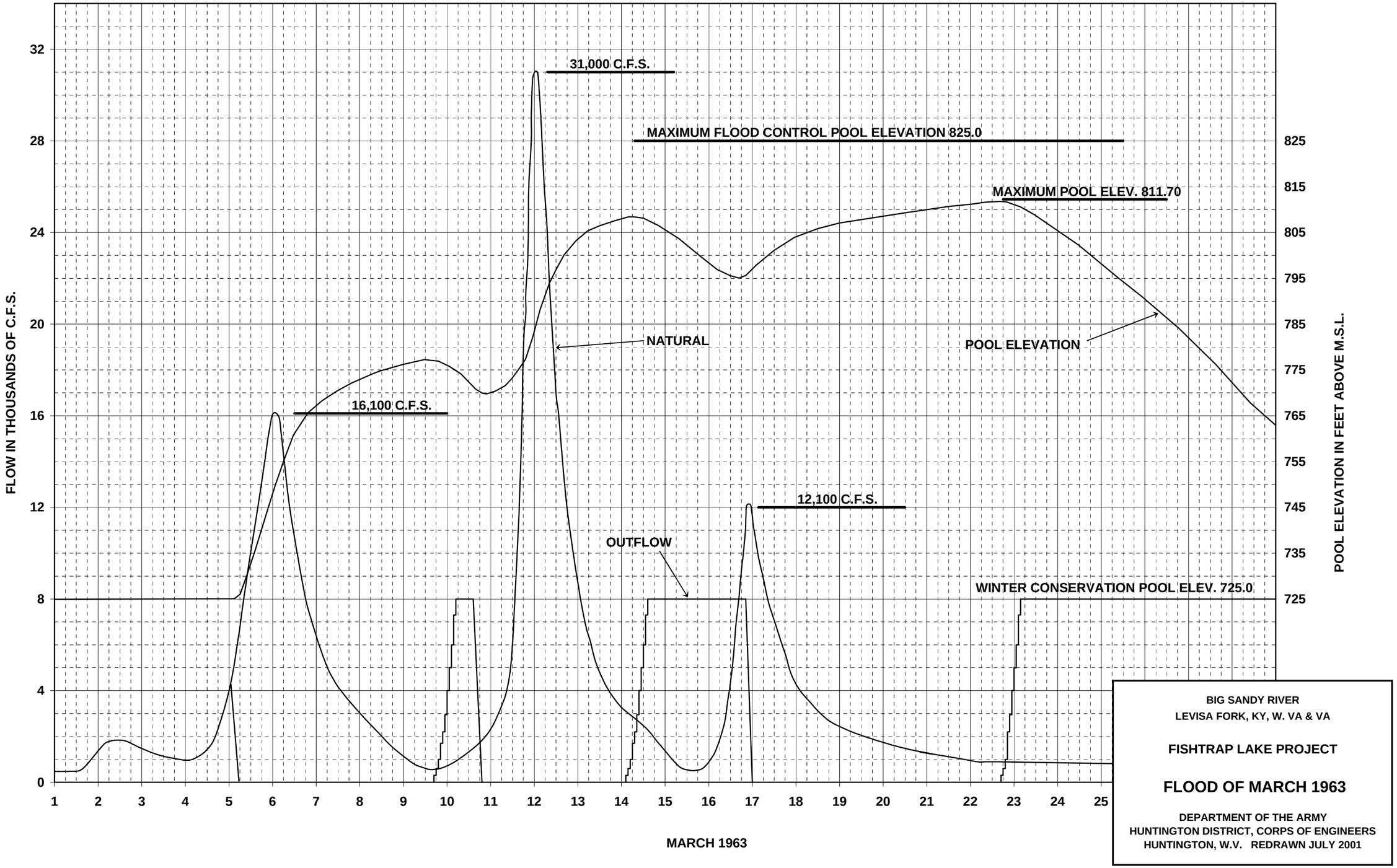


BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

FLOOD OF JANUARY 1957
PIKEVILLE, KENTUCKY

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001



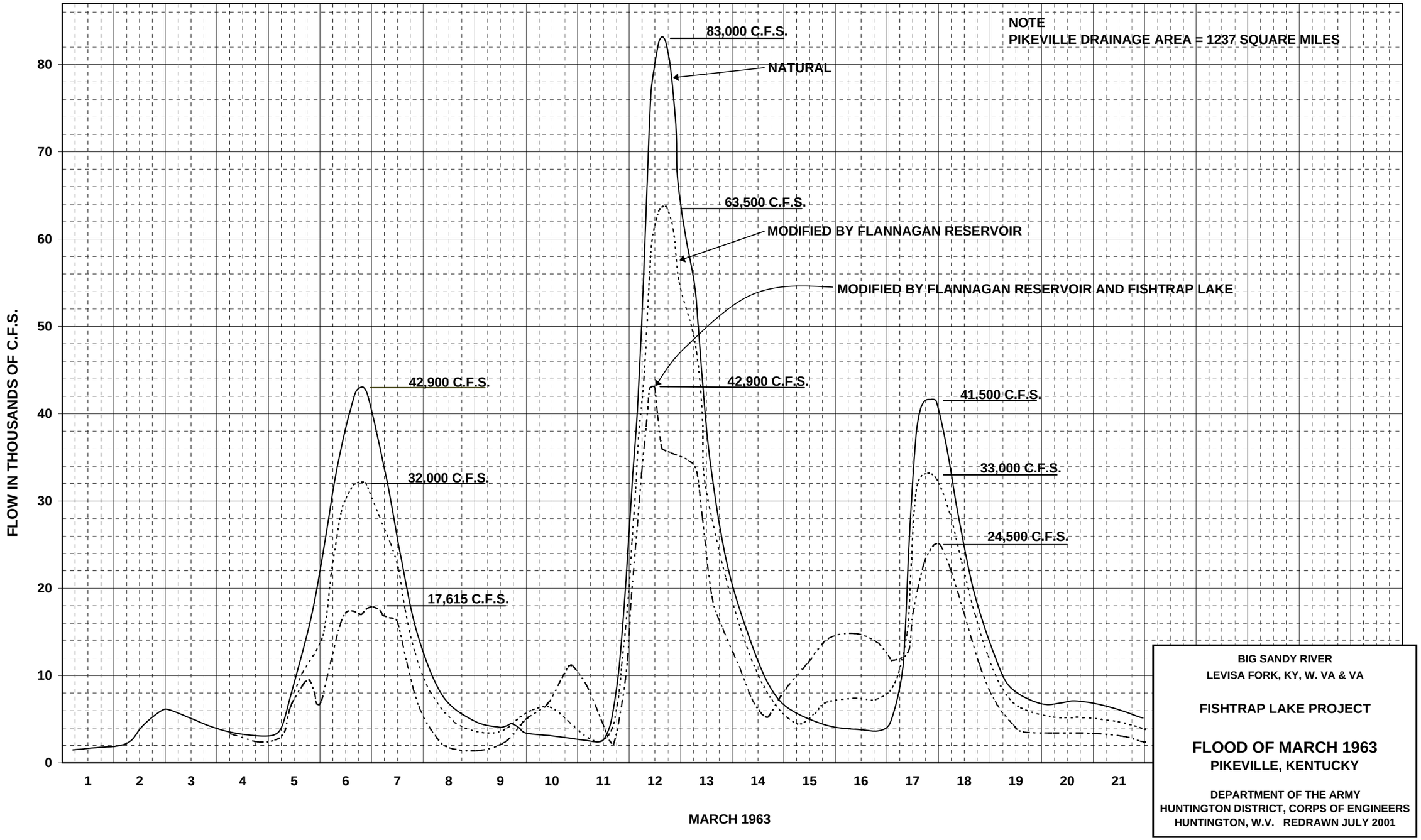
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

