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

DEER CREEK LAKE
SCIOTO BASIN
OHIO

PROJECT MANUAL
FOR WATER CONTROL MANAGEMENT
DEER CREEK LAKE – DEER CREEK

PREPARED BY
CORPS OF ENGINEERS
HUNTINGTON DISTRICT
WATER RESOURCES ENGINEERING BRANCH

July 2005

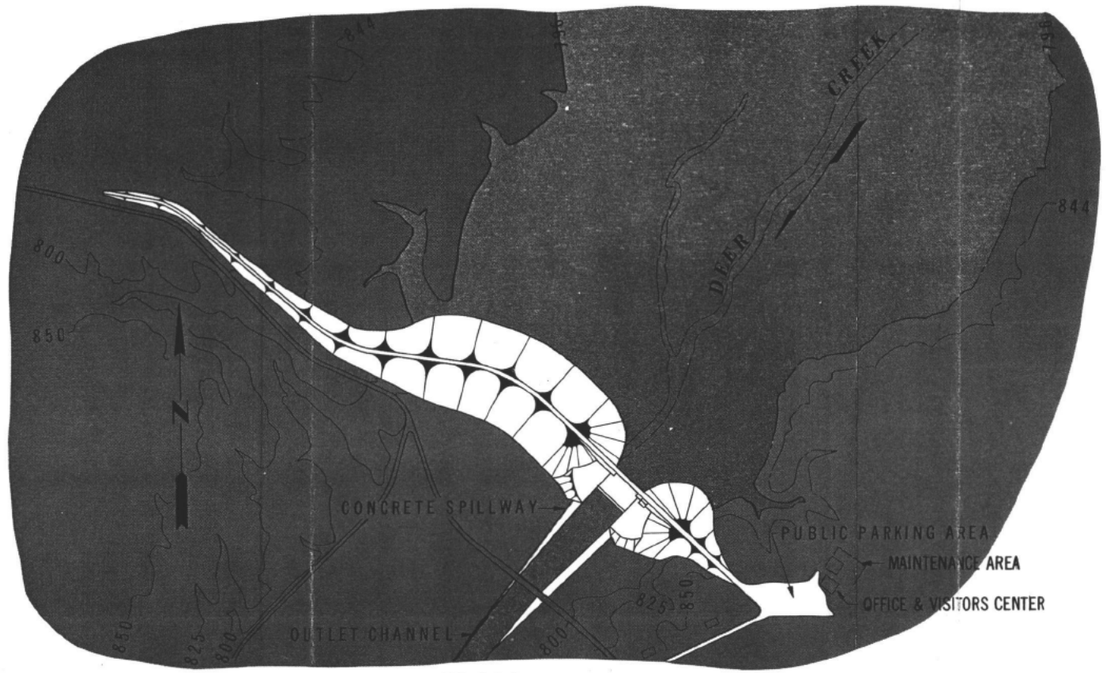
U.S. Army Corps Of Engineers
Huntington District

Date Of Photography
June 19, 2002



Deer Creek Lake, OH
Deer Creek Lake and Dam, Overall View

DEER CREEK F/C 64-A



PLAN

300 0 300 600

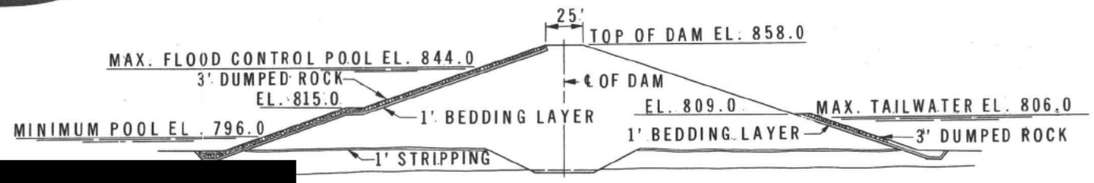
SCALE IN FEET



VICINITY MAP

50 0 50 100 150

SCALE IN MILES



TYPICAL SECTION

60 0 60 120

SCALE IN FEET

[redacted]

DEER CREEK

DEER CREEK LAKE

DAM

PLAN AND SECTIONS

HUNTINGTON DISTRICT, HUNTINGTON, W. VA.

Revised: 30 SEPTEMBER 1986

NOTICE TO USERS OF THIS MANUAL

Regulations require that this Water Control Manual be published in a hard backed 3-ring binder with the text in loose leaf form. In this way, only those sections or parts thereof requiring changes need be revised and printed. Therefore, this copy should be preserved in good condition in order that single page inserts can be made to keep the manual current. Changes to individual pages must carry the date of revision, which is the Great Lakes and Ohio River Divisions' 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.

CORPS OF ENGINEERS
Scioto Area Office,
Chillicothe, Ohio
[redacted] Area Manager

Normal Work Hours,.....[redacted]
Night, weekend, Holiday, NWS observers
Home – [redacted].....[redacted]

KEY EMERGENCY CONTACTS

Huntington District Office, Water Resources Engineering Branch
Normal Work Hours, Nights,.....([redacted]
Weekends, and Holidays.....[redacted]

DISTRICT PERSONNEL	Office Assignment	Telephone Residence
Water Resources Engineering Branch		
[redacted]	Chief, Water Resources Engineering Branch.....	[redacted]
[redacted]	Chief, Hydrology and Hydraulics Section.....	[redacted]
[redacted],	Chief, Water Management Section.....	[redacted]
[redacted]	Water Management Section.....	[redacted]

Pertinent telephone numbers that may be of value during a flood emergency are listed below:

Other Agencies

U. S. Geological Survey
New Philadelphia, Ohio.....[redacted]

Night, Weekend, Holidays
Lowell Trimble.....[redacted]

National Weather Service
W. S. Forecast Office.....[redacted]
Hydrology Section.....([redacted]
Cleveland, Ohio

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PERTINEMT DATA

DEER CREEK LAKE
SCIOTO RIVER BASIN

LOCATION OF PROJECT

The dam is located in Pickaway County, Ohio, on Deer Creek, a tributary of the Scioto River, approximately 105.8 miles above the mouth of the Scioto River and about 7 miles south-southeast of Mount Sterling, Ohio.

TYPE OF PROJECT

Multi-purpose; flood control, recreation, fish and wildlife conservation.

Dam

Type-rolled earthfill with concrete gravity channel section,
Maximum height, feet.....93
Top length, feet.....3,880
Top width, feet.....25

SPILLWAY

Type-gated concrete ogee spillway in channel section of dam,
Number of tainter gates.....3
Size of tainter gates.....42.0’x32.0’
Crest length, feet.....772
Crest elevation, feet above NGVD.....844
Top of Gates.....846

NOTE: Additional pertinent data can be found on Exhibit A.

SCIOTO RIVER BASIN
OHIO

PROJECT MANUAL
FOR
WATER CONTROL MANAGEMENT
DEER CREEK LAKE - DEER CREEK

SECTION 1 – INTRODUCTION

1-01. AUTHORIZATION OF WATER CONTROL MANUAL

This manual is prepared in accordance with Engineer Regulation 1110-2-240, Water Control Management, dated 8 October 1982; Engineer Manual 1110-2-3600, Management of Water Control Systems, dated 30 November 1987; Engineer Regulation 1110-2-8156, Preparation of Water Control Manuals, dated 31 August 1995; ER-1110-2-1941, Engineering and Design, Drought Contingency Plan, dated 15 September 1981, and ETL 1110-2-251, dated 1 April 1993, which provides for submission of regulation manuals in accordance with instructions contained in "Guide for Preparing Water Control Manuals" as prepared by SWD, dated October 1977.

1-02. PURPOSE AND SCOPE OF WATER CONTROL MANUAL

The purpose of this manual is to furnish detailed schedules for the regulation of Deer Creek Lake. The manual will serve two functions; first as documentation of the plan for water control, and second, as a reference source for higher authority and for office and field personnel responsible 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.

1-03. RELATED MANUALS AND REPORTS

The following manuals and reports concerning Deer Creek Lake or the Scioto River projects have been previously completed.

	TITLE	DATE
1.	Ohio River Survey Report - House Document 306, Seventy-Fourth Congress, First Session	August 1935
2.	House Committee on Flood Control, Document 1, Seventy-Fifth Congress, First Session	April 1937
3.	Master Regulation Manual for Reservoirs in the Scioto River Basin	July 1948
4.	Scioto River Basin Survey Report - House Document 587, Eighty-Seventh Congress, Second Session	January 1962

5. State of Ohio, Scioto Conservancy District, ...August 1962
   Official Plan

6. Water Inventory of the Scioto River Basin .....April 1963

7. Design Memoranda

   No. 1 Hydrology and Hydraulic Design .....February 1965

   No. 2 General Design .....March 1965

   No. 3a Preliminary Master Plan .....October 1965

   No. 3b Recreation Site Plan .....October 1966

   Supplement No. 1 .....April 1977

   Supplement No. 2 .....August 1977

   No. 4 Geology and Soils .....March 1965

   No. 5 Real Estate - Dam Site and S.R. 207 .....March 1965

   No. 6 Dam, Dike and Appurtenances .....May 1965

   No. 7 Concrete Aggregates .....April 1965

   No. 8 Highway Relocations .....June 1965

   No. 9 Real Estate - Reservoir .....October 1965

   No. 10 Relocation - Utilities .....December 1966

   No. 11 Relocation - Gas Lines .....February 1967

   No. 12 Reservoir Clearing .....July 1966

   No. 13 Sediment Range Layout and Supplement .....February 1977
   No. 1, Report on the 1975 Sedimentation Reconnaissance

   No. 14 The Living Filter at Deer Creek, ...Spring 1975
   (on land disposal of wastewater)

   No. 15 Periodic Inspection, Deer Creek Lake

   Report No. 1 .....August 1971
   Report No. 2 .....July 1972
   Report No. 3 .....June 1976
   Report No. 4 .....May 1982
   Report No. 5 .....September 1985
   Report No. 6 .....May 1989
   Report No. 7 .....September 1994
   Report No. 8 .....September 1999

8. Operations and Maintenance Manual .....January 1978

9. Project Manual for Reservoir Regulation, ...October 1968
   Deer Creek Reservoir, Deer Creek, Ohio

10. Operation and Maintenance Manual .....March 1973

11. Final Environmental Impact Statement .....July 1974

12. Operations and Maintenance Manual .....January 1978

13. Appendices to the Master Plan .....January 1992
Appendices A – Resource Management Plan

14. Environmental Assessment .....March 1981

15. Master Plan .....July 1982
Appendix E Project Safety Plan

16. Evaluation of Planning for Fish and .....February 1983
Wildlife, Deer Creek Lake

17. Updated Master Plan .....June 1984

1/ Not Authorized
* Month of Court Clearance

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 Deer Creek Lake. The United States Government reimbursed the private property owners for most of the surrounding land and now owns the dam and operating structures.

1-05. OPERATING AGENCY

Deer Creek Lake is staffed, attended, and operated continuously by the Huntington District, Corps of Engineers.

The mailing address is:
Deer Creek Lake
21897 Deer Creek Road
Mt. Sterling, Ohio 43143
Telephone No [redacted]

The Damtender (Resource manager) is:
[redacted]
597 Leslie Trace
Washington Court House, Ohio
43160

The Huntington District, Water Resources Engineering Branch has various responsibilities as specified in Ohio River Division Regulation 1110-2-27, dated 12 January 1976. These responsibilities include the primary overall water control management of all Huntington District projects, technical evaluations of performance of these projects, and developing plans and manuals for the reservoir systems within the District, such as the Deer Creek Lake Project. An index map of the Huntington District and locations of all Corps of Engineers Flood Control Projects is shown on **Plate No. 1-1**, plate section.

Guidelines for routine operations under identified conditions are included in standard operation instructions. Special Directives issued and signed by the Chief of the Water Management Section provide direction for operations needed for all other situations, low-flow control, or flood regulation. Any operations which might deviate from the approved water control plan as presented in this manual are coordinated with the Great Lakes and Ohio River Division Water Management Branch.

1-06. REGULATING AGENCY

The operating and regulating responsibility is exercised under the following regulations:

(1) EM 1110-2-3600, 30 November 1987,
Subject: Management of Water Control Systems;

(2) ER 1110-2-1400,DAEN-CWE-Y, 30 September 1993,
Subject: Reservoir/Water Control Centers;

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

(4) ER 1110-2-8154, DAEN-CWE-Y, 31 May 1995,
Subject: Water Quality and Environmental Management,
For Corps Civil Works Projects;

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

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

SECTION II - DESCRIPTION OF PROJECT

2-01. LOCATION

The Deer Creek Lake dam is located in Pickaway County, Ohio, on Deer Creek, a tributary of the Scioto River, approximately 7 miles southwest of the town of Mount Sterling. The damsite is located approximately 21.0 miles above the mouth of Deer Creek and 105.8 miles above the mouth of the Scioto River. Deer Creek Lake pool acreage covers portions of Pickaway and Fayette Counties, with the largest portion of the pool lying in Pickaway County. The basin drainage maps are shown on **Plate No. 2-1**, plate section.

2-02. PROJECT PURPOSES

The Deer Creek Lake project was flood control and allied purposes, in a comprehensive plan for the Ohio River Basin. The allied purposes include water conservation for general recreation, and fish and wildlife management. Inclusion of storage for water quality control was authorized by the Federal Water Pollution Act of 1948 as amended under section 2 of Public Law 87-88, July 1961.

2-03. PHYSICAL COMPONENTS

a. General. Flood control structures at Deer Creek Lake include a controlled concrete ogee overflow section dam with a rolled, homogeneous earth embankment on either side, a dike to protect the town of New Holland, and a valved sluice through the dam for low-flow regulation. General details of the dam, spillway and dike are shown on **Plate Nos. 2-2**, and **2-3**, plate section.

b. Embankment. The earth embankments extend from the spillway training walls to both abutments. The transitions between the earth embankments and the concrete spillway are concrete gravity non-overflow sections embedded in the embankments. The earth embankments have 1 on 3 slopes with berms located at elevation 815.0 feet NGVD on the upstream slope and elevation 806.0 feet NGVD on the downstream slope. The upstream slope is covered with 3 feet of dumped rock slope protection. The top of dam is 25 feet wide with a crest elevation of 858.0 feet NGVD. Details of the embankment and transition are shown on **Plate Nos. 2-4** and **2-5**, plate section. Details of the training walls are shown on **Plate No. 2-6**, plate section.

c. Spillway. The concrete spillway is located between the two earthen embankments of the dam, and has a conventional gravity ogee section. The ogee has a crest length of 184 feet at elevation 844.0 feet NGVD. Three conventional 42'x32' tainter gates are provided for control of spillway floods. Typical sections for the Spillway are shown on **Plate No. 2-7**. Details of the spillway and tainter gates are shown on **Plate Nos. 2-8** thru **2-10**, plate section. A service bridge wide enough to accommodate a motor crane spans the spillway. Details of the service bridge are shown on **Plate No. 2-11**, plate section. The gate-operating machinery is located at the top of the piers, adjacent to and accessible from the spillway bridge. A single pylon is located on the left abutment side of the spillway, and contains an elevator, stairwell, hoist well, water level and water temperature recording systems, water supply facilities, a diesel-electric emergency power generating unit, electrical controls, storage space, and office facilities for

administrative and operating personnel. Details of the pylon are shown on **Plate Nos. 2-12** and **2-13**, plate section. **Plate No. 2-14**, plate section shows the stilling basin apron baffle and end sill.

d. Outlet Works. The outlet works consists of five gated sluiceways 5'0" wide by 5'6" high located in the concrete spillway section, and discharging into the spillway bucket. The discharge is regulated by hydraulic slide gates, installed in tandem pairs. One valved sluice, 3'0" in diameter is provided for low-flow regulation. Energy dissipation for both spillway and sluice-controlled flow is accomplished by a concrete roller bucket. All sluices have two gates installed in tandem for service and emergency use. A bulkhead is provided for use in dewatering the sluices for maintenance purposes, and is installed by a motor crane operating on the spillway service bridge. Details of the outlet channel are shown on **Plate No. 2-15**, plate section.

e. Dike. An earthen dike is located approximately 3.8 miles southwest of the dam. It is a 15-foot high, rolled, homogeneous earth fill embankment with slopes of 1 on 2.5 upstream and 1 on 2 downstream. It has a crown width of 10 feet and a total crest length of approximately 4,700 feet. Dike profile and sections are shown on **Plate No. 2-16**, plate section.

f. Operating Machinery.

(1) Slide Gates. There are five sets of vertical-lift hydraulically operated, main service and emergency control gates appropriately sized for the 5'0" wide by 5'6" high at intake elevation 772.0 feet NGVD. Each service control gate is equipped with a mechanical leaf position indicator, marked in feet and tenths. Each is also equipped with a remote control gate leaf position indicator in the control center. The remote indicator dial is 8 inches in diameter and marked from zero to 10 feet, and each foot is divided into tenths. The dial has two hands, the shorter hand reading in feet and the longer hand in hundredths of a foot.

(2) Emergency Slide Gates. The emergency control gates are hydraulically operated but manually controlled from the operating chamber and have no position indicators.

(3) Low-Flow Valve. One 36" diameter low-flow sluice with invert at elevation 786 feet NGVD is controlled by a 36" valve which is hydraulically operated. The hydraulic operation is controlled by push buttons in control center B or manually from the Operating Chamber. A remote position indicator is installed in the control center and an on-site indicator is located on the hydraulic cylinder and upper position rod extension.

(4) Emergency Low-Flow Valve. The emergency valve, also 36", is manually controlled and manually operated with no position indicator.

(5) Spillway-Crest Gates. Three tainter gates are provided, 42 feet wide and 32 feet high. In normal use these are controlled and operated individually from the piers.

(6) Maintenance Bulkhead. A wheeled maintenance bulkhead of structural steel is provided for dewatering any of the sluices when needed for maintenance purposes. It is arranged with a triangular steel pickup sling on top for handling by motor crane. Guides are built into the upstream fall of the dam on either side of each of the main sluices

and of the low-flow sluice so that the bulkhead can be lowered in place in still water only.

(7) Auxiliary Power Unit. The emergency power source is a diesel-driven electric alternating current generator with a 50 KW, 80 percent power factor, 3-phase, 3-wire, 60-cycle, 480-volt unit designed for continuous duty and cold-starting by its own battery.

2-04. RELATED CONTROL FACILITIES - N/A

2-05. REAL ESTATE ACQUISITION

The land acquisition program involved an estimated 7,223 acres in fee and 352 acres in flowage easement and was completed by October 1968. The Standard Project Flood was used to provide an estimate of potential storage requirements for Deer Creek Lake. The maximum lake elevation reached was 848.08 feet NGVD, assuming that the reservoir would be at the summer pool level, elevation 810 feet NGVD when the Standard Project Flood (summer-type flood) occurred. Based on this pool elevation, the Real Estate Upper Guide Acquisition Line was recommended and established at elevation 848 feet NGVD, which is four feet above the maximum flood control pool and 2.7 feet above the maximum flood level obtained by routing the flood of January 1937, which produced the greatest volume of storage of record.

Acquisition followed accepted criteria based on the 848 feet NGVD taking elevation except for minor deviations discussed in Design Memoranda No. 5 and No. 9, certain lands acquired specifically for recreation, and addendum to Design Memorandum No. 9. This addendum reduced the requirements by 135 acres to avoid excessive costs and severance damages in a real estate development which occurred during early stages of preconstruction planning. The State of Ohio purchased 452 acres for recreation and access purposes, all adjoining or connecting Corps properties.

2-06. RECREATION AND PUBLIC USE FACILITIES

Camping, boating, fishing, picnicking, hiking, swimming, golfing, tennis, and hunting are among the recreational activities enjoyed at Deer Creek Lake. Listed in **Table No. 2-1** next page, are recreational sites in operation. Future sites and improvements will be constructed as joint funding is arranged with another governmental agency, such as the Ohio Department of Natural Resources.

The general recreation and land use plan for Deer Creek Lake was prepared and developed in cooperation with the Ohio Department of Natural Resources and the U.S. Fish and Wildlife Service.

The Ohio Department of Natural Resources operates and maintains all areas included within Deer Creek State Park. The U.S. Army Corps of Engineers is responsible for facilities at the damsite, left abutment overlook areas, and at the fishermen's access area below the dam.

TABLE NO. 2-1

RECREATIONAL SITES AT DEER CREEK LAKE

Name	Status
Dam Site and Overlook	Complete
Downstream Area	Complete
Beach Area	Complete
Marina Area	Complete
Route 207 Access Area	Complete
Deer Creek Lodge Area	Complete
Clarks Run Campground	Complete
Deer Creek Golf Course	Complete
Clarks Run Boat Access	Complete

a. Corps-Operated Sites. The Corps of Engineers operates and maintains the following public use and recreation facilities.

(1) Dam Site and Overlook. This site consists of 35 parking spaces, seven benches, a bulletin board, two drinking fountains, project office, visitor center and two project dwellings on 7 developed acres.

(2) Downstream Area. This site is approximately 12 acres in size and contains three recreation areas, (1) Buck Recreation Area, shelter with electricity, picnic sites, restrooms, playground, fishing access, (2) Doe Recreation Area – Shelter no electricity, picnic sites, restrooms, playground, fishing access, (3) Fawn Recreation Area – fishing access, and picnic sites.

b. State-Operated Sites. The State of Ohio Department of Natural Resources maintains the following sites.

(1) Beach Area. This site is approximately 45 acres in size and contains a swimming beach and picnic facilities. Approximately 200 picnic units are located in 6 separate areas at the Mill Road site. Each picnic area has a separate parking lot, with a total of 188 parking spaces provided. The beach area can accommodate between 3,500 and 4,000 bathers, and facilities include a bathhouse with lockers and showers and a parking lot to accommodate 2,038 cars.

(2) Marina Area. This 140 acre site includes a marina complex and the Miller Road and Georges Run picnic areas. The marina concession building is the dominant feature of the area. There are 174 boat mooring slips, 3 boat launching lanes, 100 car/trailer parking spaces, and a comfort station and sanitary facilities at the marina.

The Miller Road facilities are divided into two parking and picnicking areas. The parking facilities can accommodate a total of 35 cars, and sanitary facilities at the site are limited to pit toilets. The Georges Run picnic site provides parking for approximately 30 cars with good fishing access and pit toilets.

(3) Deer Creek Lodge Area. The lodge area contains about 50 acres, and makes up part of the Tick Ridge Peninsula. In addition to the 110-room lodge, there are 25 fully-equipped cabins located on the peninsula. The parking lot at the lodge provides 358 car parking spaces, and the cabin area has 40 car parking spaces distributed around 3 cul-de-sacs and along the cabin road. The lodge has indoor and outdoor swimming pools, exercise room, 4 lighted tennis courts, shuffleboard, volleyball, basketball, a putting green, and a playground. An open field area adjacent to the lodge is used for picnicking, long-rifle competition and field sports. The lodge and cabins are operated by DNS Parks and Resorts through an agreement with the Ohio Department of Natural Resources.

(4) Clarks Run Campground. This 75-acre site provides 232 Class A camp spurs, washhouses, 5 rent-a-camps available. Pets permitted. The campground area contains an amphitheater, a 1-mile hiking trail, and playground equipment. Each campsite has a gravel spur, fire pit, electrical outlet and picnic table.

A new group camp area is also located at this site. The only improvements at the site are a gravel road with 23 parking spaces, 2 fire pits, and pit toilets. Space for approximately 25 primitive campsites is also available , horse camp-primitive overnight for riders and their horses, 7 hiking trails, 1 horse trail and 1 mountain biking trail.

(5) Deer Creek Golf Course. The 18-hole golfing facility is located on approximately 340 acres north of the campground area. Facilities at the golf course include a pro shop, paved parking for 85 cars, swimming/beach area with changing area and restrooms.

(6) Clarks Run Boat Access. Boat launch facilities at this site are located on a small 13-acre peninsula that extends into the Clarks Run Cove, offering boaters protection from wave action. The boat launch provides two lanes, and a paved parking lot provides 65 car/trailer spaces. The Harding Cabin is the dominant structure in the area, sleeps 9, is on the National Register of Historic Places. Said to be visited by President Harding. A 1-mile hiking trail is located at this site, and equestrian and snowmobile trails cross through the area.

c. Division of Wildlife Facilities. Shooting range, fishing access areas, wetland including observation blind.

Route 207 Access Area. This area is located within the designated wildlife management area at Deer Creek Lake. The area contains two paved parking areas which accommodate a total of 48 cars and provide fishing access to the upper reaches of the lake.

SECTION III – GENERAL HISTORY OF PROJECT

3-01. AUTHORIZATION

Deer Creek Lake was authorized by the 1938 Flood Control Act as one of five units in the Scioto River Basin to be constructed as part of the comprehensive flood control plan for the Ohio River, as covered in Flood Control Committee Document 1, Seventy-Fifth Congress, First Session. The project was authorized for flood control and allied purposes, including water conservation for general recreation and fish and wildlife management.

3-02. GENERAL BACKGROUND AND HISTORY

Historical floods prior to installation of a gage at Williamsport in August 1926 and stage records covering most of the time since that date demonstrate that the Deer Creek Basin is subject to destructive floods. They are caused principally by basin-wide rains during winter and spring seasons, although summer-type storms occur producing local floods without affecting adjacent areas. Since the basin is primarily agricultural, damages have been almost exclusively to crops and to farm buildings and residences. House Document No. 306, 74th Congress, First Session, the Ohio River "308" Report, included a reservoir on Deer Creek as one of five selected in the Scioto River Basin. During 1937, basin-wide investigations were made to modify and enlarge the comprehensive plan for flood control in the Ohio River Basin, as set forth in Flood Control Committee Document No. 1, which included a review of House Document No. 306. As a result of this review, the Ohio River Division Engineer prepared a report setting forth a revised and enlarged flood-relief plan for the Ohio River and major tributaries. This report, "Comprehensive Flood-Control Plan for The Ohio River Basin," dated 12 November 1937, included the Deer Creek Reservoir Project as a unit in the comprehensive plan for the Scioto River. Later Congressional action resulted in the Flood Control Act of 1938, Seventy-Fifth Congress, First Session, which provided a nucleus for establishing a comprehensive plan for flood control in the Scioto River Basin. This Act authorized a system of five tributary reservoir projects in the basin; namely, Delaware, Deer Creek, Paint Creek, Big Darby and Rocky Fork. Delaware, Deer Creek and Paint Creek were eventually constructed by the Federal Government, being completed in 1951, 1968 and 1974, respectively. Rocky Fork was built by the State of Ohio in 1952 for recreational purposes but with provisions to permit later modifications to include flood control as a major purpose.

The five authorized Scioto River Basin projects, decreased to four by state construction of Rocky Fork Lake, were later increased to seven by the Flood Control Act of 1962, which authorized the addition of Alum Creek, Mill Creek and Salt Fork Reservoir projects. Alum Creek was completed in 1975; however, Salt Creek became inactive in December of that year. Big Darby was de-authorized in November 1979 and Mill Creek was de-authorized in November 1981.

3-03. PLANNING AND DESIGN

The recommended size and scope of Deer Creek Lake was determined by maximization, where applicable, of the net benefits of joint operation with the other authorized projects in the basin. Major phases of water resources development were considered in establishing the scope of the project, including flood control, water supply, water quality control, general recreation, fish and wildlife conservation and hydroelectric power. Various Federal and State agencies were asked for their views and comments. The Federal Power Commission concluded that power installation was not economically feasible and provisions for future development not justified. A U.S. Public Health Service Report stated there was no need for water supply from Deer Creek Lake. It also stated that the inclusion of storage capacity for water quality control was unwarranted. The reason given was that Deer Creek empties into the Scioto River too far downstream to be effective in the critical reach between Columbus and Chillicothe. The Bureau of Outdoor Recreation Report recommended that land acquisition and project development should emphasize the fish and wildlife uses with some facilities for general recreation. It also recommended acquisition of 660 acres of additional land. These recommendations were generally followed except that general recreation received equal emphasis with fish and wildlife and less additional land was purchased.

Early coordination with the Ohio Department of Natural Resources revealed that the Department was interested in assuming operation and maintenance and further development of recreational facilities at all reservoirs constructed in the State of Ohio. A Department letter of 18 January 1962 assured the Huntington District Engineer of this intent. Subsequent coordination with the Department secured agreement on site plans, types of facilities and cost sharing. By letter of 17 June 1966, the Director advised that the Department would contribute $400,000 toward initial development of the recreational facilities. Additionally, the State offered to provide all basic picnicking and camping facilities such as tables, cookers, etc. Later the State purchased and still retains title to 452 acres in several parcels for a golf course adjoining the Clarks Run Campground and rights-of-way between various areas of the lands leased from the Corps.

Design Memorandum No. 2, Hydrology, revised in December 1964, presented in detail the basic hydrologic aspects of the project. Based on those studies, a minimum pool was established at elevation 796 feet NGVD. The pool at this elevation includes sufficient storage to provide the 10 cfs minimum discharge during the critical year of record for support of fish populations and for storage of sediment to retard the reduction of flood control capacity by sedimentation.

General Design Memorandum No. 2 presented all general features of the project, using available data from prior Design Memorandum No. 1 and supplemented by data on lands, relocations, geology, reservoir clearing and public use of the area. Authorization of initial construction funds for the project in FY 1965 required early approval of this memorandum for completion of advance planning. Therefore, a conference was held in the Division office to rationalize all comments from a review of various supporting memoranda. A new reservoir topographic survey necessitated adjustment in flood control pool six feet higher to 844 feet NGVD in order to retain essentially the same amount of flood control capacity in inches of runoff as had been planned in H.D. No. 587, Scioto River Survey Report of 1962. Establishment of a seasonal pool for recreation and fish and wildlife conservation at elevation 810 feet NGVD was studied to more nearly equalize emphasis on recreation with that

previously accorded to fish and wildlife, and all recreational site features were set according to 810 feet NGVD.

Geologic investigations of leakage indicated possible difficulty in maintaining a pool surface above elevation 796 feet NGVD during a period of low summer inflow. However, since the only additional cost attending establishment of seasonal pool at 810 feet NGVD was the additional clearing, and that would be more than offset by additional recreation benefits, it was decided to clear for elevation 810 feet NGVD and attempt to hold the pool surface at that elevation during the first four years toward eventual establishment as a permanent feature of reservoir regulation during April through October. A gate-controlled spillway at elevation 814.0 feet NGVD provides flood control storage, up to maximum pool elevation 844.0 feet NGVD, or 5.5 inches of runoff during the summer months and 6.5 inches of runoff during the winter season. Storage data for Deer Creek Lake is shown on **Table No. 3-1** below, for minimum seasonal and maximum flood control pools.

TABLE NO. 3-1

POOL ELEVATIONS, RESERVOIR AREA, AND STORAGE CAPACITY
DEER CREEK LAKE

Pool	Elevation (Feet, NGVD)	Surface Area (Acres)	Length (Miles)	Backwater Storage Capacity (Ac. Ft.)
Minimum Pool	796	727	3.7	6,400
Seasonal Pool	8l0	l,277	5.8	21,000
Maximum Flood Control Pool	844	4,046	13.5	102,500

3-04. CONSTRUCTION

The first construction contract let was Foundation Explorations for Dam and Outlet Works, which was begun in September 1963 and accepted in June 1964. Favorable findings of the explorations facilitated contracting and construction of the "Dam and Dike", including the outlet works which commenced in July 1965. The work was organized for completion in four construction seasons beginning with mobilization and erection of the construction plant and ending with completion of the installation of operating machinery, paving and general cleanup operations in the fourth season. Clearing was finished and accepted in June 1968, and the Dam and Dike contract received final acceptance in August 1968.
Relocations or reconstructions necessary for the construction of Deer Creek Lake included 2.7 miles of State highways, 1.6 miles of county roads, two highway bridges, 4.7 miles of power lines, 2.8 miles of telephone lines, 0.8 mile of pipeline, and moving four cemeteries containing 264 graves.

Recreational facilities were cooperatively constructed by the State of Ohio and Corps of Engineers. Phase I facilities, consisting of access roads and boat launch ramps at Clarks Run and Deer Creek accesses, were constructed by the State of Ohio and completed in the fall of 1969. Phase II facilities, by the Corps, consisted of comfort stations at Clarks Run and Deer Creek Boat Accesses, Below Dam Access and County Road 34 Public Access. The Phase II work was begun in September 1969 and completed in April 1971. The State constructed the beach at Mill

Road Area, completing for full public use in August 1972. Phase III facilities, consisting of the Clarks Run Camp Area, were constructed by the Corps, the contract work beginning in November 1971 and being completed in December 1973.

All other recreation items were constructed by the State as follows:

The historic Harding Cabin was renovated for a rental cottage and was ready for occupancy in October 1974.

The marina was completed, and placed in service by a concessionaire in July 1978.

Deer Creek Lodge, with swimming pool, tennis courts, and separate cabins, was completed and opened in May 1981.

Construction work by the Corps of Engineers since completion of Phase III Recreation Facilities in December 1973 included the On-Land Wastewater Facilities completed in August 1975 and Upgrading of Sanitary Sewage Systems completed in September 1980.

Beginning 1 April 1968, the project was directed to be filled to elevation 805 feet NGVD, five feet below seasonal pool elevation 810 feet NGVD in order to allow completion of the raising of State Route 207. Elevation 810 feet NGVD was reached on 25 June 1968.

3-05. RELATED PROJECTS

Deer Creek Lake is the only flood control project in the Deer Creek Basin. However, Deer Creek Lake is operated in conjunction with three major adjacent Corps of Engineers flood control projects in the Scioto Basin. Two of the projects are above Columbus; Delaware Lake on the Olentangy River and Alum Creek on Alum Creek of Big Walnut Creek. The third flood control project is Paint Creek Lake on Paint Creek, about 25 air miles southwest of Deer Creek Lake. In addition there are two State of Ohio recreation and/or water supply lakes; Hoover dam on Big Walnut Creek above Columbus, and Rocky Fork of Paint Creek.

3-06. MODIFICATION TO REGULATIONS - N/A

3-07. PRINCIPAL REGULATION PROBLEMS – N/A

3-08. NORMAL REGULATION

The four project reservoirs are considered as a part of an integrated flood-control system for the entire Ohio River Basin, and the method of regulation is correlated with the operation of reservoirs on other tributaries of the Ohio River.

During periods of storm runoff, the reservoirs are operated to utilize the natural channel capacities by releasing storage at rates not to exceed the designated control stages. The control stages and flows at key river stages are shown in **Table No. 7-1**, page 7-7. Storage of flood flows commence in advance of predicted damage stages at key points, and continue until predicted stages for all control points indicate that releases of stored waters from the reservoirs, with proper allowance for time of travel, will not cause stages in excess

of the control stages. Gates are closed and all reservoir inflow stored for partial control of Ohio River floods when a crest stage above 50 feet at Portsmouth is forecast by the National Weather Service. Operation for reduction of Ohio River floods continues until the Ohio River at Portsmouth has crested and fallen 1 foot and further recession is indicated. Times of beginning and ending of reservoir operation are based on the estimated time of water travel from the various dam sites to the mouth of Scioto River at Portsmouth. At the end of the regulation period, outflows are gradually increased to the bankfull channel capacity below the dams and maintained at that rate until the flood storage is released, or until river stages at key stations require further storage operation.

SECTION IV - WATERSHED CHARACTERISTICS

4-01. GENERAL CHARACTERISTICS

The Deer Creek Basin upstream of Deer Creek Lake covers portions of Pickaway, Fayette, Madison, Clark, and Champaign Counties in Ohio. The basin is irregular in shape with a length of about 35 miles and a maximum width of approximately 12 miles. It has a drainage area of 277 square miles. The drainage area map is shown on **Plate No. 2-1**, plate section.

Deer Creek is the main stream in the Deer Creek Lake Basin. It flows in a general southeast direction from its headwaters through relatively flat glaciated terrain for 70 miles to its confluence with the Scioto River about 8 miles above Chillicothe. The total stream fall from its source to the mouth is 665 feet, or an average slope of 9.5 feet per mile. Deer Creek has an average slope of approximately 9.8 feet per mile above Deer Creek Lake, and a slope of about 6.4 feet per mile in the lowermost 60 miles. The stream profile of Deer Creek is shown on **Plate No. 4-1**, plate section. Sugar Run and Oak Run are the 2 largest tributaries of Deer Creek above Deer Creek Lake and have slopes of 13.1 and 19.8 feet per mile, respectively. Drainage areas of Deer Creek and its principal tributaries above Deer Creek Lake are shown in **Table No. 4-1**, below.

TABLE NO. 4-1

DRAINAGE AREAS OF DEER CREEK AND TRIBUTARIES

Stream	Point	Area (Sq. Mi.)
Deer Creek	At mouth	412
Deer Creek	At damsite	277
Clark Run	At mouth	8.5
Duffs Fork	At mouth	12.5
Opossum Run	At mouth	18.8
Sugar Run	At mouth	51.9
Oak Run	At mouth	41.9
Glade Run	At mouth	19.8

4-02. TOPOGRAPHY

Deer Creek Lake is located entirely within the Till Plains section of the Central Lowlands physiographic province. During the Pleistocene epoch, this province was subjected to glaciation, which resulted in topography that is characterized by a broad area of low relief, having flat crested hills and incised by streams having broad flood plains. The difference in elevation from the lake surface to the ridge tops in any given location ranges from 50 to 80 feet. The absence of significant topographic relief in the area has a significant impact on the surface of the lake during drawdown conditions.

4-03. GEOLOGY AND SOILS

The western two-thirds of Ohio was glaciated during the Pleistocene epoch by at least two glacial systems, the Illinoian and Wisconsin. The Wisconsin was the last glacier and covered the area in two sub-stages. Sufficient time elapsed between the sub-stages to permit weathering of the upper surface of the first sub-stage soil. The Wisconsin glacier contributed almost totally to all the glacial drift in the lake area. Glacial drift in excess of 400 feet may be found in old pre-glacial and inter-glacial valleys. The pre-glacial topography of the area was that of a flat upland of old age, highly dissected by streams. Concurrent with the withdrawal of the Wisconsin glacier, melted water cut deeply into the till along the present site of Deer Creek, and deposited glacial outwash in the channel. Generally, till is a heterogeneous, impervious, compact mixture of clay and silt containing about 40 percent pebbles, and a limited number of cobbles and boulders. Outwash deposits consist of a pervious mixture of silty-sand, gravel, and boulders. Glacial outwash deposits reach a maximum thickness of 35 feet at the dam site. The maximum thickness of glacial till at the dam site is 90 feet in the left abutment where it rests directly on bedrock.

Sedimentary rocks in the lake area range from Devonian through Cambrian, and bedrock ranges from lower Devonian through middle Silurian. The Silurian and Devonian rocks of Ohio are made up of limestone, dolomites, and shale, with some sandstones. The regional dip of the rock is east by southeast at a rate of 25 to 30 feet per mile. The strata are frequently affected by small folds, or disturbed so that locally the dip is changed.

The thick, young till deposits of the project area are of sufficient thickness to obliterate any pattern signatures of the underlying rock type or structure. Therefore, site development capability is more dependent on soil characteristics than the underlying rock.

Soils in the Deer Creek Lake Basin are predominately of the Brookston-Crosby association, with the uppermost portion of the basin having soils of the Miamian-Celina association. The Brookston-Crosby association consists mainly of very poorly to somewhat poorly drained soils. These soils are formed in calcareous glacial till and have sub-soils with about 35 to 40 percent clay. Slopes are nearly level to gently sloping.

The Miamian-Celina association consists of well drained and moderately well drained soils on uplands, frequently covered by a thin silty mantle, less than 18 inches thick. They are underlain by calcareous loam till. Sub-soils have 35 to 40 percent clay, and slopes are undulating to gently rolling. Areas of dark-colored soil commonly occupy the nearly level areas between the more sloping areas.

4-04. EROSION AND SEDIMENT YIELD

The amount of sediment generated by a watershed depends on a number of factors including land use, physiographic, rainfall and size and shape of the drainage basin. Rainfall dislodges soil particles from the earth, the first step in the erosion-sedimentation process. High intensity rainfalls with large-sized raindrops produce the highest concentrations of sediment. Steep sloping land and land with poor vegetation produces high erosion and sedimentation. Larger drainage basins generally produce less sediment per square mile from a given storm than smaller basins because of the variation in land uses and rainfall rates. And the shape of a drainage basin determines the amount

of bottom land available for sediment deposition before it reaches the reservoir.

The Deer Creek Lake watershed contains large areas of un-vegetated farmland, which creates the potential for high erosion and sedimentation in the basin. Erosion problems at Deer Creek Lake are caused by a number of factors including highly porous soils, wave action, lack of vegetation, pool drawdowns and surface water runoff. Severe shoreline erosion has been caused by wave action, drawdowns and lack of vegetation on steep slopes. Soil loss has been significant at the damsite, Tick Ridge, and Clarks Run boat launch creating cliffs that range between 10 feet and 40 feet high. Surface water erosion at Deer Creek Lake has been caused by inadequate storm water drainage facilities and lack of vegetation. Erosion control measures utilized at Deer Creek Lake include the use of riprap along shoreline areas downstream of the dam and a wall to control shoreline erosion at the Clarks Run Boat Access Area. The master plan at Deer Creek Lake recommends that a more comprehensive study of shoreline erosion be done and that a plan for shoreline stabilization be adopted.

4-05. CLIMATE

a. General. The climate of the Deer Creek Basin is typical of the central temperate zone, having highly variable temperatures between the summer and winter seasons, see **Table No. 4-2** back of section. The entire basin is affected by frontal airmass activity and is subject to both continental polar and maritime tropical airmasses. 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. Although temperature and precipitation data are measured at the Deer Creek Lake dam site, its period of record is too short to develop 30-year climatological mean values.

b. Temperature. Temperature data is recorded at the London Water Works in the northern portion of the Deer Creek Lake Basin and at Washington Court House, located just southwest of the basin. These two stations show the gradual increase in temperature from north to south across Ohio. The normal annual temperature is 51.3°F at London and 52.1°F at Washington Court House. At London, monthly temperatures range from 26.7°F in January to 73.0°F in July. The length of the growing season at London is approximately 165 days, normally extending from early May to the middle of October.

c. Precipitation. Precipitation data is recorded at the London Water Works within the Deer Creek Lake Basin, located just west of the basin and at Washington Court House, southwest of the basin. Normal annual precipitation ranges from 37.69 inches at London to 39.29 inches at Sedalia.

Normal monthly precipitation at London ranges from 2.16 inches in February to 4.15 inches in July. NOAA snowfall data is recorded at London and Washington Court House, although London data is incomplete. Total annual snowfall averages 29.2 inches at Washington Court House.

d. Evaporation and Wind. For most Scioto River Basin reservoirs, the amount of water lost by evaporation is quite small. The amount of

loss attributable to evaporation from the lake surface is the difference between actual evaporation from the lake surface and the evapotranspiration from that area before the reservoir was constructed. The average annual lake evaporation over Deer Creek Lake is approximately 33 inches. Comparison of the water surface evaporation with the water loss shows that the average increase in loss, or augmented evaporation due to a reservoir, is about nine inches per year. Lake evaporation data for the Deer Creek Lake area are shown in **Table No. 4-3**, below.

TABLE NO. 4-3

LAKE EVAPORATION LOSSES - SUMMARY

Maximum Seasonal Evaporation (1988) = 38 inches(1).
Average Annual Evaporation = 33 inches.
Average Seasonal Evaporation (May - Oct.) = 25 inches.

Average Monthly Evaporation Losses

Month	Inches(1)	Acre-feet(2)
April	3.19	335
May	4.14	435
June	5.00	525
July	5.24	550
August	4.49	471
September	3.52	370
October	2.27	238

(1) Coefficient to convert Class A pan evaporation to lake evaporation assumed to be 0.75.
(2) Measured from seasonal pool elevation 810.0 feet NGVD.