FLOOD OF MARCH 1963

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 8-9



BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

FLOOD OF MARCH 1963
PIKEVILLE, KENTUCKY

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 8-10

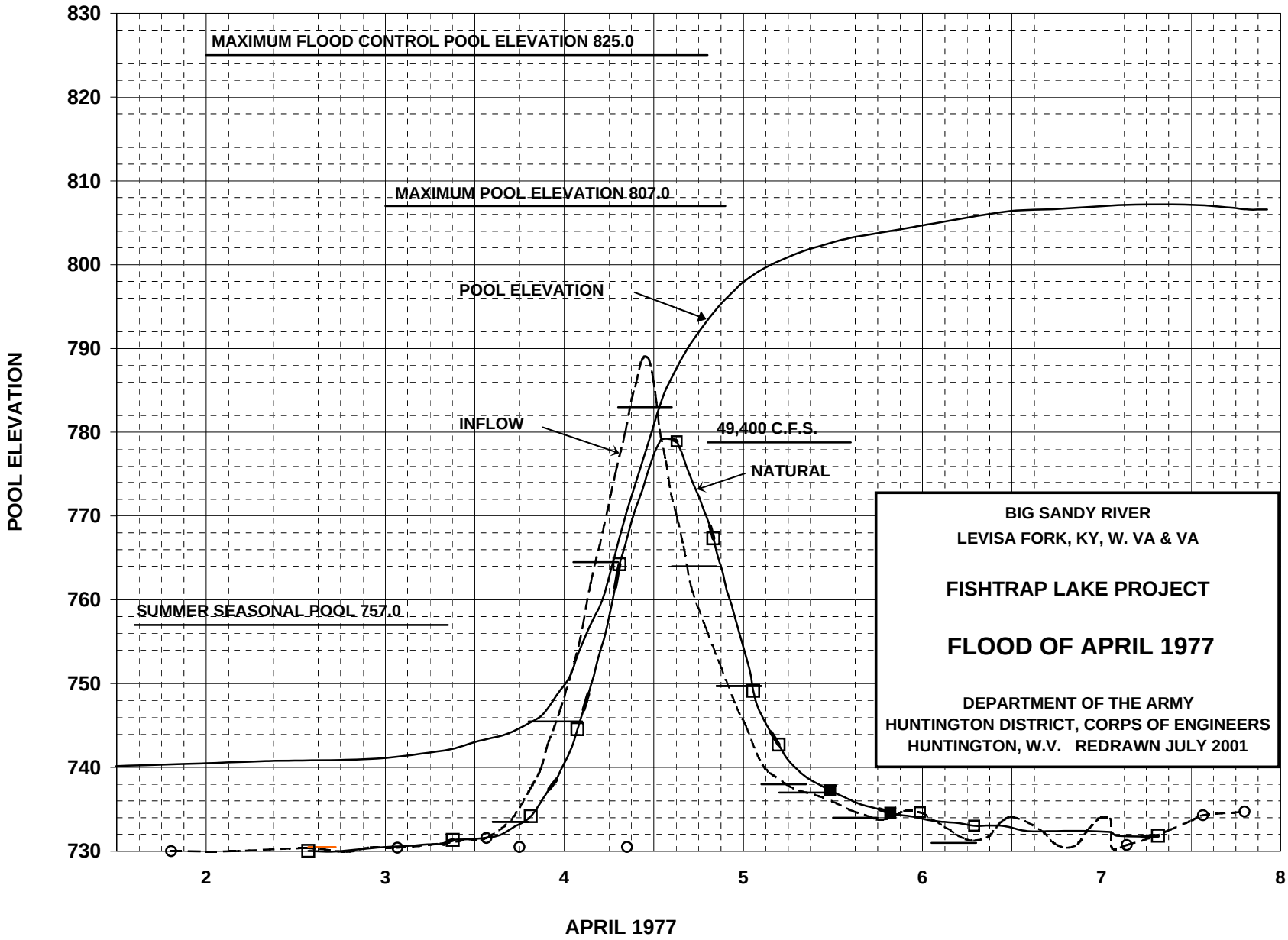
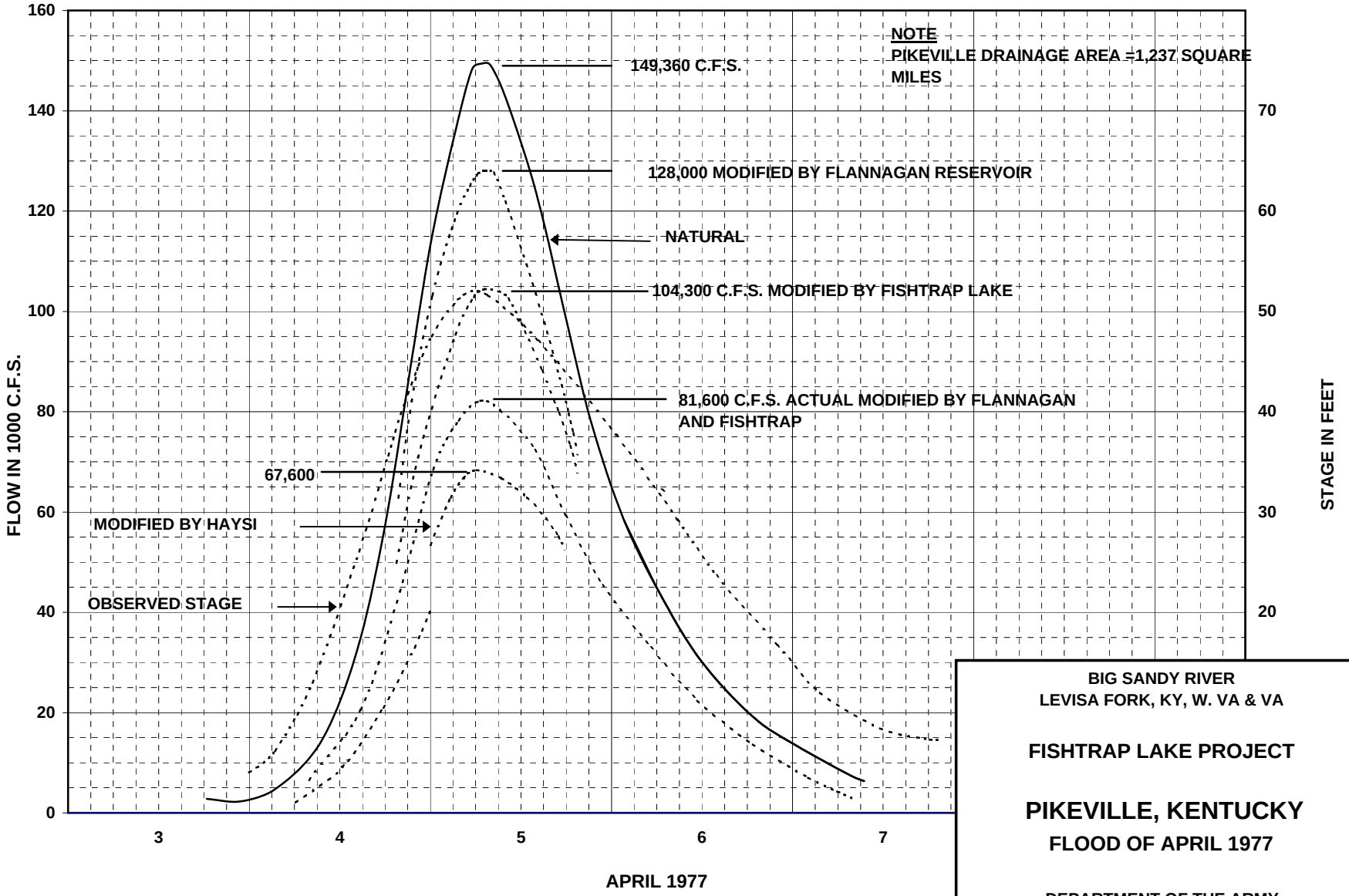