Prevailing winds in the area are from the south and southwest for most of the year; during the winter months, prevailing winds become more northwesterly. The mean annual wind speed, based on data from the Columbus Airport is 8.7 miles per hour. The maximum mean monthly wind speeds average between 9 and 11 miles per hour during the period November through April; minimum mean monthly wind speed is 6.5 miles per hour in August. Damaging windstorms are mostly associated with heavy thunderstorms, squall lines or intense large-area storms.

4-06. STORMS AND FLOODS

a. General. Most floods in Ohio are caused by precipitation of unusual intensity or of unusual duration and extent. Floods may also result from a series of ordinary storms which follow one another in rapid succession or from rain falling at relatively high temperatures on snow-covered areas. At times, though infrequently, flood conditions are caused or aggravated by ice jams, especially in the tributary streams. Severe thunderstorms frequently cause local flash flooding. General flooding in the basin occurs most frequently during the winter or early spring months, but it can occur at any time during the year.

The flooding characteristics of the Deer Creek Basin can be partially described by comparing the highest annual historical floods. These are

shown on page 4-6 in **Table No. 4-4**, next page, for the water years 1926 through 1998 for the Deer Creek at Williamsport USGS gaging station. All flows and gage heights represent natural flows occurring at the gage without regulation of Deer Creek Lake. The datum of the DCSOF outflow gage currently is 768.00 feet NGVD. From 23 October 1963 to 30 June 1966, a crest stage gage was located at a site 200 feet upstream at a datum 8.16 feet lower. From 1 July 1966 to present, the gage was located at its current site at a zero datum 768.00 feet lower. The Pancoastburg flows were increased by a drainage area ratio and listed on the **Table No. 4-4**, next page.

Flooding characteristics of the Deer Creek Basin can also be described by flow-frequency data. Flow-frequency curves for Deer Creek below Deer Creek Lake and at Williamsport are shown on **Plate Nos. 4-2** and **4-3**, plate section, respectively. The plates show flow-frequency data for natural conditions in the stream and also as modified by Deer Creek Lake. A discharge rating curve for the 36″ low-flow sluice is shown on **Plate No. 7-5**, plate section, and flow duration curves as affected by regulation of Deer Creek Lake for the area below Deer Creek Lake and at Williamsport are shown on **Plate Nos. 4-4** and **4-5**, plate section, respectively.

TABLE NO. 4-4

DEER CREEK AT WILLIAMSPORT, OHIO
MAXIMUM ANNUAL NATURAL FLOWS

Water Year	Discharge (cfs)
1959	39,600
1963	37,600
1929	29,300
1952	24,400
1913	24,000
1943	23,600
1964	23,400
1945	18,700
1940	16,600
1951	14,300
1979	*14,000 16,800
1963	13,600
1927	13,000
1948	12,800
1937	12,770
1946	12,200
1968	*11,700 14,000
1933	11,600
1949	10,000
1928	9,610
1931	9,220
1935	8,840
1975	*8,400 10,000
1938	8,090
1982	*7,350 8,800
1939	7,370
1962	7,000
1947	6,810
1950	6,510
1965	6,390
1944	6,050
1930	6,030
1961	6,000
1989	7,970
1990	4,700
1998	6,170

b. Storm and Flood of March l9l3. The storm causing this flood was general over the northern half of the Ohio River Basin, with the heaviest precipitation in the states of Indiana and Ohio. Rainfall of l.0-l.5 inches occurred on 20 and 2l March throughout the Ohio Valley and thoroughly saturated the ground, so that an unusually large percentage of the subsequently heavy rain of the main storm, on 23 to 27 March, produced rapid runoff. All flood records on the southerly flowing tributaries of the Ohio River in Ohio and Indiana were broken.

The intensive rains of 23-27 March were heaviest in the upper portion of the Scioto River Basin. Total rainfall ranged from 11.16 inches at Bellefountaine, just north of the basin, to 3.9 inches at Portsmouth. Columbus received 7.9 inches, and the average rainfall over the Scioto River Basin was about 7.2 inches. The 1913 flood produced the highest stage of record on the Scioto River at Chillicothe.

c. Storm and Flood of January 1937. A series of abnormally heavy rains in late December 1936 and most of January 1937 caused a major series of floods in the middle and lower portions of the Ohio River Valley. These storms were centered farther south than those of 1913, generally producing the heaviest rainfall south of the Ohio River. Precipitation from storms of 26 December to 12 January averaged 3 inches over the Scioto River Basin, with southern sections receiving about 4 inches and northern sections about 1 inch. During the period of 13-18 January, approximately 3.5 more inches of rain fell over the basin, ranging from 3 inches at Bellpoint to 4.9 inches at Waverly. The heaviest precipitation then fell during the period 20-27 January, as rainfall averaged about 5.6 inches over the Scioto River Basin. Chillicothe received 7.2 inches of rain, and these storms produced the fifth ranking annual flood on the Scioto River at Chillicothe.

d. Storm and Flood of January 1959. The storm and flood of January 1959 is generally regarded as one of the highest of record throughout most sections of the Scioto River Basin. The conditions prior to the generalized rains on 20 and 21 January contributed greatly to the flood stages throughout the basin. Severe cold weather during December 1958 froze the ground to depths up to 32 inches. In addition a storm occurring between 14 and 17 January deposited from 0.50 to 1.84 inches of precipitation over the state. The ground was thus saturated, frozen and covered with varying amounts of snow, all of which greatly contributed to the high percentage of runoff encountered after the generalized rain began. The storm center crossed the northern portion of the Scioto River Basin with the heaviest precipitation falling during the morning of 21 January. Rainfall over the Scioto River Basin averaged approximately 3.7 inches during the storms of 19-22 January, and combined with approximately 0.23 inch of water equivalent snowmelt. The Deer Creek basin received an average of 3.9 inches of rain which combined with about 0.2 inch of water equivalent snowmelt.

e. Storm and Flood of March 1963. Heavy rain falling on frozen, saturated and snow-covered ground was mainly responsible for flooding conditions experienced in the Scioto River Basin during early March 1963. The weather pattern and conditions in the March 1963 flood were similar to those of January 1959, except for the more southerly storm track. Excessively cold weather in January and February 1963 froze soils to a considerable depth. A storm on 1-3 March produced from 0.5 to 1.0 inch of rain and snow, which saturated the soil prior to the arrival of the main storm. The Deer Creek basin above Williamsport received 0.9 inch of precipitation during the storm of 1-3 March, and held an average snow cover of 2.5 inches, with a melted equivalent of 0.25 inch on frozen ground prior to the main storm. In the next three days, heavy rains of nearly 5 inches fell along a line from Cincinnati through Chillicothe and Athens to Uhrichsville, most of which occurred during the night of 4-5 March. Serious flooding occurred along the line of heaviest precipitation, especially in the Paint Creek and Hocking River Basins. An average of 3.7 inches of precipitation fell over the Deer Creek Basin above the Williamsport gage. The stage observed at Williamsport during this flood nearly equal the stage of record set in January 1959.

f. Storm and Flood of May 1968. Central and southern Ohio experienced the worst widespread flooding since 1913 during the latter part of May 1968. During the period 8-22 May, most areas in the southern half of the state received 3 to 5 inches of rainfall. This created saturated soil conditions over a large portion of the state, and contributed to the large runoffs that occurred during the heavy rains of 23-24 May and 26-27 May. In the Deer Creek Lake Basin, London Water Works (in the northern part of the basin) received 3.35 inches of rain from the storms of 23-24 May and 2.11 inches from the storms of 26-27 May. At Mount Sterling, located near the middle of the Deer Creek Lake basin, rainfalls for these 2 periods were 4.6 inches and 1.9 inches, respectively. Hourly precipitation data for Mt. Sterling indicates that 1.7 inches of rain fell in a 13-hour period prior to 3 p.m. on 23 May, followed by a brief period of heavy rain in which 2.4 inches of rain fell in a 4-hour period beginning about 10 p.m. that evening. The rains that fell over the southern areas of Ohio on 23-24 May were estimated to be of a 50 to 100 year frequency and caused an estimated $8.8 million in flood damages.

g. Storm and Flood of September 1979. Heavy rains from the remnants of Hurricane Frederick on 13-14 September caused major flooding on Scioto River Basin streams and other streams in Ohio. The heavy rains fell in a band about 50 miles wide from Cincinnati through Columbus to Youngstown as Frederick passed through Ohio. This storm was reported to have an intensity rating of a 200-year storm, and deposited 4.85 inches of rain at London and 3.94 inches of rain at Deer Creek Lake within the Deer Creek Lake basin. Many weather stations along the path of the storm reported in excess of 6.0 inches of rain.

h. Storm and Flood of May 1983. Heavy rains on 30 April and during the first three days of May caused minor flooding in many areas of Ohio. At Deer Creek Lake, rainfall for the period 30 April through 3 May amounted to 5.3 inches, with 2.6 inches of that total falling on 30 April. At London Water Works, located in the northern part of the basin, rainfall for the same period was 4.17 inches. These rains, along with other rainfall in May, created the third highest monthly mean discharge for the Scioto River at Higby for the period of record beginning in 1930.

i. Storm and Flood of November 1985. Precipitation totals set an all-time record for November in Ohio, and the second greatest amount for any month in this century, with a state average of 9.09 inches. The record was set in January 1937 with a state average of 9.91 inches. Deer Creek Lake, at the southern end of the basin, received 9.10 inches of precipitation in November, while London Water Works, at the northern end of the basin, received 10.20 inches. Records show that there was rain somewhere in Ohio on every day but one during the month. Stream flows for November were excessive throughout the state as a result of the record-breaking precipitation. Many records for November maximum monthly mean discharge and maximum daily flows were exceeded. Extensive flooding occurred in low-lying areas throughout the state, but no major flooding occurred, mainly because droughty conditions in preceding months had created low stream level conditions prior to the November 1985 precipitation.

4-07. RUNOFF CHARACTERISTICS

The Deer Creek watershed lies in a glaciated section of the Appalachian Plateau, and is characterized by broad areas of low relief which are conducive to a slow concentration of runoff. Basin runoff is highest during the winter months when storm rainfall may combine with snowmelt and when frozen or saturated ground can result in very low infiltration rates. Runoff is lowest during late summer and early fall when the ground is dry and infiltration losses are high.

Table No. 4-5, next page, presents average normal, maximum and minimum runoff based on 29 years of regulated flow (1968 through 1996) from the watershed at Pancoastburg USGS gage, about 1,200 feet below the Deer Creek damsite. The minimum flows for spring and summer are fairly small, but, still more than the tiny flows of the summer droughts before dam construction. The Williamsport USGS gage recorded a tiny average flow of 9.1 cfs for the six months of July thru December 1930. The same USGS gage for the same months of 1934 averaged only 12.8 cfs; and a record low annual flow of 61.5 cfs.

TABLE NO. 4-5

MONTHLY AND ANNUAL RUNOFF
DEER CREEK NEAR PANCOASTBURG, OHIO (1968-1996)

Month	Normal Average Flow (cfs)	Maximum Average Flow (cfs)	Minimum Average Flow (cfs)
January	318	903	20
February	431	1133	37
March	436	1262	59
April	269	764	9.8
May	323	1198	7.8
June	304	1345	7.7
July	163	713	10
August	110	754	12
September	77	856	6.3
October	137	538	12
November	285	1152	38
December	345	1108	27
Annual	265	484	102

4-08. WATER QUALITY

a. Geology. Deer Creek Lake is located entirely within the Till Plains section of the Central Lowlands physiographic province. During the Pleistocene epoch, this province was subjected to glaciations, which resulted in topography that is characterized by a broad area of low relief, having flat-crested hills and incised by streams having broad flood plains. The difference in elevation from the lake surface to the ridge tops in any given location ranges from 50 to 80 feet. The pre-glacial topography of the area was that of a flat upland of old age, highly dissected by streams. Concurrent with the withdrawal of the Wisconsin glacier, melted water cut deeply into the till along the present site of Deer Creek, and deposited glacial outwash in the channel. Generally, till is a heterogeneous, impervious, compact mixture of clay and silt containing about 40 percent pebbles, and a limited number of cobbles and boulders. Outwash deposits consist of a pervious mixture of silty-sand, gravel, and boulders. Glacial outwash

deposits reach a maximum thickness of 35 feet at the dam site. The maximum thickness of glacial till at the dam site is 90 feet in the left abutment where it rests directly on bedrock. Land use in the basin was mostly farming and pasture.

b. Chemical. In terms of major ions and descriptive parameters, inflow water to Deer Creek Lake is classified as a calcium-carbonate type. This represents a balanced condition. Water hardness in the basin is 296 mg/l Calcium Carbonate which is classified as very hard according to USGS classifications.

c. Impaired Waters. EPA requires the States to assign a designated use to all streams within the state. Those streams not meeting their designated use are listed as impaired waters. The Deer Creek Lake watershed is part of the Lower Scioto watershed where 41 streams are listed as impaired which is about 5% of those reported. Deer Creek is on that list. Most common problems within the lower Scioto watershed are siltation, habitat alteration, and organic enrichment/low dissolved oxygen. Problems listed within the Deer Creek watershed were nutrients, turbidity, ammonia, organic enrichment, and siltation. Potential sources of impairment are pasture land.

Water quality data collected by the Corps of Engineers from 1980 to 2001 indicate that water quality in the basin reflects watershed conditions.

4-09. CHANNEL AND FLOODWAY CHARACTERISTICS

Deer Creek follows a meandering course over most of its 70-mile length with broad floodplains, stable banks and low turbidity. At the Deer Creek Lake outflow gage, the streambed is composed of gravel and small boulders, and the flow rating at the gage has varied about 14% at the 5-foot stage and about 11% at the 7.9-foot stage since regulation was begun at the dam. Time of travel of outflow from Deer Creek Lake to Williamsport is about 3 hours at normal flow conditions, and to Chillicothe is an additional 12 hours.

4-10. UPSTREAM STRUCTURES - N/A

4-11. DOWNSTREAM SRRUCTURES - N/A

4-12. ECONOMIC DATA

a. Population. The Deer Creek Lake Drainage Basin covers portions of Pickaway, Fayette, Madison, Clark and Champaign Counties of Ohio, with the majority of the drainage lying in Madison County. Mount Sterling and London are the main population centers of the basin. London is the county seat of Madison County, and based on 2000 census data, has a population of 8,771. The 1990 census population of London was 7,807. Mount Sterling has 1990 and 2000 census populations of 1,647 and 1,865, respectively.

b. Industry and Agriculture. The principal industries in Madison County are related to stone-clay-glass, printing and publishing, and non-electrical machinery. Manufactured goods include automotive parts, artificial limbs, farm and industrial fencing, and soap. The primary

grain crops harvested include corn, soybeans, wheat, oats and hay. Primary livestock raised in the area include dairy cattle, beef cattle and swine.

Madison County has a total land area of approximately 464 square miles. Of this area, approximately 93.0% is devoted to cropland, 5% to woodlands, 2% to open water, 3.9% to other farm land, 1.8% to urban and built-up areas, and 0.4% to miscellaneous other uses.

c. Flood Damages. Areas subject to flooding downstream of Deer Creek Lake along Deer Creek consist of small farms, rural residences and the village of Williamsport. The dams in the Scioto River Basin reservoir system have continued to significantly reduce flood damages in the basin. Based on estimates of flood damages for both the natural condition, and as modified by the reservoir system, Deer Creek dam has prevented an estimated $34.2 million in total damages through 2004.

SECTION V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01. HYDROMETEOROLOGICAL STATIONS

a. Facilities. Data Collection Platforms (DCPs) have been installed at various stream gaging and precipitation stations. Installations at stations in the Deer Creek Basin are described in **Table No. 5-1**, Table section. 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. 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.

Stream gaging stations have voice DCP's, capable of answering a telephone call and responding with the current updated information by synthesized voice.

DCP's have the capability of reporting in response to a telephone query from a computer. The query can be initiated any time from the Water Control System, project office or the 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 giving several readings over a period of hours.

Stream Gaging Stations in and near the Deer Creek Basin include: Mt. Sterling and Williamsport and standard DCP's are located at the Deer Creek Lake inflow and outflow stations. Hydrologgers have also been installed at both Deer Creek Lake and outflow stations. Gage locations and pertinent data about them is listed in **Table No. 5-1**, Table Section.

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 Management Sections 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 Deer Creek 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 the USGS.

5-02. WATER QUALITY STATIONS

a. Facilities. A network of eight water-quality-sampling stations was established at Deer Creek Lake. Primary stations located on the lake are shown in **Plate No. 5-1**. All primary stations within the basin are described in **Table No. 5-2**, next page.

TABLE NO. 5-2

Description by Location of Deer Creek Lake
Primary Water Quality Sampling Stations

Station	Distance From the Dam
1DCS0001	300 feet below
1DCS0002	200 feet above
1DCS0003	15 miles above
1DCS0004	1.5 miles above
1DCS0005	2 miles above
1DCS0006	3 miles above
1DCS0007	4 miles above
1DCS0008	7 miles below

b. Reporting. Water quality data collected at Deer Creek 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 numbers of data-collection-stations are determined by specific project conditions. The water quality program design for Deer Creek 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 No. 5-3**, next page.

c. Maintenance. 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

(5) predictive capability

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

TABLE NO. 5-3

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 (SO4) Chloride (Cl)	Major Anions - Ionic Balance, ratios and relationships
Nitrogen (N) Nitrate + Nitrite Ammonia Total Kjeldahl	Nutrient
Total Organic Carbon (TOC)	Nutrient
Phosphorous (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. Lake. Sedimentation surveys were completed in 1975, 1981, and 1986. Sediment range monuments for 31 sediment ranges were established during the period December 1962 to July 1963 as part of an aerial photography, ground control and mapping contract at Deer Creek Lake. The sediment range network for Deer Creek Lake is shown on **Plate No. 5-2**, plate section. Eight of the original 31 sediment ranges were resurveyed for the 1975 sedimentation study and nine were resurveyed for the 1981 study. The 1986 reconnaissance has been conducted, and is now complete.

In the 1975 study, the rate of sedimentation in the seasonal pool area was estimated to be 0.08 acre-foot per year per square mile of contributing drainage area. This rate of sedimentation was not considered to be detrimental to the effective operation and management of the project for authorized purposes.

In the 1981 study, partial lake bottom profiles across the lake were obtained near the selected sediment ranges by use of a fathometer. Horizontal control was not maintained. The minimum elevation of each range investigated was determined from these fathometer passes. The primary sediment problem noticed during the study appeared to be due to shore erosion at seasonal pool level. Comparison of the data obtained during the 1981 sedimentation reconnaissance with that of previous surveys indicated an increase in the rate of sedimentation in the pool area since the 1975 study. However, the rate of sedimentation did not appear to be excessive and was not a matter of concern in regard to operation of the lake. The 1986 reconnaissance indicated little or no increase in the rate of sedimentation. Further studies will be conducted as funding permits.

b. Stream. Sedimentation in Deer Creek within the area inundated by the seasonal pool was analyzed as part of the l981 and 1986 sedimentation reconnaissance studies.

5-04. RECORDING HYDROLOGIC DATA

All data is stored 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.

5-05. COMMUNICATION NETWORK

Cell Phones are installed at the District Office, Area Offices, construction field offices, and navigation lock and dam installations. These installations also have commercial telephone service. Data collection DCP's are installed at several stream gaging stations and precipitation stations in the Deer Creek Basin. The DCP's transmit data (several readings over a period of hours) via the Geostationary Operational Environmental Satellite (GOES) to a computer downlink that is accessed by the Water Resources Engineering Branch water control system. As outlined previously voice DCP's have been added to some streamgaging stations. Operation of the DCP-satellite network is discussed in more detail in sub-sections 5-01 and 5-02. **Plate No. 5-3**, plate section, graphically illustrates the Hydrologic network throughout the Deer Creek Basin.

5-06. COMMUNICATION WITH PROJECTS

a. Regulating Office with Project Office.

Telephone is the primary mode for most communication between the Water Management Section, the Scioto Area Office, and the multi-purpose Scioto Projects such as Deer Creek Lake; and between projects and the Area Office. Inter-project communication is mostly by cell phone with some telephone communications when privacy is essential. District wide Cell Phones are also used for secondary backup communication, while mobile radio, State Police, courier, etc. are utilized during an emergency when neither the telephone or district Cell Phones are operational.

Water Management Section personnel use the telephone to request and receive additional operation information and weather information and to give operational guidance and directives. The U.S. Postal Service is utilized for letter reports from projects to the Water Management Section, other voluminous or detailed information, pictorial material, confirmation of Special Directives, and any other formal communication between the Water Management Section and the projects.

Occasional visits to the projects afford an opportunity for office and project personnel to discuss ideas, problems, new procedures, etc.

b. Between Project Office and Others.

1. District Staff. Major flood conditions may require daily or more frequent briefings for key staff members. During floods or other disasters when the Emergency Operations Center is in operation, Water Management Section personnel distribute copies of all reports received for critical and adjoining areas to the Center, District Engineer, Chief Engineer, and Executive Officer. Storm analysis, critical situation information and operational data are provided to pertinent key staff as determined to be informational or necessary. The Public Affairs Office is kept advised to ensure proper public notification.

2. Emergency Management Branch. The Water Management Section has no regular communication with Emergency Management Branch (EMB) except as mentioned above when the Emergency Operations Center is in operation. When storms occur in the district or high precipitation is shown on a NWS Quantitative Precipitation Forecast, the Water Management Section telephones EMD or visits to pass on the information. Frequently EMD personnel will visit the Water Management Section in person for further briefing. When EMB personnel learn of storms in or heading for the district, they visit the Water Management Section for evaluation and determination of impact. During these meetings, participants view Quantitative Precipitation Forecasts, other NWS forecasts and current information, District Isohyetal (precipitation) Maps, morning reports, etc.

3. Great Lakes and Ohio River Division Water Management Team. Telephone land lines and the U.S. Postal Service carry all normal communications between the Water Management Section and the Water Management Division (WMD). Cell Phones are now used as backup in emergency situations. When desired, pictorial, handwritten or printed material can be transmitted in a matter of minutes over land lines by fax. A file containing observed data, 3-day forecasts of lake and outflow for all reservoir projects and 5-day flow forecasts for Ohio River tributary gage points is generated by the water control system daily. Subsequent to final modeling and certification, the file is

transmitted to Water Management Division by leased line. The Water Management Section briefs Water Management Division personnel may call three times weekly, normally Monday, Wednesday and Friday, for updates on any and all special operations in the district. A Report of Deviation, revised Form ORD 1018R, may be requested by Water Management Division on the occasion of a special purpose operation at Deer Creek Lake outside the approved plan of regulation.

4. Operations and Readiness Division Area Office. Deer Creek Lake is, for administrative purposes, included with the Scioto River Reservoirs under the Scioto Area Office, at Circleville, Ohio. Normal communication between Water Management Section and the Area Office is by telephone, mail transfer of disposition forms, reports, maps, drawings, and other pictorial material, and occasional visits by Branch personnel. Emergency back-up communication is now by Cell Phone.

5. National Weather Service. Communication with National Weather Service (NWS) begins with cooperative arrangements for the Ohio River Network (ORN) program. Precipitation amounts are included in the morning report to the District water control system and to the NWS in Wilmington, Ohio.

The Division Office currently has a direct link with the NWS Automated Field Operating System (AWIPS) and disseminates data from AWIPS to the District water control system at least once an hour. Information formerly received from the NWS Weather Wire is also now received via the AFOS link in the Division Office and the internet.

6. U.S. Geological Survey. Communication between the Water Resources Engineering Branch and U.S. Geological Survey (USGS) is varied and affected by the meshing of interests of the two entities. A large portion of the communication surrounds the stream cooperative program and involves telephone discussions and mailed information on gage location, ratings, and rating extensions. Telephone requests are made by the Water Resources Engineering Branch for the USGS to repair a gage critical to regulation of a reservoir in flood condition. Annual meetings are held with the USGS concerning the cooperative program. Additional meetings are held with the USGS as deemed necessary.

7. State and Local Agencies. Water Resources Engineering Branch communicates with the Ohio Department of Natural Resources about fish and wildlife enhancement at Corps of Engineers lakes in Ohio and downstream areas, timing of spring filling and fall drawdown, and other gate operations. Project personnel contact the Deer Creek State Park Office to advise of pool rises and storage releases, including scheduled dates of initiation of spring filling and fall drawdown. The Park Office advises the project of scheduled recreational events.

The State Health Department communicates with the project twice a month regarding testing of the drinking water at the dam and at the fisherman's access below the dam. Results of the testing are received by mail. The Water Resources Engineering Branch coordinates directly with the Ohio Department of Natural Resources' representative in the Ohio Office of Disaster Services during an emergency.

Within the county, communication occurs with the sheriff's office of Pickaway County, which is responsible for crime protection, as well as for conceivable emergency needs such as fire, medical, or under-water rescue.

8. General Public and Commercial Interest. Farmers below the dam telephone Water Resources Engineering Branch to request relief from flooding after 4-5 days of maximum-rate release of summer floods. Apparently some few days time is required for water from Deer Creek to seep through the soil into nearby low-lying fields.

The general public can access the internet for information (www.lrh-wc.usace.army.mil/home.htm), pool elevation in relation to seasonal level, lake water clarity, temperature at surface and below at 10-foot depth intervals, outflow stage in relation to normal, cfs discharge and tailwater conditions of clarity and temperature. Also included is visitor information on availability and timing of tours of the dam and activities scheduled at the Park such as opening and closing of the swimming beach.

Project personnel have contact with commercial interests. Water Resources Engineering Branch communication with construction and engineering firms was more frequent during the 1970's while construction of the major portion of recreation facilities was in progress. Several requests were received from contractors and bidders for information or adjustment in lake level or drawdown schedule to aid specific construction plans. Since then, in September 1980 a water supply company requested the Corps to adjust discharge sufficiently to simulate a 1975 low-flow condition at the Williamsport gage of 12 cfs. In August 1981, a power company requested information on configuration of the outlet and duration of discharge curves for their investigation of hydropower possibilities at the dam.

There are no interests downstream from the dam vulnerable to flooding at discharge rates up through respective channel capacities other than the farmers mentioned above. However, in order to advise recreators below the dam of impending increases in outflow, a discharge warning horn is blown at the pylon whenever the total gate opening is to be increased. Project personnel call the Park office when closing for flood control and upon opening to discharge flood storage. Water level warnings at Deer Creek, are shown on **Table No. 5-4**, table section.

5-07. PROJECT RECORDING INSTRUCTIONS

Project personnel will report hydrometerologic and water quality data to the Water Management Section as described in Instructions to the Damtender, Exhibit B, chapter 4. The project will report any operational problems by telephone to the Water Management Section and the Technical Support Branch of Operations.

5-08. WARNINGS

Project personnel are required to sound a horn to warn the users of the downstream recreation area that the volume of outflow is expected to rapidly increase. The National Weather Service is responsible for issuing public flood watches and warnings in the Scioto - Deer Creek Basin. If the situation is grave or serious enough, the Dam Safety Emergency Action Plan lists individuals to contact and warn of dam operations.

SECTION VI - HYDROLOGIC FORECASTS

6-01. GENERAL

Hydrologic forecasts of lake elevations and stream flows in the Scioto River Basin are vitally important for Water Control Management as these forecasts provide information which enables the optimal regulation of the projects. These forecasts are conducted under low-flow, normal flow, and flood conditions and are primarily developed by the Corps of Engineers and the National Weather Service on a daily basis.

a. Role of Corps.

(1) District Office. In accordance with ORDR 1110-2-27, dated 12 January 1976, Subject: Water Control Management Activities, the Water Management Section performs water control management activities for multi-purpose projects throughout the Huntington District. These activities include the preparation of forecasts for lake inflows, lake levels, project outflows, water quality, outflow temperature, and flows at downstream stations to ensure the safe and efficient operation of the district projects. River forecasts prepared by the Corps of Engineers are generally used for its own responsibilities and are not normally issued to the general public unless the National Weather Service is willing to make the release or agrees to such a release.

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

b. National Weather Service. The National Weather Service (NWS) has the official responsibility for preparing forecasts of Ohio River stages and tributary stages and flows, and for transmitting data, forecasts, watches, and warnings to users and the general public. NWS also collects and evaluates weather data from a variety of sources to prepare short and long-term weather forecasts.

6-02. FLOOD CONDITION FORECAST

Whenever "flood threat" conditions approach, as defined by the Schedule for Reading Gages, **Plate No. 3-1**, Exhibit B, forecasting effort primarily focuses on area rainfall, downstream flood control points, and the lake elevation. The Scioto Basin has been subdivided by drainage areas and sub-areas for accurate forecasting. The basin forecast is computed using these small areas and one hour data and it normally takes one/half hour to complete the forecast of the Scioto 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 No. 6-1**, next page.

The detailed drainage areas for the Scioto – Deer Creek Basin are listed in **Table No. 6-2**, below.

TABLE NO. 6-1

RESERVOIR POOL DATA
DEER CREEK LAKE
SCIOTO-RIVER

Pool	Elevation (NGVD)	Area (Acres)	Capacity Backwater Main Stream (Miles)	Surface Acre-Feet (Thousands) Net	Surface Acre-Feet (Thousands) Gross	Surface Runoff Inches.. Net	Surface Runoff Inches.. Gross
All Year Minimum:	796.0	727	3.7	6.4	6.4	0.4	0.4
Summer Recreation:	810.0	1,277	5.8	14.6	21.0	1.0	1.4
Flood Control Pools:							
Winter	844.0	4,046	13.5	96.1	102.5	6.5	6.9
Summer	844.0	4,046	13.5	81.5	102.5	5.5	6.9
TOTAL	844.0	4,046	13.5	102.5	102.5	6.9	6.9

TABLE NO. 6-2

DRAINAGE AREAS OF DEER CREEK AND TRIBUTARIES

Stream	Point	Area (Sq. Mi.)
Deer Creek	At mouth	412
Deer Creek	At damsite	277
Clark Run	At mouth	8.5
Duffs Fork	At mouth	12.5
Opossum Run	At mouth	18.8
Sugar Run	At mouth	51.9
Oak Run	At mouth	41.9
Glade Run	At mouth	19.8

b. Methods. In order to achieve the most efficient water control management possible, a real-time computer model, developed for Water Management Section by the Hydrologic Engineering Center (HEC), Davis, California, was adapted and calibrated for use in water management of the Scioto River Basin. The basin computer model is the major part of the District water control system, uses real time data from the Corps of Engineers' satellite-platform network in and adjacent to the basin, in conjunction with the tables used to interpret this data. The modeling process includes reviewing and editing of all data, estimation of future flows, development and review of multiple lake outflow plans, and determining the optimal method of operation to decrease downstream flooding while still insuring the projects viability.

A typical modeling sequence of 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 data base. This is done automatically each hour. Information may be edited.

2. Observed precipitation and 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 is considered in the model execution at the request of Division.

4. The small basin hydrograph forecasts 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.

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

The 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 route the flood downstream and through Deer Creek Dam. With this computer program and practical experience the Water Management Section is able to produce a reliable forecast for the Scioto River Basin. **Table No. 6-2**, previous page, is an example of the various small areas above and below Deer Creek Dam which small-area unit hydrographs were developed.

The small area 6-hour adopted unit-hydrographs for the various Deer Creek Dam uncontrolled forecast areas are shown on the **Table No. 6-3**, next page.

TABLE NO. 6-3

ADOPTED SIX - HOUR UNIT-HDROGRAPHS FOR UNCONTROLLED AREA ABOVE DEER CRREK DAM

Time Hours 6-hours	Natural Unit Graph 278.0	Inflow Unit Graph 278.0	1-A Pool Head 256.0	#2 Around Pool 17	#3 Pool Area 5.0
0	0	0	0	0	0
6	1430	1800	1515	950	533
12	2935	3000	1890	500	0
18	2120	2800	2843	240	
24	6900	8000	7932	110	
30	6940	6100	5538	28	
36	4275	3600	3092	0	
42	2220	1800	1479		
48	1080	900	781		
54	585	400	478		
60	380	240	315		
66	290	180	244		
72	205	160	199		
78	150	140	169		
84	115	120	140		
90	95	90	127		
96	75	75	116		
102	55	50	103		
108	35	40	91		
114	25	25	79		
120	15	0	68		
126	0	0	59		
132	0	0	54		
138	0	0	48		
144	0	0	42		
150			36		
156			30		
162			24		
168			18		
174			12		
180			7		

Stream and lake forecasting is accomplished with data stored and processed through the Ohio River Reporting Network. This network is a division-wide cooperative program with the National Weather Service, which involves interchanges of information between the Weather Service and the Corps of Engineers that utilize the respective installations and experience of the two agencies. All weather stations in the Scioto River Basin are automated DCP stations. The Weather Service also provides weather and stream stage data, Ohio River and tributary forecasts, regular and requested special forecasts, radar and other special reports on request.

In addition to reimbursing NWS for direct costs on Corps behalf, the Huntington District provides NWS with all precipitation, snow cover, and stage information received in the Water Resources Engineering Branch from reservoir reports. Also included are three day pool and outflow forecasts, and depth reports from the Scioto River Basin projects areas. The extent and intensity of the ORN program is shown by the fact that in addition to the project morning report data, all data received by NWS in the Scioto River Basin are from Corps financed satellite stations.

The data collection platforms mentioned above 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. All the data entered into the Water Control System is stored in a data base and used by water control software programs, allowing more timely and efficient water management decisions and generation of required reports.

Water Management Section personnel use Weather Service data, available between 0700 and 0930 hours, in forecasting and computing average precipitation over the basin, area, and District. The data is used to fill in, by implication, for missing data and for confirmation or refutation of doubtful readings. Weather Service coverage of areas lacking Corps projects, when plotted on the District Isohyetal Map, provides basis for better understanding of storm movement and areal intensity, which contributes to improved water management decisions. Radar images on the NWS screen at Charleston and Wilmington provide valuable information for regulation and forecasting. The NWS Hydrologist analyzes for position, direction, speed and estimated precipitation amounts in storms and relays this analysis by telephone on request. Ohio River and tributary stage and forecasts provided by the NWS are used to answer telephone calls from the public and particularly from local barging concerns. Data from NWS is received by the water control system via network connection. Project data is also disseminated back to NWS by the water control system.

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 normal run of the Deer Creek is passed on each day; therefore no additional storage is available for downstream drought requests. The daily outflow data of Deer Creek Dam is interfaced with data from the Scioto River Basin reservoirs to produce a Scioto River Basin drought forecast. This passing of all normal inflow also provides downstream 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 any acquired 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 Scioto River Basin. The normal run of the Deer Creek is passed on each day; therefore no additional storage is available for long-range downstream requests. The daily outflow data of Deer Creek Dam is interfaced with data from the other Scioto River Basin reservoirs to produce a long range Scioto River Basin forecast. However, a long range forecast of a dry spring, a projected summer drought, or knowledge of an impending drought in the fall could result in a slightly different

release of flood storage, if not injurious to other project purposes. 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 Team 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 Management Section produces a weekly 30-day forecasts 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 FORECASTS

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 Ohio Department of Natural Resources and the Ohio USGS for past drought periods, Water Availability Studies for the Scioto 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 a weekly drought information bulletin for distribution to all concerned groups.

6-06. NORMAL CONDITION FORECASTS

a. Requirements. Normal conditions, as defined by the Schedule for Reading Gages, **Plate No. 3-1**, Exhibit B, covers all hydrologic conditions from drought to the beginning of high water conditions labeled "Flood Threat". The various conditions are based on the quantity of water a project is required to handle in comparison with design quantities. Other forecasts that are used for management of the Scioto River Basin projects include water quality and outflow temperature. The Water Control Center in the Great Lakes and Ohio River Division Office requires daily 3-day pool-and-outflow forecasts and a 5-day forecast of tributary inflows to the Ohio River in order to implement its 5-day forecast of flow in the Ohio River and into the Mississippi River.

b. Methods. The forecast procedures described in paragraph 6-04 are used to produce forecasts for normal ranges of flows. A basin forecaster, assigned to the Scioto 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.

(1) Low-Flows - The procedures outlined in 6-04 are used in low-flow conditions. If forecasts indicate a continued low-flow condition leading to a drawdown of the lake level below seasonal pool, the Damtender is aware of the condition. Marina operators and other affected parties are in turn notified of the changing situation by the Damtender.

(2) Water Quality - Routine water quality sampling has shown that concentrations of manganese and iron are present in the lower portions of Deer Creek Lake. These constituents are not harmful, but when released downstream under summer stratification conditions they can cause taste and odor problems. The results of chemical tests on water samples are not returned soon enough for simulation purposes; however, the concentration of manganese and iron are known to increase with the depletion of oxygen in the lower lake portions during stratification. Therefore, the weekly dissolved oxygen profiles taken during the summer months are used as a forecast of weekly conditions within the pool and as an indicator of which upper level selective withdrawal outlets should be used for releases.

(3) Temperature-During stratification periods, daily outflow temperatures are monitored and the selective withdrawal gates are adjusted in an effort to maintain water release temperatures within ±2°F of the natural stream temperature. Weekly temperature profiles are used as an indicator of weekly temperature conditions in the lake. If the trend of the outflow temperature appears to soon exceed allowable criteria, gate adjustments are made to offset the trend and remain within allowable temperature limits.

SECTION VII - WATER CONTROL PLAN

7-01. GENERAL OBJECTIVES

In accordance with ER 1110-2-240, "Water Control Management," and ORDR 1110-2-27, "Water Control Management Activities", the plan of water control management and regulation reflects optimal consideration of each project purpose, namely flood control, lake and downstream recreation, and 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 management plan for the Deer Creek Project, the Scioto River Basin, and the Ohio River Basin.

1. Prevention or reduction of serious flood damages to communities, crops, properties, and industry below the dam along Deer Creek and the Scioto River to the greatest extent consistent with safe operation of the project.

2. Maximum retention of flows that would add to flood crests on the Ohio River at Portsmouth, Ohio when the NWS forecast predicts a stage of more than 50 feet.

3. Maintenance of a minimum discharge of 10 cfs, which is designed to be adequate to sustain downstream aquatic populations.

4. Maintenance of a minimum pool elevation 796.0 feet NGVD, subject to minimum discharge, to support fish populations and provide space for sediment storage.

5. Maintenance of seasonal pool elevation 810.0 feet NGVD for recreation and fish and wildlife conservation between approximately 15 April and the optimum date to begin drawdown in the fall, considering all hydrometeorological and recreational factors, subject to flood control and minimum discharge purposes.

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

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

8. Sensitivity to reasonable requests for operational changes from other agencies.

9. Concern for safety and well-being of humans, fish and wildlife, man-made structures and streambanks downstream of dam, which can be affected by discharge control.

10. 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. CONSTRAINTS

Operation of Deer Creek Dam must be within the confines or constraints of the Scioto River Basin Water Control plan. The various project purposes may at times strongly conflict; therefore priorities must be established and followed. Flood control is the primary project purpose,

but this function can be inhibited by restrictions on the hourly rate of gate change, the lack of storage volume because of construction in the lake area, or the inability to discharge storage as quickly as planned because of floodplain encroachment or downstream construction. During the summer there is a recreation function with a recreation pool to be maintained, plus a continuous minimum flow for water supply, therefore, there is a concern for low inflow due to lack of upstream rainfall. Operational limitations concerning flood control, recreation, low-flow and water quality, and fish and wildlife conservation are listed in **Table No. 7-1**, below.

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 No. 6-1,** page 6-2. The difference in storage volume at maximum flood control pool elevation, 844.0 feet NGVD, and the minimum winter pool at 796.0 feet NGVD is 96,100 acre feet, equivalent to 6.5 inches of run off from the drainage area. After proper study and authorization, this volume was all allocated for winter flood storage capacity. Below elevation 796 feet NGVD, there is still a small minimum winter pool at Deer Creek Dam of 6,400 acre-feet, which provides for sediment storage space and winter habitat. During normal routine reservoir operations, the minimum continuous 10 cfs, plus any additional daily inflow is passed on through the sluice gate LFS.

Table No. 7-1
Operational Limitations

	Pool Level Elevation NGVD	Capacity Acre-feet - Gross
Streambed	765.0	zero storage
Minimum Pool	786.0	1,483
Water Supply Pool	796.0	6,420
Summer seasonal pool	810.0	21,029
Maximum Flood Control Pool	844.0	155,361
Maximum Surcharge Level	855.0	102,540
Top of Dam	858.0	

Gate Change Maximum Rate - 1.0 feet per hour at Outflow gage except for emergencies

Spillway flow at
Max flood control pool - 810.0 NGVD Outflow - Zero
Spillway Maximum Flow – 855.0 NGVD Outflow - 122,500 cfs
Maximum Flow for
Two Caterpillar Sluice Gates-elevation 845.0 feet NGVD – 10,400 cfs

Max. Winter flow without directive - 1,310 cfs, 4.4ft. @ "O" gage
Max. Summer flow without directive - 910 cfs, 3.4ft. @ "O" gage
Max. Winter flow by SPECIAL DIRECTIVE – 2,911 cfs, 6.9ft. @ "O" gage
Max. Summer flow by SPECIAL DIRECTIVE - 1,820 cfs, 5.5ft. @ "O" gage

Constraints to regulation that are of special concern are those affecting fulfillment of the project purposes. Exercise of the flood control function can be inhibited by restrictions on storage of the design volume of water such as construction in the lake area and/or by inability to discharge storage as quickly as planned, because of floodplain encroachment. Operational limitations concerning flood control functions are listed on **Table No. 7-1,** above. With Deer Creek Dam the principal problem encountered since regulation has been gradually building encroachment of the flood plain below the dam.

Compliance with a requested deviation as outlined in subsection 7-06a may become a constraint to regulation if some assumed factor, such as weather, developed differently from the original assumed conditions and the requested special regulation was substantially different than the regulation dictated by the changed conditions.

The normal Huntington District release rate for many years had been based on a maximum rate of change in stage of 1.0 foot per hour. In order to retard the post flood bank erosion the rate of change is very carefully monitored. This rate is used unless an emergency arises and the Water Management Section may issue Special Directives for a higher rate of stage change.

The major constraint to operation for flood control is the buildup of housing that has occurred along Deer Creek below the dam since it was constructed. The gradual flood plain encroachment problem was created and compounded because the only time the maximum channel capacity was ever used was in a major flood, and sometimes not then. Therefore, the maximum channel capacity was gradually forgotten or dismissed, with the result that the residents along Deer Creek soon began to gradually build and move a little closer to the stream. Soon the new property was within the maximum channel limits and on occasions the property owners would complain about flooding in their basements.

Other constraints to regulation are those affecting fulfillment of the project purpose of flood control. Exercise of the flood control function can be inhibited by restrictions on storage of the design volume of water such as construction in the lake area and/or by inability to discharge storage as quickly as planned because of floodplain encroachment.

7-03. OVERALL PLAN FOR WATER CONTROL

Deer Creek Lake operates to reduce flooding on Deer Creek, the Scioto and the Ohio River, provide consistent low-flow releases, provide habitat for fish and wildlife conservation, and provide recreation in and below the lake.

Deer Creek Lake is one of four major flood control reservoirs in the Scioto River system. During a flood on either the Scioto or Ohio River flood regulation procedures for Deer Creek are closely coordinated with all other nearby lakes that affect the Ohio River. 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 system to meet potential flood threats in the basin and along the Ohio River below Portsmouth.

Historically, flood damages occurring along the lower Scioto have primarily involve 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 Williamsport, Chillicothe, Higby, and Portsmouth; as well as individual residences along the river and to small villages of less than 50 people. The most valuable agricultural products are from livestock, which sustain only slight damage from flooding.

Deer Creek Lake operates to maintain a minimum pool of 796.0 feet NGVD for sediment storage, fish habitat, and downstream water supply pool;

in addition, during the summer the pool is maintained as near as possible to elevation 810 feet NGVD for recreation and boating. The minimum pool was designed to contain 50 years of sediment storage. Based on suspended sediment measurements made by the U.S. Geological Survey during the period 1957-1962 for Deer Creek at Williamsport, Ohio, sediment storage was estimated to contain 56 years of sediment accumulation. Later, the 1981 sediment survey indicated that under the current sedimentation rate the minimum pool will contain 90 years of sediment storage. A comparison of data from the 1986 sedimentation reconnaissance indicated little or no increase in the rate of sedimentation since 1981.

The Deer Creek record floods have all occurred in the months of February – March, 1913, 1945, 1963, 1964 and 2005. And all were created by a combination of very heavy rainfall and melting ice and snow. The record flood of March 1913 had an estimated record crest flow of about 60,000 cfs at the Williamsport USGS gage. Much later, severe flooding occurred during March 1963 and March 1964; and these floods crested at nearly the same level as 1913, 52,700 and 59,600 cfs, respectively. In between these huge floods, a third near record flood occurred during March 1945. This flood had a near record crest flow of about 52,100 cfs at the Williamsport USGS gage. All of these huge floods occurred before construction of the Deer Creek Dam, but, the flood of March 1945 has been reconstituted and operated on a theoretical after-the–event basis. The theoretical operations indicate that Deer Creek Dam would have reduced the March 1945 flood crest at Williamsport to about 16,900 cfs. This reduced flood stage would still have created wide flood damage, but, not nearly as much as the 52,100 cfs natural flood.

7-04. STANDING INSTRUCTIONS TO DAMTENDER

The Deer Creek Lake Project Damtender and staff operate the project in accordance with general instructions and Special Directives issued by the Water Management Section to the Project Office.

a. Regulations. The above mentioned general instructions and Special Directives are written in accordance with the regulations listed under Section 1-03 of this manual, Operating and Regulating Responsibility. These regulations are as follow:

EM 1110-2-3600, 30 Nov 1987, Subject: Management Water Control System;

ER 1110-2-1400, DAEN-CWE-Y, 30 Sept 1993, 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;

ER 1110-2-8154, 31 August 1995, ORDED-W, Subject: Water Quality Investigations and Control Activities;

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

b. General Instructions. The general instructions apply at all times except when instructed 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 stream flow data, reservoir regulation at the start of a flood before contact can be made with the Project Office and emergency regulation in the event that all communications fail during a flood. These instructions are contained in Exhibit "B", "Instructions to the Damtender", Deer Creek Lake," along with plates and schedules pertaining to their use. The Schedule for Reading Gages, **Plate No. 3-1**, Exhibit "B", in addition to establishing the minimum number of observations to be made, is designed to ensure that any necessary gate operation will be promptly executed and that special reports will be initiated by the damtender before reservoir and stream conditions reach critical limits. If work is required after normal duty hours for the collection and transmission of hydrologic data, and for the execution of necessary gate operations, overtime will be approved by proper authority.

c. Special Directives. Special Directives are issued by telephone and confirmed by mail to record all substantive guidance given to the project by Water Management 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 Scioto River Basin streams or Ohio River control.
(b) Release of 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) Special regulations. for:

(a) Construction activities downstream affected by flow.
(b) Stream clean-up 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) Complete closure for inspection on an emergency or periodic basis.
(g) Canoeing activities or rescue training exercises.
(h) Stocking tailwaters-stable flow for 24-48 hours.

(4) Spring filling, fall drawdown. Beginning and adjustments to discharge rate in order to control rate of rise or fall in lake level.

(5) Change in general instructions.

(6) Pertinent operations. Any and all other pertinent operations as deemed necessary by the Water Management Section.

7-05. FLOOD CONTROL

Damages resulting from flooding along Deer Creek and the Scioto River to the Ohio River are mainly to land and buildings. Crop damage is considerably higher in June and July for a given flood level.

a. Requirements. Summer-type storms featuring intensive rainfall of relatively small areal extent can be destructive and result in local flooding. Winter-type storms occur when vegetation and soil conditions lead to high percentage runoff. They are usually of wide extent, necessitating the operation of reservoirs on several Ohio River tributaries. Both headwater flooding and backwater flooding from the Ohio River are likely from these storms as opposed to the highly localized flooding from summer-type storms.

The following are the general requirements of the plan of operation for Deer Creek Reservoir.

(1) Prevention of serious damage at Williamsport and Chillicothe during floods of the magnitude of the maximum of record.

(2) Reduction of agricultural losses from minor floods on Deer Creek and the Scioto Rivers to the greatest extent consistent with safe operation of the reservoir.

(3) Maximum retention of flows which would add to flood crest stages on the Ohio River.

Operation for Ohio River control is based on retention of flows that would add to crest stages in excess of 50 feet at Portsmouth. This stage represents the point at which damage begins in unprotected communities of the Ohio River Valley below the Scioto River.

b. Normal Plan. Deer Creek Lake is part of the flood control system of the entire Ohio River Basin as well as the Scioto River Basins. Regulation procedures must therefore be correlated with the operation of reservoirs on other tributaries of the Scioto and Ohio Rivers to the fullest extent possible.

Due consideration must also be given to local concerns and requirements. Control stages were determined based on damage surveys conducted by Corps Personnel during previous flood events.

During reservoir regulation activity, a maximum stage at the outflow gage of 5.5 feet (1,900 cfs) during DEMIA (December to mid-April) or 6.9 feet (2,830 cfs) during MIANO (Mid-April through November) can be maintained without causing any appreciable damage from Deer Creek immediately downstream of the dam. **Table No. 7-2** next page, shows the control stages and flows at key river stations below Deer Creek Lake. These control stages were determined based on damage surveys conducted by Corps personnel during previous flood events.

TABLE NO. 7-2

CONTROL STAGES AND FLOWS AT KEY RIVER STATIONS

Station	Stream	MIANO Stage (feet)	MIANO Flow (cfs)	DEMIA Stage (feet)	DEMIA Flow (cfs)	Time of Travel From Dam (hours)
Outflow gage	Deer Creek	5.5	2,082	6.9	2,911	0
Williamsport	Deer Creek	8.3	2,388	9.1	3,008	3
Chillicothe	Scioto River	12.5	27,040	16.0	41,800	15
Higby	Scioto River	13.0	23,320	16.0	31,000	21
Portsmouth	Ohio River	50.0	-	50.0	-	39

(1) Flood stage
(2) Operational time prior to crest stage in excess of 50 feet.

(1) All inflow is to be released up to that causing a stage at the outflow gage not to exceed 6.9 feet (2,911 cfs) during the period 1 December-15 April or 5.5 feet (2,082 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 Management Section has directed special operations.

The plan of operation is based on having adequate flood forecasting and flood warning systems in effect. Streamflow data is obtained from the platform-satellite network, and from the Deer Creek Lake reports. Precipitation amounts in and near the Deer Creek Basin are received through the Corps of Engineer's platform satellite system, as well as supplemental precipitation data comes from the project reports which contain project gage data and data from observers in the Ohio River Network and from NWS. Water Management Section personnel use current and previous rainfall, soil and foliage conditions, and stream stage data as input to the Water Control System to forecast lake and downstream stages. **Plate Nos. 7-1** and **7-2**, plates section, Area and Capacity Curves and Percent Storage Utilization, can be used to determine available storage for flood control purposes.

Consideration of other projects in the Scioto River Basin may result in adjusting operation of the Deer Creek Lake Project to maintain a balance of flood control storage. The operation schedule for Scioto River control is given in Exhibit B, Instructions to Damtender, and is based on not exceeding the control stages at the key river stations mentioned in **Table No. 7-2**, above. The procedure consists of the Damtender calling the DCP gage at Williamsport daily when there is 0.4 inches of precipitation at the dam in 24 hours or less. Deer Creek Lake is then operated according to the operation schedule for Scioto River control so that the Deer Creek control stages on **Table No. 7-2**, above are not exceeded.

It is desirable to empty the lake of flood storage as quickly as possible, considering any special operations, in view of the possibility of a major flood occurring at a time when the lake is partly filled. Operation for Deer Creek and the Scioto River is based on stages at the outflow gage and downstream stations in relation to the control stages on **Table No. 7-2**, previous page.

During flood events, the following operation will provide for effective management of the project to meet downstream flood control objectives.

(1) All inflow is to be released up to that causing a stage at the outflow gage "O" not to exceed 6.9 feet (2,911 cfs) during the period 1 December - 15 April or 5.5 feet (2,082 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 Management Section has directed special operations.

(2) All inflow will be stored, subject to the minimum flow requirement, or the flow augmentation requirement, if greater, which would contribute to stages in excess of the designated control stages at the key stations along Deer Creek and the lower Scioto River as listed in **Table 7-2**, previous page.

(3) All inflow will be stored, subject to the minimum flow requirement, or the flow augmentation requirement, if greater, beginning 39 hours in advance of the predicted time of reaching a forecast crest stage in excess of 50 feet on the Ohio River at Portsmouth, Ohio. 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 on the Ohio River at Portsmouth.

(4) If the river stage at Portsmouth is not indicative of flooding conditions further downstream along the Ohio River, recommendations from LRD Reservoir Control Center 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 Scioto River Basin to establish an operational scheme that will benefit the downstream Ohio River areas and not prove detrimental to Scioto River Basin flood control objectives.

(5) Release of accumulated flood storage will be based on determinations by the Water Management Section after a complete evaluation of all hydrologic conditions that impact effective management of the project for optimal flood control benefits. Each individual flood event will be evaluated and Special Directives issued for the release of stored flood waters.

(6) 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 under emergency conditions.

(7) 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 forecasted inflow hydrograph predicted from reports of rainfall depths above the dam, the relationship of the inflow unit hydrograph to the updated inflow hydrograph calculated from pool change and outflow values, and the updated inflow hydrograph. After the inflow hydrograph has been predicted, Water Management Section 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. Under the above circumstances, lake regulation will be governed by an analysis of current and forecast rainfall above the reservoir and forecast conditions at key downstream control stations. Full consideration will be given to the effect of increased discharge from the reservoir, which would result from delaying the originally indicated outflow. The Water Management Section will direct these operations by Special Directives.

Plate No. 7-3, Slide Gate Rating Curve, **Plate No. 7-4**, Gated Spillway Discharge Characteristics, and **Plate No. 7-5**, Discharge Rating Curve are useful in determining the discharge that will result from a particular group of gate settings for both the slide gates and the tainter gates on the spillway. **Plate No. 7-5a** is the rating that applies to the outflow station below Deer Creek Lake.

c. Emergency Plan. During a major flood, all communications between Deer Creek Lake and the Huntington District may be disrupted. In that event, Water Management 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 a communication blackout. In addition, the Damtender will immediately make every effort to reestablish communications with the District Office. **Plate No. 7-6** plate section, is the Deer Creek Regulation Schedule for Major Floods.

Plate No. 1-4, Emergency Operation Schedule, found in the Instructions to Damtender in Exhibit B, to this manual, contains rate of rise curves which are used by project personnel to operate the reservoir when communication with the District Office is disrupted. 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 control a given flood totally. The Instructions to Damtender contain operational procedures to be followed when there is a delay greater than three hours in establishing contact with the Water Management Section and the rate of rise curves indicate gate settings greater than those being maintained from previous instructions.

7-06. RECREATION

a. Lake.

(1) Requirements. Recreational activities at Deer Creek Lake generally begin with fishing in March and continuing through November.

The peak lake recreational season falls between Memorial Day and Labor Day. It is usually advantageous to maintain a constant pool level for recreational purposes. Noticeable variations in pool level can cause concern to visitors if they are not aware of the cause. Changing water levels affect boating safety by changing the normal view of the lake. Disorientation may occur to boaters or fishermen who are not familiar with the lake under variable pool level conditions. Higher pool levels after rainfalls can increase chances of boaters hitting newly inundated obstructions, or grounding themselves in shallow bay areas. Higher lake levels also cause difficulties in launching and retrieving boats. Lower

lake levels bring submerged obstructions closer to the surface, creating possible snagging problems for fishermen.

In order to minimize conflicts relating to recreational lake use, Deer Creek Lake is divided into 3 water use zones, "Unrestricted Area", "Controlled Area, No Wake Zone", and "Boat Exclusion Area". Waters allocated to "Unrestricted Area" are available for all water-oriented recreation activities, such as skiing, pleasure boating, sailing, and fishing. Approximately 1032 acres of the 1277-acre summer pool are allocated to this zone. In the "Controlled Area, No Wake Zone", boat speeds are restricted to levels which will not create damaging waves, safety hazards, or undue disturbance of fragile ecosystems. These areas include shallow water areas, waters near boat launching ramps and marinas, and waters having a high use of fishing, hunting, canoeing or conservation. Approximately 232 acres of the summer pool are allocated to this zone. The "Boat Exclusion Area" applies to areas which are buoyed off, prohibiting watercraft beyond a designated point. These areas are located around operational structures such as the dam. Approximately 13 acres are allocated to this zone.

(2) Control Plan. The water control plan at Deer Creek Lake attempts to maintain the pool level at or near seasonal elevation 810 NGVD during the recreational season. Under normal conditions, this is accomplished by the operation of the low-flow sluice in the outlet works. These operations prevent unnecessary build-up of water level under normal flow or minor storm conditions. At times, however, heavy runoff may require utilization of available flood storage at Deer Creek Lake, causing a rise in the lake level. Part of the plan of regulation includes forecasts of lake level and outflow rates.

b. Downstream.

(1) Requirements. Project personnel must maintain an awareness of downstream usage of Deer Creek for both recreation and other purposes since safety of these interests is of prime importance to lake regulation. Any interest accustomed to using the stream at low water should be notified of impending high discharges.

(2) Control Plan. In order to be aware of downstream activities, project personnel make occasional surveys, during both low water and high water, to observe potentially hazardous situations. In the interest of downstream safety of life and property and integrity of stream banks, the water control plan limits the rate of increase or decrease of discharge in Deer Creek at the Deer Creek Lake outflow gage, except during an emergency. If a spillway flood should occur, project personnel would evacuate downstream areas and remove any equipment which could be damaged by high discharge.

7-07. WATER QUALITY

The dam at Deer Creek was completed in 1968, and backs water for 5.8 miles on Deer Creek a tributary of the Scioto River. The lake is impounded by a rolled-earth-fill dam with an impervious core and has a capacity of 21,000 acre-feet at a seasonal pool elevation of 810.0 feet NGVD. Streambed elevation at the dam was 765 feet NGVD at the time of construction, but was only 772 feet NGVD (water-quality lake profiles) in 2001.

The outlet works include an intake structure with five 5’9”X5’6”

sluice gates at invert elevation 772 feet NGVD and one 3’0” diameter low-flow sluice at elevation 786 feet NGVD.

The lake stratifies during the summer with warm, oxygenated water in the epilimnion and colder water with little or no oxygen in the hypolimnion. The project was designed for flood control, general recreation, and fish and wildlife enhancement. The outlet structure was designed with maintenance or improvement of water quality as one of its purposes, but the pool elevation was raised, which restricted the ability to regulate the quality of release water. A water temperature rule curve is used as a guide for temperatures of release water. Current outflow temperatures and average monthly water quality conditions of the lake can be seen at www.lrh-wc.usace.army.mil under “Lake Quality”.

7-08. FISH AND WILDLIFE

a. Requirements.

(1) Lake. Under a license with the Federal Government, the Ohio Department of Natural Resources (ODNR), Division of Wildlife, and Division of Parks and Recreation manage the Deer Creek Lake area for wildlife and general recreational purposes. The ODNR Division of Wildlife completed a "Long Range Wildlife Management Plan for the Deer Creek Wildlife Area" on 10 May 1974. The primary objective of the plan was to provide public hunting by managing game species best suited within the land capabilities of the project area. ODNR has also prepared several Lake Management Reports that address fishery conditions at Deer Creek Lake. Recommendations of these reports include the continuation of saugeye stocking, brushpile construction to concentrate and increase panfish harvest, and continued research and documentation of fish growth and location in the lake. Conservation requirements in the lake are met by various features of the Department management program which includes stocking of the lake, monitoring populations, general chemical water quality analyses and administering licensing regulations for sport fishermen.

Fish and wildlife at Deer Creek Lake are affected by fluctuating lake levels. A stable or rising pool is required for fish spawning. Rises in pool level can affect ground nesting animals living near the pool. Drawdowns affect waterfowl and furbearing animals through elimination of shallow area feeding grounds. Drawdowns can affect hunters, especially during duck season, when shallow marsh areas are drained. Dry weather drawdowns expose muddy lake sides, and boat waves can then produce turbid water conditions an appreciable distance from the bank. This is the fertile littoral area into which fishermen cast. Fishing success suffers under such conditions because the lures are not readily visible.

(2) Downstream. Habitat maintenance, including continuous flow of clean water at proper temperature, constitutes the conservation needs of the downstream aquatic community as to reservoir outflow. Lower food chain members which live on the bottom are dependent on clean rocks, gravel and sand for normal habitat. Silt and iron hydroxide, particularly under summer low flow conditions, can coat this habitat making it unsuitable. This suppresses that basic portion of the food chain and depresses populations of higher members until the habitat is improved, as by flushing, and populations of lower members reestablished. Water in lower zones of the lake, subject to reducing conditions common during stratification, contains iron which is soluble

in the reduced state. When this water is released and aerated in the stilling basin, the iron is changed to insoluble oxide by oxidation and hydrolyzed to the hydroxide mentioned above.

b. Control Plan. As explained in subparagraph 7-05 a(1), the normal mode of regulation for both recreation and flood control, with the guiding principle of conserving storage capacity for possible early flood control needs, fosters a stable pool; however, downstream flooding may require gate closure and consequent pool rise.

Water Resources Engineering Branch exhibits flexibility in spring filling on behalf of fish spawning. When the Ohio Department of Natural Resources requests maintenance of a special pool level during a spawn, Water Resources Engineering Branch normally will honor the request if it does not interfere with other project purposes. A minimum discharge of 10 cfs is maintained for the benefit of fish downstream of Deer Creek Lake.

7-09. WATER SUPPLY

Prior to construction of Deer Creek Lake, summer flows in Deer Creek at Williamsport often decreased to less than 10 cfs, occasionally remaining there for a week or more, creating stagnant or nearly stagnant conditions that were harmful to all water consumers.

Accordingly, modern environmental policies were developed to resolve any problems. When the first modern environmental policies were developed nationwide they were soon applied regionally to the Scioto River to resolve water shortage problems. Therefore, preliminary design provisions, later finalized, were made to increase flows below the dam to improve water supply and fishery support and benefit. In this way, a guaranteed continuous minimum flow became a project purposes required of Deer Creek Lake for the State of Ohio.

The discharge rate for fishery and water supply maintenance of 10 cfs was selected after a study to determine the maximum rate that does not exceed the maximum acceptable drawdown in the driest year. It is estimated that the minimum continuous release of 10 cfs from Deer Creek Reservoir would satisfy the water requirements of the city of Williamsport, and other water users on Deer Creek, and would also provide water for pollution abatement and for maintenance of the fishery habitat in the lower Scioto River. This discharge is to be maintained at all times, even during closure for flood control.

Therefore, Deer Creek Lake is required to provide water for low-flow augmentation and municipal water supply for Williamsport village. For these purposes the lake has been partitioned accordingly. The city of Williamsport, Ohio, has its water supply intake and pump station on Deer Creek about three miles upstream from the city. The capacity of the water supply plant is 2.0 million gallons per day (mgd), which corresponds to a flow of 3.1 cfs. Therefore, the minimum summer outflow of 10 cfs is now considered adequate for Williamsport.

At all times during the period of lake stratification, the downstream water temperature is controlled by use of the selective withdrawal system to provide near normal temperatures for the downstream aquatic community. Project personnel take data on Monday for a temperature and dissolved oxygen profile of the lake, which includes temperature and dissolved oxygen concentration at the surface and at 2-foot depth intervals to the bottom. This data is transmitted to the Water

Management Section where it is computer plotted to produce the Water Quality Assessment. The Assessment is used by Water Quality Team in conjunction with daily outflow temperature and Outflow Temperature Objective, **Plate No. 7-7**, plate section, to determine which combination of the selective withdrawal inlets to use to obtain the desired temperature downstream.

7-10. HYDROELECTRIC POWER - N.A.

7-11. NAVIGATION - N.A.

7-12. DROUGHT CONTINGENCY PLAN – See ANNEX I

7-13. FLOOD EMERGENCY ACTION PLANS

Although the Huntington District does not have a specific Flood Emergency Action Plan for Deer Creek 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 Deer Creek Lake for the upstream and downstream spillway design flood with and without Dam failure. The maps were prepared in accordance with ER 1130-2-530 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 CELRH-EC-GD, Deer Creek Lake, and the individual maps are stored in EC-W.

b. Floods Without Dam Integrity Problems. In the course of a 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, 30 September 2001, Which can be found in the EOC. The EOC may ask for periodic updates of the river situation from the Water Management 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 action in Exhibit B 1-06b. Project personnel will use the Deer Creek Lake Dam Safety Emergency Action Plan prepared by CELRH-EC-GD to determine what events will initiate this action and which individuals to contact. The Water Management Section will be kept informed of the situation as a result of the reporting requirements as defined in Exhibit "B", **Plate No. 3-1**. Water Management Personnel will contact the Dam Safety officer when the lake rise 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 Crisis Management Team. The District Engineer, the head of the Crisis Management Team, will open the EOC if he determines it is necessary.

7-14. OTHER PLANS

Deer Creek 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 paragraph 7-15, below.

Emergency drawdown procedures are graphically illustrated on **Plate No. 7-8**, plate section, and the Rule Curve for Reservoir Regulation is graphically on **Plate No. 7-9**, plate section. In the event of drawdown the directory of Key Emergency Personnel is located on page iv and **Plate No. 4-2** in the Instructions to Damtender

7-15. DEVIATION FROM NORMAL REGULATION

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

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

c. Major Deviations. Each condition should be analyzed on its merits. Sufficient data on flood potential, lake and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful presented by letter or fax to the division for review and approval. Major deviations involve time periods greater than five-days, or a change of pool levels greater than one foot.

7-16. RATE OF RELEASE CHANGE

The Deer Creek 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 feet per hour.

SECTION VIII - RESULTS OF WATER CONTROL PLAN

8-01. GENERAL

The results of regulation for the authorized purposes of flood control, recreation, and fish and wildlife enhancement at Deer Creek Lake are presented in the following paragraphs and referenced plates. Regulation for various hypothetical design floods and for representative actual floods demonstrate the capability of the project to control and pass runoff from the drainage basin. The same capability is described in probability terms by **Plate No. 8-1**, Frequency of Filling, and **Plate No. 8-2**, Duration of Filling, plate section. **Plate No. 8-2** shows that the lake is likely to be filled to the maximum flood control pool of elevation 844 feet NGVD once in 33 years. Effects of the water control plan on recreation and fish and wildlife are also presented in later paragraphs.

Regulation of the Deer Creek Lake Project has been simulated using historical data from the beginning of its operation. To facilitate review and understanding of the project, records and plots of inflow, outflow, and pool elevation in annual segments of the most recent 37-year period are on file in the Huntington District Water Management Section

8-02. FLOOD CONTROL

Deer Creek Lake controls 277 square miles, or approximately 68% of the total Deer Creek Basin. Deer Creek Lake in combination with the other flood control reservoirs in the Scioto River Basin controls approximately 53% of the total drainage area of the Scioto River above Chillicothe. The chief benefit of the Deer Creek Lake dam is the reduction of flood heights along Deer Creek below the dam to the mouth of Deer Creek, along with benefits along the Scioto River to the Ohio River. The application of the adopted water control plan to 3 hypothetical floods, 4 historical floods, and 3 recent floods as they occurred are discussed in subsequent paragraphs.

a. Standard Project Flood. The Standard Project Flood constitutes a standard for design of structures that provides a high degree of protection without regard to economic or physical limitations. For Deer Creek Lake, the Standard Project Flood was determined from the generalized rainfall criteria and procedures outlined in EM 1110-2-1411. It was determined to be a summer-type storm, most likely to occur in July or August. A review of past summer storms indicated a minimum infiltration rate of 0.05 inch per hour, which was adopted in determining the rainfall excess. Total rainfall for the storm was determined to be 13.96 inches, with a runoff of 11.02 inches. Assuming a base flow of 1 cfs per square mile for the basin, the natural peak inflow for the storm was estimated to be approximately 69,000 cfs. The maximum outflow calculated for this flood was 36,500 cfs, and the peak pool level calculated for the flood was elevation 848.08 feet NGVD. The operation Standard Project Flood hydrograph is shown on **Plate No. 8-3a**, plate section.

b. Standard Project Flood Series. A standard project storm and flood series was developed to provide an estimate of the potential storage requirements during the winter season when the rainfall is usually of lesser intensity but of more extended duration than the summer-type storm. The series was composed of the flood of February-

March 1945 followed by a winter-type standard project flood for the month of March. The rainfall of the series was comprised of the storm of February-March 1945, as it occurred, through the rainfall period ending at 0600, 7 March and followed by a winter-type standard project storm for March, commencing with the rainfall period beginning at 0600, 10 March, to complete the standard project flood series. The winter-type standard project storm, and resultant flood, were in EM 1110-2-1411 and Hydrometeorological Report No. 29. The natural and modified inflow hydrographs, outflow hydrograph and the resulting reservoir pool elevations are shown on **Plate No. 3b**.

c. Spillway Design Flood. Current Corps criteria specify that the Spillway Design Flood (SDF) be based on the runoff from the Probable Maximum Precipitation (PMP), as indicated in Hydrometeorological Reports 51 and 52. Using the current Spillway Design Flood criteria, the existing Deer Creek Lake spillway has been shown to be inadequate. The existing spillway is not capable of safely passing the Probable Maximum Flood with appropriate freeboard necessary to accommodate potential wind and wave conditions. However, if the pool level is allowed to reach the top of the dam without allowing for freeboard, the project can pass 100% of the current SDF. Because the project can contain the current SDF without being overtopped, it is not being considered as a high priority item for modification at this time. After the more deficient projects are corrected for hydrology deficiencies under the Dam Safety Assurance Program, Deer Creek Lake may be approved for further evaluation of remedial actions to correct its deficiency. After remedial action has been approved, **Plate No. 8-4**, plate section, Spillway Design Flood, Current Criteria, will be issued for this manual showing inflow, outflow, and pool elevation hydrographs.

d. Representative Floods.

(1) General. The historical floods which were selected for illustration of the water control plan are the floods of March 1913, January 1937, January 1959, and March 1963. Also selected were the floods of September 1979, May 1983 and November 1985, which illustrate floods actually regulated according to the water control plan. The flood of March 1913 was caused by widespread heavy rains which resulted in record stages along the Scioto River. The flood of January 1937 stemmed from a series of severe storms and resulted in record stages along the Ohio River. The floods of January 1959 and March 1963 resulted from generalized rains with high runoff due to saturated, frozen and snow-covered ground. The flood of September 1979 was the result of runoff from heavy rains associated with the remnants of Hurricane Frederick. The flood of May 1983 was the result of runoff associated with a series of intense rainfalls over a 2-day period. The flood of November 1985 was caused by a series of low-intensity, long-duration storms. Reductions at Williamsport for representative floods occurring before Deer Creek Lake became operational are listed in **Table No. 8-1**, next page. Reductions for floods on the Ohio River at Portsmouth are shown on **Table No. 8-2**, next page.

TABLE NO. 8-1

FLOOD REDUCTIONS AT WILLIAMSPORT BY REGULATION OF DEER CREEK LAKE

Flood	Natural Flow (cfs)	Natural Stage (ft.)	Modified Flow (cfs)	Modified Stage (cfs)	Reduction by Deer Ck Lake (ft.)
March 1913	24,000	15.90	6,000	10.80	5.10
May 1933	9,940	12.80	2,525	8.13	4.67
January 1937	12,770	13.67	8,186	12.12	1.55
February/March 1945	18,110	14.92	2,975	8.72	6.20
January/February 1952	24,550	15.98	4,457	10.08	5.90
January 1959	38,360	17.68	5,044	10.50	7.18
March 1963	38,700	17.60	4,500	9.90	7.70

TABLE NO. 8-2

REDUCTIONS EFFECTED DURING SELECTED FLOODS ON OHIO RIVER AT PORTSMOUTH, OHIO

Flood	Mod. Stage (ft.)[1]/	Modified Stage Credited to Deer Creek Lake (ft.)	Reductions to Deer Ck Lake (feet)
January 1927	54.4	54.36	0.04
March 1933	53.8	53.76	0.04
March 1936	53.6	53.54	0.06
January 1937	64.3	64.20	0.10
February 1939	53.8	53.76	0.04
April 1940	56.2	55.94	0.26
December 1942	59.0	58.79	0.21
March 1945	61.3	60.47	0.83
April 1948	62.0	61.83	0.17
January 1950	47.1	47.01	0.09
January 1952	54.1	53.16	0.94
March 1955	55.3	55.26	0.04

[1]/ Natural as modified by Group "A" Reservoirs (existing, under construction or advanced planning, FY 1961).

(2) Flood of March 1913. The flood of March 1913 resulted from excessive precipitation over a comparatively large area enabling great volumes of water to be dumped into the streams throughout the Scioto River Basin. The rain was exceptionally heavy through the northern sections of Ohio, amounting to 10 inches or more in some areas. Since the winter had been mild, the ground was without snow, not frozen and already saturated from the heavy rains of January and the first portion of March. In the Scioto River Basin, the main storm began on 23 March, became increasingly heavy the next two days, and continued on the 26th and in some portions of the basin on the 27th. Total rainfall during the five days, most of which occurred in a 96-hour period or less at individual locations, averaged about 7.2 inches over the Scioto River Basin.

Deer Creek Lake did not exist at the time of the March 1913 flood, but the flood has been reconstituted. In the reconstituted operation of the dam, two major inflow peaks occurred at the reservoir on 26 March; one of approximately 18,400 cfs in the morning, and another of approximately 19,600 cfs in the early evening. At the onset of the flood, the outlets were regulated to maintain the minimum pool elevation. In the afternoon of 24 March, the outflow was reduced to the minimum discharge of 10 cfs to begin storing inflow. Outflow remained at 10 cfs until larger releases were initiated on 2 April to begin drawing down the flood pool. The maximum pool level calculated for this flood was elevation 842.75 feet NGVD. Results of regulation of this flood at Deer Creek Lake and at Williamsport, Ohio, are shown on **Plate Nos. 8-5** and **8-6**, respectively, plate section.

The hydrographs shown in this and subsequent exhibits labeled "natural" represent the flow conditions that would exist without the Deer Creek Lake Project, and those labeled "modified" represent the inflow conditions that exist with the project. The outflow hydrograph represents the regulated outflow from Deer Creek Lake.

(3) Flood of January 1937. A series of abnormally heavy rains, centered largely in the middle and lower portions of the Ohio River Valley, began late in December 1936 and continued through most of January 1937. These rains caused a series of floods along the Ohio River that were greater than any previously recorded. The heavy general rainfall continued off and on for almost one month and concluded with the heaviest rainfall of the period during the storms of 20 to 27 January in which about 5.6 inches fell over the Scioto River Basin and produced damaging floods.

The Deer Creek Lake dam was not built at the time, but the flood has been reconstituted. In the reconstituted operation of Deer Creek Lake, there were 4 major inflow peaks into the lake during the month. The highest peak of approximately 11,600 cfs occurred on 25 January, and was the last of the 4 peaks. The other 3 lower peaks occurred on 15, 18, and 23 January. Outflow was reduced to the minimum outflow of 10 cfs on 14 January to begin storing flood runoff. As the pool level approached the maximum flood control pool elevation 844.0 feet NGVD, gate operations began on 24 January to release outflow as required by the Regulation Schedule for Major Floods. Outflow was increased according to the schedule until the pool level had crested and fallen to the maximum flood control pool elevation 844.0 feet NGVD. This elevation was maintained until 29 January, when drawdown operations were initiated. The maximum pool level calculated for this flood was elevation 845.56 feet NGVD on 25 January. Results of regulation of this flood at Deer Creek Lake and downstream at Williamsport are shown on **Plate Nos. 8-7** and **8-8**, respectively, plate section.

(4) Flood of January 1959. The flood of January 1959 generally ranks as one of the largest floods of record on the Scioto River Basin. The conditions prior to the generalized rains of 20 and 21 January contributed greatly to the flood stages throughout the basin. Severe cold weather during December 1958 caused the ground to freeze to depths up to 32 inches. In addition, a storm occurring between 14-17 January deposited from 0.50 to 1.84 inches of precipitation over the state. The ground was thus saturated, frozen and covered with varying amounts of snow, all of which greatly contributed to the high percentage of runoff encountered after the generalized rain began. Most of the flood producing rains fell during the morning of 21 January. The Deer Creek Basin received an average of 3.9 inches of rain, which combined with about 0.2 inch of equivalent snowmelt from the basin.

Deer Creek Lake was not built at the time, but the flood has been reconstituted. In the reconstituted operation of the dam, the main peak inflow of approximately 33,600 cfs occurred in the early morning hours of 22 January. At the onset of the flood, outflow was regulated to maintain the minimum pool level, then outflow was reduced to the minimum of 10 cfs on 21 January to store inflow. The minimum discharge was maintained until 26 January, when drawdown of the flood pool was initiated. The maximum pool level calculated for this flood was elevation 839.86 feet NGVD on 26 January. Results of regulation of this flood at Deer Creek Lake and at Williamsport are shown on **Plate Nos. 8-9** and **8-10**, respectively, plate section.

(5) Flood of March 1963. The weather pattern and conditions in this flood were very similar to those of January 1959, except this storm tracked farther south. Excessively cold temperatures in January and February 1963 froze ground to a considerable depth. Prior to the main storm, the ground had an average snow cover of about 2.5 inches. During the major storm of 4-5 March, approximately 4 inches of rain fell over the Deer Creek Basin above Williamsport, and the ensuing runoff created a peak stage at Williamsport that nearly equaled that of the January 1959 flood.

The dam was not yet built at the time, but the flood has been reconstituted. The major inflow peak of 26,400 cfs occurred on 5 March. The minimum pool level was maintained at the onset of the storm, but outflow was reduced to the minimum of 10 cfs on 4 March to store inflow. The minimum outflow was maintained until 10 March, when outflow was gradually increased to the DEMIA channel capacity to draw down the flood pool. The maximum pool level calculated for this flood was elevation 837.52 feet NGVD on 10 March. Results of regulation of this flood at Deer Creek Lake and downstream at Williamsport are shown on **Plate Nos. 8-11** and **8-12**, respectively, plate section.

(6) Flood of September 1979. Heavy rains associated with the remnants of Hurricane Frederick fell in a band about 50 miles wide from Cincinnati through Columbus to Youngstown on 13-14 September 1979. Deer Creek Lake received 4.2 inches of rain from this storm, and many weather stations along the path of the storm received in excess of 6.0 inches of rain. Heavier rainfall amounts and greater rainfall intensities were measured in the upper portion of the Deer Creek Lake Basin. At London Water Works, located near the northern end of the basin, 5.4 inches of rain was recorded in a 16-hour period, including 2.8 inches of rain in a 6-hour period, and 5.0 inches of rain in a 12-hour period. Rainfall at Deer Creek Lake was less intense, and included amounts of 2.4 inches in a 6-hour period, and 3.5 inches in a 12-hour period.

At Deer Creek Lake, the major inflow peak of approximately 13,100 cfs occurred on the afternoon of 14 September. At the onset of the flood, the gates were regulated to maintain the seasonal pool, but the outflow was reduced to the minimum allowable discharge on the morning of 14 September to store inflow. The gates were then opened gradually beginning on the afternoon of 19 September to begin drawing down the flood pool. The maximum pool level observed for this flood was elevation 830.73 feet NGVD on 19 September. Results of regulation of this flood at Deer Creek Lake and Deer Creek at Williamsport are shown on **Plate Nos. 8-13** and **8-14**, respectively, plate section.

(7) Flood of May 1983. Minor flooding conditions on Ohio streams were created by heavy rains which fell over the state in late April and early May. During a 4-day period from 30 April through 3 May,

Deer Creek Lake received 5.3 inches of rainfall and London Water Works, located at the northern end of the Deer Creek Lake Basin, received 4.17 inches of rain. The most intense portions of the storm occurred on 30 April, as Deer Creek Lake received 1.6 inches of rain in an 8-hour period during the morning, followed by another 1.2 inches of rain in a 6-hour period beginning about 8 p.m. that following evening.

A series of inflow peaks occurred at Deer Creek Lake during the period 1-3 May, with the highest peak of approximately 5,200 cfs occurring early on 3 May. The gates were regulated to maintain the seasonal pool, then the control stage at Williamsport at the onset of the storm, but outflow was reduced to minimum values by order of a Special Directive on 1 May. Gates were reopened on 5 May to begin drawing down the flood pool. The maximum pool level observed during the flood was elevation 827.90 feet NGVD on 6 May. Results of regulation of this flood at Deer Creek Lake and downstream at Williamsport are shown on **Plate Nos. 8-15** and **8-16**, respectively, plate section.

(8) Flood of November 1985. Record-breaking rainfalls in November 1985 created excessive streamflows throughout the state. Monthly rainfall totals averaged 9.09 inches across the state, second only to the average rainfall of 9.91 inches recorded in Ohio during January 1937. Within the Deer Creek Lake Basin, Deer Creek Lake recorded 9.10 inches of precipitation and London Water Works received 10.20 inches. The most significant storms during the month occurred during the periods 1-3, 9-11, 15-16, and 26-28 November. At Deer Creek Lake, precipitation totals for these periods were 1.8, 1.9, 2.0, and 2.1 inches, respectively. At London Water Works, totals were 1.1, 3.2, 1.3, and 2.7 inches, respectively. Rainfalls during the month were generally of the long-duration, low-intensity type.

Deer Creek Lake experienced a series of inflow peaks during November. The largest peak occurred on 28 November, with a inflow peak of approximately 4800 cfs. Deer Creek Lake was in the process of fall drawdown to the minimum pool level when the flood occurred. The gates were regulated based on a series of Special Directives issued during November and early December. The maximum pool level observed for this flood was elevation 820.22 feet NGVD on 2 December. Results of regulation of this flood at Deer Creek Lake and at Williamsport are shown on **Plate Nos. 8-17** and **8-18**, respectively, located in the plate section.

(9) Flood of January 2005. This flood began with heavy snow cover over the basin of several inches around Christmas, December 2004. The weather then warmed up and the heavy snow melted creating saturated soils. Then in January 2005, there were three periods of heavy rainfall occurring, 3-8 January, 12 January and 14 January. Due to the antecedent snowmelt and then heavy rain, extreme runoff occurred on the Deer Creek Basin. The peak inflow at Deer Creek was approximately 11,800 cfs on 6 January 2005. The maximum pool of record, was 839.61 feet NGVD on 14 January 2005.

d. Benefits. Flood damages prevented by reservoirs in the Scioto River Basin have been estimated based on elevation-damage relationships derived from detailed damage surveys for various stream reaches in the basin. Based on these studies, it is estimated that Deer Creek Lake has prevented 47.3+ million dollars(cumulative) in flood damages 2005.

8-03. RECREATION

Success of the recreational purpose of the project, as measured by the number of visitors, has been excellent. Visitation figures for Deer

Creek Lake from 2001 thru 2003 are shown on **Table No. 8-3**, next page. Total visitation in Deer Creek Lake was 4,031(visit, Thousands) in 2000. Corps of Engineers visitors in the area spent 52.52 million dollars on trip within 30 miles of the project, 55% of this spending was captured by local economy yielding 28.88 million dollars in direct sales to tourism related firms. These sales generated 11.10 million dollars in direct personal income and supported 878.53 direct jobs.

A rise or fall in the pool elevation at Deer Creek Lake affects the lands surrounding the lakes, recreational facilities, and project visitation. A rise to the 5 or 10-year pool level renders some recreational facilities, such as the swimming beach, boat launching ramps, and marina concession temporarily unusable. Floating facilities such as the docks at the marina are also adversely affected. Other effects associated with high water levels include the accumulation of driftwood, the degradation of surrounding vegetation and accelerated shoreline erosion. Flooding elevations at recreational and other critical sites are shown in **Table No. 8-4** below, with probable frequency of occurrence. **Plate No. 8-1**, Frequency of Filling, plate section, shows the probable time between occurrences of elevations of the pool, and **Plate No. 8-2**, Duration of Filling, plate section, shows the probable length of time of each occurrence.

TABLE NO. 8-3
VISITATIONS AT DEER CREEK LAKE

Year	Visitations
2001	2,621,073
2002	1,952,910
2003	2,675,511

TABLE NO. 8-4
FLOODING ELEVATIONS AND FREQUENCIES AT DEER CREEK LAKE SITES

Area	Item	Flooding Elevation (Ft, NGVD)	Frequency In Years Between Occurrences
Old Rt. 207 Fishing Access	Fishing less attractive	811	0.4
State Rt. 207 Boat Ramp	Ramp immersed	812.5	0.5
Clarks Run	Boat ramp immersed	812.5	0.5
Marina	Low walk immersed	814	0.6
State Rt. 207 Picnic Area	Road immersed	815	0.7
State Rt. 207 Boat Ramp	Parking lot immersed	815.85	0.8
Miller Run Picnic Area	Sewage treatment and lagoon drainage pipe flooded	816	0.8
Old McCafferty Rd.	D-62 immersed	816	0.8
Miller Run Picnic Area	Sewage treatment-lagoon, top elevation	822	1.8
Miller Run Picnic Area	Parking lot immersed	825	2.5
Marina	Second floor flooded	826	2.8
Yankeetown Road	Bridge and shooting range flooded	830	4.4
State Rt. 207 Boat Launch	Comfort station flooded	830	4.4
Yankeetown Public Fishing Access	Comfort station flooded	834.5	7.7

A significant lowering of the pool elevation, caused by drought or winter drawdown exposes aesthetically displeasing banks and mud flats, and creates a significant boating hazard resulting from increased shallow water areas. Because of siltation, both boat launch ramps become basically un-useable during the winter. However, adverse effects of drawdowns on recreational use are minimal since major drawdowns occur primarily in winter.

8-04. WATER QUALITY

a. Special Problems. The most significant water quality problem affecting Deer Creek Lake relates to excessive levels of organic enrichment which cause low dissolved oxygen conditions within the lake. Only one low-flow intake is provided for purposes of blending water to achieve improved water quality conditions in the tailwaters. Because of a pool elevation change the intake is located in the hypolimnion during the stratification. Consequently, reservoir releases may be anoxic during this time of year. There is little aeration in the tailwater because the release is submerged due to a downstream weir. This is especially troublesome for the tailwaters and fish kills have happened.

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 1980 and 2001.

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 Deer Creek Lake is classified as a calcium-carbonate type. This represents a balanced 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 referred to as the hypolimnion. The layer in the middle is called 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. Deer Creek Lake remains

nearly isothermal during the winter months. In the spring the lake starts to stratify. **Plate No. 8-19** shows a typical temperature profile while the lake is stratified.

d. Retention. The calculated average retention time of 52 days is average (compared to other projects within the Scioto Basin) and should affect thermal stratification. It is expected that significant stratification would exist, but the design of the outflow structure calls for the release of hypolimnetic water during a large portion of the stratification season. Only a well defined epilimnion exists. The metalimnion and hypolimnion blend together. See **Plate No. 8-19**. Water in the upper part of the lake remains there for longer periods of time.

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 and thermal stratification can result in zones that exhibit greatly different characteristics. In well-mixed epilimnetic waters, relatively high levels of dissolved oxygen occur and the water is usually of acceptable quality, but 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 Deer Creek Lake were constant throughout the water column after fall mixing completed, and remained so until April when the lake showed signs of thermal stratification. At that time, dissolved oxygen levels near the bottom declined until anoxic conditions were reached. Dissolved oxygen remained above 5.0 mg/l through the first 10 feet. This implied that a maximum of 53 percent of the lake was available for fishing during summer stratification. Dissolved oxygen is one of the key parameters for fishing which indicates that only a little more than ½ of the lake was available during the months July through September. **Plate No. 8-20** shows a typical dissolved oxygen profile during the summer months. During fall turnover, the lake mixes and dissolved oxygen is redistributed throughout the water column.