MAXIMUM FLOOD CONTROL POOL ELEVATION 825.0
MAXIMUM POOL ELEVATION 807.0
POOL ELEVATION
INFLOW
49,400 C.F.S.
NATURAL
SUMMER SEASONAL POOL 757.0
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA
FISHTRAP LAKE PROJECT
FLOOD OF APRIL 1977
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001
POOL ELEVATION
830
820
810
800
790
780
770
760
750
740
730
2
3
4
5
6
7
8
APRIL 1977

PLATE NO. 8-11



BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

PIKEVILLE, KENTUCKY

FLOOD OF APRIL 1977

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN MAY 2001

PLATE NO. 8-12

Fishtrap Lake Temperature
August 31, 1999

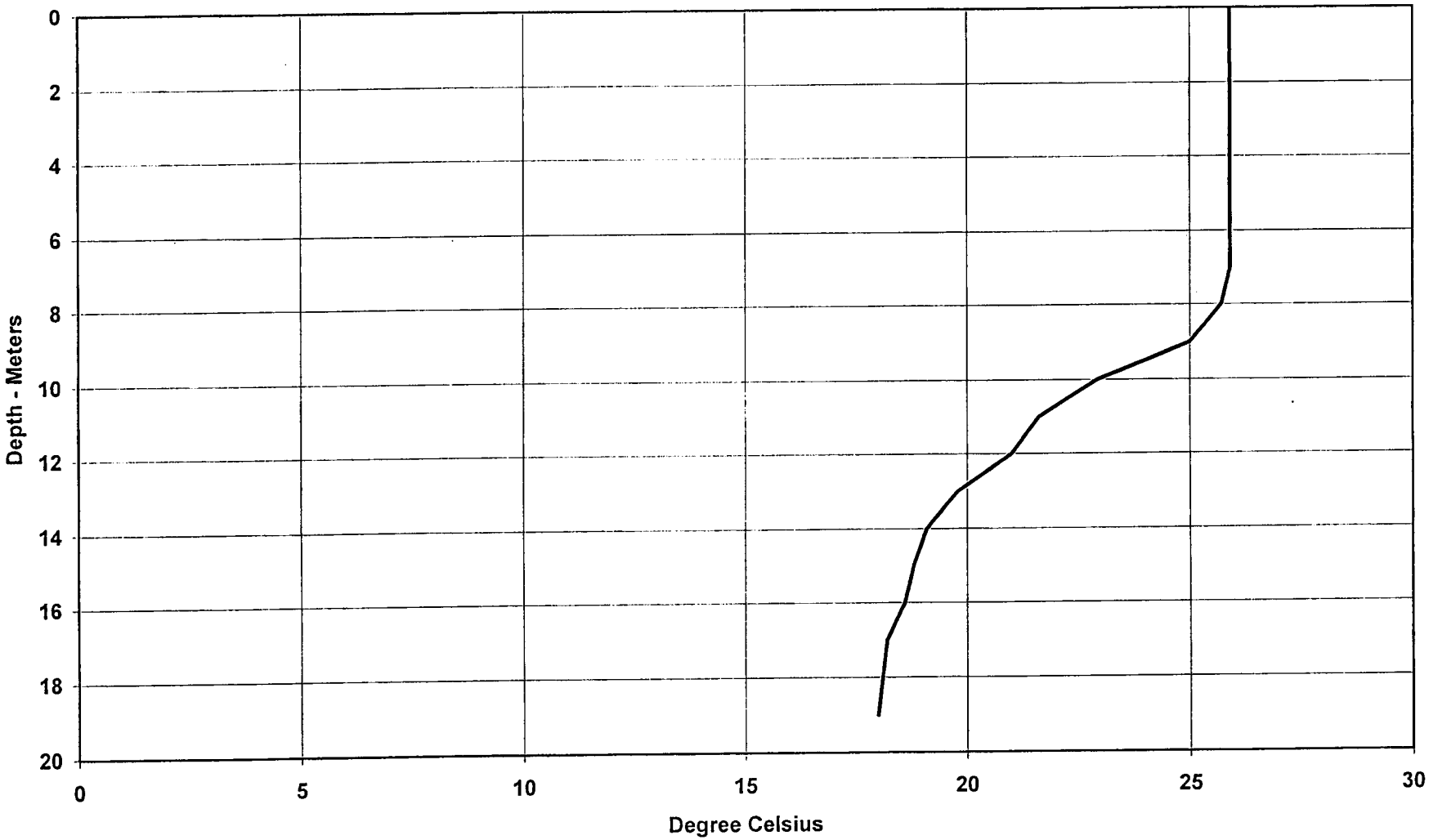


PLATE NO. 8-13

Fishtrap Lake Dissolved Oxygen
August 31, 1999

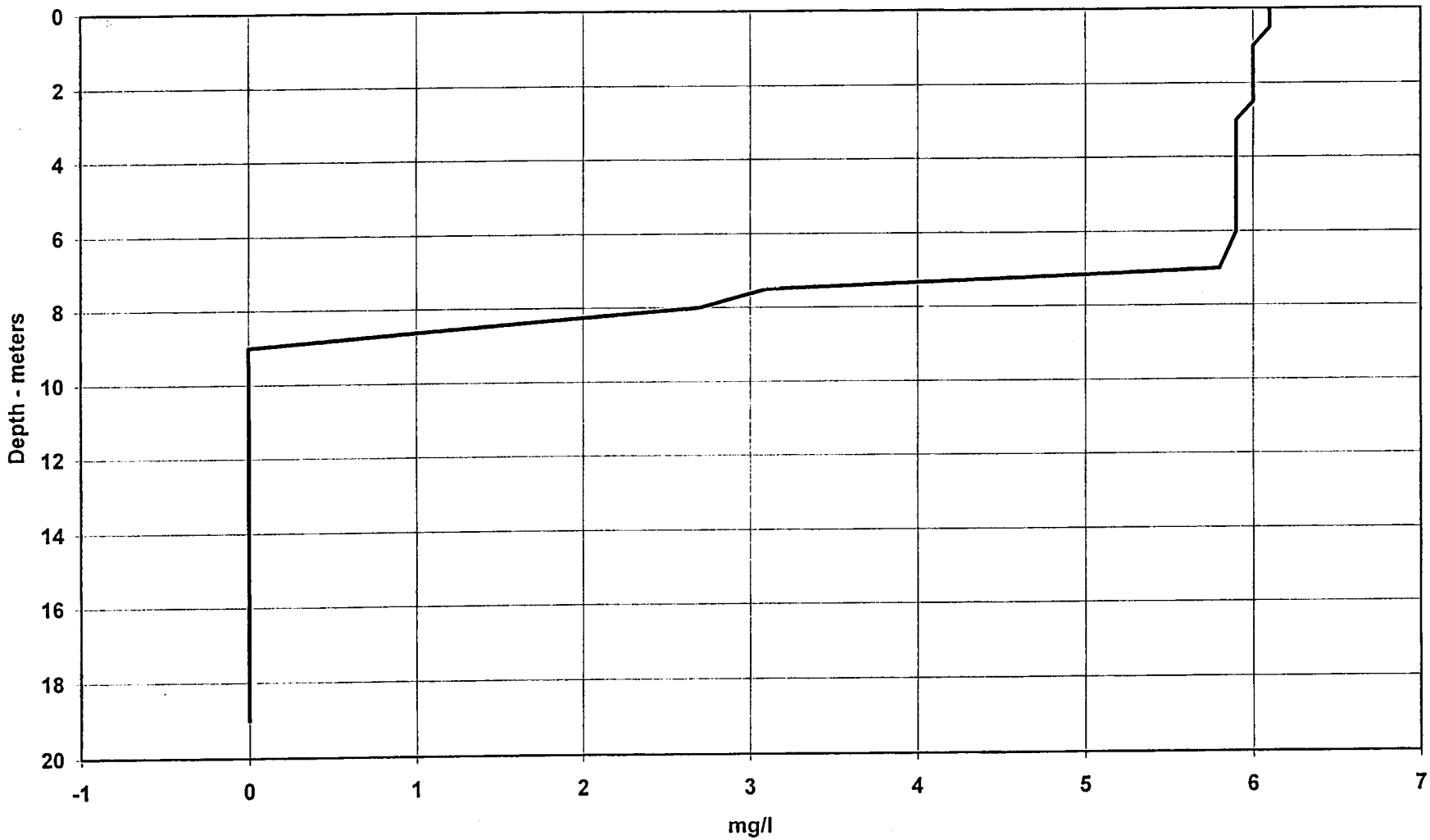