Deer Creek is the major inflow to Deer Creek Lake. Dissolved oxygen concentrations in Deer Creek averaged 103% saturation which indicates a good condition. Deer Creek Lake averaged 73% saturation which is good. Average values in the tailwater were 104% saturation. The outflow system was not designed to allow for regulation of the quality of water, but there is significant aeration below the stilling basin. During the summer months water released from the lake had a dissolved oxygen concentration of 0.0 mg/l. By the time it left the stilling basin dissolved oxygen values increased to just over 82%.

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 such as Deer Creek Lake, but phosphorous is the limiting nutrient. As long as there is available phosphorous, the food supply is not limiting productivity.

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/l at the inflows and 0.09 mg/l 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. The average pH value found in the database for headwater stations was 8.0 as compared to 7.8 at the tailwater station. 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 200 mg/l CaCO3 in the headwaters and 182 mg/l CaCO3 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/l 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 in inflows to the lake was 296 mg/l calcium carbonate and was 231 mg/l calcium carbonate in the tailwater. This range is classified as “very hard” (greater than 180 mg/l CaCO3) based on U.S. Geological Survey classifications.

i. Sulfates. Sulfates are widely distributed in nature. Although there is no standard for sulfate in surface waters, sulfate is listed under EPA’s Secondary Maximum Contaminant Level for drinking water (SMCL). Secondary standards are based on taste, odor, color, corrosives, foaming and staining properties of water. Sulfate minerals can cause scale buildup in water pipes similar to other minerals and may be associated with a bitter taste in water. Sulfates may also have a laxative effect that can lead to dehydration. With time, people and young livestock become acclimated to the sulfates and the symptoms disappear. The SMCL standard for sulfate is 250 mg/l.

The average concentration of sulfate in the inflows to the lake was 52 mg/l which is much lower than the SMCL standard. The average sulfate concentration in the outflow was 48 mg/l which is about the same as the inflow.

j. Iron Concentration. Iron is an abundant element on the earth, but usually occurs as an insoluble form in water and at low concentrations. The average concentration of iron in the inflow waters to Deer Creek Lake was 549 ug/l. This is lower than the average value of 762 ug/l found in the tailwaters. Both are well within the limits for surface water standards. During the stratification season, average iron levels in the lake were also below

the recommended limit of 1000 ug/l (**Plate No. 8-21**). Long-term trends indicated no significant changes in iron concentrations.

k. Manganese Concentration. Manganese levels in the headwaters were well below a standard of 1000 ug/l, averaging 32 ug/l. During lake stratification, manganese concentrations in the hypolimnion were higher (**Plate No. 8-22**). The average manganese concentration in the tailwater area was 60 ug/l. This is about double the conditions at the inflow, but still well below the standard. The increase is attributed to the bottom-level-releases from the lake. During stratification, manganese levels in the tailwaters can exceed 1000 ug/l, but the timeframe is short lived. Long-term trends indicated no significant change in manganese concentrations.

l. 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 good in headwater streams with an average chlorophyll concentration of 14.9 ug/l. Productivity on the lake was considered high with an average chlorophyll concentration of 20.5 ug/l.

Freshwater macroinvertebrates (aquatic insects and worms, 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. Macroinvertebrates have been used as an assessment parameter to evaluate the overall water quality conditions of Deer Creek at the outflow station below the dam (DCSO0001) and the inflow station at Mount Sterling, just below the OH-56 Bridge (DCS0003). See **Plate No.8-23**.

8-05. FISH AND WILDLIFE

Effects of the water control plan on fish and wildlife at Deer Creek Lake are associated mainly with pool level fluctuations in the lake and outflow from the outlet works.

Requirements of a constant or rising pool for fish spawning are incorporated into the water control plan at Deer Creek Lake. The seasonal pool level at Deer Creek Lake is normally reached before the spawning periods of the fish at Deer Creek Lake. The water plan at Deer Creek Lake will therefore normally provide adequate pool conditions for fish spawning.

8-06. WATER SUPPLY - N/A

8-07. HYDROELECTRICE POWER N/A

8-08. NAVAGATION N/A

8-09. DROUGHT CONTINGENCY PLANS - SEE ANNEX I

8-10. FLOOD EMERGENCY ACTION PLANS

Since the Deer Creek Lake Project has been operational, no emergency drawdown has occurred. The time required to draw down the reservoir from the maximum flood control pool (elevation 844.0 feet NGVD) is dependent on the inflow into the reservoir and on the maximum allowable discharge assumed from the outlets. Assuming an inflow of 600 cfs (2.15 cfs per square mile), the time required to draw down the reservoir to the seasonal pool level of elevation 810.0 would be approximately 18.5 days discharging at the winter channel capacity. If all gates were assumed open, the maximum flood control pool could be drawn down to the seasonal pool level in approximately 6 days. To further draw down the pool from seasonal pool level to the minimum pool at elevation 796 feet NGVD would take an additional 3.4 days discharging at summer channel capacity, 2.5 days discharging at winter channel capacity, and 1.6 days discharging with all gates fully open. Emergency drawdown curves for Deer Creek Lake are shown on **Plate No. 7-8**, plate section.

Should emergency drawdown become necessary, various procedures such as surveillance of the dam or notification of key personnel may be placed into effect, depending on the cause and its severity.

8-11. FREQUENCIES AND DURATIONS

a. Natural Discharge Frequency and Duration at the Outflow Gage. The natural discharge frequency curve for Deer Creek at the Deer Creek Lake outflow gage was developed on a regional basis 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 Scioto River and surrounding river basins. This enabled generalized relationships 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.

Flow values for selected exceedence intervals from 1 year to 100 years are given in **Table No. 8-5**, next page. Since 1968, flows in Deer Creek have been regulated by Deer Creek Lake. A computer study of the duration of flow at the outflow gage was conducted using the U.S. Geological Survey record of flow past the gage for the period l968 through l978. Percent of total elapsed time during which the flow was at or above certain selected values was calculated. These flow values were then plotted against the percent of time as calculated for the full year to produce the Annual Flow Duration curve for Deer Creek below Deer Creek Lake.

b. Pool Elevation Frequency and Duration. Peak pool elevations for all significant rises experienced during actual operation of the Deer Creek Lake Project through 1986 have been analyzed using graphical frequency procedures. The annual curve derived from this study is shown on **Plate No. 8-1**, Frequency of Filling, plate section. Durations of selected pool elevations have been derived from historical pool elevations experienced at the Deer Creek Lake Project for the same period ending in 1986. Duration curves for average and maximum number of days per year derived from this study are shown on **Plate No. 8-2**, Duration of Filling. A frequency summary of Deer Creek Lake pool

elevation deviations is shown below on **Table No. 8-6**, below. Lake level utilization curves are shown on **Plate No. 8-24**, plate section.

TABLE NO. 8-5

FREQUENCY SUMMARY
DEER CREEK AT DEER CREEK LAKE OUTFLOW GAGE
ALL SEASONS - NATURAL

Exceedence Interval (years)	Natural Discharge (cfs)	Modified Discharge (cfs)
100	42,500	5,600
50	33,000	3,700
20	23,000	3,500
10	17,000	3,500
5	12,300	3,500
2	7,700	3,500
1	5,300	3,500

TABLE NO. 8-6
FREQUENCY SUMMARY
DEER CREEK LAKE POOL ELEVATION DEVIATION - ALL SEASONS

Exceedence Interval (years)	Elevation (feet NGVD)
33	844.0
20	841.4
10	836.9
5	831.2
2	823.2
1	817.6

c. Control Station - Williamsport, Ohio. The natural frequency of Deer Creek at Williamsport was estimated using nearly the same methods and techniques of data handling and calculation as were used for Deer Creek at the damsite. The major difference was that a nearly continuous record existed at the Williamsport gage, making unnecessary the regional approach used for ungaged areas.

Actual peaks occurring at the gage since the Deer Creek Lake project went into operation were increased by the routed lake reductions to produce natural flows. 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" curve of Natural and Modified Flow Frequency Curves, see **Plate No. 8-3b**, Standard Project Flood Series, plate section. Flows for selected exceedence intervals from 1 year to 100 years are included below in **Table No. 8-7**, below Frequency Summary, Deer Creek at Williamsport, OH, All Seasons-Natural Conditions.

TABLE NO. 8-7
FREQUENCY SUMMARY

DEER CREEK AT WILLIAMSPORT, OHIO
ALL SEASONS

Natural Condition		Modified Condition	
Exceedence Interval (Years)	Discharge (CFS)	Exceedence Interval (Years)	Discharge (CFS)
100	49,600	100	8,300
50	38,600	50	5,100
20	27,100	20	4,640
10	20,100	10	4,640
5	14,400	5	4,640
2	9,100	2	4,640
1	6,300	1	4,640

In order to estimate modified frequencies, representative floods from the record prior to beginning operation of the Deer Creek project were routed through the lake and reductions routed to the Williamsport gage. These were applied to the actual (natural) and the resulting modified peaks noted. Reductions of Deer Creek flows effected by the Deer Creek project since 1968 were routed to Williamsport and added to the actual (modified) flows to produce the natural. The peak modified flow for each event was plotted against the peak natural flow for the event. The most representative smooth curve, to be known as the "Correlation Curve," was drawn among the points, the upper end of the curve being defined by the natural and modified of the Standard Project Flood. Any point on the Correlation Curve gives, for the peak natural flow specified, the probable peak flow to be experienced at the Williamsport gage because of Deer Creek Lake control of Deer Creek flows; and exceedence intervals of modified flows are the same as those of the corresponding natural flows. Therefore, intervals of selected natural flows were plotted against their corresponding modified flows to produce the "Modified" curve.

A study of duration of flow at the Williamsport gage was performed for the period beginning with the commencement of regulation of flow in Deer Creek by Deer Creek Lake in 1968 and ending with the year 1988. Using the U.S. Geological Survey record of flow at the gaging station, the percent of total elapsed time during which the flow was at or above certain specified values was calculated by computer. These flow values were then plotted against the respective percent of time as calculated for the entire year to produce the Annual Flow Duration at Williamsport Control Gage.

8-12. OTHER STUDIES - N/A

SECTION IX - WATER CONTROL MANAGEMENT

9-01. RESPONSIBILITIES AND ORGANIZATION

a. Corps of Engineers.

(1) General. Authorization 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 enactment's subsequent to original project authorization. Deer Creek Dam is owned and operated by the U.S. Government. The Huntington District, Corps of Engineers is the operating agency for the project, with the administrative control under the Scioto Area office within Operations and Readiness Division.

(2) OCE Role in Water Control Activities. HQUSACE 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.

(3) Great Lakes and Ohio River Division. The Division Engineer (LRD) 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 LRD Division Office will coordinate water control management activities associated with interdistrict, interdivision and interagency water resource needs. As established in accordance with ER 1110-2-1400, the Great Lakes and Ohio River Division Reservoir Control Center is responsible for administration of the Division Engineer's policy for water control management.

(4) 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 the Engineering and Construction Division, is the responsible element for all water control activities which include the following reservoir project functions:

(a) Flood control.
(b) Regulation of flows for water supply and water quality control.
(c) Recreation.
(d) Fish and wildlife enhancement.
(e) Alleviation of sediment and erosion problems affected by reservoirs.

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 with 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.

(5) Water Resources Engineering Branch. The Water Management Section 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-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-WM, 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 office. An organizational chart is shown on **Plate No. 9-1**, plate section, for Water Control Management at Deer Creek Lake. As shown on the chart, the Recreation-Resource Management Branch and the Scioto Area Office are responsible for supervision of the operation and maintenance of Deer Creek Dam. The Damtender at Deer Creek Lake will regulate the project in accordance with general instructions and Special Directives issued by the Water Management Section. General instructions are included in Instructions to Damtender, Exhibit B of this manual and Special Directives will be issued and signed by the Chief, Water Management Section, as necessary to efficiently regulate the project for optimal water control management for all project purposes.

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

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

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

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

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

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

(f) Promoting and conducting effective public information programs to inform and educate the public regarding Corps of Engineers'

water control management activities.

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

(h) 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:

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

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

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

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

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

During a FLOOD EMERGENCY SITUATION Exhibit B, “Instruction to Damtender” of this manual describes the responsibilities of the Corps of Engineers on site project personnel. Details and responsibilities of other elements are indicated in the overall District plan in the Emergency Operations Center Plan and ER 500-1-1, and all annexes to this ER.

During normal non-flood periods, water control management activity is accomplished by personnel of the Water Management Section. During flood conditions and other emergencies, assistance of other Water Management Section personnel may be required to maintain effective water control management within the Huntington District. The area affected and magnitude of the flood will determine the number of people engaged in each particular activity and assigned to each sub-basin or major river basin.

The National Weather Service and project personnel are provided with a list of names of Water Resources Engineering Branch personnel and home telephone numbers with instructions to contact them during off duty hours if unusual conditions occur or a project is in a particular reporting schedule. During emergency conditions or flood regulation, Water Resources Engineering Branch staff are available from 18 to 24 hours daily, depending on the magnitude of a particular event. At each project, responsible personnel will be on duty or on call at all times.

The Huntington District also works in cooperation with other Federal, State, local and private organizations and agencies. These relationships are described in detail in the following paragraphs.

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 is required by the Fish and Wildlife Coordination Act (48 Stat. 401 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 Ohio Department of Natural 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 Ohio Department of Natural Resources. Shown on **Plate No. 9-2**.

c. Local and State Agencies. No local or State agency has funding or operational responsibilities in the Huntington District multipurpose reservoirs except in leased recreation areas. The State of Ohio fee title to much of the project land and manages the recreational facilities at the projects having conservation pools. The State of Ohio 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 Natural Resources, as mandated by State Code, has responsibility for conservation of fish and wildlife.

9-02. INTERAGENCY COORDINATION

a. Local Press and Corps Bulletins. 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. Many such varied articles are printed in Castle Comments, the District newspaper, and Engineer Update, the newspaper from the Office of the Chief of Engineers. Both are unofficial monthly publications for Corps' employees and retirees.

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 which 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 paragraph sub-section 5-02b, 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 Survey to operate specific stations for the Corps on an advance of funds basis. Although data from these stations are required by the Corps, the information is also used by all Federal, State and private agencies and individuals interested in water data.

The data are published by the Survey which assures maximum availability and use of all data.

The Survey coordination and cooperation with the Corps, described in sub-section 5-01a, 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 stations for which flow data are required by the Corps are determined and the local representative of the Survey is requested to furnish an estimate of the cost of installing and/or operating each station. The final selected program is forwarded by the District Engineer 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. Ohio Department of Natural Resources. The District coordinates with the Ohio Department of Natural Resources about fish and wildlife enhancement in the Ohio lakes and downstream areas, timing of spring filling and fall drawdown, and probable height of a rise.

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 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 Corps' areas of responsibility and expertise. In certain cases, such as potential downstream flooding concern or emergency complication involving regulation of Deer Creek Lake, the District Emergency Operations Manager coordinates with the Ohio Disaster Services Office in Columbus. 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 accordance with the Corps of Engineers statutory responsibility for operation of its reservoirs in the public interest, the 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 two-way communication through various levels of

government and among various agencies of government and other organizations, all of which serve the public. Selected Water Resources Engineering Branch personnel of Corps' Districts attend meetings of the Group which have the stated objective of bringing focus to the public's varied interests in reservoir regulation and accordingly perfecting that regulation to the maximum extent possible.

9-03. INTERAGENCY AGREEMENTS, MEETINGS AND ORGANIZATIONS

Agreements between the Corps of Engineers and U.S. Geological Survey and National Weather Service are mentioned above and outlined in sub-sections 9-02a and 9-02b. An annual meeting is held with each of the State branches of the Survey in conjunction with the stream gage installation and maintenance work the Survey performs in the Stream Gaging Program. The Corps and Weather Service mutually agree upon scheduling of meetings concerning the Ohio River Network on an as-needed basis.

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 Ohio with the Ohio Department of Natural Resources to be administered by its Division of Forestry. The understanding includes cooperative warning and suppression of fires on or threatening Corps' owned lands, Department maintenance of a standard cache of fire-fighting tools at the project, Department training of project personnel on an as needed basis at the project, and payment by the Corps of extinguishment costs incurred by the Department.

Great Lakes and Ohio River Division Reservoir Control Center holds a quarterly meeting of the Reservoir Operations Coordinating Group. The meeting is attended by representatives of Federal, Regional, and State agencies and commissions, along with Corps' representatives of District and Division reservoir regulation elements. The purpose of the meetings is to exchange information and views on regional water resource concerns.

9-04. COMMISSIONS, RIVER AUTHORITIES and COMMITTEES

a. Ohio River Basin Commission(ORBC). This commission has an active interest in the operation of Deer Creek Lake and acts in a consultative capacity to both governmental and private interests in the basin. The commission members are representatives of Federal and State leaders in Water Resources. The commissions purpose is to provide a forum for the Ohio River border 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, 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 New York, Ohio, Indiana, Illinois, Pennsylvania ,West Virginia, Kentucky, and Virginia are represented on this commission.

c. Ohio Fish and Wildlife Service(OFWS). This commission has interest in water related issues as they affect fishery resources and boating opportunities in the state.

d. Ohio Department of Natural Resources(ODNR). Through its several divisions, the ODNR regulates water appropriation and all activities with direct impact on public streams and lakes in the state of Ohio.

e. 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 Council; and the Public Affairs Office. The purpose of this committee is to review guidelines, develop and implement functional drought contingency plans, and to keep the CDMC informed on drought status and drought related topics and issues.

f. Corps Drought Management Committee(CDMC). The CDMC is composed of 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 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 Division uses guidelines from this committee in developing and justifying deviations from approved water management plans and procedures.

g. Inter-agency Drought Management Committee(IDNMC). The IDNMC is composed of local, state, and Federal agency directors that have the authority to represent all user water needs within the Scioto River Basin. Federal members include the Huntington District Commander who serves as the Chairmen, and agency heads or their designees from the Federal Emergency Management Committee Agency, U.S. Fish and Wild Life 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 Ohio Department of Environmental Protection and the Ohio Emergency Management Agency. Local members include representatives from the area counties. The purpose of the committee is to review the status of Districts 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 end of this sub-section contains a listing of the various Periodic and Special Reports provided by Huntington District Water Management Section.

a. Periodic.

(1) Daily. Districts are required to report current hydrologic data as prescribed daily by the Division Office. The data type, format, and mode and frequency of transmission will vary as computer assisted techniques and automatic data collection systems are integrated into the daily water control management functions. Changes in specific data reporting requirements will be implemented by the Division Office. All periodic daily reports are prepared five days per week by the Water Management Section and, when staffing is provided, as

under flooding conditions, on Saturdays, Sundays and holidays.

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.

In carrying out water control activities, Corps of Engineers personnel must recognize and observe the legal responsibility of the National Weather Service (NWS) and the National Oceanic and Atmospheric Administration (NOAA) for issuing weather forecasts and flood warnings, including river discharges and stages. River forecasts prepared by the Corps of Engineers in the execution of its responsibilities should not be released to the general public, unless the NWS is willing to make the release or agrees to such dissemination. However, release to interested parties of factual information on current storms or river conditions and properly quoted NWS forecasts is permissible. District offices are encouraged to provide assistance to communities and individuals regarding the impact of forecasted floods. Typical advice would be to provide approximate water surface elevations at locations upstream and downstream of the NWS forecasting stream gages. Announcement of anticipated changes in reservoir release rates as far in advance as possible to the general public is the responsibility of Corps of Engineers water control managers for projects under their jurisdiction.

(2) Weekly. Each week a list of 24 hour reservoir effects at tributary gage points is transmitted to ORD. The list, which gives flows in cfs held out from or added to the natural flow, shows the data for an entire week ending with the current week. Gage points reported are Branchland, West Virginia, for the Guyandotte Basin; Charleston, West Virginia for the Kanawha Basin; Elizabeth, 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.

Water Resources Engineering Branch reports to the weekly District staff meeting current reservoir and stream information and current and forecast weather information as applicable to water control management. During any flood, drought or other emergency involving reservoirs, the Ohio River or other streams in the District, Water Resources Engineering Branch provides all available information to the District Engineer, Chief Engineer and interested elements as frequently as necessary.

(3) Monthly. A monthly record of reservoirs operated by the District, in accordance with 33 CFR 208.11, is promptly prepared and maintained by Water Resources Engineering Branch in tabular form readily available for transmittal to the Chief of Engineers or others on request.

(4) Quarterly. Each District provides a review of meteorological influences and water control management activities to each of the meetings of the Reservoir Operations Coordinating Group mentioned above in sub-section 9-03. Huntington District personnel of the Water Management 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 ORDED-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) Reservoir regulation manual submission schedule.

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

By Executive Order 13148, the President ordered 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 plan while the second part presents specific project information.

A major objective of this report is to summarize information pertinent to overall water management responsibilities. An Annual Water Quality Report by Districts to LRD includes narrative and tabular summaries of water quality activities and conditions in the Districts. Huntington District report of October 1979 contains a synopsis of activities, specific cases of interest, improvements during the year, and plans for future emphasis. 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 Management Section, special studies aimed at identification or solution of problems and problems requiring special studies with schedules 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 Summaries of Reservoir Effects. Reservoir effects including evaluation of the stage reductions at key stations and estimates of damages prevented by projects will be included in the post flood reports required by ER 500-1-1. The Water Management Section has new computer programs to calculate stage reductions at the following gaging stations pertinent to Deer Creek Lake: Deer Creek at Pancoastburg and Deer Creek at Williamsport; Scioto River at Chillicothe, Higby, and Portsmouth.

(3) 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 the 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 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 determined 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 10th of the month. For further information on reporting refer to ER 500-1-1.

(5) 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 for water control data systems and significant revisions thereto will be prepared by Division water control managers and submitted to HQDA (DAEN-CWE-HY) Washington, 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 will be maintained current and will be updated as necessary to meet needs.

Modified master plans should be 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 will allow adequate time for OCE review and approval prior to annual budget submittals.

(7) Any additional or pertinent reports which might be required from higher authority.

TABLE NO. 9-1

HUNTINGTON DISTRICT REPORTS
BY
WATER MANAGEMENT SECTION

PERIODIC REPORTS - Computer reports keyed to forms formerly completed by hand as follows:

Daily Computer reports of observed and forecast stages and flows including:

-Morning reservoir pool elevation, outflow, outflow temperature and three-day pool and outflow forecast.

-24-hour rainfall, morning stage, flow and five-day flow forecasts at Ohio River tributary gage points.

Weekly Reservoir effects at Ohio River tributary gage points.

Monthly Records of District reservoirs available on request.

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, when and as requested.

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, relevant NWS zone forecasts and special bulletins, and computer generated isohyetal maps of the District.

Reports on reservoir operations to OCE during flood emergencies including inflow, outflow, pool elevation, predicted crest, and maximum storage utilization to date.

Post-flood reports.

Budget requests for water control management activities to OCE.

Snowmelt runoff and flood potential reports to OCE.

Narrative summaries of major drought or low-flow conditions likely to require special regulation of District reservoirs.

Master plans for water control data systems and significant revisions thereto are submitted to HQDA (DAEN-CWE-HY) Washington, DC 20314, for review and approval of engineering.

TABLE NO. 5-1

DEER CREEK LAKE
DEER CREEK BASIN STREAM GAGING NETWORK - PERTINENT DATA

Stream and Station	Zero Gage Elevation (Feet NGVD)	Drainage Area (Sq Mi)	Date Established (Mo/Yr)	Existing Station Facilities	Method of Obtaining Data
Deer Creek at Mt. Sterling, Ohio	836.25	228	10/66	Stevens continuous recorder, called strip chart, telemark Analog-to-digital recorder (ADR), electric tape gage and staff sections.	Project personnel call telemark and include readings in regular and extra reports. Platform transmits to LRD computer downlink every 4 hours via satellite and LRD disseminates hourly to LRH water control.
			6/82	Encoder and Voice DCP (Data Collection Platform).	system. Voice DCP is equipped to respond to telephone calls with an electronically synthesized voice.
Deer Creek at Deer Creek Lake	770.07	277	7/66	Strip chart, ADR, electric tape gage and staff sections.	Project personnel view digital readout and including readings in regular and extra reports. Platform transmits to LRD computer
			6/82	Encoder and DCP.	downlink every 4 hours via satellite and LRD disseminates hourly to LRH water control system. control system.
Deer Creek below Deer Creek Lake	768.00	277	4/68	Strip chart, ADR, and electric tape gage.	Project personnel view digital readout and include readings in regular and extra reports. Platform transmits to LRD computer
			6/82	Encoder and DCP.	downlink every 4 hours via satellite and LRD disseminates hourly to LRH water control system.

TABLE NO. 5-1 (Cont'd)

DEER CREEK LAKE
DEER CREEK BASIN STREAM GAGING NETWORK - PERTINENT DATA

Stream and Station	Zero Gage Elevation (Feet NGVD)	Drainage Area (Sq Mi)	Date Established (Mo/Yr)	Existing Station Facilities	Method of Obtaining Data
Deer Creek at Williamsport, Ohio	718.66	333	8/26	Strip chart, telemark, ADR, and wire weight gage on downstream side of bridge.	Project personnel call telemark and include readings in regular and extra reports. Platform transmits to LRD computer down-link every 4 hours via satellite and LRD disseminates hourly to LRH water control system
			6/82	Encoder and Voice DCP.	Voice DCP is equipped to respond to telephone calls with an electronically synthesized voice.

TABLE NO. 5-4

DEER CREEK LAKE - WATER LEVEL WARNINGS

AREA	PARTY WARNED	MANNER ISSUED	CRITERIA	ACTION TAKEN	PHONE NUMBER
Any work site	Person in charge	In person	Special Directive from H&HB or other indication of probable lake level change affecting work.	Advise person in charge to take necessary action in planning or executing work.	N/A
Old St. Rt. 207 Wildlife Area	Wildlife Manager	Telephone	Elevation - 811.00	Install "HIGH WATER (ROAD CLOSED" Signs	
Clarks Run Boat Access	Day - Park Manager Night - Ranger	Telephone	Elevation - 812.50 Ramp flooded. Usable with care.	Post warning signs.	
St. Rt. 207 Boat Access & Picnic Area	Day - Park Manager Night - Ranger	Telephone	Elevation - 812.50 Ramp flooded. Usable with care.	Post warning signs. (	
Marina	Day - Park Manager Night - Ranger	Telephone	Elevation - 814.0 Sidewalk & lower level flooded.	Close lower area.	
St. Rt. 207 Boat Access and Picnic Area	Day - Park Manager Night - Ranger	Telephone	Elevation - 815.0 Road to picnic area flooded.	Barricade road.	

TABLE NO. 5-4 (Cont'd)

DEER CREEK LAKE - WATER LEVEL WARNINGS

AREA	PARTY WARNED	MANNER ISSUED	CRITERIA	ACTION TAKEN	PHONE NUMBER
St. Rt. 207 Boat Access & Picnic Area	Day - Park Manager Night - Ranger	Telephone	Elevation - 815.85 Boat ramp parking lot flooded.	Barricade entrance to area.	[redacted]
Miller Road Picnic Area	Day - Park Manager Night - Ranger	Telephone	Elevation - 816.0 Entrance road flooded.	Barricade road.	[redacted]
Miller Road Picnic Area	Day - Park Manager Night - Ranger	Telephone	Elevation - 822.0 Sewage Treatment Lagoon wall topped by lake.	None	[redacted]
Miller Park Picnic Area	Day - Park Manager Night - Ranger	Telephone	Elevation - 825.0 Parking lot flooded.	Barricade entrance road from Rt. 207.	[redacted]
Marina	Day - Park Ranger Night - Ranger	Telephone	Elevation - 826.0 Water in second floor.	Close Area	[redacted]
Yankeetown Bridge Co. Rd. 17	Fayette Co. County Engineer	Telephone	Elevation - 830.0 Road flooded.	Barricade	[redacted]

DEER CREEK LAKE
SCIOTO RIVER BASIN
PERTINENT DATA

LOCATION

The dam is located in Pickaway County, Ohio, on Deer Creek, a tributary of the Scioto River, approximately 105.8 miles above the mouth of the Scioto River and about 7 miles south-southeast of Mount Sterling, Ohio.

TYPE OF PROJECT

Multi-purpose; flood control, recreation, fish and wildlife conservation.

AUTHORITY

Deer Creek Lake was authorized by the Flood Control Act of 1938, 75th Congress, first session, as one of five reservoir projects in the Scioto River Basin to be constructed as part of the comprehensive flood control plan for the Ohio River.

PURPOSES

The project was initially authorized for construction as a flood control project. In addition to flood control, other major purposes today are general recreation and fish and wildlife conservation.

DRAINAGE AREAS (Square Miles)

Deer Creek at Deer Creek Lake	277
Deer Creek at Williamsport	333
Deer Creek at Mouth	408
Scioto River at Chillicothe	3,849
Scioto River at Higby	5,131
Scioto River at Mouth	6,510

STREAMFLOW DATA (Cubic feet per second)

Average annual flow just below Damsite	265
Maximum peak discharge at Damsite	19,500
Minimum discharge just below Damsite	0

DEER CREEK LAKE
SCIOTO RIVER BASIN
PERTINENT DATA (cont'd)

Elevations (NGVD)

Streambed at Damsite	765
Minimum Pool	796
Seasonal Pool	810
Flood Control Pool	844
Spillway Design Flood	---

	Acre-Feet		Inches of Runoff	
Capabilities	Net	Gross	Net	Gross
Minimum Pool	6.4	6.4	0.4	0.4
Seasonal Pool	14.6	21.0	1.0	1.4
Flood Control Pool				
Above Minimum	96.1	102.5	6.5	6.9
Above Seasonal	81.5	102.5	5.5	6.9
Total Storage	102.5		6.9	

Surface Areas (Acres)

Minimum Pool	727
Seasonal Pool	1,277
Flood Control Pool	4,046

Backwater Along Main Stream (Miles)

Minimum Pool	3.7
Seasonal Pool	5.8
Flood Control Pool	13.5

DAM

Type - rolled earthfill with concrete gravity channel section	
Maximum height, feet	15
Top length, feet	4,695
Top width, feet	10

EXHIBIT A
Sheet No. 2 of 3

DEER CREEK LAKE
SCIOTO RIVER BASIN
PERTINENT DATA (cont'd)

SPILLWAY

Type – gated concrete ogee spillway in
Channel section of dam.
Number of tainter gates.....3
Size of tainter gates.....42'x32'
Crest length, feet.....184
Crest elevation, NGVD.....814
Design discharge, cfs.....---
Surcharge, feet.....---

OUTLET WORKS

Type – gated sluices through spillway
Section of dam.
Number of sluice gates.....5
Size of sluice gates, feet.....5'0"x5'6"
Invert elevation of sluices.....772
Number of low-flow sluice (circular).....1
Size of low-flow sluices)diameter in feet).....3'0"
Invert elevation of low-flow sluice.....786

STILLING BASIN

Type – concrete roller bucket
Radius of rolling bucket, feet.....45
Low point of rolling bucket, NGVD.....742
Elevation of end sill, NGVD.....755
Bottom width of stilling basin, feet.....142

DIKE

Type - rolled earth fill embankment,
Located approximately 3.8 miles southwest of dam
Maximum height, feet.....15
Top length, feet.....4,695
Top width, feet.....10

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

SCIOTO RIVER BASIN
OHIO

PROJECT MANUAL
FOR
WATER CONTROL MANAGEMENT
DEER CREEK LAKE - DEER CREEK

INSTRUCTIONS TO DAMETNDER
DEER CREEK LAKE

July 2005

EXHIBIT B

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INSTRUCTIONS TO DAMTENDER
DEER CREEK LAKE

SECTION I - GENERAL OPERATION INSTRUCTIONS

1-01. GENERAL

Follow instructions given in this section under one or more of the sub-sections listed below at all times, except when other operations are required by Special Directive issued by the Water Management Section of the Huntington District Office.

a. In order to maintain downstream aquatic environment, the stage at the outflow gage shall never fall below 0.56 feet (10 cfs) except under Special Directive.

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

1-02. GATE REGULATION TECHNIQUE

1 a. General. Facilities provided for water control include five sluice gates for bottom discharge of all but major floods and three spillway tainter gates for control of major flood releases over the spillway. In addition, a 36 inch valved sluice is provided for low-flow control. Speed of movement of the gates and low-flow valve is controlled by the mechanism in all cases. Sequence and manner of operation, where applicable, appear in subsequent paragraphs. Operate the gates in such a manner as to avoid a change in stage at the "O" gage greater than 1.0 foot per hour except as otherwise instructed by Special Directive or under conditions of sub-section 1-07.

b. Sluice Gates. The five sluice gates are hydraulically operated and electrically controlled, vertical-lift type slide gates 5.0'x 5.5' with inverts at 772.0 feet NGVD. To avoid possible damage to operating mechanisms, sluice gates are not to be operated with greater openings than 4.4 feet except under Special Directives or under conditions of paragraph 1-07c. The gates are designated S1-S5 from left to right facing downstream.

Plate No. 1-1 this section, tabulates the approximate stages and flows which will be reached at the "O" gage with certain openings of one gate and various lake elevations. **Plate No. 1-2** this section, is the same except for uniform openings of all five gates concurrently. Equal openings of all five sluice gates is normal operation but not required except in fall drawdown. By using **Plate No. 1-2** this section, as a guide, the approximate opening of the five gates required to maintain a designated stage at the "O" gage can be determined. When the flow has stabilized after making the approximate setting, only minor adjustments should be necessary.

c. Low-Flow Gate. The low-flow sluice controlled by this gate takes water from the lake at invert elevation 786 feet NGVD and discharges into the flip bucket beside the main sluice discharge.

The gate (properly written, gate-type valve) is vertical-lift, hydraulically operated, electrically controlled and 36 inches in size. It is designated LFG. **Plate No. 1-3** this section, a tabulation of discharges to be expected through the gate at various openings and selected pool elevations.

LFG may be used in any but the fall drawdown operation discussed in 1-03 below. Control is accurate up to the full 36-inch opening.

d. Spillway Gates. Deer Creek Dam has three spillway crest gates. They are designated T1, T2, and T3 from left to right, looking downstream. They are electric hoist-operated, tainter type, 42 feet by 32 feet, with inverts at 814.0 feet NGVD. Except for testing, emergency operation in accordance with the Emergency Operation Schedule, **Plate No. 1-4**, this section, or Special Directive, the tainter gates are to be kept in the closed position at all times. Operation of the gates in flood control is always to be as nearly simultaneous as possible and never more than 1.0 foot per hour.

1-03. ROUTINE OPERATION

Rule Curve for Regulation, **Plate No. 7-9**, plate section, shows two main elevations, 796 feet and 810 feet NGVD, at which to hold the lake level during DEMIA* and MIANO* periods, respectively, barring flood control operation, Special Directive or drought. Under normal conditions project personnel are responsible for reservoir regulation to maintain the pool level at or near designated elevations by discharging up to certain allowable rates without Special Directive. These are 4.4 feet on the “O” gage, 1,458 cfs, during DEMIA or 3.4 feet, 958 cfs, during MIANO*. If unable to prevent the pool level from rising 2 feet above designated elevation, telephone Water Management Section for instructions except under communications failure as outlined in 1-07 below.

Water Management Section will issue special instructions about 1 April to begin raising the pool level to MIANO* elevation 810 feet NGVD by closing to minimum flow. When the pool level reaches 810 feet NGVD, hold this elevation subject to flood control, drought or Special Directive. After 1 September, Water Management Section will assess current and anticipated hydrologic conditions to determine the optimal usage of the impounded seasonal storage during the drawdown period and issue appropriate instructions to the project. The instructions may entail holding the seasonal pool for a period of time to accommodate recreation interests or releasing gradually to augment low-flows downstream under less than normal conditions. In any event, drawdown to DEMIA* elevation 796 feet NGVD will begin no later than 15 November. As requested by Ohio Wildlife Division, all fall drawdown is discharged through the five sluice gates open equally. The smaller openings tend to minimize loss of fishes from lake to downstream.

1-04. LOW-FLOW AND TEMPERATURE REGULATION

Minimum discharge to be maintained for downstream habitat at all times, even during closure for flood control, is 10 cfs, which is equivalent to a stage of 0.56 feet on the "O" gage.

One of the missions of water control management is maintenance of natural water temperature downstream. Specifically to avoid thermal shock to downstream aquatic communities, outflow temperature is regulated as much as possible within a 2°F band around the desired stream temperature. "Outflow Temperature Objective" **Plate No. 7-7,** plate section is a year long graph of this band of desired outflow temperature by calendar day and Julian day. During the period of lake stratification, approximately mid-April through mid-October, project personnel take weekly temperature and dissolved oxygen data in the lake if required and send to Water Management Section where they will be plotted as Water Quality Profiles which can be found at http://www.lrh-wc.usace.army.mil/wq/dcswq.html. Section personnel, considering the depths of low-flow intakes on the lake, use the latest profile and hourly outflow temperature for the day from **Plate No. 7-7**, plate section and devise an acceptable plan of regulation. A special directive is then issued providing details of gate operation. All gate changes for temperature control are to be covered by special directive from the Water Management Section.

1-05. OPERATION FOR DOWNSTREAM CONTROL

When significant rainfall occurs in the basin, regulation usually becomes necessary to avoid exceeding downstream control stages anywhere from Williamsport down to Portsmouth on Ohio River. In these cases, Special Directives based on model-generated forecasts are provided by Water Management Section. Maximum allowable stages at the "O" gage for MIANO and DEMIA seasons are 5.5' (2,082 cfs) and 6.9' (2,911 cfs) respectively. These discharges can be maintained during light rainfall without causing any appreciable damage along Deer Creek downstream from the dam to the confluence with Scioto River. When more runoff occurs, regulation for Williamsport is directed under MIANO and DEMIA controls of 8.3' (2,388 cfs) and 9.1' (3,008 cfs) respectively.

Operation directed for the Scioto River at Chillicothe is based on MIANO and DEMIA control stages of 12.5 feet (27,040 cfs) and 16.0 feet (41,800 cfs) respectively(see **Table No. 7-2** on page 7-7 of main text). If MIANO flows at Chillicothe from uncontrolled areas should exceed 16.5 feet for 24 hours or more, low-lying farm land will already be water covered, therefore, the Water Management Section may later direct release of flood storage from Deer Creek Lake which contributes to stages higher than the listed 12.5 feet control stage.

Operation for the Ohio River at Portsmouth, Ohio, is based on stage forecasts by National Weather Service and water travel time from the project to Portsmouth. Special Directives will be issued by Water Management Section for operation of Deer Creek Lake for Ohio River control. All inflow will be stored, subject to minimum flow requirements, from 39 hours in advance of predicted time of reaching a forecast crest stage in excess of 50 feet on the Ohio River at Portsmouth. Releases will be timed so as not to add to the crest at Portsmouth, Ohio.

1-06. EMERGENCY RESPONSE

a. General. An Emergency Operation Schedule is provided for use by the Damtender for a rare flood event and complete failure of communications with the Water Management Section.

b. Emergency Operation Schedule. The schedule shown as **Plate No. 1-4**, this section, provides for increases in outflow when the rate of rise in reservoir level indicates that the available storage capacity of the reservoir will be insufficient to completely control the flood. The procedure to be followed in using the emergency schedule is described on the chart. Whenever the lake is above elevation 824 feet NGVD, a close check shall be kept on the rate of rise in lake level. Whenever the rate of rise approaches a value at which the schedule indicates that the current gate openings must be increased, contact Water Management Section immediately.

Project personnel are authorized to operate the reservoir in accordance with the emergency schedule when there is a delay of two hours in establishing contact with Water Management Section from the time that the curves indicate gate openings greater than those being maintained in accordance with any other instruction.

The other condition under which the reservoir must be operated in accordance with the emergency schedule is when a second rise occurs while the reservoir is being held at elevation 844.0 feet NGVD. (See instruction 8 on emergency schedule). In this event, the required operation shall be executed without delay, but every effort shall be made to advise Water Management Section personnel of the operations undertaken.

It should be noted that proper operation according to rate-of-rise curves requires close adherence to a 60-minute hour in reading of gages and operating gates.

1-07. OPERATION DURING COMMUNICATION FAILURE

During a flood, every effort shall be made to contact personnel of the Water Management Section in the District Office(see **Plate No. 4-2** back of section). In the event of failure of both radio and telephone facilities, cooperation of local radio and TV stations, amateur radio operators, or the State Police shall be solicited.

The emergency procedure outlined below shall be followed during any period when the Water Management Section cannot be contacted.

a. If the reservoir was being operated in accordance with a Special Directed from the Water Management Section when communications failed, the instructions contained in the Special Directive are to be followed until:

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

(2) twenty-four hours have elapsed since the last contact with the District Office, or

(3) Sufficient rainfall or snow melt occurs which causes the lake and/or stream in the vicinity to rise rapidly.

b. Whenever any of the foregoing conditions, (1), (2) or (3) occurs, the operating instructions will be followed as given in sub-section 1-03, 1-04, or 1-05, whichever is applicable.

c. Under the conditions described in paragraph a, the operations indicated by the “Emergency Operation Schedule” described in sub-section 1-07 will take precedence over all previous instruction.

1-08. PUBLIC NOTIFICATION OF UNUSUAL RELEASES

Operation of reservoir projects during major floods has on occasion 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, Deer Creek Damtender must stay informed and inform the Water Management Section of all developments along Deer Creek between the dam and the lower end of the community of Williamsport.

If required by unusual release patterns, obtain directions for Water Management Section which will coordinate the release with Public Affairs Office for public notification procedures. Unusual release patterns closure for maintenance purposes, special increases or decreases for downstream requests and requirements, and emergency, above channel capacity, discharges. Notifications of large releases is to afford those likely to be affected an opportunity to take remedial measures in advance of the arrival of the releases so as to prevent damage to or loss of their property.

DEER CREEK LAKE

SLUICE GATE RATING – ONE GATE, PARTIAL OPENINGS

Outflow Stage Feet	Discharge c.f.s.	Gate Opening in Feet and Tenths at Lake Elevation													
		796	800	804	808	810	812	816	820	824	828	832	836	840	844
0.77	25	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.91	40	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1.02	55	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
1.12	70	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3
1.22	90	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4
1.32	110	0.8	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.4	0.4
1.44	140	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6
1.56	170	1.2	1.1	1.0	1.0	1.0	0.9	0.9	0.8	0.8	0.8	0.8	0.7	0.7	0.7
1.66	200	1.4	1.3	1.2	1.2	1.1	1.1	1.1	1.0	0.9	0.9	0.9	0.9	0.8	0.8
1.81	250	1.8	1.6	1.5	1.4	1.4	1.4	1.3	1.2	1.2	1.2	1.1	1.1	1.0	1.0
1.95	300	2.2	2.0	1.8	1.7	1.7	1.6	1.6	1.5	1.4	1.4	1.3	1.3	1.2	1.2
2.10	350	2.5	2.3	2.2	2.0	2.0	1.9	1.8	1.7	1.7	1.6	1.6	1.5	1.5	1.4
2.22	400	2.9	2.6	2.5	2.3	2.2	2.2	2.1	2.0	1.9	1.8	1.8	1.7	1.7	1.6
2.33	450	3.2	3.0	2.8	2.6	2.5	2.5	2.3	2.2	2.2	2.1	2.0	1.9	1.9	1.8
2.45	500	3.6	3.3	3.1	2.9	2.8	2.7	2.6	2.5	2.4	2.3	2.2	2.1	2.1	2.1
2.56	550	3.9	3.6	3.4	3.2	3.1	3.0	2.9	2.7	2.6	2.5	2.4	2.4	2.3	2.2
2.67	600	4.3	4.0	3.7	3.5	3.4	3.3	3.1	3.0	2.9	2.8	2.7	2.6	2.5	2.4

PLATE NO. 1–1
Sheet 1 of 2

DEER CREEK LAKE

SLUICE GATE RATING – ONE GATE, PARTIAL OPENINGS

Outflow Stage Feet	Discharge c.f.s.	Gate Opening in Feet and Tenths at Lake Elevation													
		796	800	804	808	810	812	816	820	824	828	832	836	840	844
2.78	650		4.3	4.0	3.7	3.7	3.6	3.4	3.2	3.1	3.0	2.9	2.8	2.7	2.6
2.88	700			4.3	4.0	3.9	3.8	3.6	3.5	3.3	3.3	3.2	3.0	2.9	2.8
3.00	750				4.3	4.2	4.1	3.9	3.7	3.6	3.4	3.3	3.2	3.1	3.0
3.12	800					4.4	4.3	4.1	3.9	3.8	3.6	3.5	3.4	3.3	3.2
3.25	850							4.4	4.2	4.0	3.9	3.7	3.6	3.5	3.4
3.37	900								4.4	4.2	4.1	3.9	3.8	3.7	3.6
3.50	950										4.3	4.2	4.0	3.9	3.8
3.63	1000											4.4	4.2	4.1	4.0
3.75	1050												4.4	4.3	4.2
3.89	1100														4.3
3.93	1115														4.4

PLATE NO. 1–1
Sheet 2 of 2

DEER CREEK LAKE

SLUICE GATE RATING : Five Gates Equal Opening

Sheet 1 — Flow In CFS
Sheet 2 — Effect At Outflow Gage

Gate Opening	Lake Elevation										
	796	800	805	810	815	820	825	830	835	840	844
0.1	70	80	90	100	105	110	120	130	140	150	155
0.2	145	150	160	180	200	215	235	250	260	270	275
0.3	220	225	250	280	295	310	340	360	365	385	400
0.4	285	300	335	360	395	415	445	465	490	500	515
0.5	360	390	425	450	495	515	555	590	610	630	645
0.6	430	460	500	550	590	620	655	690	720	750	760
0.7	510	540	585	635	690	720	760	800	840	875	895
0.8	570	610	660	720	770	820	865	910	950	975	1000
0.9	640	690	155	805	860	920	960	1020	1060	1095	1110
1.0	700	765	840	900	960	1015	1065	1115	1160	1205	1240
1.1	785	845	915	990	1055	1125	1175	1225	1285	1330	1375
1.2	850	915	1000	1085	1150	1220	1285	1345	1400	1450	1495
1.3	910	1000	1080	1165	1245	1315	1400	1460	1510	1570	1620
1.4	985	1060	1155	1250	1335	1410	1485	1560	1625	1690	1740
1.5	1055	1150	1240	1345	1425	1520	1600	1670	1745	1805	1855
1.6	1125	1215	1320	1425	1525	1615	1700	1785	1860	1945	1995
1.7	1200	1295	1400	1510	1615	1710	1810	1900	1975	2060	2125
1.8	1265	1365	1485	1600	1705	1810	1915	2005	2095	2180	2245
1.9	1340	1450	1575	1690	1810	1915	2015	2115	2205	2300	2355
2.0	1400	1520	1655	1790	1905	2015	2125	2230	2325	2415	2485
2.2	1535	1660	1810	1955	2095	2215	2345	2450	2555	2655	2740
2.4	1655	1810	1985	2140	2290	2430	2555	2685	2795	2895	2955
2.6	1805	1960	2145	2315	2470	2625	2765	2900	3020	3135	3220
2.8	1950	2110	2305	2490	2660	2820	2975	3120	3250	3380	3460
3.0	2085	2265	2490	2685	2870	3050	3210	3355	3505	3645	3725
3.5	2430	2640	2890	3120	3350	3550	3750	3930	4100	4255	4360
4.0	2770	3035	3320	3595	3850	4095	4310	4520	4700	4895	5015
4.4	3045	3320	3645	3950	4240	4500	4750	4975	5195	5395	5525

PLATE NO. 1-2
Sheet 1 of 2

DEER CREEK LAKE

SLUICE GATE RATING : Five Gates Equal Opening
Effect At Outflow Gage

Gate Opening	Lake Elevation										
	796	800	805	810	815	820	825	830	835	840	844
0.1	1.11	1.17	1.22	1.27	1.29	1.32	1.36	1.40	1.44	1.48	1.50
0.2	1.46	1.48	1.52	1.59	1.66	1.71	1.77	1.81	1.84	1.87	1.88
0.3	1.72	1.74	1.81	1.90	1.94	1.98	2.07	2.12	2.13	2.18	2.21
0.4	1.91	1.95	2.05	2.12	2.21	2.25	2.32	2.36	2.42	2.45	2.48
0.5	2.12	2.19	2.27	2.33	2.43	2.48	2.57	2.65	2.69	2.73	2.77
0.6	2.28	2.35	2.44	2.56	2.65	2.71	2.79	2.86	2.92	2.99	3.02
0.7	2.47	2.54	2.64	2.75	2.86	2.92	3.02	3.12	3.22	3.31	3.36
0.8	2.61	2.69	2.80	2.92	3.05	3.17	3.28	3.40	3.50	3.56	3.62
0.9	2.75	2.86	3.01	3.13	3.27	3.42	3.52	3.67	3.78	3.87	3.91
1.0	2.88	3.03	3.22	3.37	3.52	3.66	3.79	3.93	4.04	4.16	4.24
1.1	3.08	3.23	3.41	3.60	3.77	3.95	4.08	4.21	4.35	4.45	4.56
1.2	3.35	3.41	3.62	3.85	4.02	4.19	4.35	4.49	4.62	4.73	4.84
1.3	3.40	3.62	3.83	4.06	4.26	4.42	4.62	4.76	4.87	5.00	5.10
1.4	3.59	3.78	4.03	4.27	4.46	4.64	4.81	4.98	5.11	5.25	3.35
1.5	3.77	4.02	4.24	4.49	4.68	4.89	5.06	5.21	5.36	5.47	5.56
1.6	3.95	4.18	4.43	4.68	4.90	5.09	5.27	5.43	5.58	5.73	5.82
1.7	4.15	4.37	4.62	4.87	5.09	5.29	5.48	5.65	5.78	5.93	6.04
1.8	4.30	4.53	4.81	5.06	5.28	5.48	5.67	5.83	5.99	6.14	6.24
1.9	4.48	4.73	5.01	5.25	5.48	5.67	5.85	6.02	6.17	6.33	6.42
2.0	4.62	4.89	5.17	5.44	5.65	5.85	6.04	6.22	6.37	6.52	6.63
2.2	4.92	5.19	5.48	5.74	5.99	6.19	6.40	6.56	6.74	6.89	7.02
2.4	5.20	5.48	5.80	6.07	6.32	6.54	6.74	6.94	7.09	7.22	7.26
2.6	5.47	5.75	6.07	6.36	6.60	6.85	7.05	7.23	7.38	7.53	7.63
2.8	5.73	6.01	6.34	6.64	6.89	7.13	7.33	7.51	7.67	7.83	7.92
3.0	5.97	6.44	6.64	6.94	7.19	7.42	7.62	7.80	7.98		
3.5	6.54	6.87	7.22	7.51	7.79						
4.0	7.06	7.39	7.75								
4.4	7.41	7.76	*								

* Vacant spaces because flows above rating.

PLATE NO. 1-2
Sheet 2 of 2

DEER CREEK LAKE

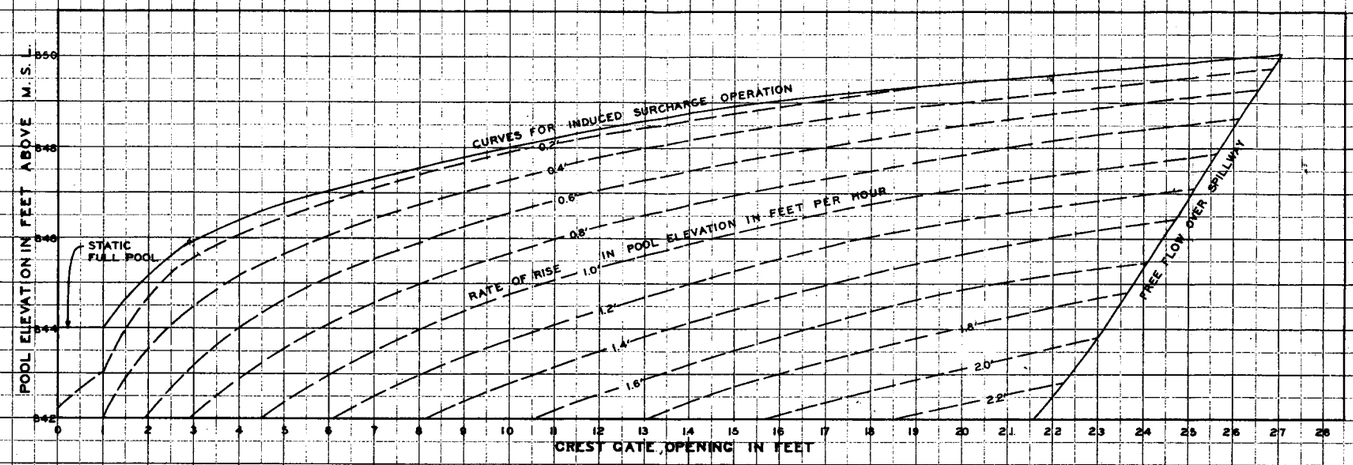
LOW FLOW VALVE RATING – 36" GATE VALVE

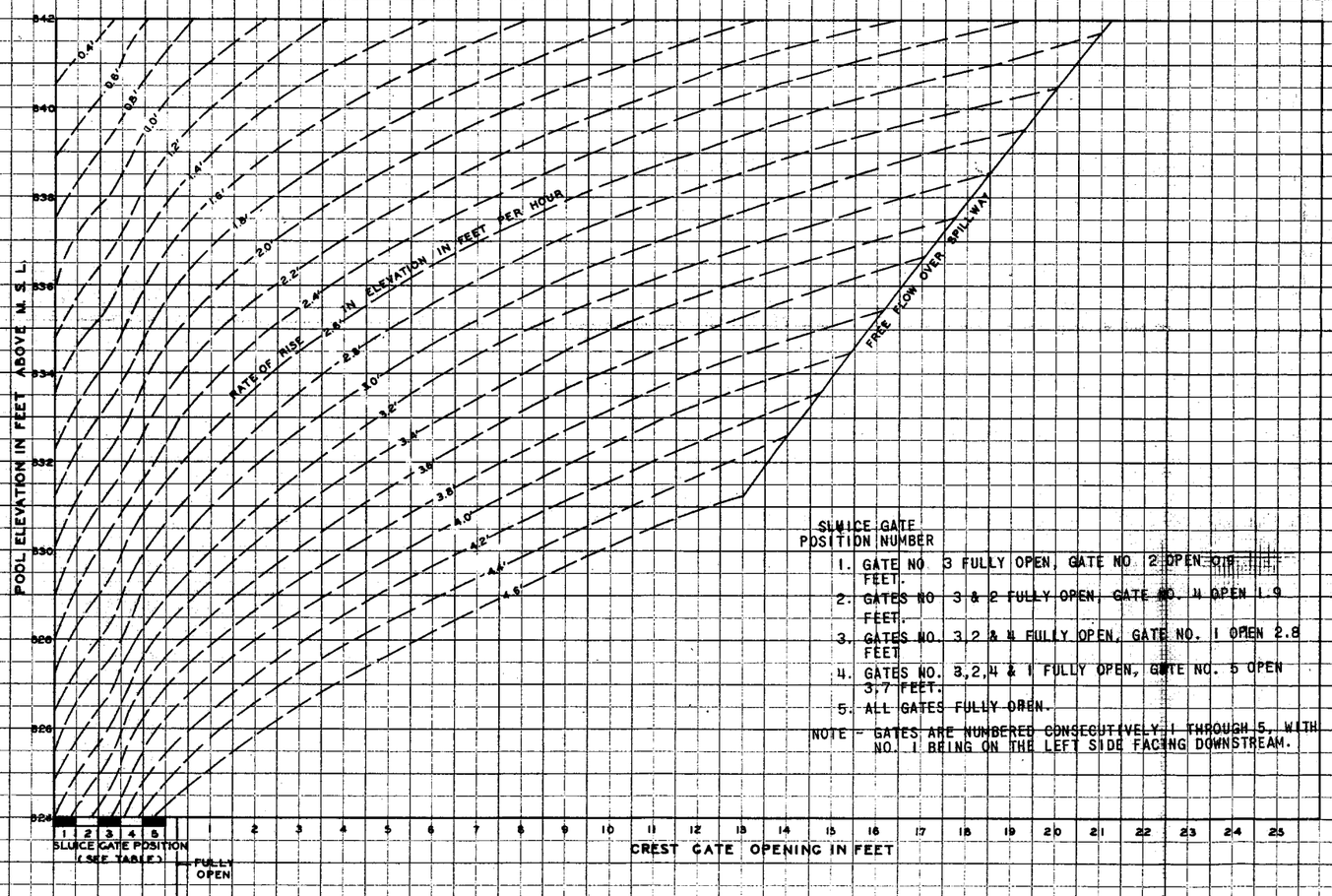
Discharge cfs	Stage at '0' Gage	Gate Opening in Feet and Tenths at Lake Elevation											
		796	798	800	802	804	806	808	810	812	814	816	818
10	0.57	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
15	0.65	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2
25	0.77	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
40	0.91	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
55	1.02	0.9	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7
75	1.14	1.1	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.8	0.8
90	1.22	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0
110	1.32	1.5	1.4	1.4	1.3	1.3	1.3	1.2	1.2	1.2	1.2	1.1	1.1
135	1.42	1.7	1.6	1.6	1.5	1.5	1.4	1.4	1.4	1.4	1.3	1.3	1.3
165	1.54	2.1	2.0	1.9	1.8	1.8	1.7	1.7	1.6	1.6	1.5	1.5	1.5
200	1.66	2.9	3.0	2.6	2.4	2.3	2.2	2.1	2.0	2.0	1.9	1.9	1.8
235	1.77	OPEN	OPEN	OPEN	OPEN	OPEN	2.9	2.6	2.5	2.3	OPEN	OPEN	2.9
275	1.88						OPEN	OPEN	OPEN	OPEN			OPEN

PLATE NO. 1-3

CORPS OF ENGINEERS

DEPARTMENT OF THE ARMY





SLUICE GATE POSITION NUMBER

1. GATE NO 3 FULLY OPEN, GATE NO 2 OPEN 0.6 FEET.
2. GATES NO 3 & 2 FULLY OPEN, GATE NO. 4 OPEN 1.9 FEET.
3. GATES NO. 3, 2 & 4 FULLY OPEN, GATE NO. 1 OPEN 2.8 FEET
4. GATES NO. 3, 2, 4 & 1 FULLY OPEN, GATE NO. 5 OPEN 3.7 FEET.
5. ALL GATES FULLY OPEN.

NOTE - GATES ARE NUMBERED CONSECUTIVELY 1 THROUGH 5, WITH NO. 1 BEING ON THE LEFT SIDE FACING DOWNSTREAM.

OPERATION INSTRUCTIONS

1. SEE SEPARATE INSTRUCTIONS AS TO WHEN RESERVOIR MAY BE OPERATED WITHOUT SPECIFIC INSTRUCTIONS FROM DISTRICT OFFICE
2. READ THE "LAKE" GAGE EVERY HOUR ON THE HOUR, COMPUTE THE AVERAGE RATE OF RISE IN RESERVOIR ELEVATION IN FEET PER HOUR FROM THE CHANGE IN ELEVATION DURING THE PRECEDING HOUR.
3. ADJUST THE GATE SETTING EACH HOUR AS INDICATED BY THE CURVES ON THE BASIS OF THE AVERAGE RATE OF RISE AND THE CURRENT RESERVOIR ELEVATION.
4. WHEN THE CURRENT RESERVOIR ELEVATION IS BELOW 842.0, USE THE LOWER SET OF CURVES DO NOT RAISE THE CREST GATES UNTIL ALL SLUICES ARE OPEN. RAISE ALL CREST GATES AS UNIFORMLY AS POSSIBLE.
5. WHEN THE HOURLY RESERVOIR LEVEL READING FIRST EXCEEDS ELEVATION 844.0, CLOSE ALL SLUICES AND RAISE ALL CREST GATES AS UNIFORMLY AS POSSIBLE TO THE OPENING INDICATED BY THE UPPER SET OF CURVES. USE THE UPPER SET OF CURVES AS LONG AS THE POOL LEVEL EXCEEDS 844.0 FEET. OPEN THE SLUICE GATES WHEN THE CREST GATES HAVE BEEN LIFTED CLEAR OF THE WATER SURFACE.
6. AFTER THE RESERVOIR LEVEL STARTS TO FALL, MAINTAIN THE CURRENT GATE SETTING UNTIL THE POOL RECEDES TO ELEVATION 844.0. THEN CLOSE THE SLUICE GATES IF THEY ARE OPEN, AND CLOSE THE CREST GATES AS REQUIRED TO MAINTAIN RESERVOIR ELEVATION 844.0.
7. HOLD THE POOL AT ELEVATION 844.0 OR AT MAXIMUM LEVEL ATTAINED, IF BELOW 844.0 UNTIL ORDERED BY SPECIAL DIRECTIVE TO BEGIN DRAWDOWN OPERATION.
8. IF A SECOND RISE OCCURS WHILE THE POOL IS BEING HELD AT ELEVATION 844.0 FEET, FOLLOW THE "CURVE FOR INDUCED SURCHARGE OPERATION." IF THE CREST GATES ARE OPEN MORE THAN 2.0 FEET WHEN THE SECOND RISE OCCURS, MAINTAIN THE CURRENT GATE SETTING UNTIL THE RESERVOIR LEVEL RISES TO THE ELEVATION CORRESPONDING TO THE GATE SETTING ON THE "CURVE FOR INDUCED SURCHARGE OPERATION," THEN FOLLOW THE CURVE UNTIL THE POOL CEASES TO RISE. WHEN THE POOL STARTS TO FALL OPERATE IN ACCORDANCE WITH INSTRUCTIONS NO. 6 ABOVE.

DEER CREEK
OHIO

DEER CREEK LAKE

EMERGENCY OPERATION SCHEDULE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON W. VA. JULY 1990

PLATE NO. 1-4

SECTION II - COLLECTION OF HYDROMETEOROLOGIC DATA

2-01. PRECIPITATION AT DEER CREEK LAKE

a. General. Obtain precipitation data by direct observation of the rain gage at the damsite, and by telephonic reports from other precipitation stations in the project drainage basin. Instructions for preparation and transmission of hydrologic reports are contained in Section IV.

b. Official Precipitation Gage. The standard National Weather Service 8 inch (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 0730 hours daily. Observe and record the times of beginning and ending of precipitation as it occurs or from the recorder tape. Instructions for 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 about 0730 hours daily. Remove punched-tape record monthly, marking record and unused portions with date and time, and mail the record to NWS Columbus in the canister provided.

e. Extra and Special Readings. Take extra readings of the precipitation gage whenever required by Schedule for Reading Gages, **Plate No. 3-1**, next section, and special readings when requested by Water Management Section. 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. Tipping bucket rain gages and data collection platforms (DCPs) have been installed to collect, record and report precipitation at eight precipitation station locations in or near the Deer Creek Basin. They are at or near the towns of Washington Courthouse, Mt. Sterling, London, West Jefferson, Darbyville, Williamsport and at the project outflow station. The platforms collect, store, and transmit data every four hours via satellite to the LRD downlink. The LRD water control system receives from the downlink and disseminates hourly, the data is stored in a database of the Water Control System, WCS, in Water Management Section for use in water control management and dissemination. The data can be accessed by project personnel by use of the portable computer terminal assigned to the project at https://cwms.lrh.usace.army.mil/dbases/briefing/dcs.htm. After signing onto the water control system, the command "SCAN" will create a list of the most recent readings at all stations pertinent to the project.

g. Snow Depth and Moisture Content. During the winter, make regular measurement of snowfall and snow depth about 0730 hours daily when relevant. 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 and report to EC-WM by 0900 hours the water content of the snow at least 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.

2-02. 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.

SECTION III - COLLECTION OF STREAMFLOW DATA

3-01. GENERAL

Obtain river and lake stage data by observing the project office readouts of the lake and outflow gages and by interrogating surrounding telemetered gages. The necessary frequency for reading the gages at the project and for obtaining reports from the telemetered stations is set forth in the Schedule for Reading Gages, **Plate No. 3-1**, 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 DEER CREEK LAKE

a. Gage Listing. Information about gages of importance to operation of the project and communication information on platform reported gaging stations appears in **Table No. 3-1**, next page.

b. Reading and Recording Gage Heights. List all gage readings 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 elevation above NGVD, but record all other gages in feet above gage zero under conditions set forth in the Schedule for Reading Gages, **Plate No. 3-1**, which appears at the end of this section.

3-03. TELEPHONIC GAGES

In order to facilitate collection of stage information, data collection platforms (DCP'S) capable of responding to telephone calls were installed at the lake outflow, Mt. Sterling (inflow), Williamsport (Deer Creek control), and Chillicothe. The lake and outflow gages are remoted into the control room. To obtain reports from the gages by telephone, call the station telephone number. After a few seconds of high-pitched tone, the platform will repeat with synthesized voice the unit identification and the latest reading and time of the reading. Stage is called "level," and precipitation "rain." The message ends with battery voltage and time of reading. Hydrologgers, at the lake and outflow stations add the request, "Enter command," which is to be ignored. One should note that the time given by platforms is Greenwich Mean Time. 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 the telemetered gages is set forth in the Schedule for Reading Gages, **Plate No. 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 the gages to be called by project personnel appear in **Table No. 3-1**, next page.

TABLE NO. 3-1

STREAM AND LAKE GAGE TELEPHONE NUMBERS

Gage	Symbol	Telephone No.
Deer Creek lake station	DCSG2	[redacted]
Deer Creek outflow	DCSOF	
Mt. Sterling, inflow	MTSF2	
Williamsport, Deer Creek control	WMTH2	
Chillicothe, Scioto River control	CHSH3	

3-04. DATA COLLECTION

Project personnel read the lake gage and outflow gage and telephone the voice platform. All the values are recorded in the project information report and given to the District Data System, EC-WM, by INTRANET. Gate positions and operations are noted in the log and on Form 14 and the positions are included in required reports to the Area Office. Supplemental lake and outflow data, discussed in next section, are taken along with regular readings or soon after.

The Project Report is given by Deer Creek as detailed in Section IV when required. **Plate No. 4-1** is a three page form, and each page has a Supplemental Data block to furnish requested information to the Water Management Section. Data collection platforms report stage data at all the locations (plus precipitation at some stations) listed above in **Table No. 3-1**. They transmit the data by electronic signal to the LRD downlink via satellite every four hours. The LRD Water Control System retrieves from the downlink and disseminates hourly to the Water Management Section CMS data base.

DCP's report stage and/or precipitation data at the stations listed in **Table No. 6-2** page 6-3, main text. Those at the lake and outflow stations update at 1/2 hour intervals and the others hourly.

Use of the computer to obtain from INTRANET stored stage/elevation or precipitation readings from platform-reported stations relevant to the project is also described in 2-01f.

TABLE NO. 3-1

DEER CREEK
PERTINENT GAGE DATA

Gage	Location	Code Symbol	Equipment	Reference Gages		Recorder	Visual Indicator	Datum of Gage[1]
				Staff	Other			
Lake	Pylon	DCSG2	H, Re	SL	TL	RL	D	NGVD
Outflow	1200' below dam	DCSOF	V, H, Re	SO	TO	RO	D	768.00
Inflow	Mt. Sterling	MTSF2	V, P	--	TM,WW	RM	D	836.25
Deer Creek Control	Williamsport	WMTH2	V, P	--	WW	RW	D	718.66
Scioto River Control	Chillicothe	CHSH3	V, P	SC	ET	RC	D	594.04

[1] Feet - NGVD
R Analog-to-digital recorder
V Voice Platform
H Hydrologger
S Staff
T Electric Tape
WW Wire weight gage (on bridge)
Re Remote to office
P Tipping bucket precipitation gage reported by platform
D Display of stage on platform and Hydrologger

SCHEDULE FOR READING GAGES
DEER CREEK LAKE

The regular stream gages HL and HO/VO, office remotes, or SL and SO(2) must always be read and recorded immediately before each gate operation except when they have been read in the last hour with no intervening gate operation. They must also be read within one hour after completion of any operation. However, when the gates are being operated practically 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 operation will be sufficient. If the recorders are operating properly, the above gage heights may be read from the charts at the time of the next reading. Reading and recording of gages shall be carried out as defined under Schedule A except when gage levels precipitation are such that the Damtender or Assistant anticipate 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.

	SCHEDULE A(1) Normal Conditions		SCHEDULE B(1) Flood Threat		SCHEDULE C(1) Flood Condition		SCHEDULE D Major Flood Condition	
CONDTIONS	MIANO*	DEMIA*	MIANO*	DEMIA*	MIANO*	DEMIA*	MIANO*	DEMIO*
Lake elevation	Below 813	Below 801	813-824	801-824	824-840.5(4)	824-840.5(4)	Above 840.0	Above 840.0(4)
Stage at ‘O’ gage	Below 3.4(6)	Below 4.4(6)	3.4-4.5(6)	4.4-5.8(6)	4.5-5.5(6)	5.8-6.9(6)	Above 5.5(6)	Above 6.9(6)
Precipitation Within 24 hours	Less than 0.75	Less than 0.50	0.75-1.25	0.50-1.00	1.25-2.50	1.00-2.50	More than 2.50	Above 2.50
Stage at Blaine	Below 6.6	Below 7.1	6.6-9.1	7.1-9.2	9.1-10.4	9.2-10.4	Above 10.4	Above 10.4
Stage at Fullers	Below 6.5	Below 7.4	6.5-8.7	7.4-9.0	8.7-10.1	9.0-10.1	Above 10.1	Above 10.1
READ GAGES								
HL & HO(2)	At 0730 & 1330(3)		At 0730 & 1330		At 0730, 1330, 1930 & 0130		At 3 hour intervals (4)	
RL & RO Charts	Reading for 0730,1330, 1930 & 0130(5)		Readings for 0730, 1330, 1930 & 0130(5)		Readings for 0730, 1330, 1930 & 0130(5)		Readings for 0730, 1330, 1930, 0130(5)	
Precipitation Gage	At 0730		At 0730 & 1330		At 0730, 1330, 1930 & 0130		At 3 hour intervals	
Mt. Sterling Voice	Daily at 0730		At 0730 & 1330		At 0730, 1330, 1930 & 0130		At 3 hour intervals	
Williamsport Voice	Daily at 0730		At o730 & 1330		At 0730, 1330, 1930 & 0130		At 3 hour intervals	
TL, TO, RO,SL and SO	Twice weekly(as check)		Twice weekly(as check)		Twice weekly(as check)		Twice weekly (as check)	

(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 and D into effect, notify **by phone** one of the Water Management personnel.
(2) When the readings of an office remote of lake or outflow gage does not agree with the respective Hydrologger or voice report available by telephone, red the relevant staff or electric tape gage for correct value to report. If unable to adjust the instrument to read properly notify Water management Section.
(3) Take readings on workdays regularly and on weekends and holidays by special arrangement.
(4) Whenever the reservoir level is between elevation 824 and 844 and rising or at elevation 844 or above, a constant check shall be kept on the rate of rise in pool level. Whenever the rate of rise approaches a value which indicates a gate opening on the “Emergency Operation Schedule,” readings of the “Lake” gage shall be taken every hour, on the hour.
(5) The 1330, 1930, and 0130 readings on workdays and all readings for weekends and holidays may be obtained from the chart at the time of the next Scheduled reading of visual gages. If necessary to obtain the required readings, roll the chart back and, after taking readings, return to the proper position.
(6) All releases above a stage of 3.4 feet in MIANO and 4.4 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 streams or inflow, read lake, outflow, Mt. Sterling and Williamsport gages by 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. All gage readings made in addition to those required by the foregoing table must be recorded.

* Acronyms for mid-April through November (crop season) and December to mid-April (non-crop season)

PLATE NO. 3-1

SECTION IV - COMPLETION AND TRANSMISSION OF REPORTS

4-01. REGULAR REPORTS

a. 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 Damtender 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 gauge readings which are utilized by project personnel for gate operation decision making. See **Plate No. 3 of 5**, Sheet 3 of 5, back of section.

b. Project 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 (See **Plate No. 4-1**, Sheet 1 of 5, back of section).

c. Gate Operations Report. This sub-section is modified to note that: Generation and transmission of the gate operation report is only required when requested by the Water Management Section. Neither daily transmissions not transmissions after every gate operation are necessary any longer. See **Plate No. 4-1**, Sheet 2 of 5 back, of section.

d. Water Quality Report. The third report available from the Index Page is the Water Quality Report. This report is used during the times that the lake is subject to stratification. Monitoring begins when a special directive is sent by Water Management Section at the request of Water Quality Team. Water Quality data is reported in accordance with the special directive. The Water Quality Team will request the Water Management Section to issue a special directive ending monitoring when it is no longer necessary.

As in the Project Report, a password is necessary to submit the Water Quality Report to the WCDS-A computer. The same password is used to the Project Report and the Water Quality Report. If the report is submitted with the proper password, a confirmation screen will be transmitted back to the terminal. If the information is correct, click on the “Correct” button at the top of the page. The information will be entered into a permanent record. This procedure is illustrated in **Plate No. 4-1**, Sheet 5 of 5, back of section.

e. Weekly Precipitation Report. 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. See **Plate No. 4-1**, sheet 1 of 5, back of section.

f. Additional Comments. 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 Section. 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 Section 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.

4-02. EXTRA REPORTS

Always transmit extra reports, as indicated by the Schedule for Reading gages, **Plate No. 3-1**, previous section, to INTRANET over the project computer in the same way as the regular MORNING report. If some circumstance prohibits, such as for example, malfunction of the computer or lack of computer competency by personnel on duty, attempt to telephone the report to Water Management Section in the District Office.

Failing this attempt, telephone the report to one of the Water Management Section personnel in the order listed on the Key Personnel Table shown in **Plate No. 4-2**, back of section.

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 Water Management Section.

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

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

(1) Gate positions and/or operations.
(2) Flooding upstream or downstream.
(3) Request for special operation.
(4) A catastrophe such as drowning.
(5) Unusual or abnormal water quality conditions in the lake, inflow streams, or a reasonable distance downstream from the dam.
(6) Moisture content of snow.
(7) Outflow temperature and/or air temperature at time other than 0730 hours.
(8) Local weather forecast.

c. Transmission of Special Reports. All special reports should be made at any time of day or night, including weekends and holidays, or when requested by Water Management Section. During office hours, submit them by telephone; however, if it is impossible by telephone, utilize the District Cell Phones.

When making telephone calls after hours or during weekends or holidays, unless advised that the Water Management Section will be on duty, place a call to one of the Water Resources Engineering Branch-Key Personnel, **Plate No. 4-2**.

4-04. CELL PHONE AS BACKUP COMMUNICATION.

Backup communication is provided by the Cell Phone. The Cell Phone with beeper should be turned on at all times, including overtime periods. The District Operator is often on duty when away from the project outside of regular work hours. Messages may be relayed through other projects when there is difficulty in transmitting reports to INTRANET or via telephone. Transmit by 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-W).

b. Downstream Channel Conditions. At the request of the Water Management 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 “H” gage, inspections will be made along Deer Creek to Chillicothe, Ohio.

(2) Inspections will be made downstream to Chillicothe, Ohio, during or immediately after periods of unusual storage releases.

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

(4) An any other times, as requested by the Water Management 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 Management Section.

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 Management Section. Stream gages, rain gages and temperature equipment shall be periodically checked for proper functioning and performance or when directed by the Water Management Section. During periods of stratification, outflow temperature requirements will be maintained according to the Water Management Section Special Directive.

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, 833 feet NGVD for Deer Creek 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 the Water Management 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 condition should be reported to the Water Resources Engineering Branch, 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 condition 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 Resources Engineering Branch should be informed concerning application of chemicals to the water or to surrounding land. This includes fertilizers and pesticides.

US Army Corps of Engineers

Huntington District
Water Control Section

Welcome to the

DEER CREEK LAKE

WATER CONTROL INTRANET PAGE

[redacted]

WEEKLY DATA ENTRY

WEEKLY PRECIP REPORT/MOISTURE CONTENT	Additional Comments (including gage problems, etc)

WATER QUALITY DATA ENTRY

WATER QUALITY

AS NEEDED DATA ENTRY

PROJECT DATA	GATE OPERATIONS

OTHER PAGES OF INTEREST

EMERGENCY CONTACTS		
WEATHER FORECASTS	RADAR	CORPS GOES DATA
OTHER LINKS	SPECIAL DIRECTIVES	WHAT'S NEW
WHITEWATER PAGE	LAKE REPORT	USGS DATA
Huntington District Current Conditions	Scioto Basin Current Conditions	Project Report Archive

The POC for this page:

[redacted] *CELRH-EC-WW*

Huntington, WV

Send Email to Water Resources

USACE Home

Civil Works

You Are Here

Date last modified: 30 Apr 2004 at 0425

PLATE NO. 4-1
SHEET 1 OF 5

DEER CREEK LAKE

GATE OPERATIONS

This file is a New submission.

GATE ID	VALUE		DATE	TIME	
	Start	End		Start	End
S01	0.0	0.0	22 Oct 2004	0700	0705

ADDITIONAL COMMENTS

PLEASE ENTER THE DEER CREEK PASSWORD:

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

The POC for this page:

CELRH-EC-WW

Huntington, WV

Send E-mail to Water Resources

USACE Home

Civil Works

You Are Here

Date last modified: 16 Jan 2004 at 0609

PLATE NO. 4-1
SHEET 2 OF 5

DEER CREEK 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
22 Oct 2004	0730

CURRENT PROJECT INFO

COE ID	PRECIP (IN)	POOL ELEV (FT-MSL)	TAIL WATER STAGE (FT)	FLOW (KCFS)	SNOW DEPTH (IN)	WATER EQUIVILENT (IN)	WEATHER CONDITI
DCSG2	0	800	1.0	0	0.0	0.0	0 Unchanged

CURRENT GATE SETTINGS

GATE	S01-05	S01	S02	S03	S04	S05
SETTING	.00	.00	.00	.00	.00	.00

GATE	LFV	TL	TM	TR
SETTING	.00	.00	.00	.00

ADDITIONAL STATION INFORMATION

COE ID	PRECIP (IN)	STAGE (FT)
CHSH3	0	0.0
MTSF2	0	0.0
WMTH2	0	0.0

ADDITIONAL COMMENTS

PLEASE ENTER THE DEER CREEK PASSWORD:

PLATE NO. 4-1
SHEET 3 OF 5

[redacted]



CLICK HERE TO RETURN TO DEER CREEK 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: 16 Jan 2004 at 0709

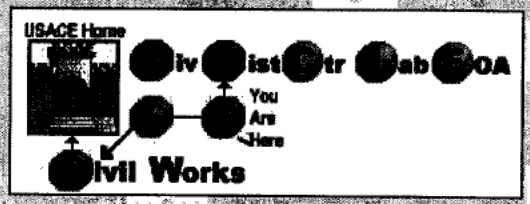


PLATE NO. 4-1
SHEET 4 OF 5

Deer Creek Lake

Water Quality Report

Date	Time	Lake Elev (ft)

Lake				
Depth (m)	Temp (C)	D.O.	Cond	pH
0.0				
1.0				
2.0				
3.0				
4.0				
5.0				
6.0				
7.0				
8.0				
9.0				
10.0				
11.0				
14.0				

Outflow				
Depth (m)	Temp (C)	D.O.	Cond	pH
0.0				

Gate Operations

Gate ID	Value	Gate ID	Value
S01		TL	
S02		TM	
S03		TR	
S04		LFV	
S05			

KEY EMERGENCY PERSONNEL

Huntington District Office - Water Resources Engineering Branch

Normal Work Hours 0700 to 1600 hrs		[redacted]
Nights, Weekends, and Holidays	Additional Extensions	[redacted]

Water Resources Engineering Branch Personnel	Home Telephone Number
[redacted] Chief, Water Resources Engineering Branch	[redacted]
[redacted] Chief, Water Management Section	[redacted]
[redacted] Water Management Section	[redacted]

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

Scioto Area Office

[redacted]	[redacted]

Deer Creek Lake Project Office

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

Other Agencies

U. S. Geological Survey New Philadelphia, Ohio		[redacted]
Nights, Weekends, Holidays	Commercial	[redacted]
[redacted] National Weather Service	Commercial	[redacted]
Forecast Office, Hydrology Section Cleveland, Ohio	Commercial Commercial from HDQ	[redacted]

UPON APPROVAL OF NEPA DOCUMENTATION, THE DROUGHT CONTINGENCY PLAN WILL BE FURNISHED FOR ENCLOSURE IN THE WATER CONTROL MANUALS.

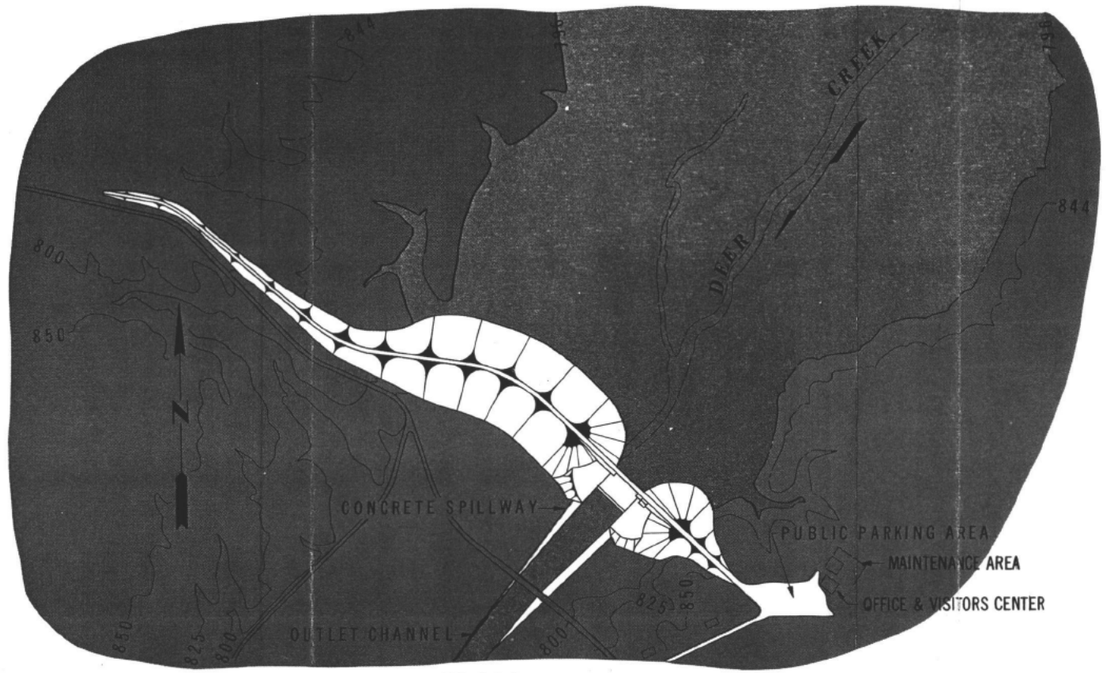
CORPS OF ENGINEERS

U. S. ARMY

DEER CREEK F/C 64



DEER CREEK F/C 64-A



PLAN

300 0 300 600

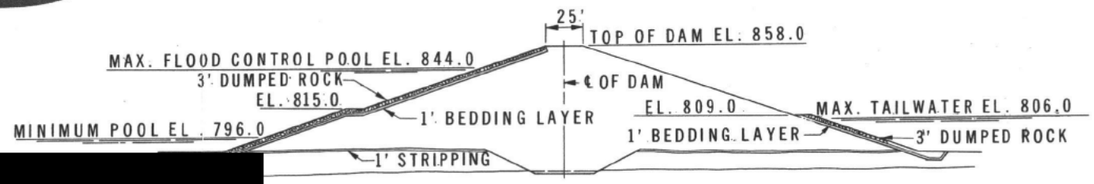
SCALE IN FEET



VICINITY MAP

50 0 50 100 150

SCALE IN MILES



TYPICAL SECTION

60 0 60 120

SCALE IN FEET

[redacted]

DEER CREEK

DEER CREEK LAKE

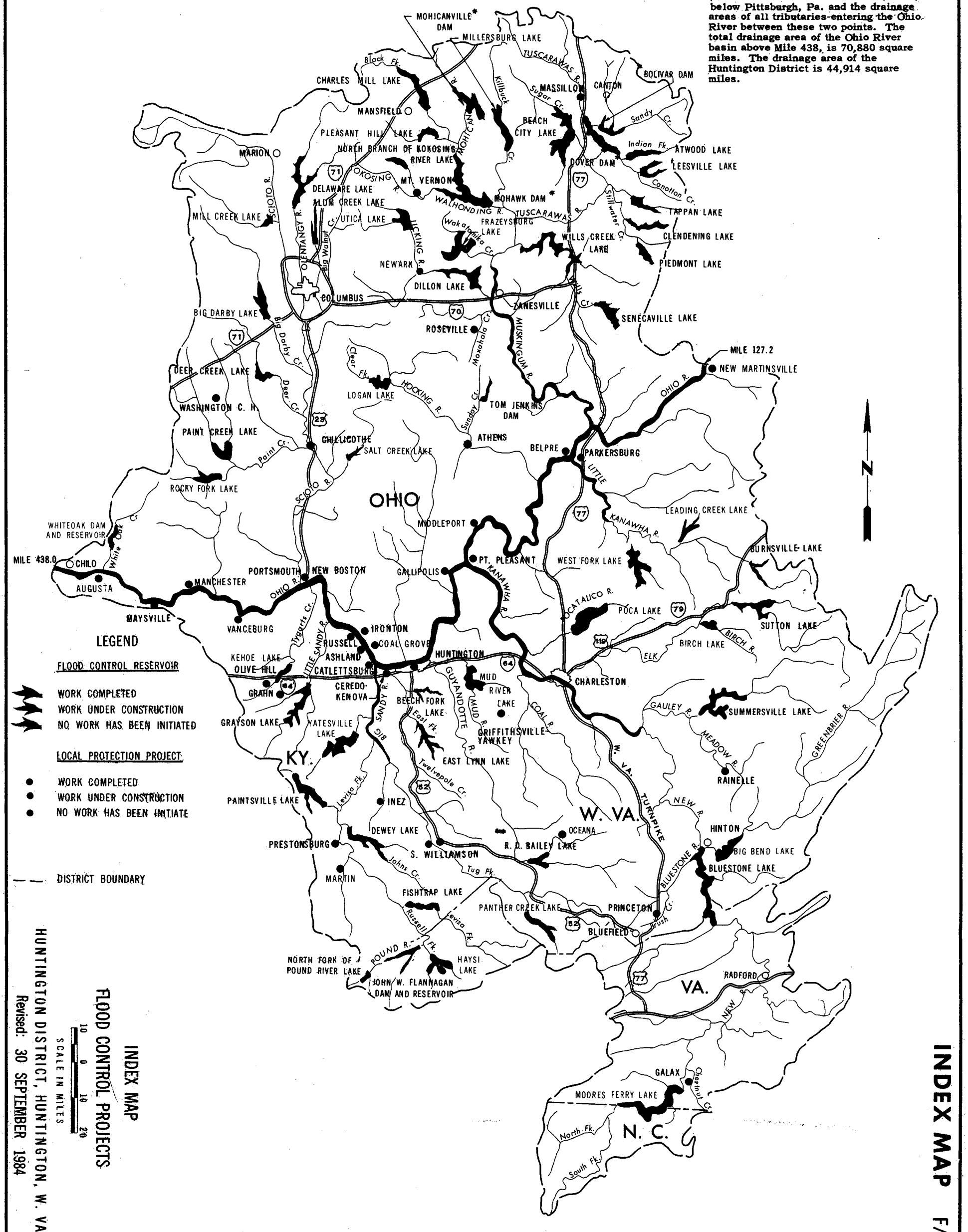
DAM

PLAN AND SECTIONS

HUNTINGTON DISTRICT, HUNTINGTON, W. VA.

Revised: 30 SEPTEMBER 1986

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 areas 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.