PLATE NO. 8-14

Fishtrap Lake - Iron
August 31, 1999

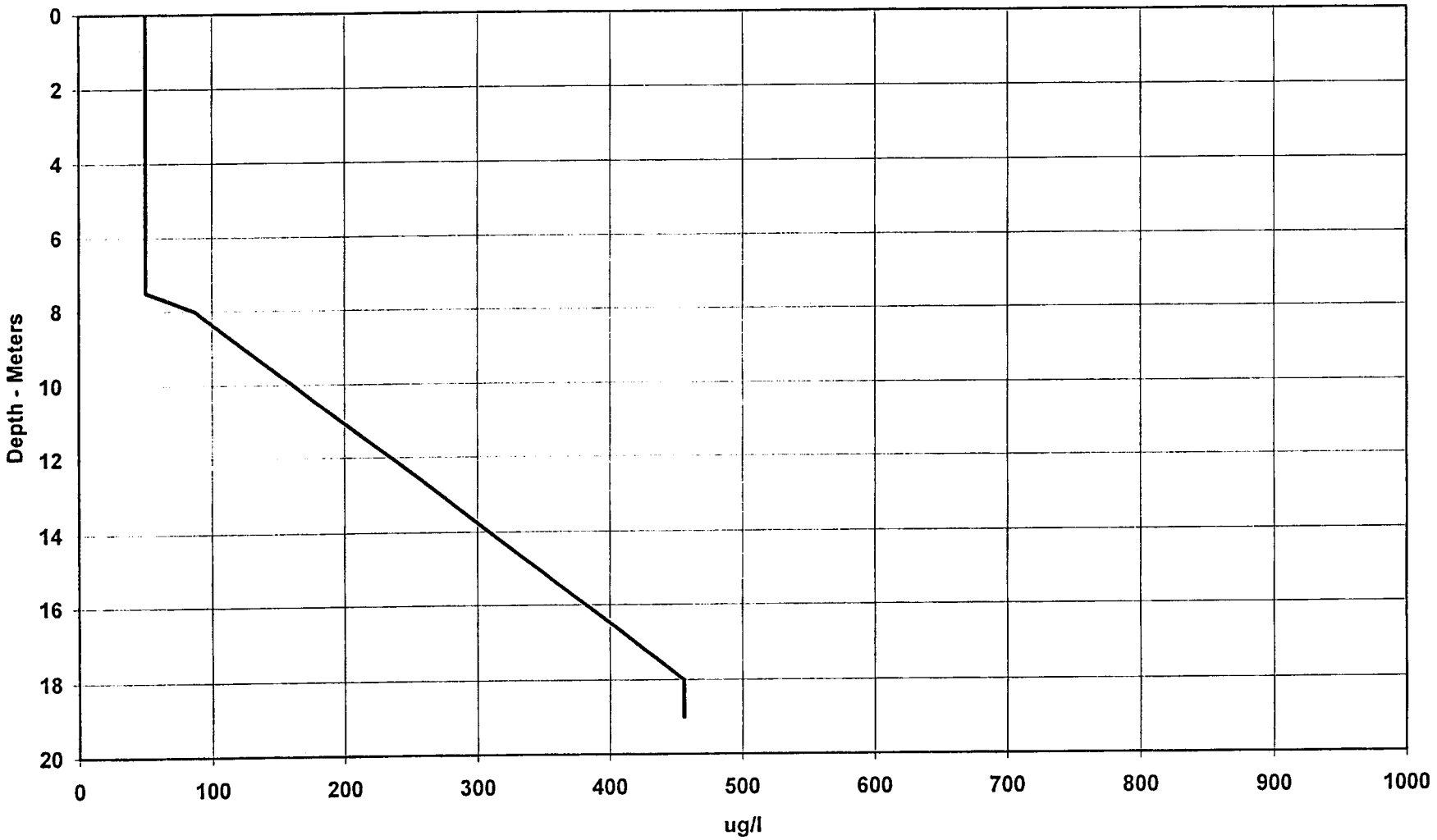


PLATE NO. 8-15

Fishtrap Lake - Manganese
August 31, 1999

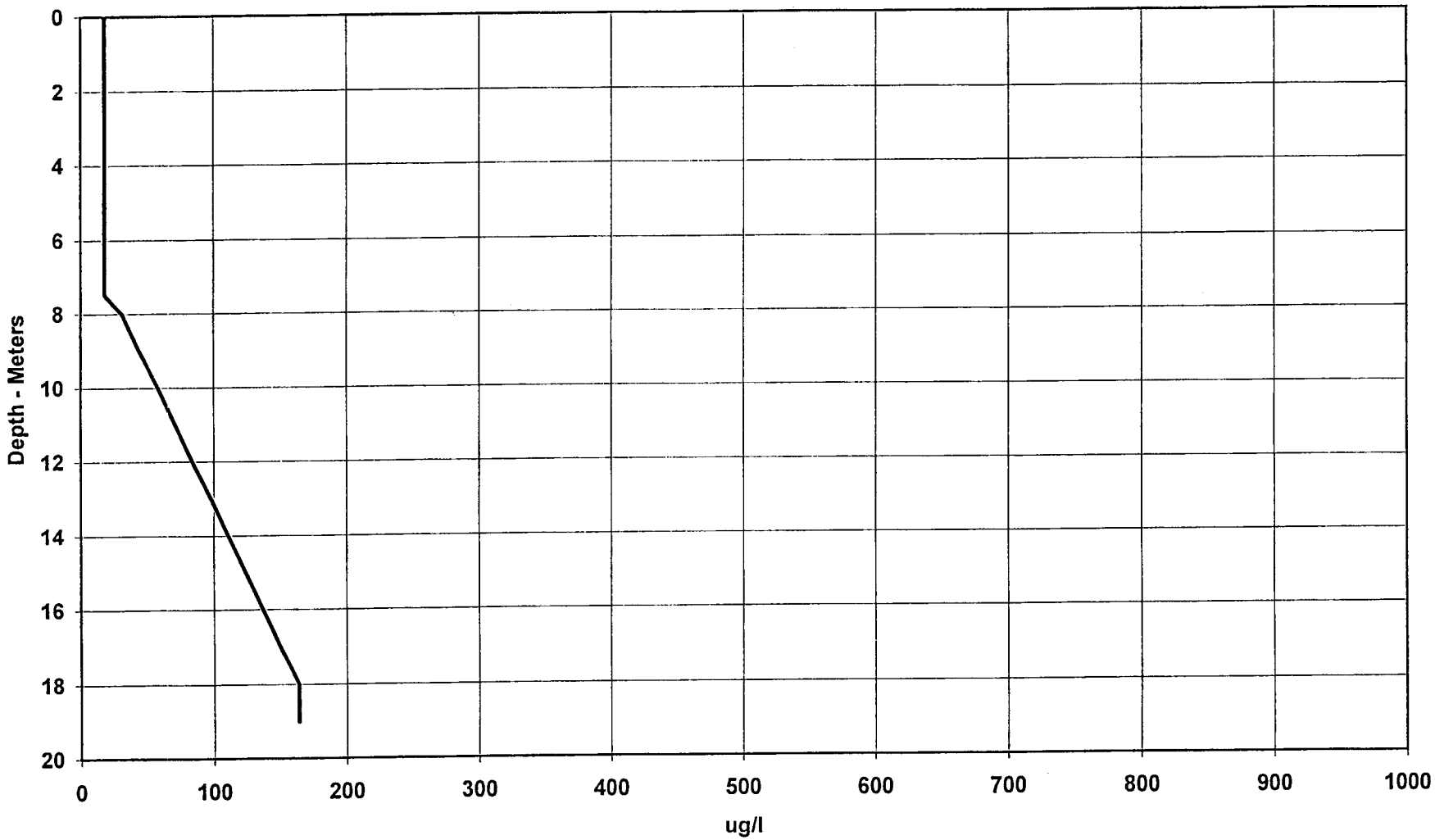


PLATE NO. 8-16

-- OVERALL QUALITY RATING --

For Macroinvertebrate Stations
Fishtrap Lake Project

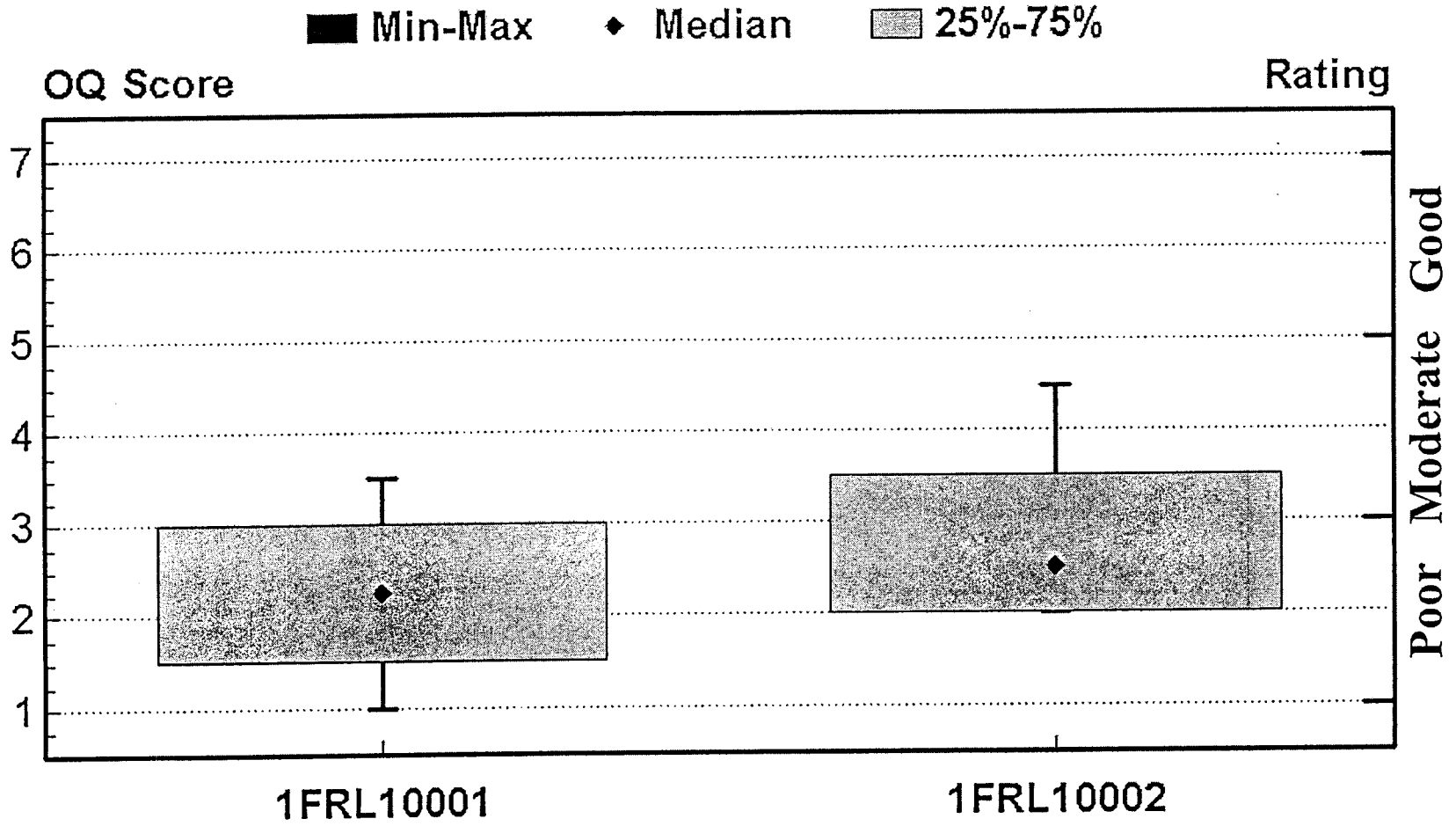
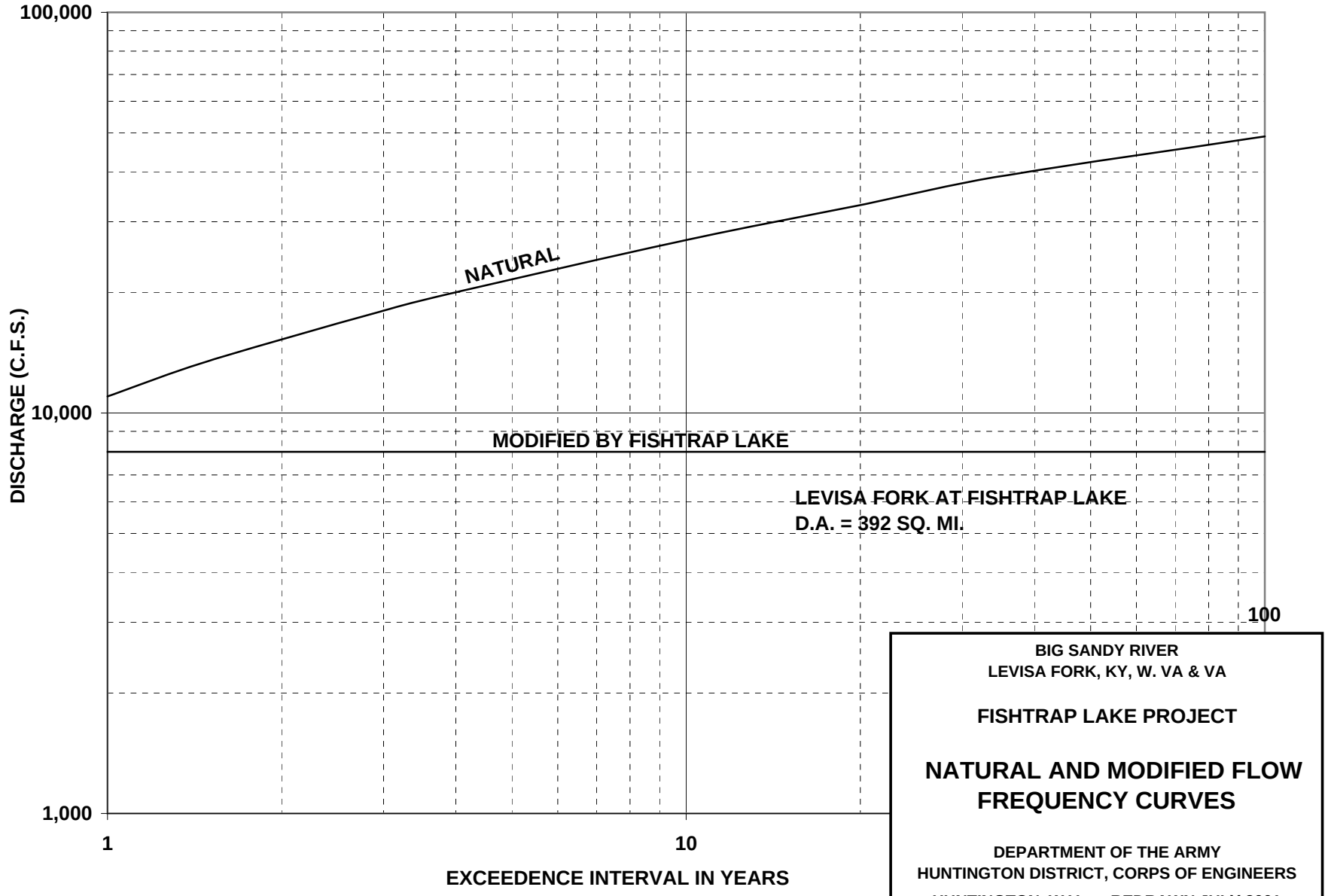