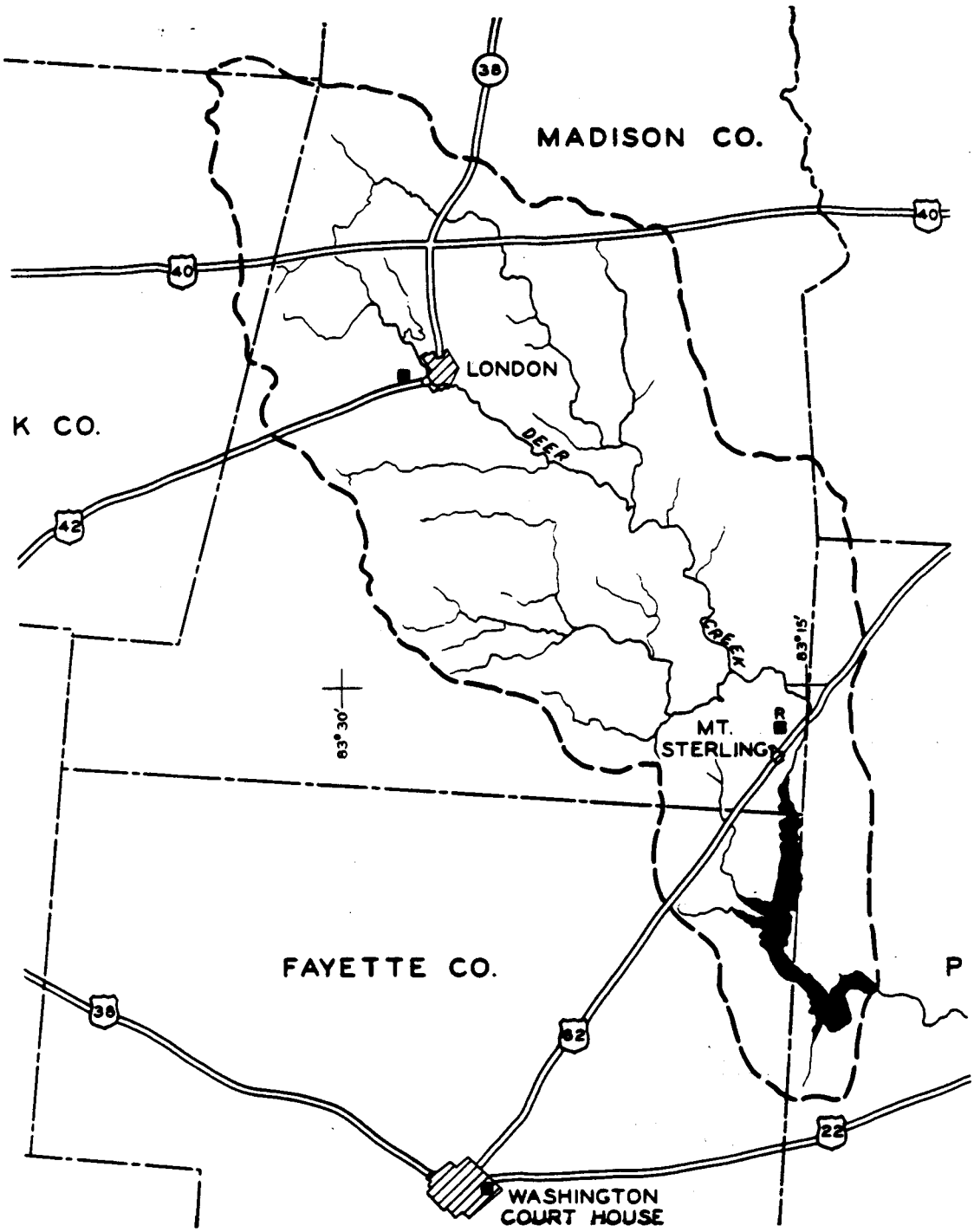


*Dry dam, with flood control pool outlined.
**Completed project where further improvements are in progress or authorized.

INDEX MAP
FLOOD CONTROL PROJECTS
HUNTINGTON DISTRICT, HUNTINGTON, W. VA.
Revised: 30 SEPTEMBER 1984

INDEX MAP F/C1

PLATE NO. 1-1



DEER CREEK

OHIO

DEER CREEK LAKE

DRAINAGE AREA MAP

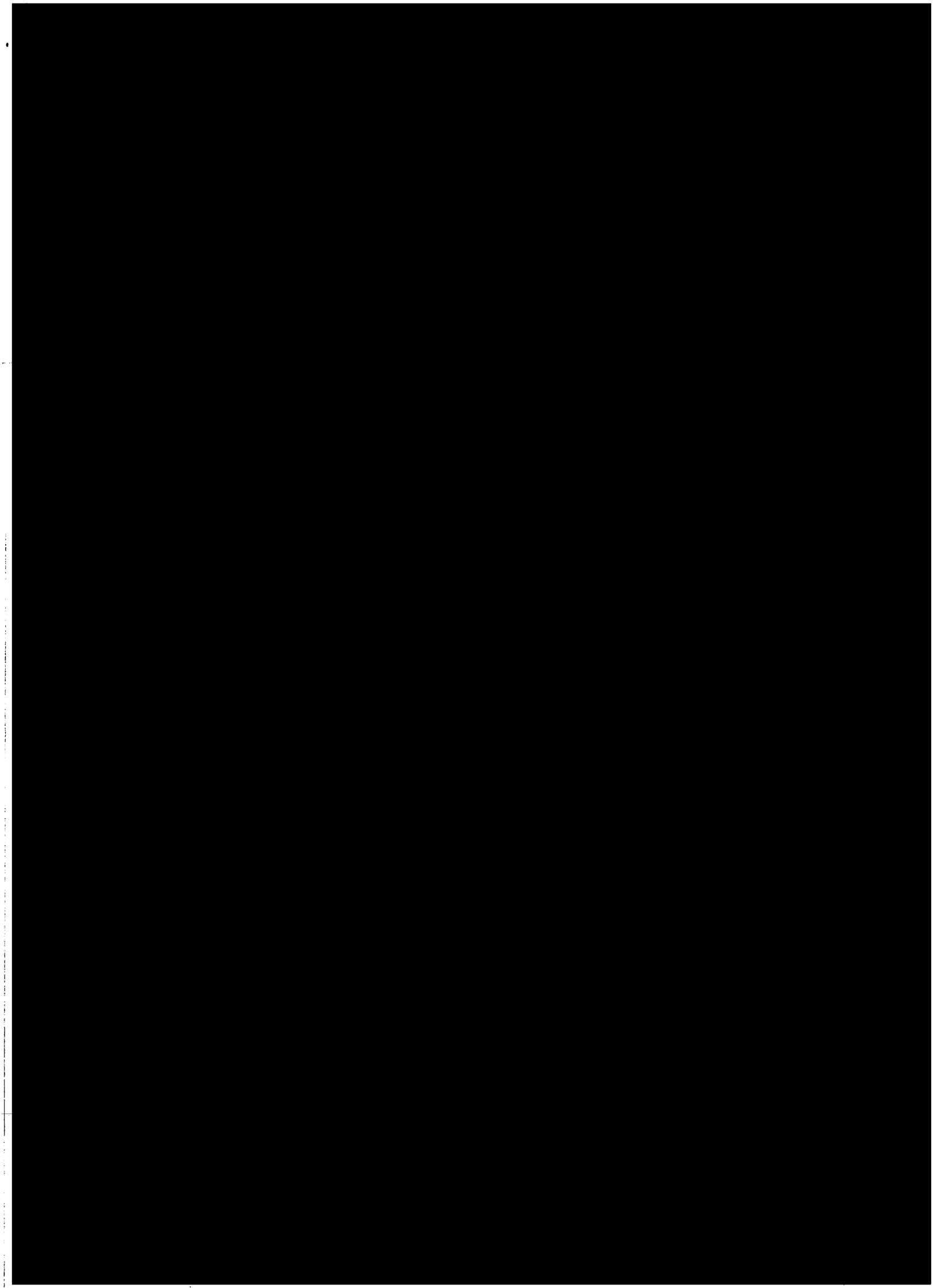
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. V. JUNE 1989

PLATE NO. 2-1



PLATE NO. 2-2



CORPS OF ENGINEERS



PLATE NO. 2-4



PLATE NO. 2–5

CORPS OF ENGINEERS

U.S. ARMY



U. S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
HUNTINGTON, W. VA.

DRAWN BY: E.L.W
TRACED BY: R.L.S.-E.J.
CHECKED BY: K.O.B.-H.T.S.
SUBMITTED BY:
APPROVED BY:
DATE: MAY 1965
CH., U.S. DISTRICT ENGINEER
APPROVED FOR:
DATE:

DEER CREEK, OHIO
DEER CREEK RESERVOIR
DAM
SPILLWAY
TRAINING WALLS
PLAN, SECTIONS AND DETAILS

SCALE: AS SHOWN
DRAWING NUMBER: 016-UDCI-52.1/61
SHEET 12 OF 13

PLATE NO. 2-6

CORPS OF ENGINEERS

U.S. ARMY



U. S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
HUNTINGTON, W. VA.

DRAWN BY: R.L.S.
TRACED BY: R.L.S.
CHECKED BY: K.O.S.-H.T.S.
SUBMITTED BY: CHIEF, ENGINEERING DIVISION
CHIEF, ENGINEERING DIVISION
APPROVED FOR: DATE:

DEER CREEK OHIO
DEER CREEK RESERVOIR DAM
GENERAL PLANS
TYPICAL SECTIONS

APPROVED: DATE: MAY 1966
CHIEF, ENGINEERING DIVISION
CHIEF, ENGINEERING DIVISION
DIST. CO. DISTRICT ENGINEER

SCALE AS SHOWN | SPEC. NO:
DRAWING NUMBER
016-1-UDCI-521/3
SHEET 3 OF 6

PLATE NO. 2-7

CORPS OF ENGINEERS

U.S. ARMY

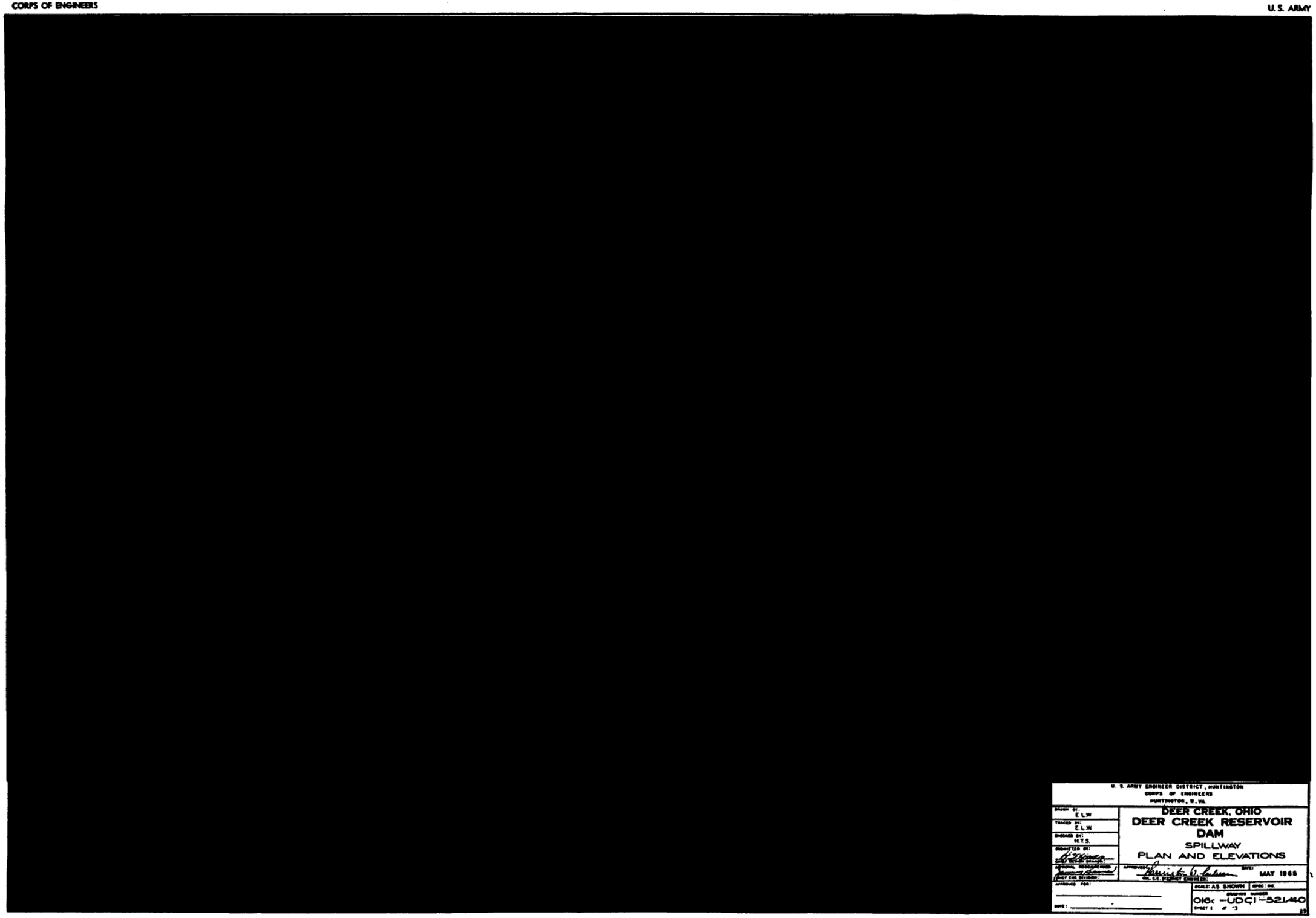


U. S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
HUNTINGTON, W. Va.

DRAWN BY: R.E.B.	DEER CREEK, OHIO DEER CREEK RESERVOIR DAM SPILLWAY UPSTREAM ISOMETRIC CUT-AWAY VIEW
TRACED BY: R.E.B.	
CHECKED BY: ROB MTS.	
SUBMITTED BY: CHIEF DESIGN BRANCH	
APPROVAL RECOMMENDED: CHIEF CIVIL DIVISION	APPROVED: Dwight W. Johnson, DIV. C.E. DISTRICT ENGINEER — DATE: MAY 1965
APPROVED FOR: — DATE:	SCALE: 1/8" = 1'-0" — SPEC. NO: — DRAWING NUMBER: 016-UDC1-52.142 — SHEET 3 OF 13

41

PLATE NO. 2-8



U. S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
HUNTINGTON, W. VA.

DRAWN BY: E.L.W.	DEER CREEK, OHIO DEER CREEK RESERVOIR DAM SPILLWAY PLAN AND ELEVATIONS
TRACED BY: E.L.W.	
CHECKED BY: H.T.S.	
SUBMITTED BY: CHIEF, DESIGN BRANCH	APPROVED: Maurice G. Salmon, Jr. Col. CE, DISTRICT ENGINEER — DATE: MAY 1965
APPROVED: CHIEF, ENGINEERING DIVISION	SCALE: AS SHOWN — SPEC. NO.
APPROVED FOR: DATE:	DRAWING NUMBER 016c-UDC1-52140 SHEET 1 OF 13

PLATE NO. 2-9

CORPS OF ENGINEERS

U.S. ARM



U. S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
HUNTINGTON, W. VA.

DESIGNED BY: W.E.G.
DRAWN BY: L.M.W.
CHECKED BY: J.B. W.E.G.
QUANTITIES BY:
SUBMITTED:
RECOMMENDED:
CHIEF, ENG. DIVISION:
APPROVED:
DATE: MAY 1965
CO., U.S. DISTRICT ENGINEER.
APPROVED FOR:
DATE:

DEER CREEK, OHIO
DEER CREEK RESERVOIR
DAM
TAINTER GATES
GENERAL ARRANGEMENT

SCALE: AS SHOWN
SPEC. NO:
DRAWING NUMBER
016c-UDC1-52.2/10
SHEET 1 OF 7

PLATE NO. 2-10

CORPS OF ENGINEERS

U.S. ARMY



U. S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
HUNTINGTON, W. VA.

DRAWN BY: D W
TRACED BY: D W
CHECKED BY: ROB-HTJ
DIGITIZED BY:
CHIEF, DESIGN BRANCH:
CHIEF, ENGINEERING DIVISION:

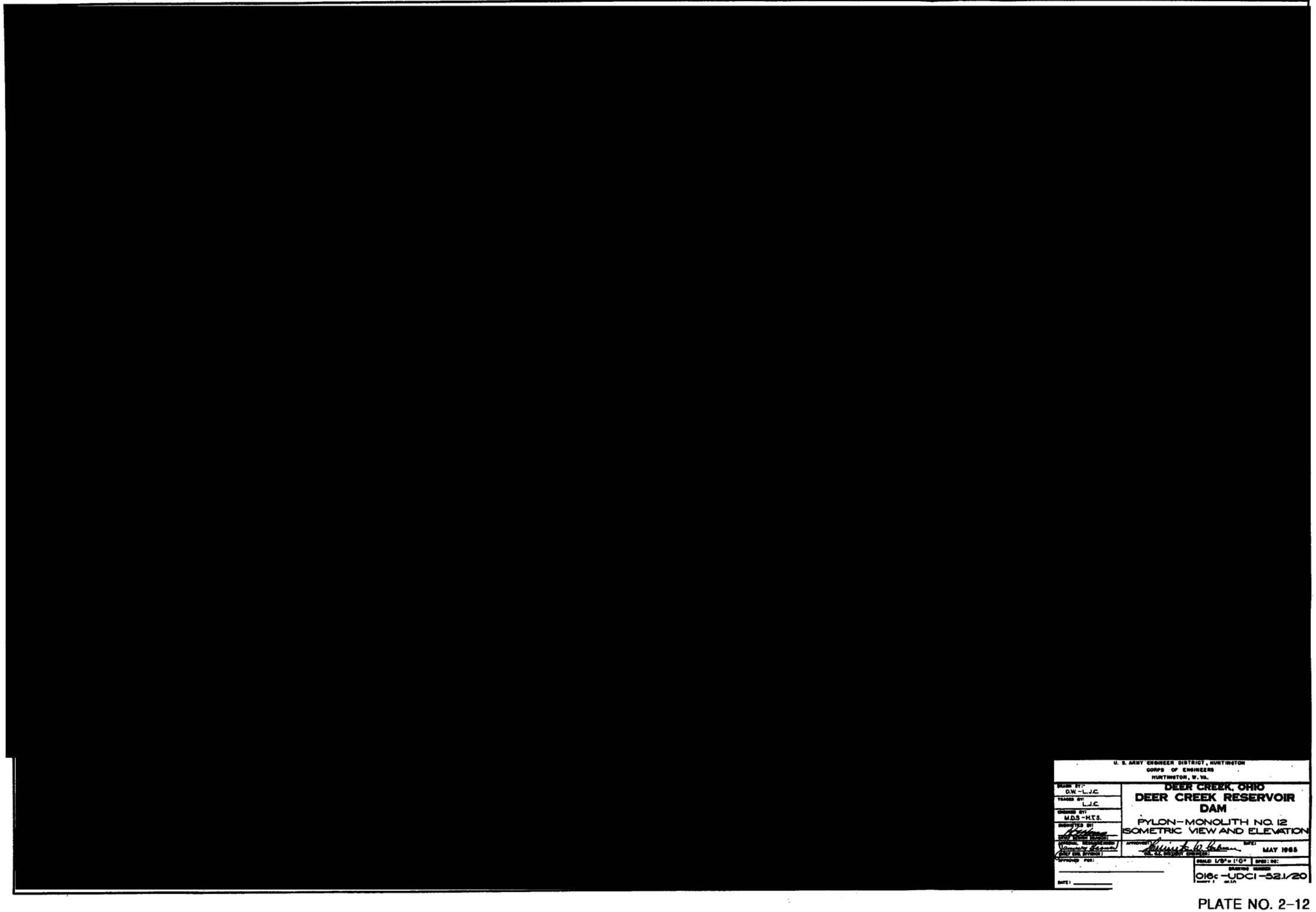
DEER CREEK, OHIO
DEER CREEK RESERVOIR
DAM
SPILLWAY
SERVICE BRIDGE
PLAN AND SECTIONS

APPROVED:
CHIEF, ENGINEERING DIVISION:
DATE: MAY 1965

APPROVED FOR
DATE:

SCALE: AS SHOWN
DRAWING NUMBER
016-UDCI-521/48
SHEET 9 OF 13

PLATE NO. 2-11



U. S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
HUNTINGTON, W. VA.

DRAWN BY: D.W. - L.J.C.
TRACED BY: L.J.C.
CHECKED BY: M.D.S - H.T.S.
SUBMITTED BY:
CHIEF, DESIGN BRANCH
APPROVED:
CHIEF, ENGINEERING DIVISION
APPROVED FOR:
DATE:

DEER CREEK, OHIO
DEER CREEK RESERVOIR
DAM
PYLON - MONOLITH NO. 12
ISOMETRIC VIEW AND ELEVATION
APPROVED:
CO., U.S. ARMY ENGINEER
DATE: MAY 1965
SCALE: 1/8" = 1'0" SPEC. NO:
DRAWING NUMBER
016-1-UDC1-52.1/20

PLATE NO. 2-12

CORPS OF ENGINEERS

U.S. ARMY



U. S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
HUNTINGTON, W. VA.

DESIGN BY: R.E.B.
TRACED BY: E.J. – R.E.B.
CHECKED BY: M.D.S.–H.T.S.
SUBMITTED BY: [signature] CHIEF, ENGR. DIVISION
RECOMMENDED FOR APPROVAL: [signature] CHIEF, ENG. DIVISION
APPROVED FOR: _____
DATE: _____

DEER CREEK, OHIO
DEER CREEK RESERVOIR
DAM
PYLON–MONOLITH NO. 12
SECTIONAL ELEVATIONS

APPROVED: [signature] DATE: MAY 1965
CHIEF, U.S. DISTRICT ENGINEER

SCALE: 1/4" = 1'-0" SPEC. NO:

DRAWING NUMBER
016-UDC1-521/21
SHEET 2 OF 10

PLATE NO. 2–13

CORPS OF ENGINEERS



U. S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
HUNTINGTON, W. VA.

DESIGN BY: KMW & R E B
TRACED BY: R E B
CHECKED BY: LRC - KGB - HTS
SUBMITTED BY:
RECOMMENDED:
APPROVED FOR:
DATE:

DEER CREEK, OHIO
DEER CREEK RESERVOIR
DAM
SPILLWAY
STILLING BASIN
APRON BAFFLE AND END SILL
APPROVED:
DATE: MAY 1965
CHIEF, C.E. DISTRICT ENGINEER:

SCALE: AS SHOWN | SPEC. NO:
DRAWING NUMBER
016-NDCI-52.1/52
SHEET 13 OF 13

PLATE NO. 2-14



PLATE NO. 2–15

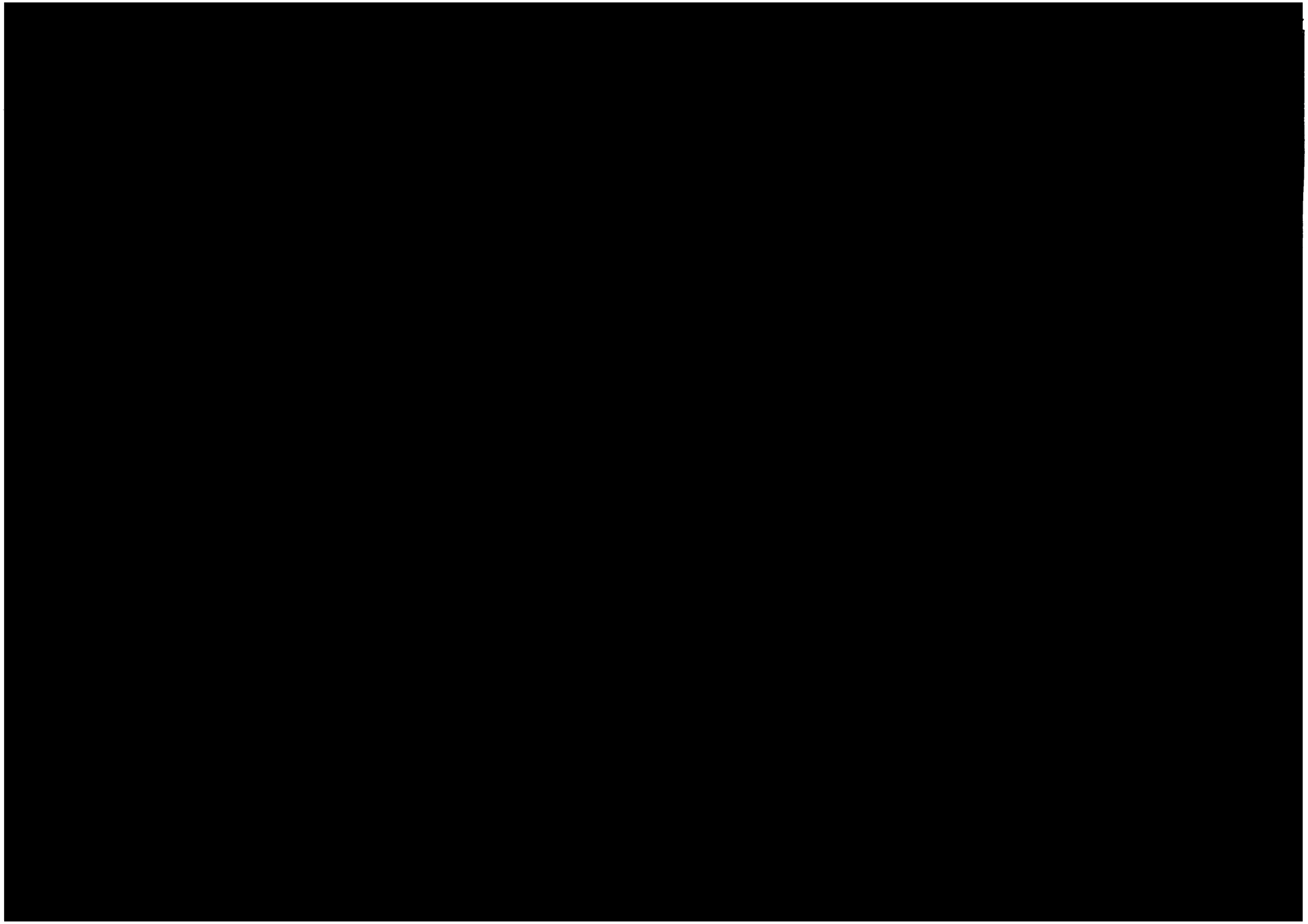


PLATE NO. 2-16

47 0703

K+E 10 X 10 TO THE INCH • 10 X 15 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

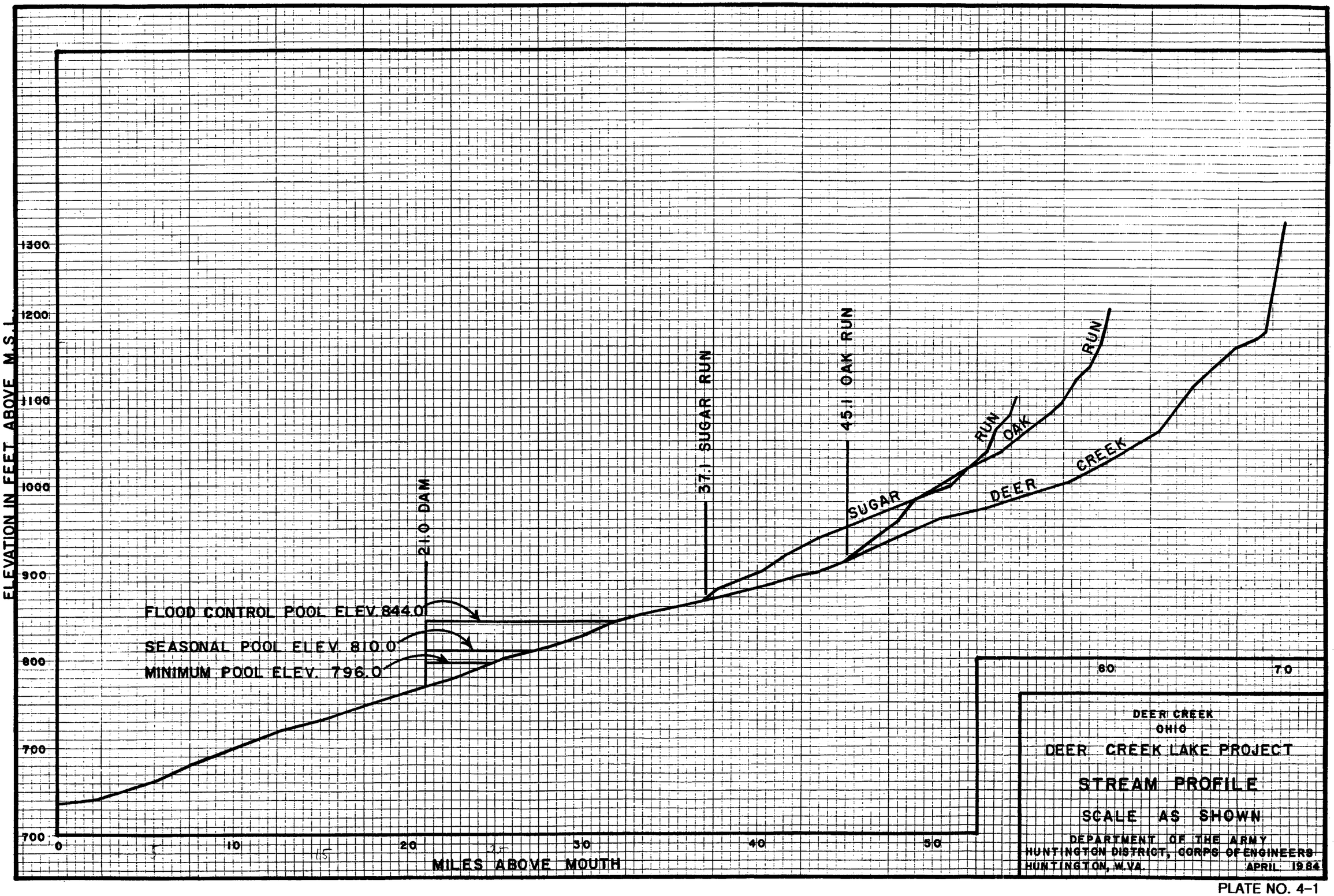
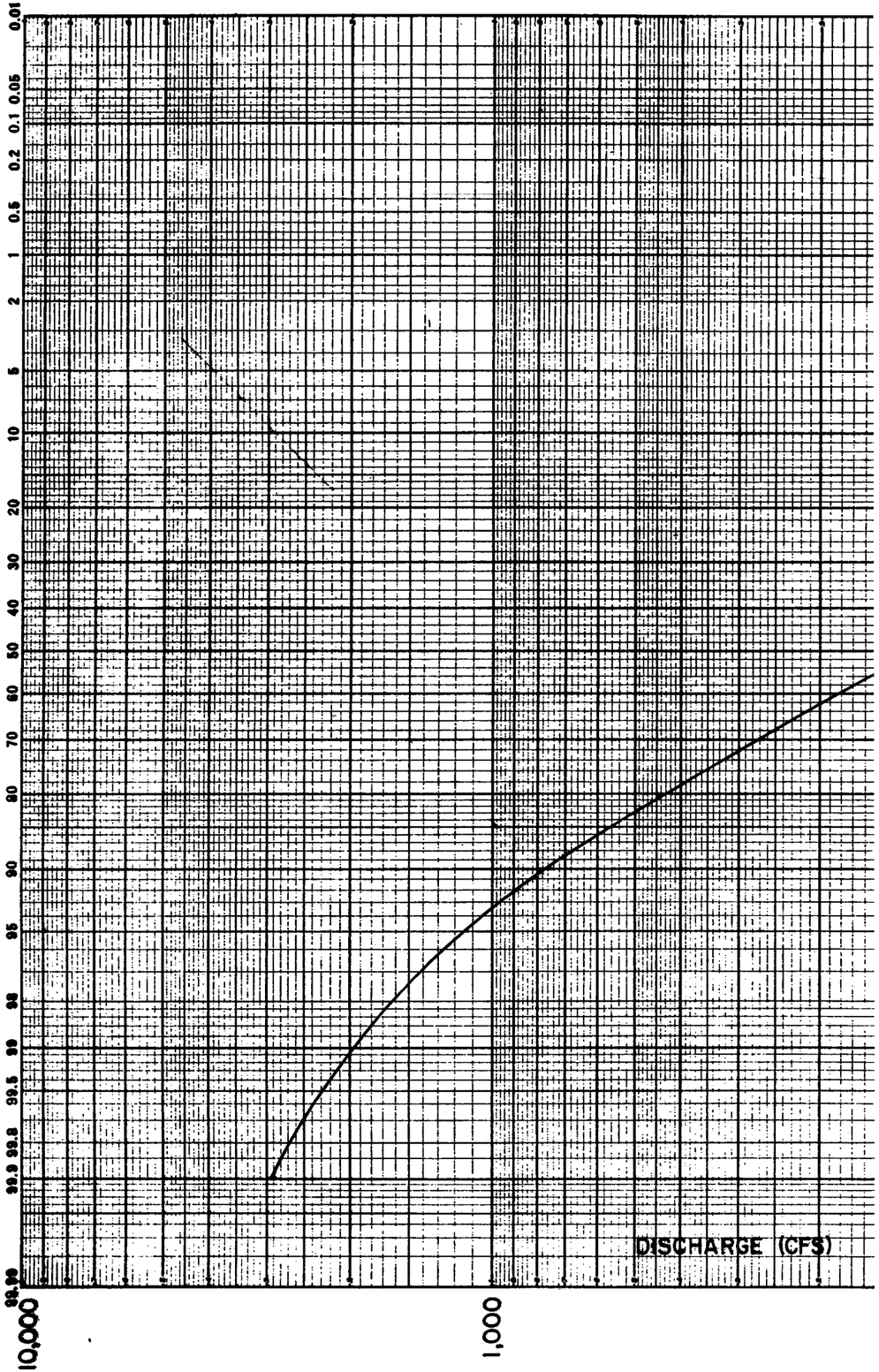


PLATE NO. 4-1

Codex
GRAPH PAPER
IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062
PRINTED IN U.S.A.
NO. 4126. PROBABILITY 2 FOUR 3½ INCH LOGARITHMIC CYCLES.



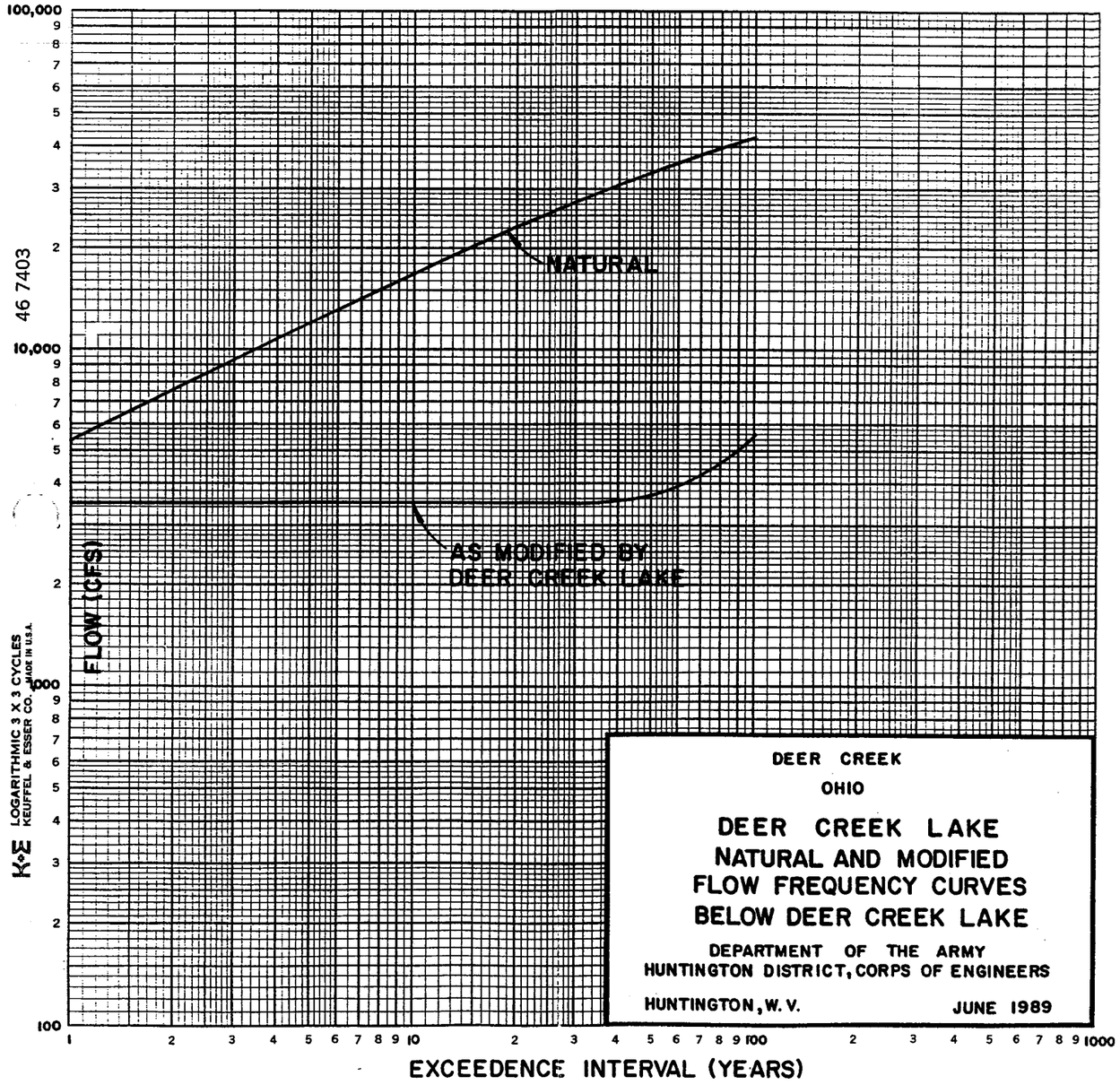


PLATE NO. 4-2

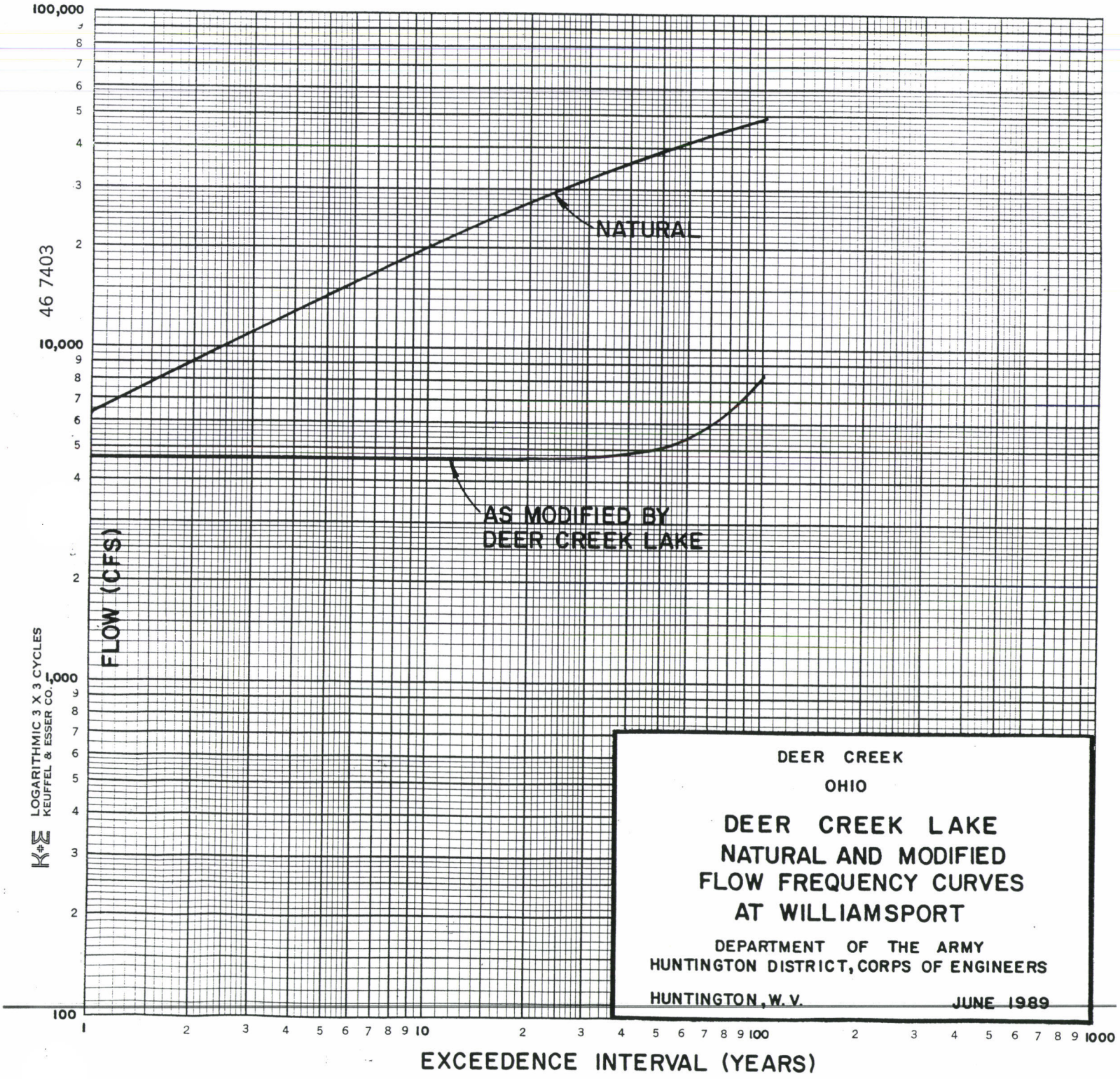
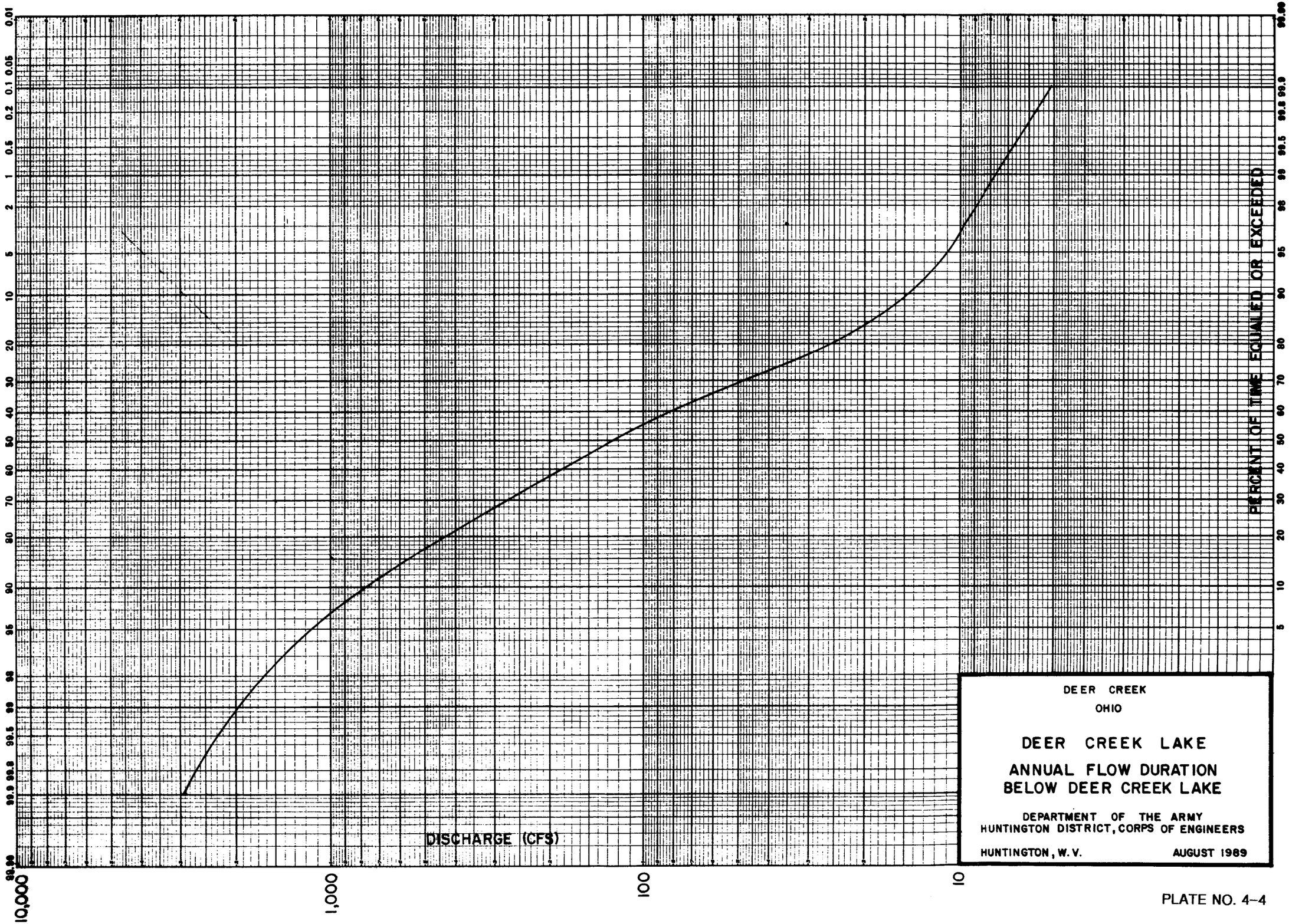

100,000
10,000
1,000
100
FLOW (CFS)
NATURAL
AS MODIFIED BY
DEER CREEK LAKE
1
2
3
4
5
6
7
8
9
10
100
1000
EXCEEDENCE INTERVAL (YEARS)
46 7403
LOGARITHMIC 3 X 3 CYCLES
KEUFFEL & ESSER CO.
DEER CREEK
OHIO
DEER CREEK LAKE
NATURAL AND MODIFIED
FLOW FREQUENCY CURVES
AT WILLIAMSPORT
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. V.
JUNE 1989

PLATE NO. 4-3

codex IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062
GRAPH PAPER PRINTED IN U.S.A.
NO. 4128. PROBABILITY 2 FOUR 3½ INCH LOGARITHMIC CYCLES.



DEER CREEK
OHIO

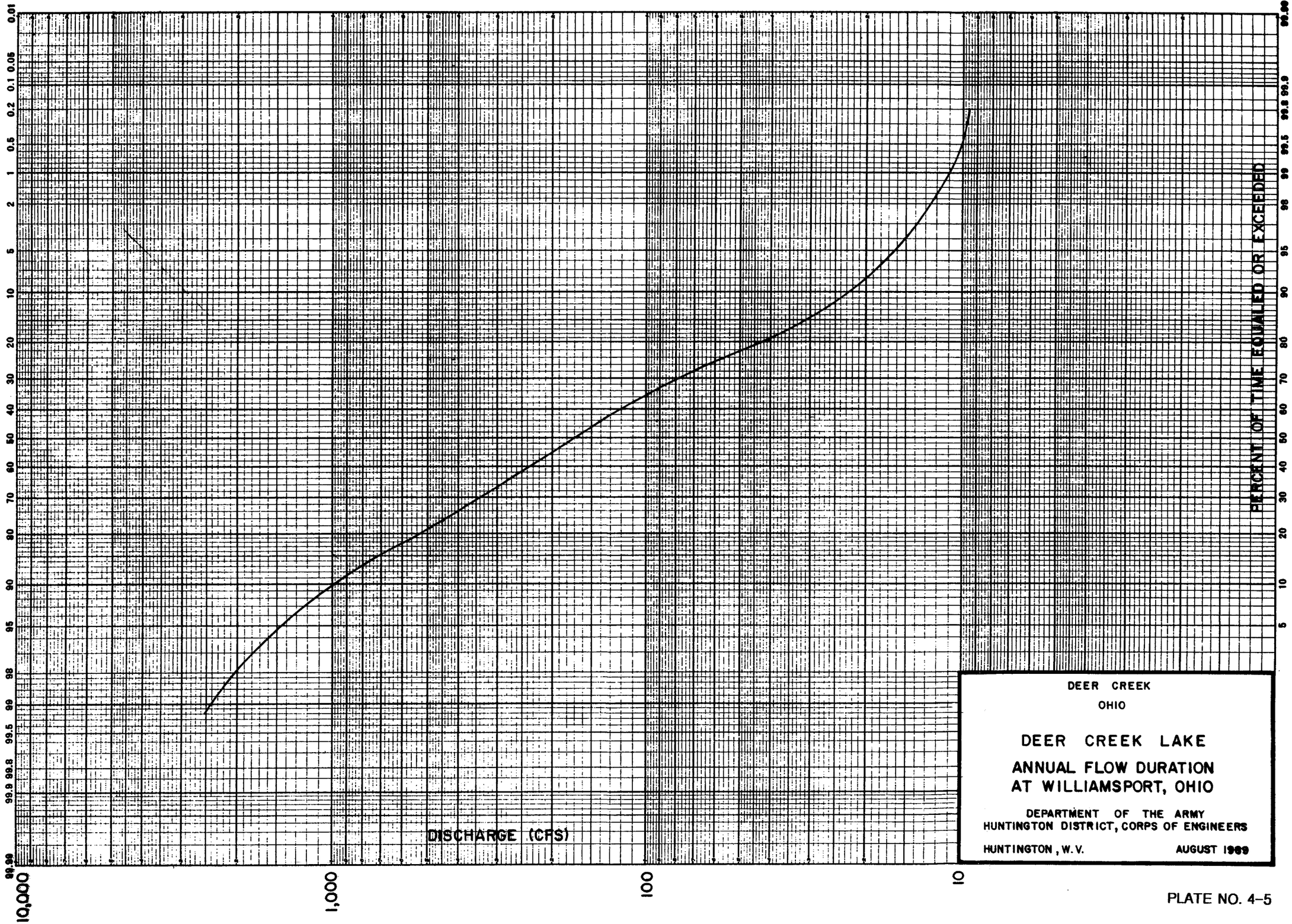
DEER CREEK LAKE
ANNUAL FLOW DURATION BELOW DEER CREEK LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. AUGUST 1989

PLATE NO. 4-4

Eastman Kodak
IN STOCK DIRECT FROM CODEX BOOK CO., NORWOOD, MASS. 02062
GRAPH PAPER
PRINTED IN U.S.A.
NO. 4128. PROBABILITY 2 FOUR 2½ INCH LOGARITHMIC CYCLES.



DEER CREEK
OHIO

DEER CREEK LAKE

ANNUAL FLOW DURATION AT WILLIAMSPORT, OHIO

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. V. AUGUST 1969

PLATE NO. 4-5

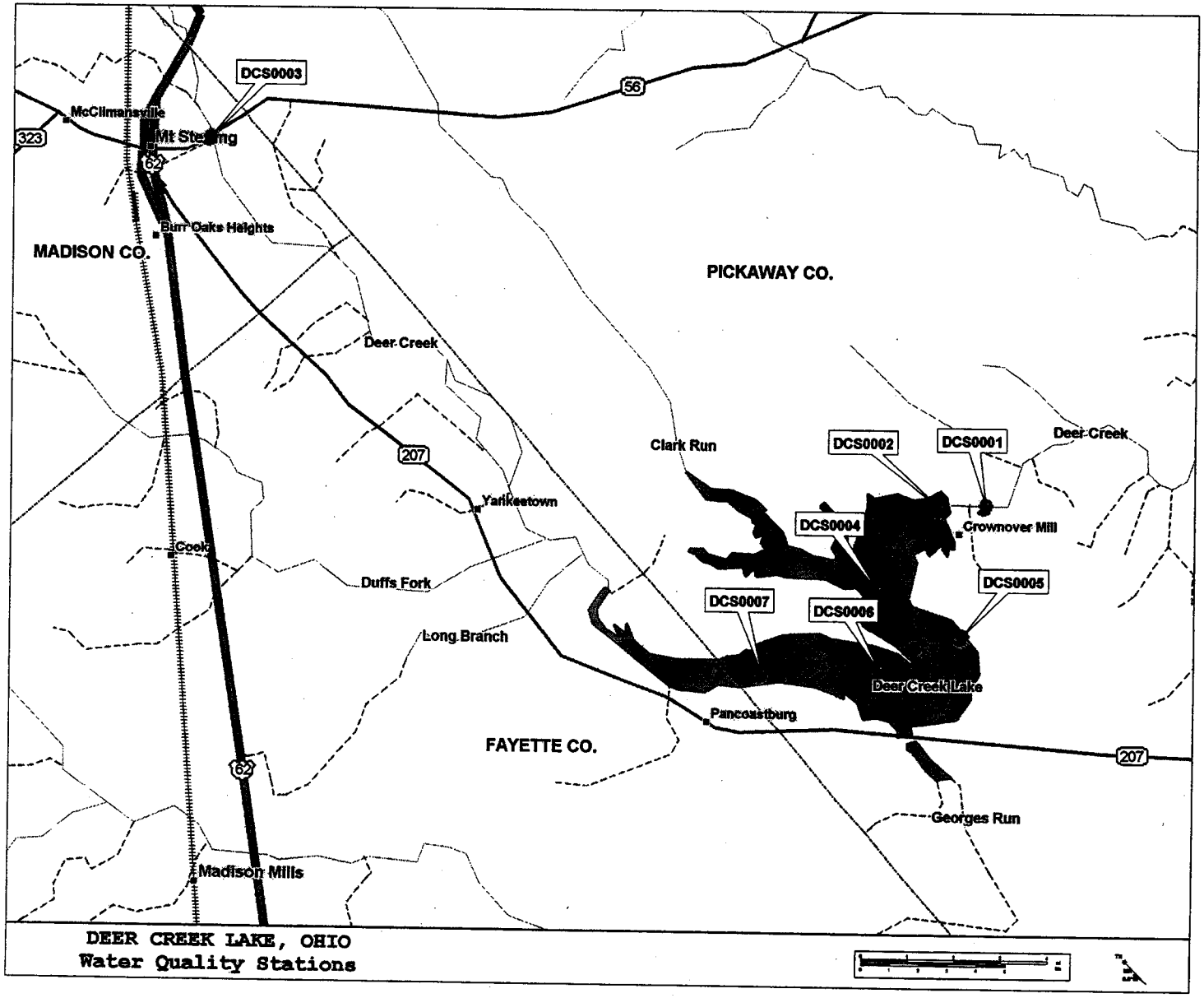
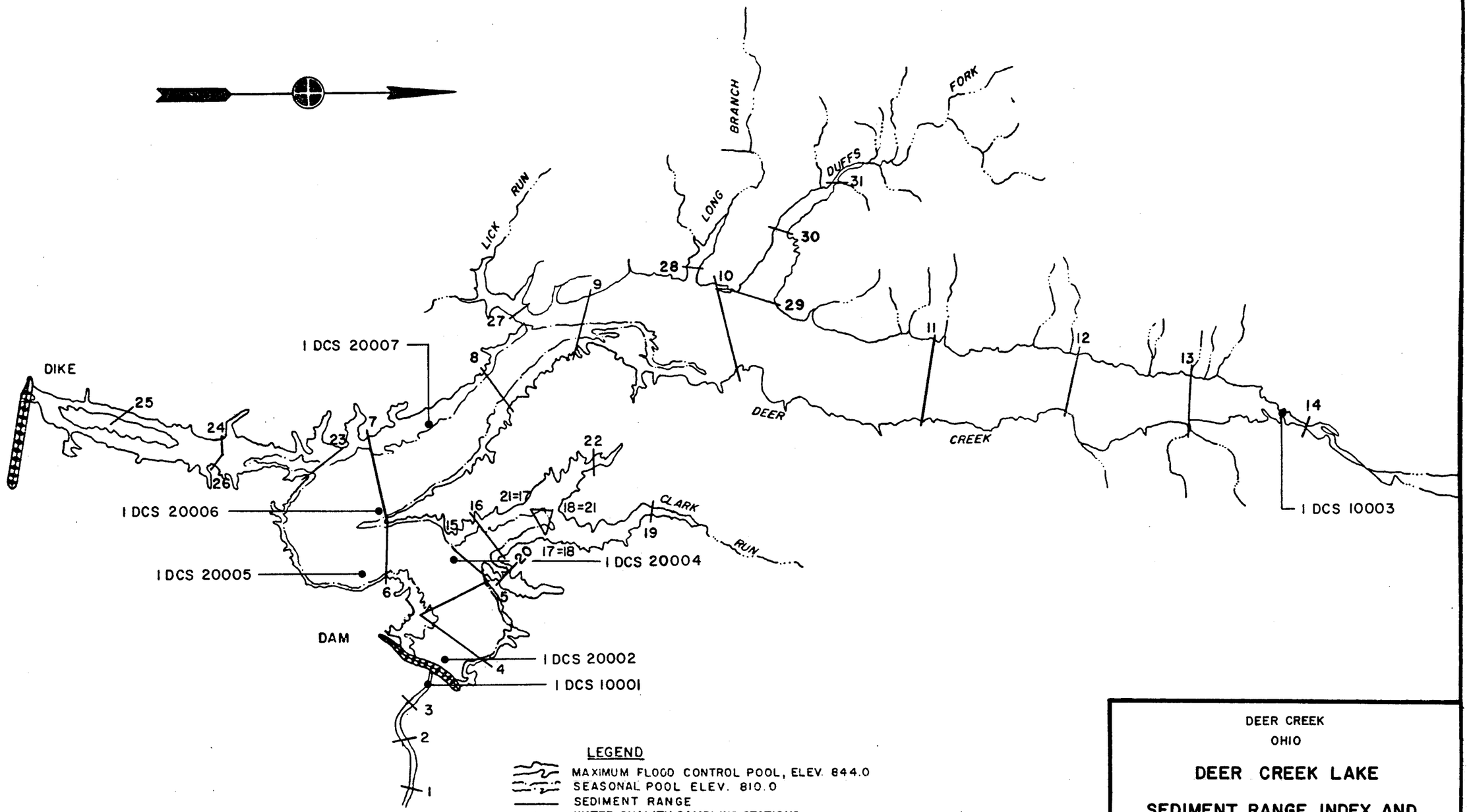

DCS0003
56
McClimansville
323
Mt Sterling
62
Burr Oaks Heights
MADISON CO.
PICKAWAY CO.
Deer Creek
207
Clark Run
DCS0002
DCS0001
Deer Creek
Yarkeetown
DCS0004
Crownover Mill
Cook
Duffs Fork
DCS0005
DCS0007
DCS0006
Long Branch
Deer Creek Lake
Pancoastburg
FAYETTE CO.
207
62
Georges Run
Madison Mills
DEER CREEK LAKE, OHIO
Water Quality Stations

PLATE NO. 5-1



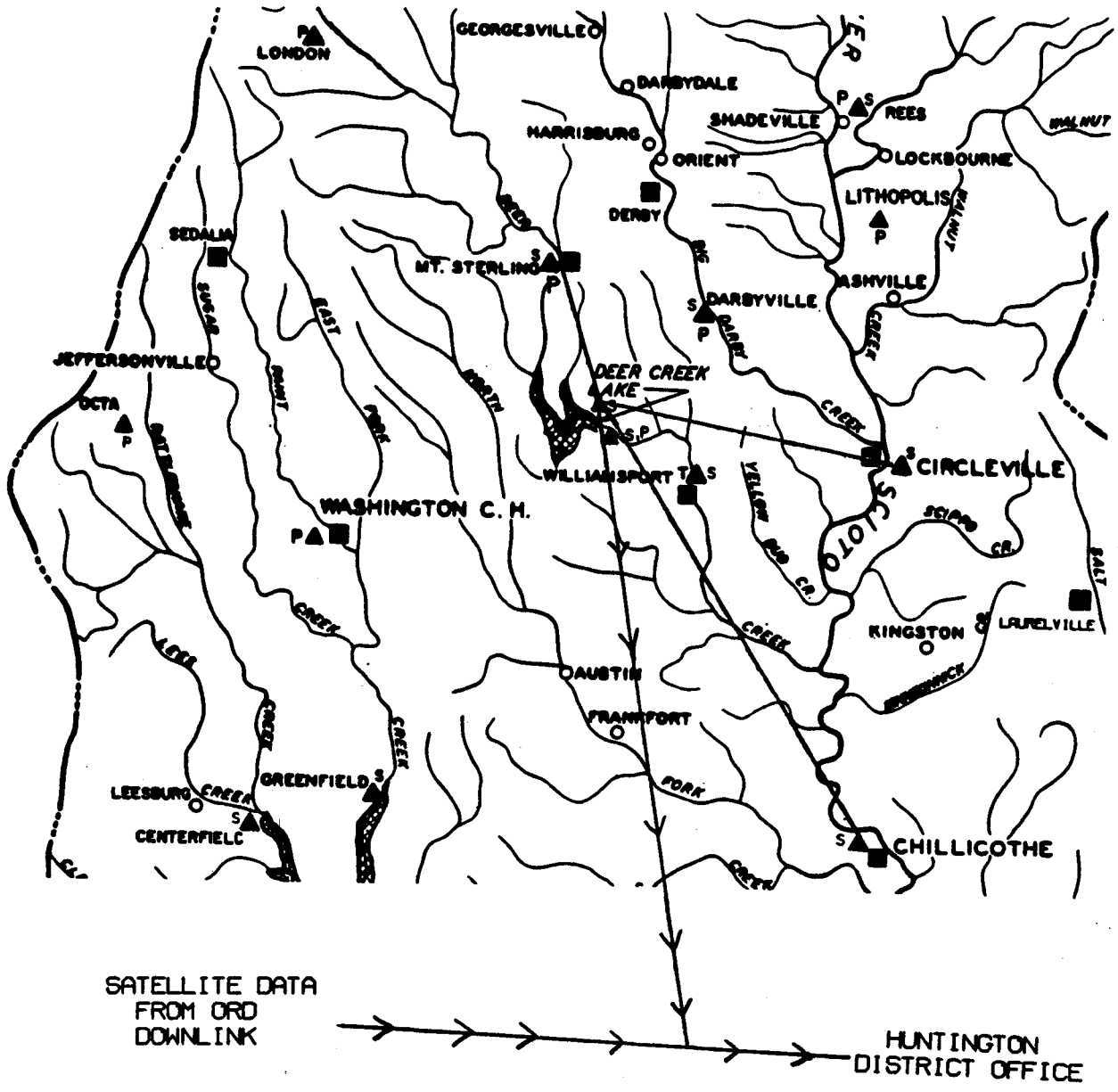
DEER CREEK
OHIO

DEER CREEK LAKE

SEDIMENT RANGE INDEX AND WATER QUALITY STATIONS

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. JUNE 1989

PLATE NO. 5-2



LEGEND

- STATE CAPITAL
- CITY OF 10,000 OR LESS
- SCIOTO BASIN BOUNDARY
- CORPS OF ENGINEER LAKES IN OPERATION
- PRECIPITATION STATIONS
- STREAMFLOW STATIONS
- DATA PLATFORMS (EXISTING)

S STAGE

P PRECIPITATION

R RECORDING GAGE

DEER CREEK

OHIO

DEER CREEK LAKE

HYDROLOGIC NETWORK

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. V. JUNE 1989

PLATE NO. 5-3

DEER CREEK LAKE
DEER CREEK

AREA AND CAPACITY TABLES

DRAINAGE AREA = 277 SQ.MI. 1 IN. RUNOFF = 14,773 AC.FT.

POOL EL.	CAPACITY AC.FT.	CAPACITY INCHES	AREA ACRES	POOL EL.	CAPACITY AC.FT.	CAPACITY INCHES	AREA ACRES
769	0	0.00	0	804	13,936	0.94	1,092
770	1	0.00	0	805	15,042	1.02	1,121
771	1	0.00	1	806	16,178	1.09	1,151
772	2	0.00	1	807	17,345	1.17	1,182
773	4	0.00	2	808	18,542	1.25	1,212
774	7	0.00	4	809	19,769	1.34	1,243
775	12	0.00	7	810	21,029	1.42	1,277
776	27	0.00	21	811	22,324	1.51	1,313
777	57	0.00	39	812	23,657	1.60	1,351
778	107	0.01	61	813	25,028	1.69	1,391
779	181	0.01	86	814	26,441	1.79	1,434
780	279	0.02	112	815	27,898	1.89	1,478
781	405	0.03	139	816	29,402	1.99	1,529
782	558	0.04	168	817	30,957	2.09	1,581
783	741	0.05	199	818	32,565	2.20	1,636
784	956	0.06	231	819	34,230	2.31	1,694
785	1,203	0.08	264	820	35,955	2.43	1,756
786	1,483	0.10	297	821	37,744	2.55	1,822
787	1,798	0.12	332	822	39,601	2.68	1,892
788	2,148	0.15	368	823	41,530	2.81	1,965
789	2,534	0.17	405	824	43,534	2.94	2,042
790	2,960	0.20	445	825	45,615	3.08	2,120
791	3,425	0.23	485	826	47,776	3.23	2,203
792	3,932	0.27	528	827	50,021	3.38	2,288
793	4,481	0.30	572	828	52,353	3.54	2,375
794	5,078	0.34	619	829	54,772	3.70	2,463
795	5,722	0.39	669	830	57,278	3.87	2,550
796	6,420	0.43	727	831	59,870	4.05	2,633
797	7,177	0.49	788	832	62,544	4.23	2,715
798	7,997	0.54	851	833	65,300	4.41	2,798
799	8,877	0.60	909	834	68,142	4.61	2,886
800	9,812	0.66	961	835	71,074	4.80	2,979
801	10,792	0.73	1,000	836	74,106	5.01	3,084
802	11,809	0.80	1,034	837	77,245	5.22	3,194
803	12,858	0.87	1,063	838	80,497	5.44	3,311

DEER CREEK LAKE (Cont'd)
DEER CREEK

AREA AND CAPACITY TABLES

DRAINAGE AREA = 277 SQ.MI. 1 IN. RUNOFF = 14,773 AC.FT.

POOL EL.	CAPACITY AC.FT.	CAPACITY INCHES	AREA ACRES	POOL EL.	CAPACITY AC.FT.	CAPACITY INCHES	AREA ACRES
839	83,867	5.67	3,429				
840	87,357	5.91	3,550				
841	90,968	6.15	3,671				
842	94,700	6.40	3,794				
843	98,557	6.66	3,919				
844	102,540	6.93	4,046				
845	106,650	7.21	4,175				
846	110,890	7.50	4,304				
847	115,260	7.79	4,435				
848	119,760	8.10	4,567				
849	124,397	8.41	4,705				
850	129,174	8.73	4,849				
851	134,096	9.06	4,996				
852	139,169	9.41	5,149				
853	144,398	9.76	5,308				
854	149,791	10.13	5,479				
855	155,361	10.50	5,661				

DEER CREEK LAKE

PERCENT STORAGE UTILIZATION - WINTER

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
796	0.00	0.08	0.15	0.23	0.31	0.39	0.46	0.54	0.62	0.71
797	0.79	0.87	0.95	1.04	1.12	1.21	1.29	1.38	1.47	1.55
798	1.64	1.73	1.82	1.91	2.00	2.09	2.18	2.28	2.37	2.46
799	2.56	2.65	2.75	2.84	2.94	3.04	3.13	3.23	3.33	3.43
800	3.53	3.63	3.73	3.83	3.93	4.03	4.14	4.24	4.34	4.44
801	4.55	4.65	4.76	4.86	4.97	5.07	5.18	5.29	5.39	5.50
802	5.61	5.71	5.82	5.93	6.04	6.15	6.26	6.37	6.48	6.59
803	6.70	6.81	6.92	7.03	7.14	7.26	7.37	7.48	7.59	7.71
804	7.82	7.93	8.05	8.16	8.28	8.39	8.51	8.62	8.74	8.85
805	8.97	9.09	9.20	9.32	9.44	9.56	9.68	9.79	9.91	10.03
806	10.15	10.27	10.39	10.51	10.63	10.76	10.88	11.00	11.12	11.24
807	11.37	11.49	11.61	11.74	11.86	11.98	12.11	12.23	12.36	12.49
808	12.61	12.74	12.86	12.99	13.12	13.25	13.37	13.50	13.63	13.76
809	13.89	14.02	14.15	14.28	14.41	14.54	14.67	14.80	14.93	15.07
810	15.20	15.33	15.47	15.60	15.73	15.87	16.00	16.14	16.27	16.41
811	16.55	16.68	16.82	16.96	17.10	17.23	17.37	17.51	17.65	17.79
812	17.93	18.07	18.21	18.36	18.50	18.64	18.78	18.93	19.07	19.21
813	19.36	19.50	19.65	19.80	19.94	20.09	20.24	20.38	20.53	20.68
814	20.83	20.98	21.13	21.28	21.43	21.58	21.73	21.89	22.04	22.19
815	22.35	22.50	22.65	22.81	22.96	23.12	23.28	23.43	23.59	23.75
816	23.91	24.07	24.23	24.39	24.55	24.71	24.87	25.04	25.20	25.36
817	25.53	25.69	25.86	26.02	26.19	26.36	26.52	26.69	26.86	27.03
818	27.20	27.37	27.54	27.71	27.89	28.06	28.23	28.41	28.58	28.76
819	28.93	29.11	29.29	29.46	29.64	29.82	30.00	30.18	30.36	30.54
820	30.73	30.91	31.09	31.28	31.46	31.65	31.84	32.02	32.21	32.40

DEER CREEK LAKE (Cont'd)

PERCENT STORAGE UTILIZATION - WINTER

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
821	32.59	32.78	32.97	33.16	33.35	33.55	33.74	33.93	34.13	34.33
822	34.52	34.72	34.92	35.12	35.31	35.51	35.72	35.92	36.12	36.32
823	36.53	36.73	36.94	37.14	37.35	37.56	37.77	37.98	38.19	38.40
824	38.61	38.83	39.04	39.25	39.47	39.68	39.90	40.12	40.34	40.56
825	40.78	41.00	41.22	41.44	41.67	41.89	42.12	42.34	42.57	42.80
826	43.03	43.26	43.49	43.72	43.95	44.18	44.42	44.65	44.89	45.12
827	45.36	45.60	45.84	46.08	46.32	46.56	46.81	47.05	47.29	47.54
828	47.79	48.04	48.28	48.53	48.78	49.03	49.29	49.54	49.79	50.05
829	50.30	50.56	50.82	51.08	51.34	51.60	51.86	52.12	52.38	52.65
830	52.91	53.18	53.44	53.71	53.98	54.25	54.52	54.79	55.06	55.33
831	55.61	55.88	56.16	56.43	56.71	56.99	57.27	57.55	57.83	58.11
832	58.39	58.67	58.96	59.24	59.53	59.81	60.10	60.39	60.68	60.97
833	61.26	61.55	61.84	62.13	62.43	62.72	63.02	63.32	63.62	63.91
834	64.21	64.51	64.82	65.12	65.42	65.73	66.03	66.34	66.65	66.95
835	67.26	67.57	67.89	68.20	68.51	68.83	69.14	69.46	69.78	70.10
836	70.42	70.74	71.06	71.39	71.71	72.04	72.36	72.69	73.02	73.35
837	73.68	74.02	74.35	74.69	75.02	75.36	75.70	76.04	76.38	76.72
838	77.07	77.41	77.76	78.11	78.46	78.81	79.16	79.51	79.86	80.22
839	80.57	80.93	81.29	81.65	82.01	82.37	82.74	83.10	83.47	83.84
840	84.20	84.57	84.95	85.32	85.69	86.07	86.44	86.82	87.20	87.58
841	87.96	88.34	88.73	89.11	89.50	89.89	90.28	90.67	91.06	91.45
842	91.84	92.24	92.64	93.03	93.43	93.83	94.24	94.64	95.04	95.45
843	95.86	96.27	96.68	97.09	97.50	97.91	98.33	98.74	99.16	99.58
844	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DEER CREEK LAKE

PERCENT STORAGE UTILIZATION - SUMMER

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
810	0.00	0.16	0.31	0.47	0.63	0.79	0.95	1.11	1.27	1.43
811	1.59	1.75	1.91	2.07	2.24	2.40	2.56	2.73	2.89	3.06
812	3.22	3.39	3.56	3.72	3.89	4.06	4.23	4.40	4.57	4.74
813	4.91	5.08	5.25	5.42	5.59	5.77	5.94	6.11	6.29	6.46
814	6.64	6.82	6.99	7.17	7.35	7.53	7.71	7.88	8.07	8.25
815	8.43	8.61	8.79	8.97	9.16	9.34	9.53	9.71	9.90	10.09
816	10.27	10.46	10.65	10.84	11.03	11.22	11.41	11.60	11.79	11.99
817	12.18	12.37	12.57	12.76	12.96	13.16	13.36	13.55	13.75	13.95
818	14.15	14.35	14.56	14.76	14.96	15.17	15.37	15.58	15.78	15.99
819	16.20	16.40	16.61	16.82	17.03	17.24	17.46	17.67	17.88	18.10
820	18.31	18.53	18.74	18.96	19.18	19.40	19.62	19.84	20.06	20.28
821	20.51	20.73	20.96	21.18	21.41	21.64	21.86	22.09	22.32	22.55
822	22.79	23.02	23.25	23.49	23.72	23.96	24.19	24.43	24.67	24.91
823	25.15	25.39	25.64	25.88	26.12	26.37	26.62	26.86	27.11	27.36
824	27.61	27.86	28.11	28.37	28.62	28.87	29.13	29.39	29.64	29.90
825	30.16	30.42	30.69	30.95	31.21	31.48	31.74	32.01	32.28	32.54
826	32.81	33.09	33.36	33.63	33.90	34.18	34.45	34.73	35.01	35.29
827	35.57	35.85	36.13	36.42	36.70	36.99	37.27	37.56	37.85	38.14
828	38.43	38.72	39.01	39.31	39.60	39.90	40.20	40.50	40.80	41.10
829	41.40	41.70	42.00	42.31	42.61	42.92	43.23	43.54	43.85	44.16
830	44.47	44.79	45.10	45.42	45.73	46.05	46.37	46.69	47.01	47.33
831	47.65	47.98	48.30	48.63	48.95	49.28	49.61	49.94	50.27	50.60
832	50.93	51.27	51.60	51.94	52.27	52.61	52.95	53.29	53.63	53.97
833	54.31	54.66	55.00	55.35	55.70	56.04	56.39	56.74	57.09	57.45
834	57.80	58.15	58.51	58.87	59.22	59.58	59.94	60.31	60.67	61.03
835	61.40	61.76	62.13	62.50	62.87	63.24	63.61	63.99	64.36	64.74

DEER CREEK LAKE (Cont'd)

PERCENT STORAGE UTILIZATION - SUMMER

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
836	65.12	65.50	65.88	66.26	66.64	67.03	67.41	67.80	68.19	68.58
837	68.97	69.36	69.75	70.15	70.55	70.95	71.35	71.75	72.15	72.55
838	72.96	73.37	73.77	74.18	74.59	75.01	75.42	75.84	76.25	76.67
839	77.09	77.51	77.94	78.36	78.79	79.22	79.64	80.07	80.51	80.94
840	81.37	81.81	82.25	82.69	83.13	83.57	84.01	84.46	84.91	85.36
841	85.80	86.26	86.71	87.16	87.62	88.07	88.53	88.99	89.46	89.92
842	90.38	90.85	91.32	91.79	92.26	92.73	93.20	93.68	94.16	94.64
843	95.12	95.60	96.08	96.56	97.05	97.54	98.03	98.52	99.01	99.51
844	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MAXIMUM FLOOD CONTROL POOL EL. 844.0

POOL ELEVATION IN FEET ABOVE M.S.L.

840
835
830
825
820
815
810
805
800

0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
1 GATE OPEN 2.4 FEET
2.6
2.8
3.0
3.5
4.0
4.4

SPILLWAY CREST EL. 814.0

SEASONAL POOL EL. 810.0

MINIMUM POOL EL. 796.0

0 100 200 300 400 500 600 700 800 900 1000

DISCHARGE IN C.F.S.

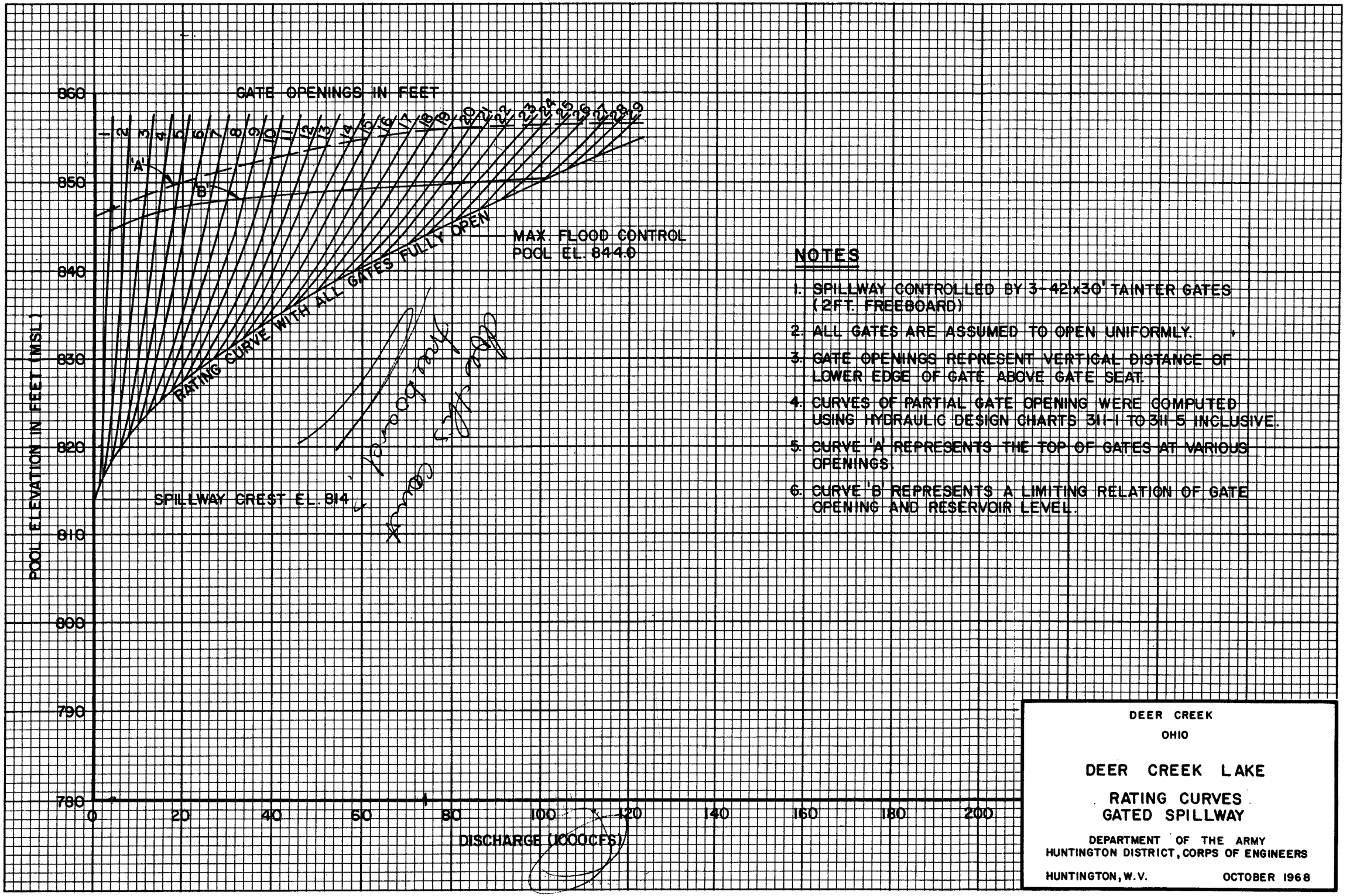
DEER CREEK
OHIO

DEER CREEK LAKE

SLUCE GATE RATING CURVES
ONE GATE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON W. VA. AUGUST 1990

PLATE NO. 7-3



NOTES

1. SPILLWAY CONTROLLED BY 3-42'x30' TAINTER GATES (2FT. FREEBOARD)
2. ALL GATES ARE ASSUMED TO OPEN UNIFORMLY.
3. GATE OPENINGS REPRESENT VERTICAL DISTANCE OF LOWER EDGE OF GATE ABOVE GATE SEAT.
4. CURVES OF PARTIAL GATE OPENING WERE COMPUTED USING HYDRAULIC DESIGN CHARTS 311-1 TO 311-5 INCLUSIVE.
5. CURVE 'A' REPRESENTS THE TOP OF GATES AT VARIOUS OPENINGS.
6. CURVE 'B' REPRESENTS A LIMITING RELATION OF GATE OPENING AND RESERVOIR LEVEL.

DEER CREEK
OHIO

DEER CREEK LAKE

RATING CURVES GATED SPILLWAY

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. OCTOBER 1968

PLATE NO. 7-4

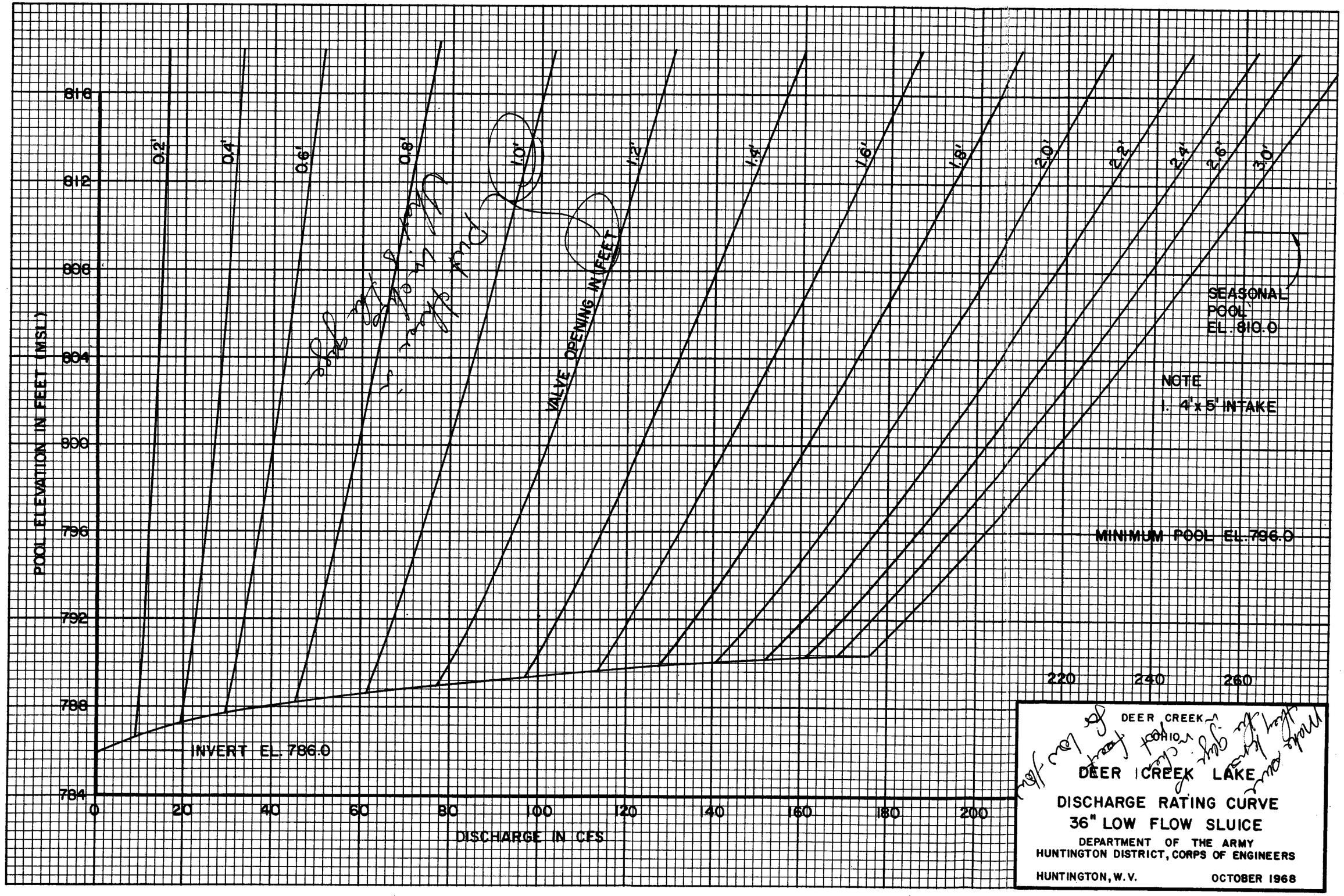
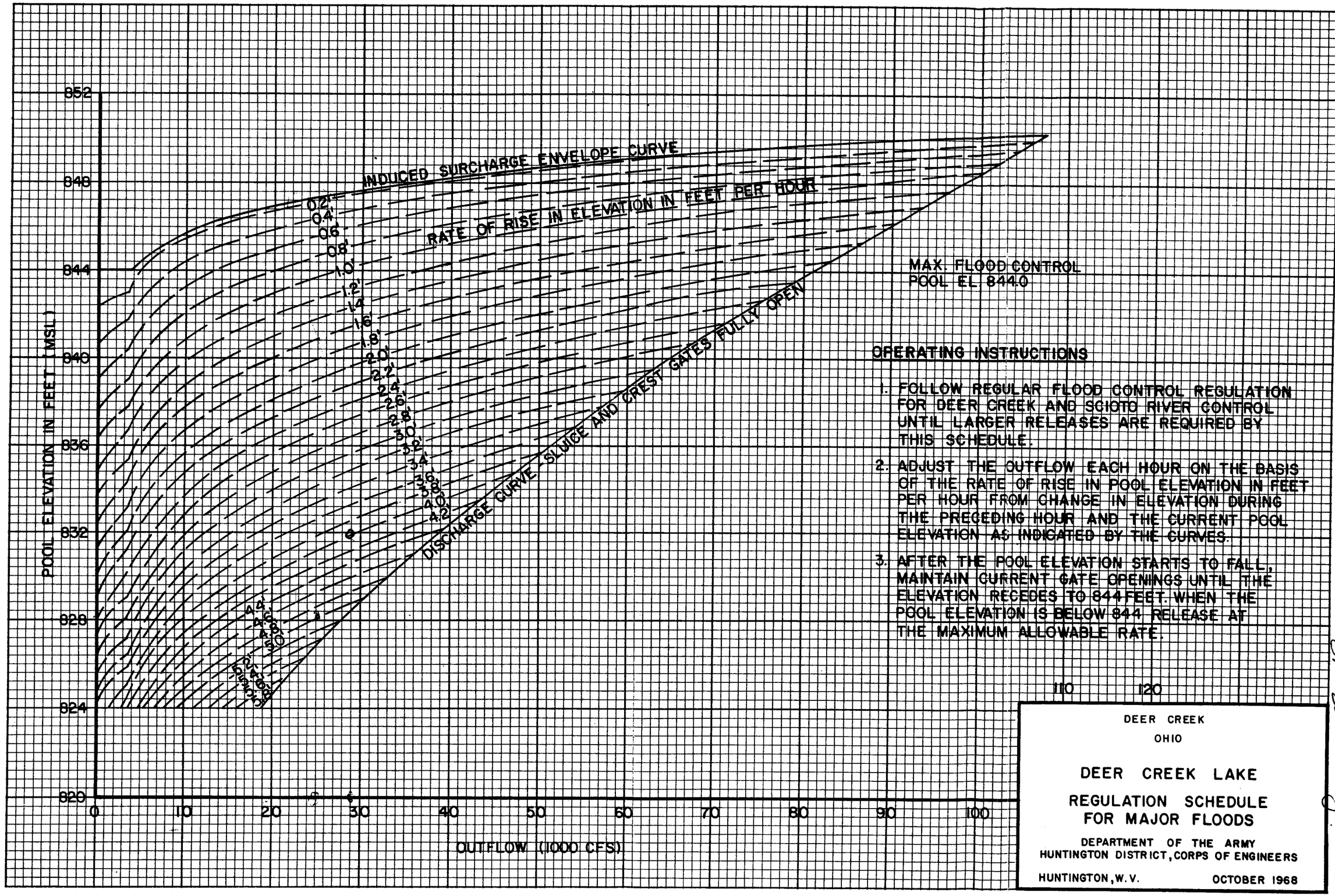

POOL ELEVATION IN FEET (MSL)
816
812
808
804
800
796
792
788
784
0
20
40
60
80
100
120
140
160
180
200
220
240
260
DISCHARGE IN CFS
0.2'
0.4'
0.6'
0.8'
1.0'
1.2'
1.4'
1.6'
1.8'
2.0'
2.2'
2.4'
2.6'
3.0'
VALVE OPENING IN FEET
SEASONAL POOL EL. 810.0
MINIMUM POOL EL. 796.0
INVERT EL. 786.0
NOTE
1. 4'x 5' INTAKE
DEER CREEK
OHIO
DEER CREEK LAKE
DISCHARGE RATING CURVE
36" LOW FLOW SLUICE
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V.
OCTOBER 1968

PLATE NO. 7-5



MAX. FLOOD CONTROL
POOL EL 844.0

OPERATING INSTRUCTIONS

1. FOLLOW REGULAR FLOOD CONTROL REGULATION FOR DEER CREEK AND SCIOTO RIVER CONTROL UNTIL LARGER RELEASES ARE REQUIRED BY THIS SCHEDULE.
2. ADJUST THE OUTFLOW EACH HOUR ON THE BASIS OF THE RATE OF RISE IN POOL ELEVATION IN FEET PER HOUR FROM CHANGE IN ELEVATION DURING THE PRECEDING HOUR AND THE CURRENT POOL ELEVATION AS INDICATED BY THE CURVES.
3. AFTER THE POOL ELEVATION STARTS TO FALL, MAINTAIN CURRENT GATE OPENINGS UNTIL THE ELEVATION RECEDES TO 844 FEET. WHEN THE POOL ELEVATION IS BELOW 844 RELEASE AT THE MAXIMUM ALLOWABLE RATE.