PLATE NO. 8-17



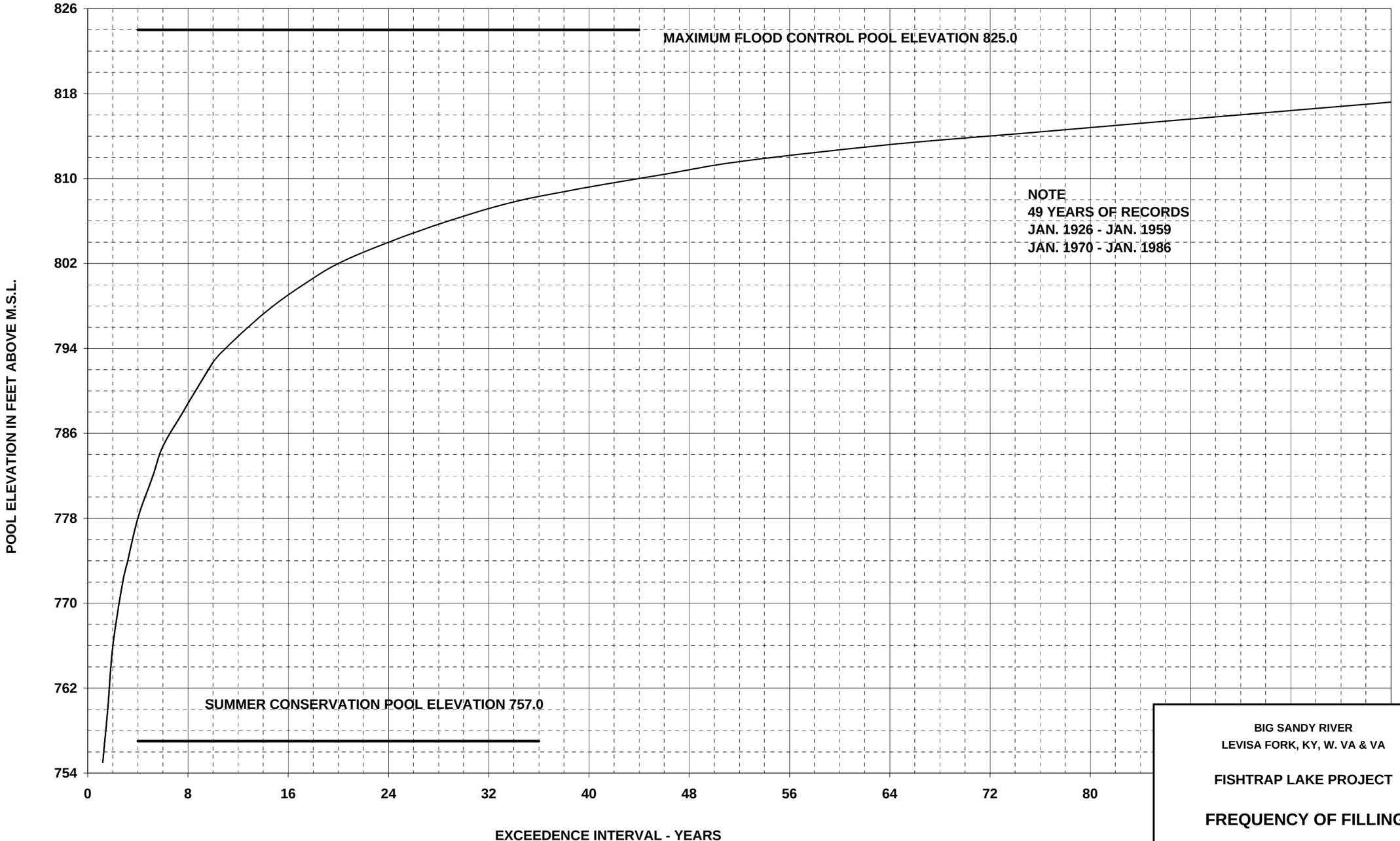
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

NATURAL AND MODIFIED FLOW FREQUENCY CURVES

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 8-18



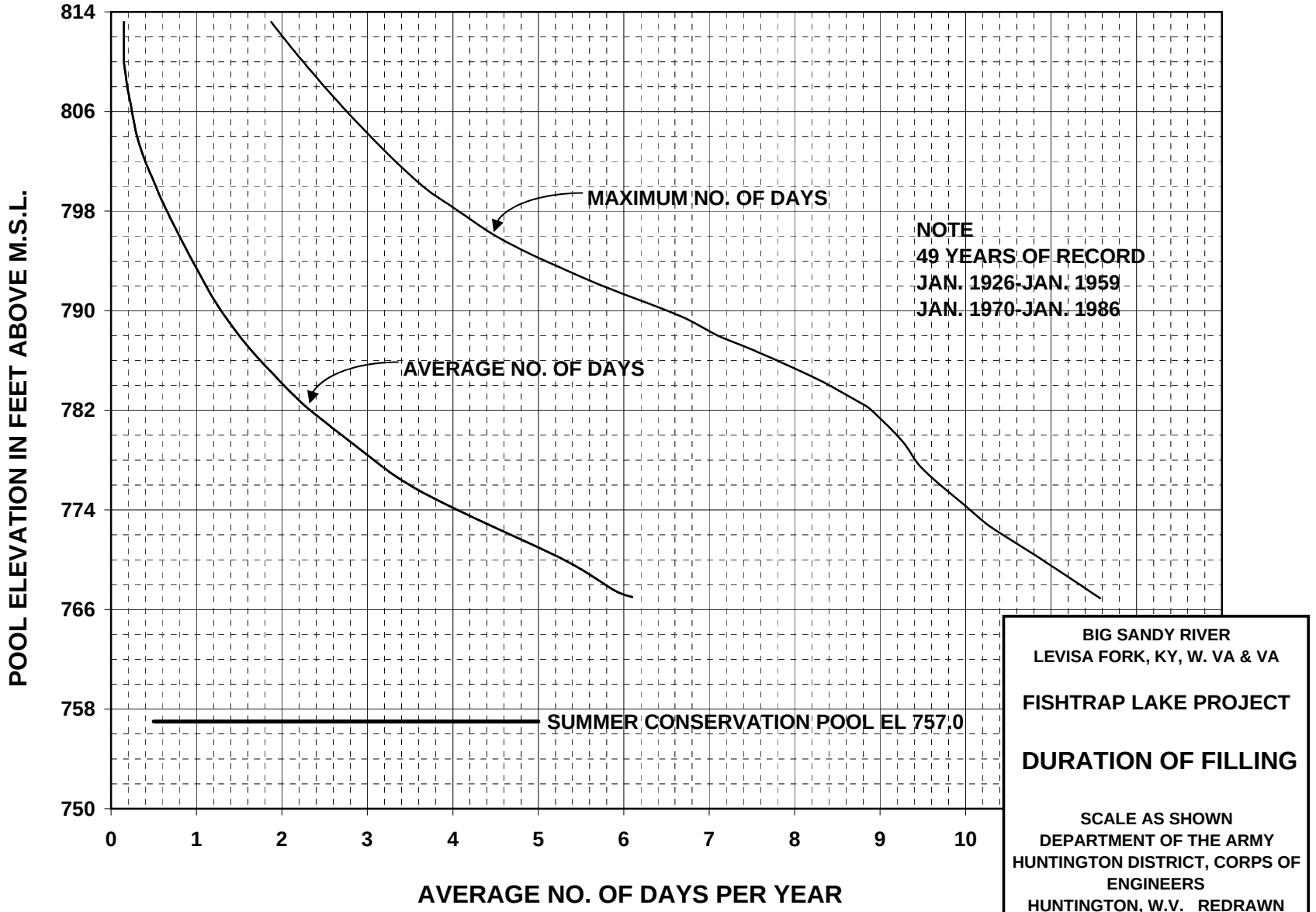
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

FREQUENCY OF FILLING

SCALE AS SHOWN
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 8-19



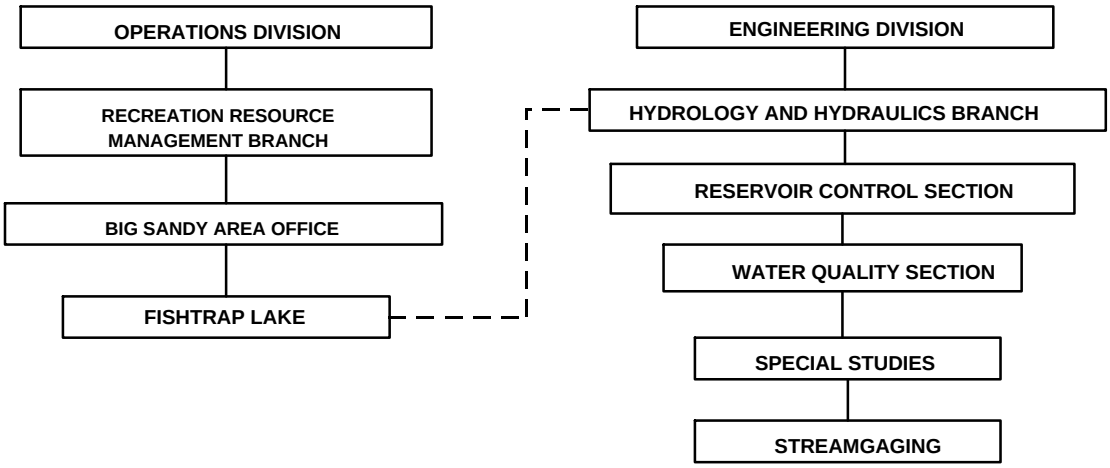
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

DURATION OF FILLING

SCALE AS SHOWN
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN
JULY 2001

PLATE NO. 8 -20



WATER CONTROL MANAGEMENT INSTRUCTIONS GIVEN TO PROJECT BY HYDROLOGY AND HYDRAULICS BRANCH

BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

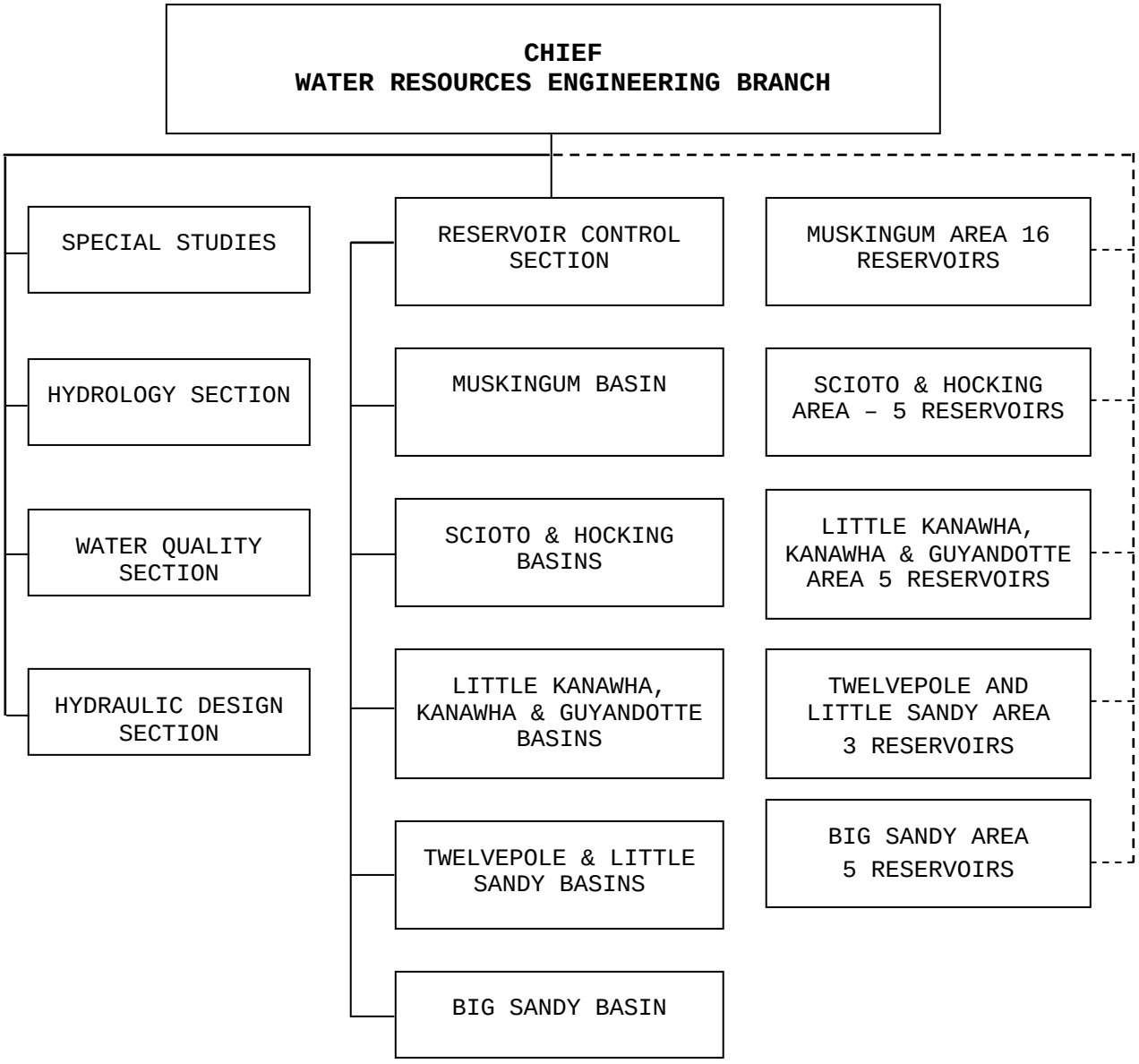
FISHTRAP LAKE PROJECT

WATER CONTROL MANAGEMENT NORMAL ORGANIZATION

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. 9-1

WATER RESOURCES ENGINEERING BRANCH
FLOOD EMERGENCY ORGANIZATION

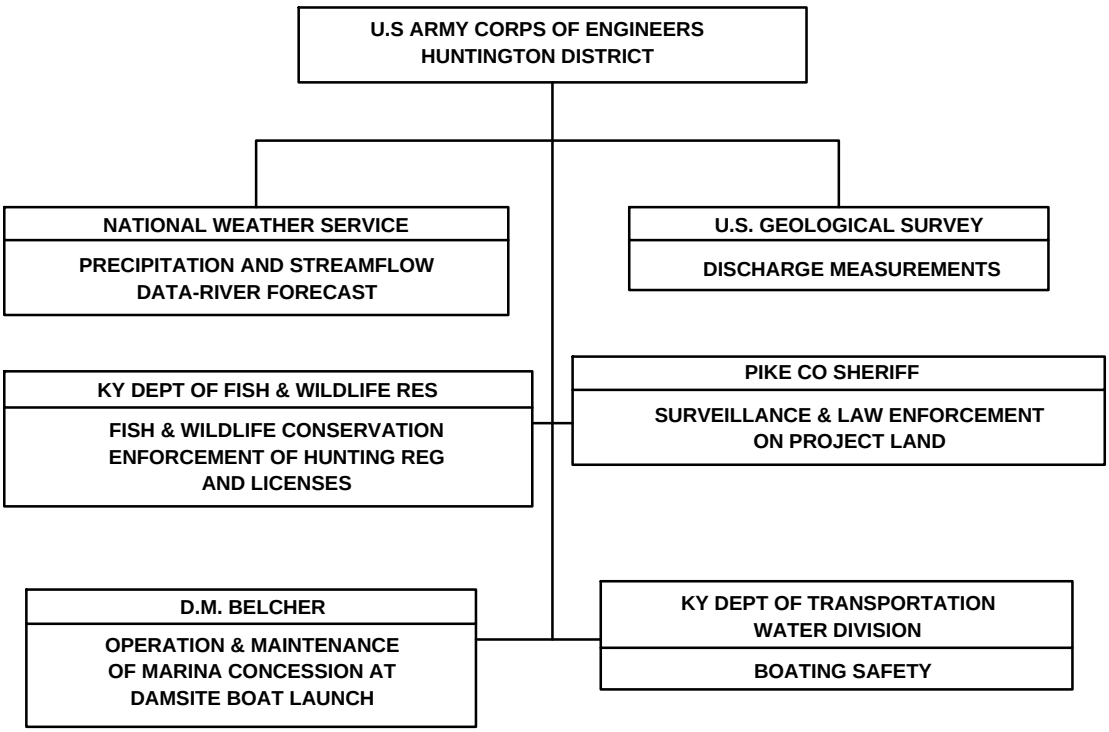


FLOOD EMERGENCY ORAGNIZATION

LINES OF COMMUNICATION

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT
CORPS OF ENGINEERS, HUNTINGTON, W.V.
JULY 2001

PLATE NO. 9-2



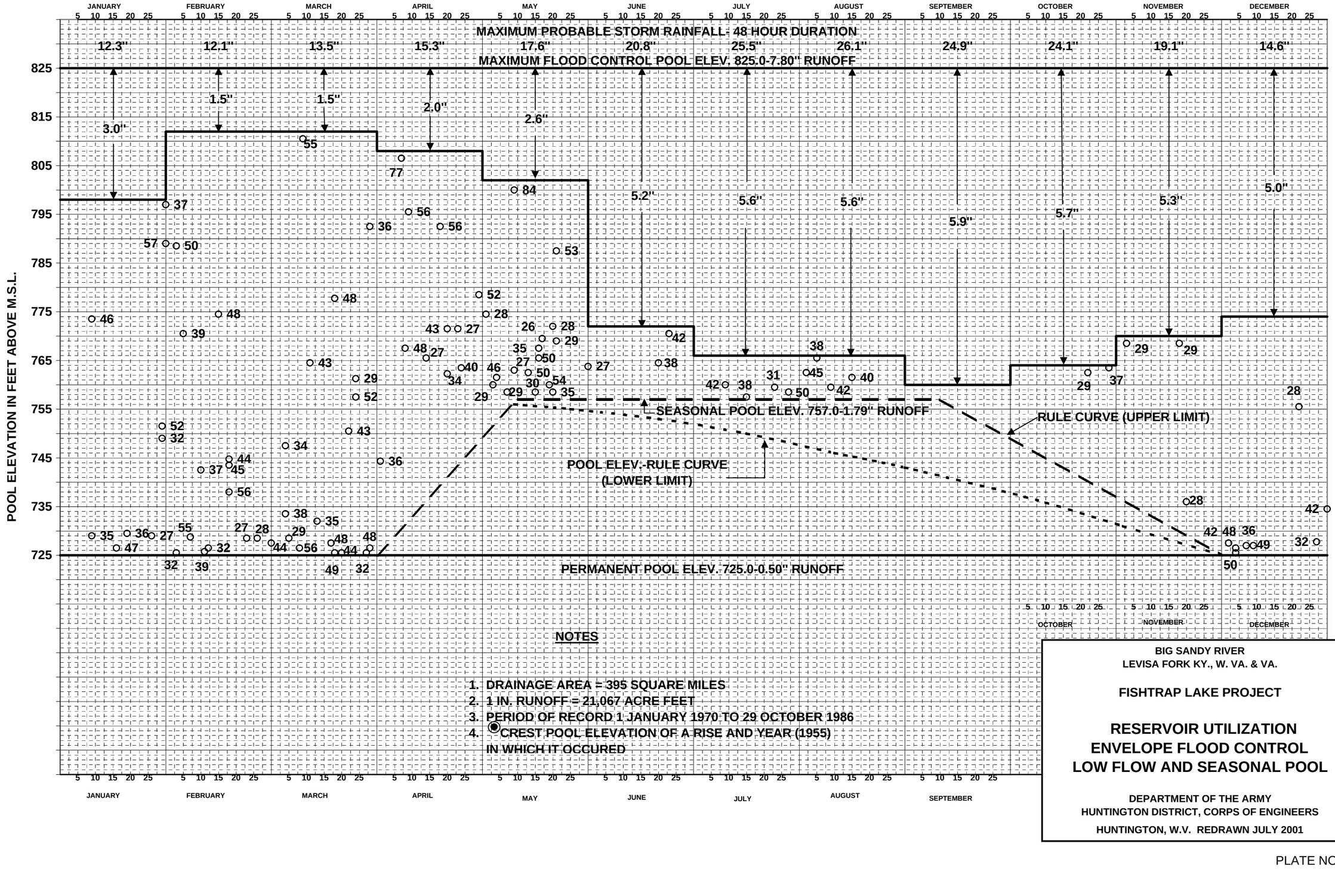
BIG SANDY RIVER
LEVISA FORK, KY, W. VA & VA

FISHTRAP LAKE PROJECT

HUNTINGTON DISTRICT RELATIONS WITH OTHER AGENCIES

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE 9-3



NOTES

1. DRAINAGE AREA = 395 SQUARE MILES
2. 1 IN. RUNOFF = 21,067 ACRE FEET
3. PERIOD OF RECORD 1 JANUARY 1970 TO 29 OCTOBER 1986
4. ◉ CREST POOL ELEVATION OF A RISE AND YEAR (1955) IN WHICH IT OCCURED

BIG SANDY RIVER
LEVISA FORK KY., W. VA. & VA.

FISHTRAP LAKE PROJECT

RESERVOIR UTILIZATION ENVELOPE FLOOD CONTROL LOW FLOW AND SEASONAL POOL

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN JULY 2001

PLATE NO. ??