DEER CREEK
OHIO

DEER CREEK LAKE

REGULATION SCHEDULE FOR MAJOR FLOODS

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. OCTOBER 1968

Mark it red on last page by Dwight J.

PLATE NO. 7-6

DEER CREEK LAKE, OH - OUTFLOW TEMPERATURE OBJECTIVE

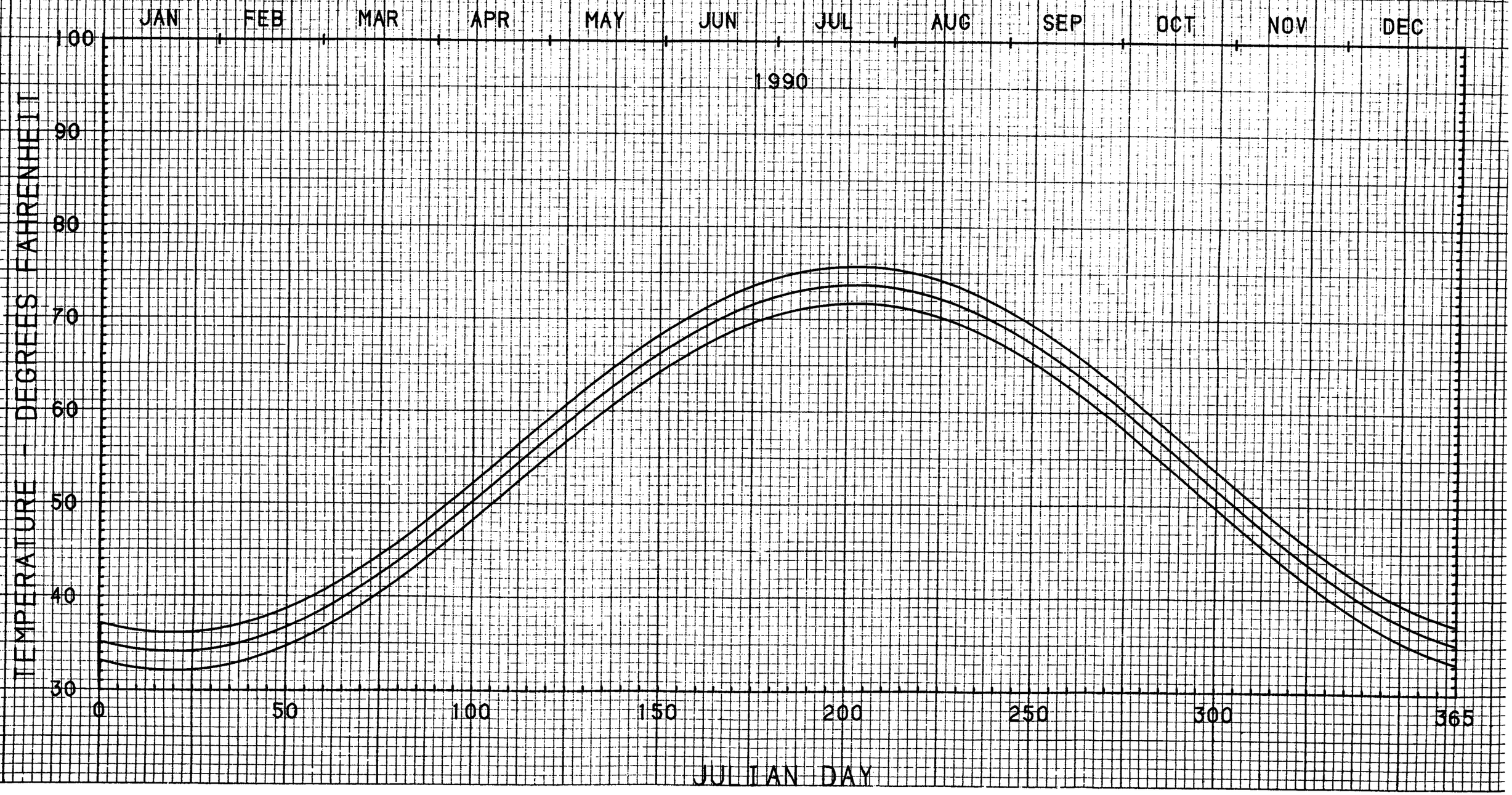
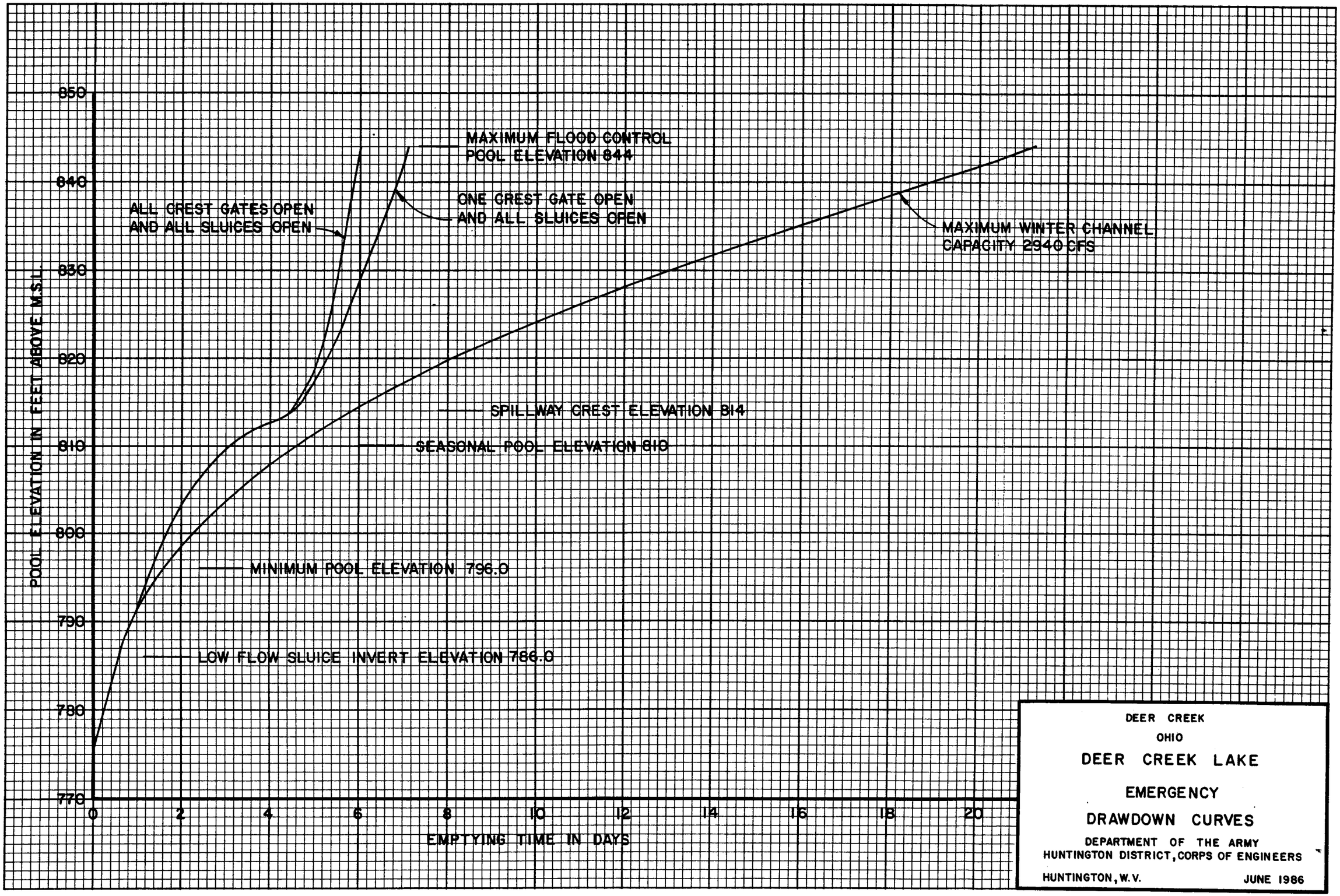


PLATE NO. 7-7



DEER CREEK
OHIO

DEER CREEK LAKE
EMERGENCY
DRAWDOWN CURVES

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. JUNE 1986

PLATE NO. 7-8

JANUARY 5 10 15 20 25 | FEBRUARY 5 10 15 20 25 | MARCH 5 10 15 20 25 | APRIL 5 10 15 20 25 | MAY 5 10 15 20 25 | JUNE 5 10 15 20 25 | JULY 5 10 15 20 25 | AUGUST 5 10 15 20 25 | SEPTEMBER 5 10 15 20 25 | OCTOBER 5 10 15 20 25 | NOVEMBER 5 10 15 20 25 | DECEMBER 5 10 15 20 25

POOL ELEVATION IN FEET (MSL)

850
840
830
820
810
800
790
780
770
760
750

MAXIMUM FLOOD CONTROL POOL EL 844.0

SEASONAL CONSERVATION POOL EL. 810.0

MINIMUM CONSERVATION POOL EL. 796.0

q/15 → decrease 10/1

RULES OF OPERATION

A. NOV. - MAR.
- (1) MAINTAIN MINIMUM RELEASE OF 10 C.F.S.
- (2) MAINTAIN POOL EL. 796.0, INSOFAR AS POSSIBLE.

B. APR. - SEP.
- (1) MAINTAIN MINIMUM RELEASE OF 10 C.F.S.
- (2) BEGINNING 1 APRIL, RAISE TO POOL EL. 810.0 BY 30 APRIL, THEN MAINTAIN THAT POOL ELEVATION INSOFAR AS POSSIBLE UNTIL 15 SEPTEMBER, THEN LOWERING TO POOL EL. 796.0, REACHING THAT ELEVATION BY 1 NOVEMBER.

DEER CREEK
OHIO

DEER CREEK LAKE

RULE CURVE FOR REGULATION

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. JUNE 1989

PLATE NO. 7-9

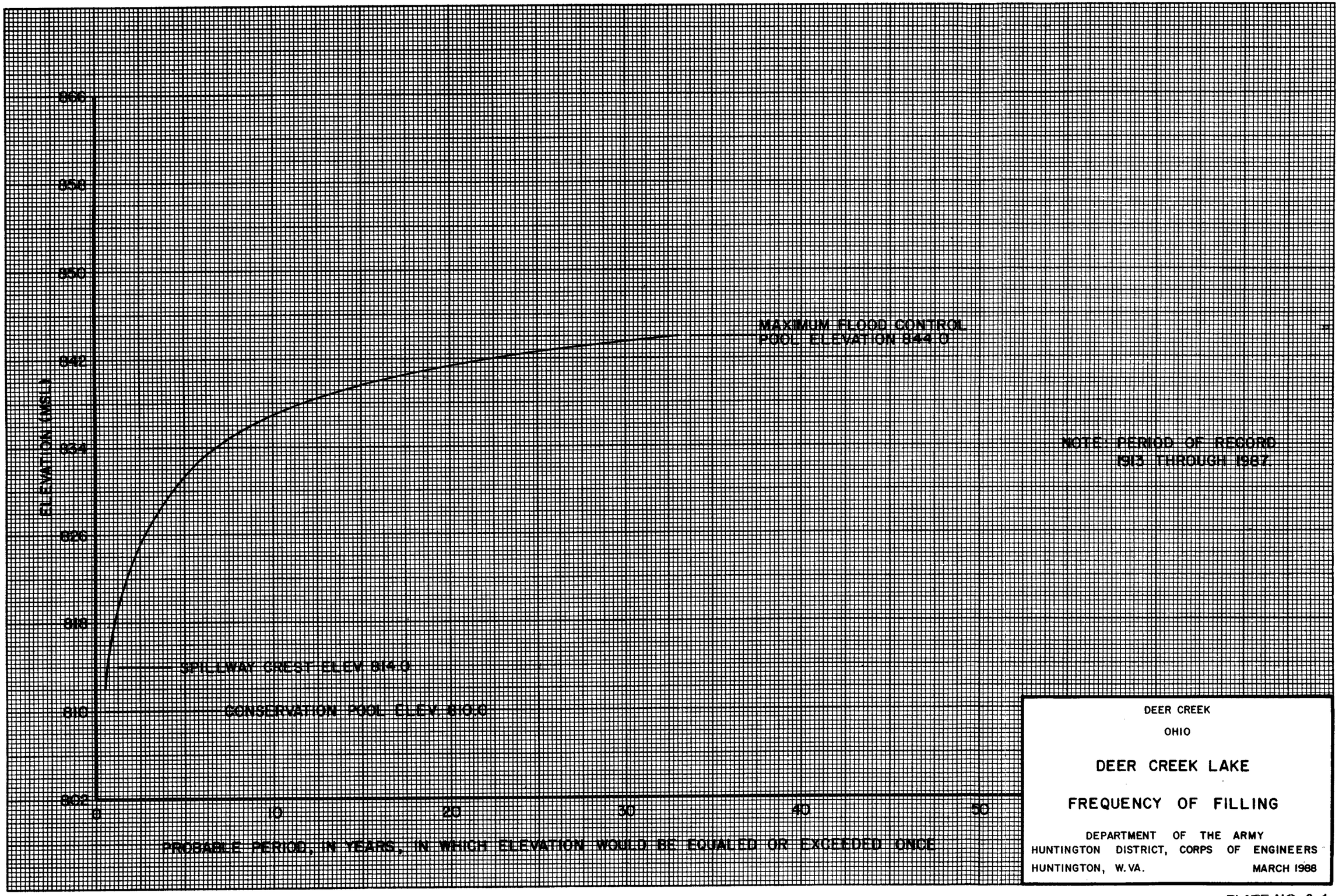
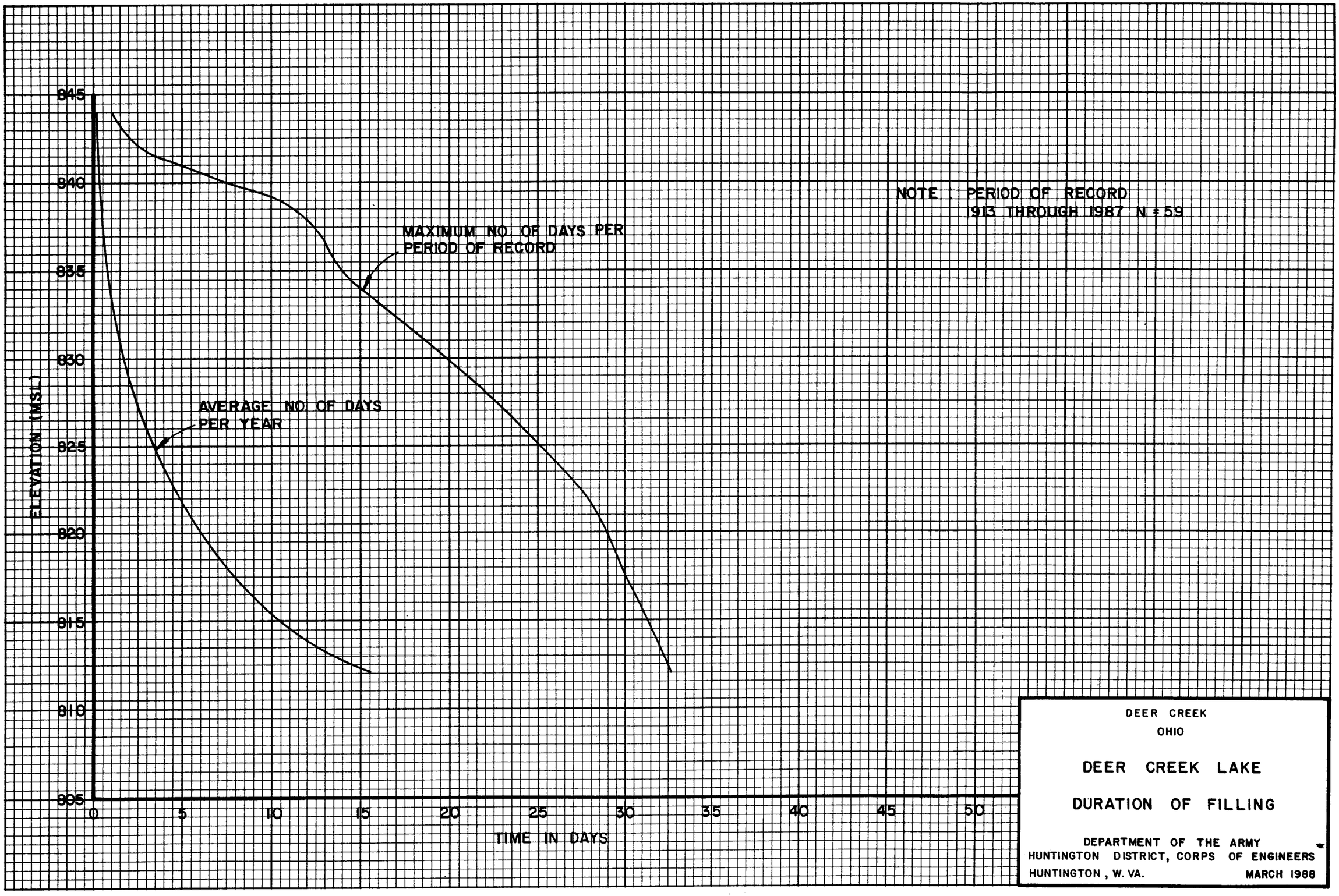

866
858
850
842
834
826
818
810
802
ELEVATION IN FEET
MAXIMUM FLOOD CONTROL POOL ELEVATION 844.0
NOTE: PERIOD OF RECORD 1913 THROUGH 1987
SPILLWAY CREST ELEV 814.0
CONSERVATION POOL ELEV 810.0
0
10
20
30
40
50
PROBABLE PERIOD, IN YEARS, IN WHICH ELEVATION WOULD BE EQUALED OR EXCEEDED ONCE
DEER CREEK
OHIO
DEER CREEK LAKE
FREQUENCY OF FILLING
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.VA.
MARCH 1988

PLATE NO. 8-1



DEER CREEK
OHIO

DEER CREEK LAKE

DURATION OF FILLING

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. MARCH 1988

PLATE NO. 8-2

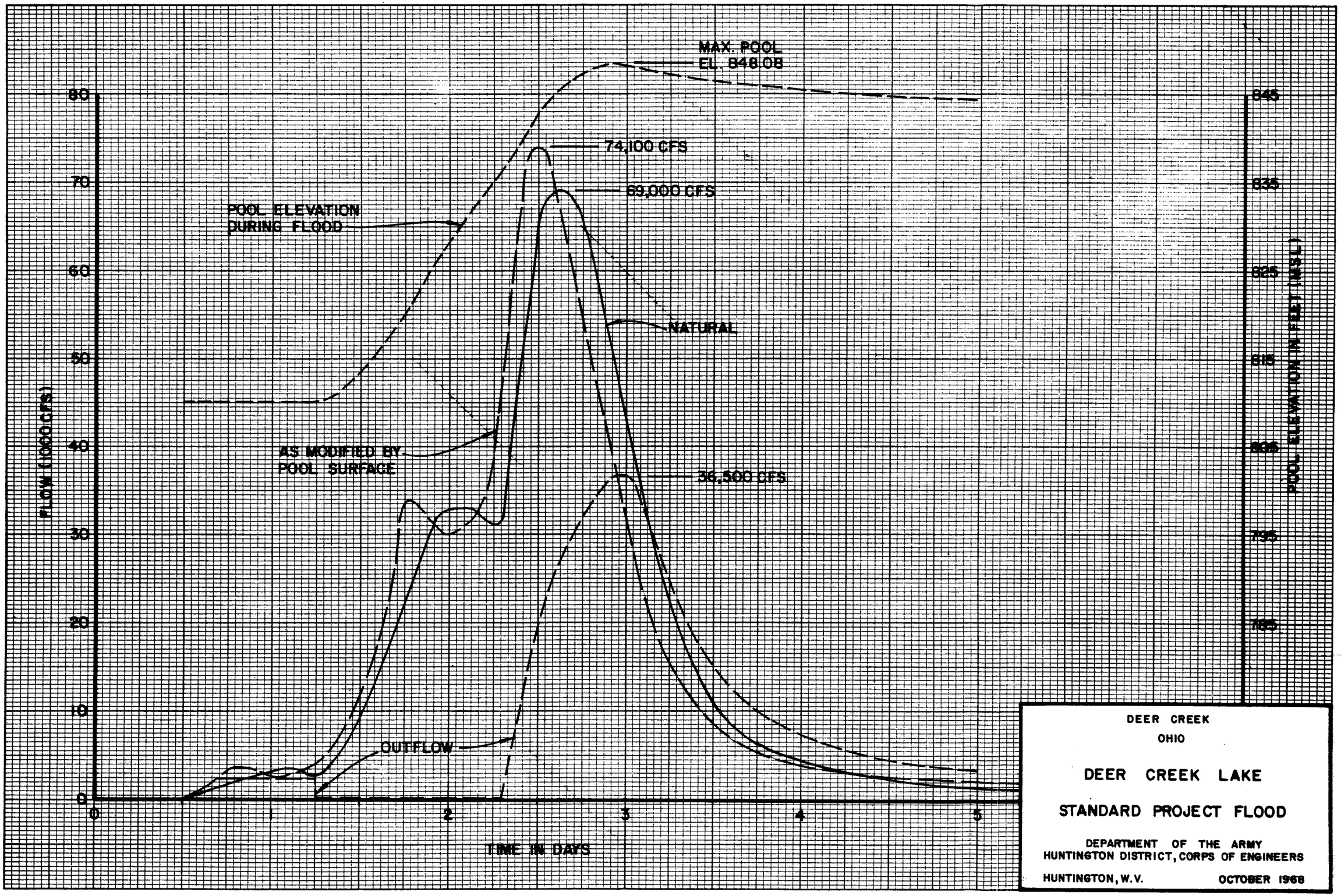
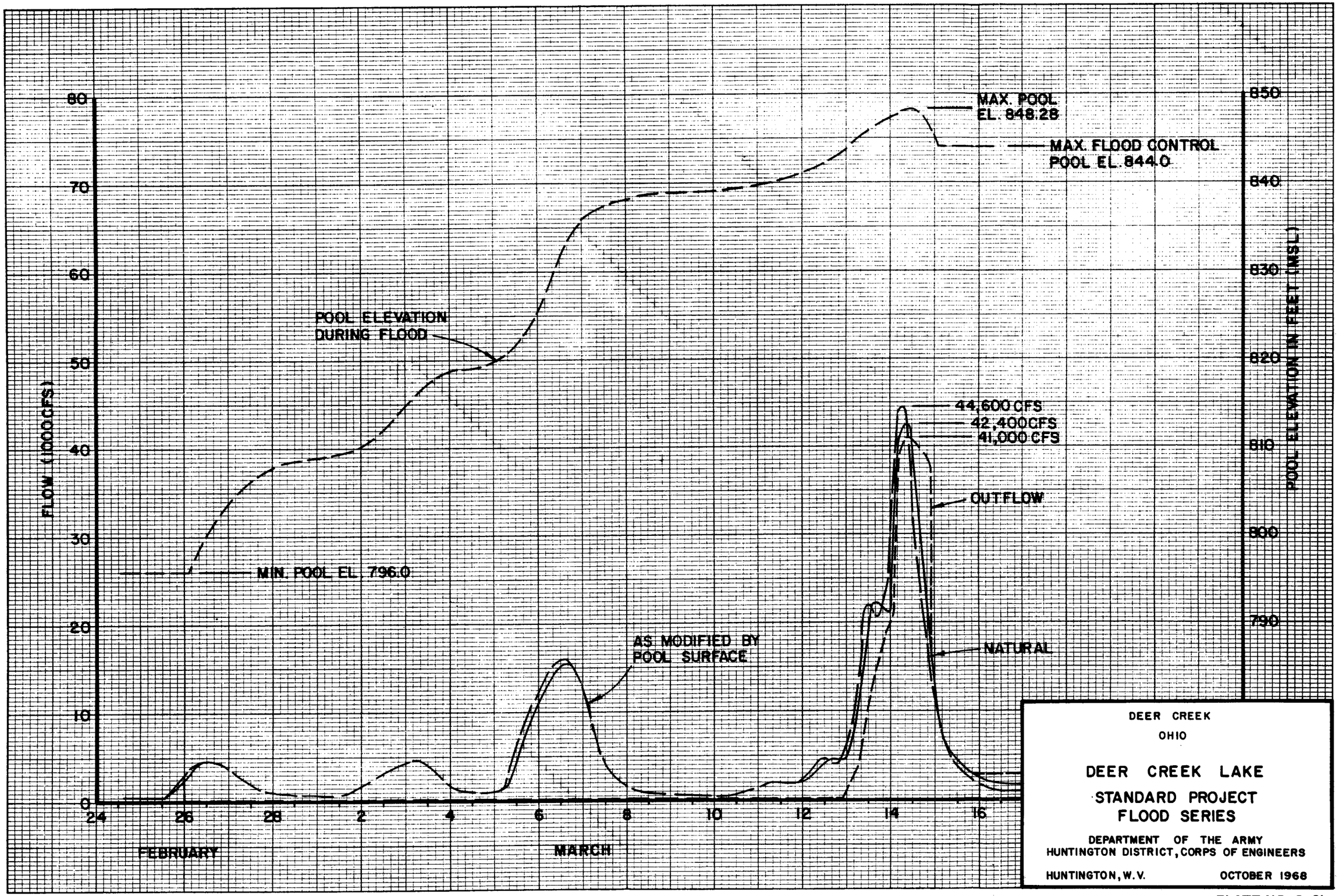

MAX. POOL
EL. 848.08
74,100 CFS
69,000 CFS
POOL ELEVATION
DURING FLOOD
NATURAL
AS MODIFIED BY
POOL SURFACE
36,500 CFS
OUTFLOW
80
70
60
50
40
30
20
10
0
0
2
3
4
5
TIME IN DAYS
845
835
825
815
805
795
785
ELEVATION IN FEET (MSL)
DEER CREEK
OHIO
DEER CREEK LAKE
STANDARD PROJECT FLOOD
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V.
OCTOBER 1968

PLATE NO. 8-3a



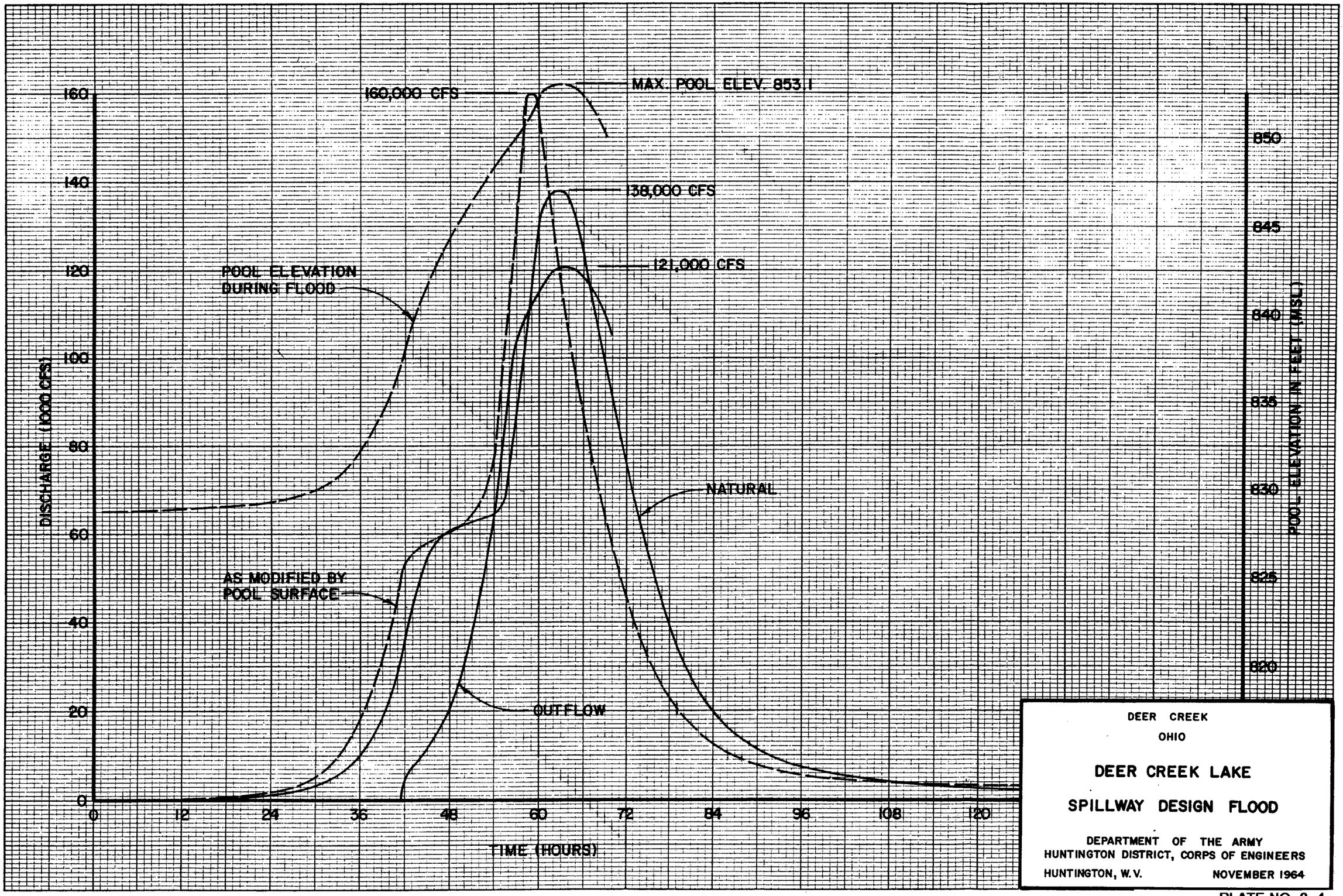
DEER CREEK
OHIO

DEER CREEK LAKE
STANDARD PROJECT
FLOOD SERIES

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. OCTOBER 1968

PLATE NO. 8-3b



DEER CREEK

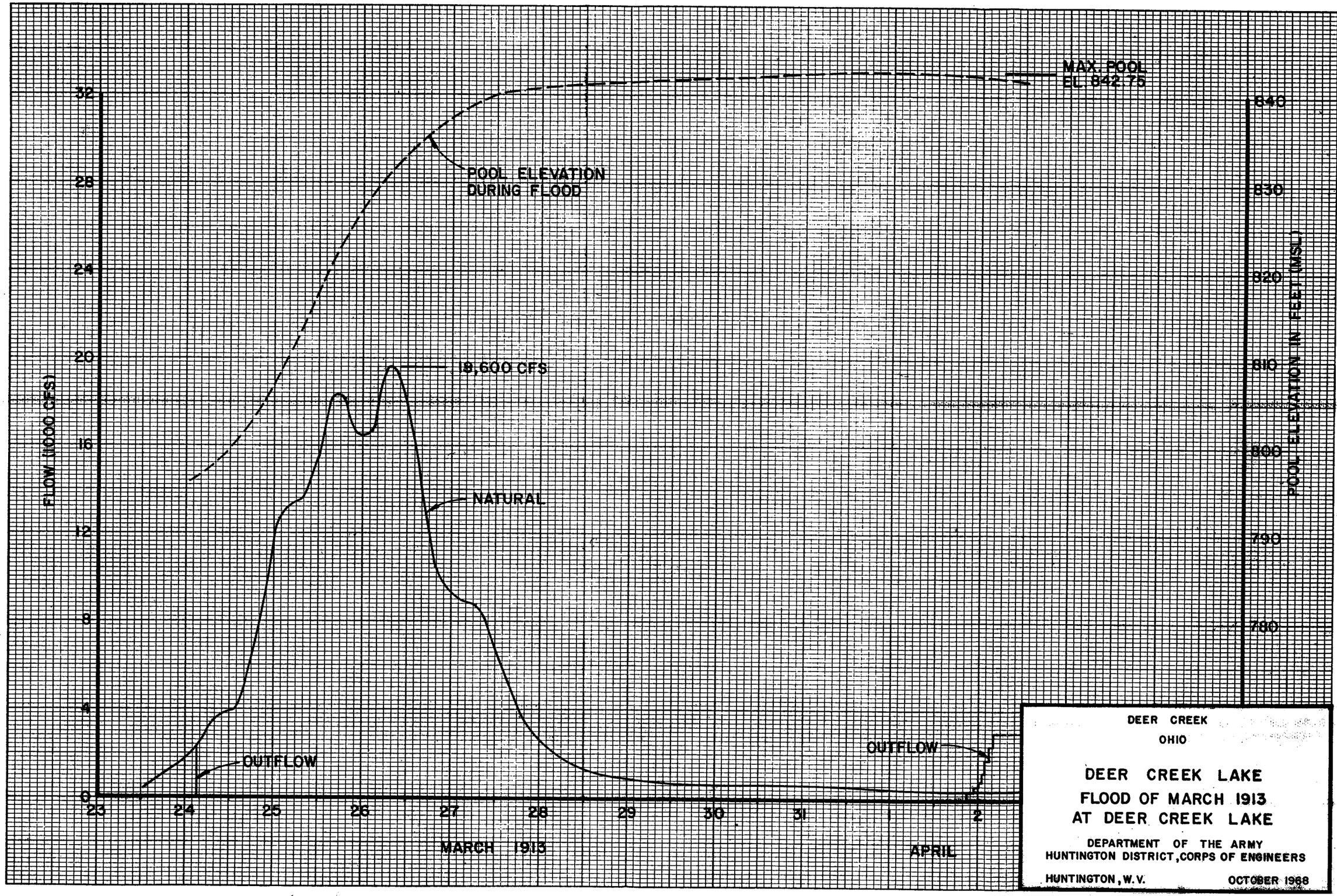
OHIO

DEER CREEK LAKE

SPILLWAY DESIGN FLOOD

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. NOVEMBER 1964

PLATE NO. 8-4



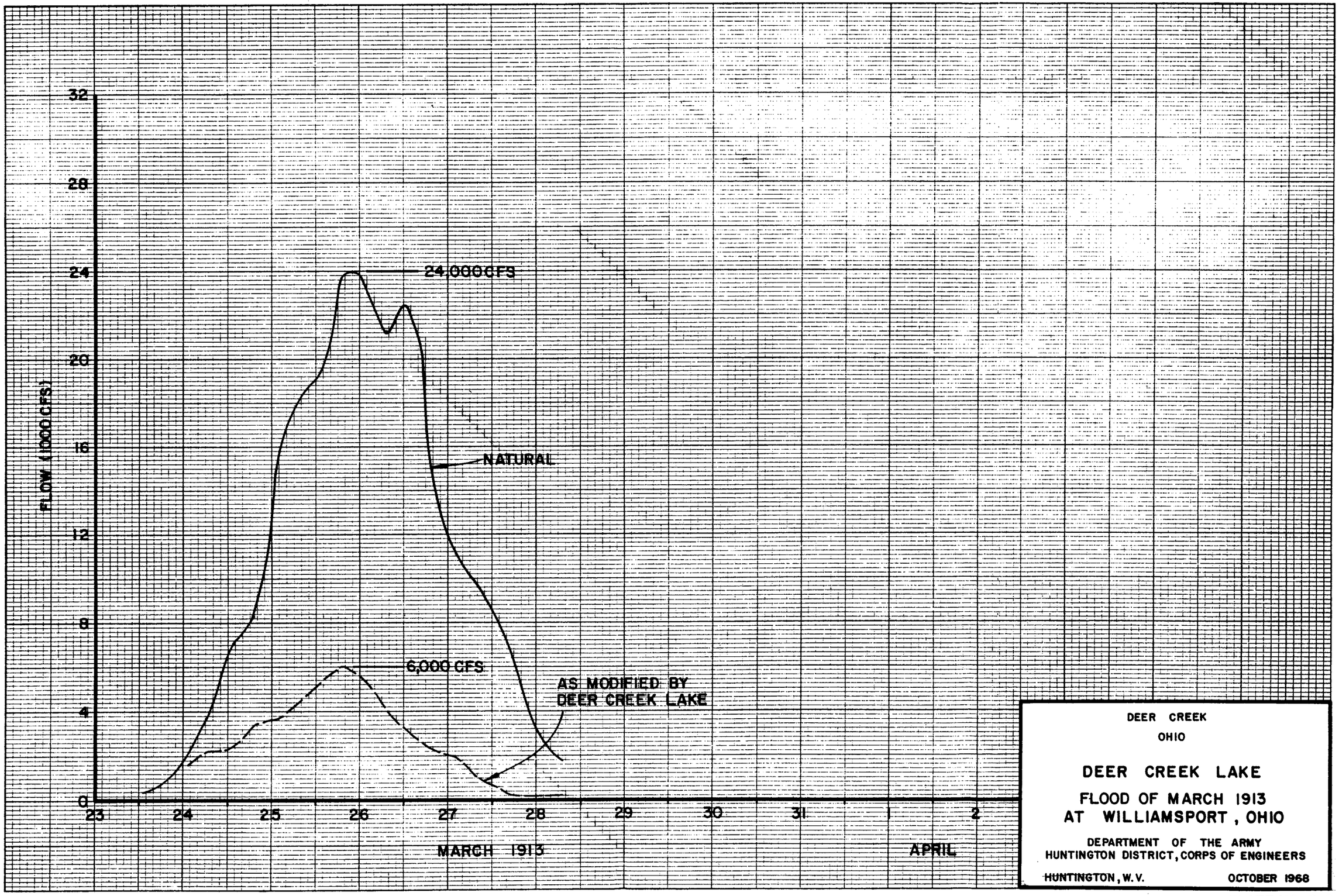
DEER CREEK
OHIO

DEER CREEK LAKE
FLOOD OF MARCH 1913
AT DEER CREEK LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. OCTOBER 1968

PLATE NO. 8-5



DEER CREEK
OHIO

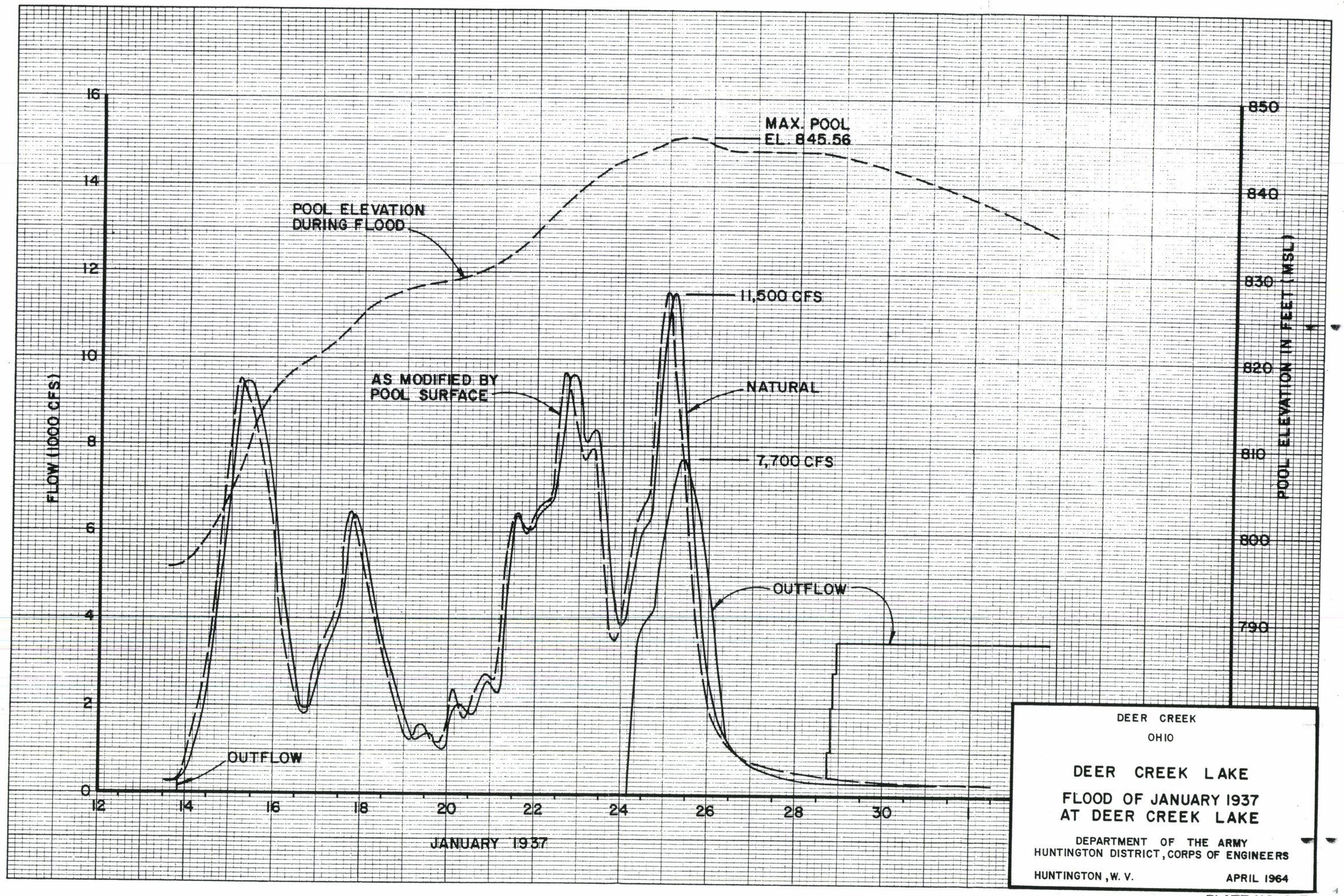
DEER CREEK LAKE

FLOOD OF MARCH 1913
AT WILLIAMSPORT, OHIO

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. OCTOBER 1968

PLATE NO. 8-6



DEER CREEK
OHIO

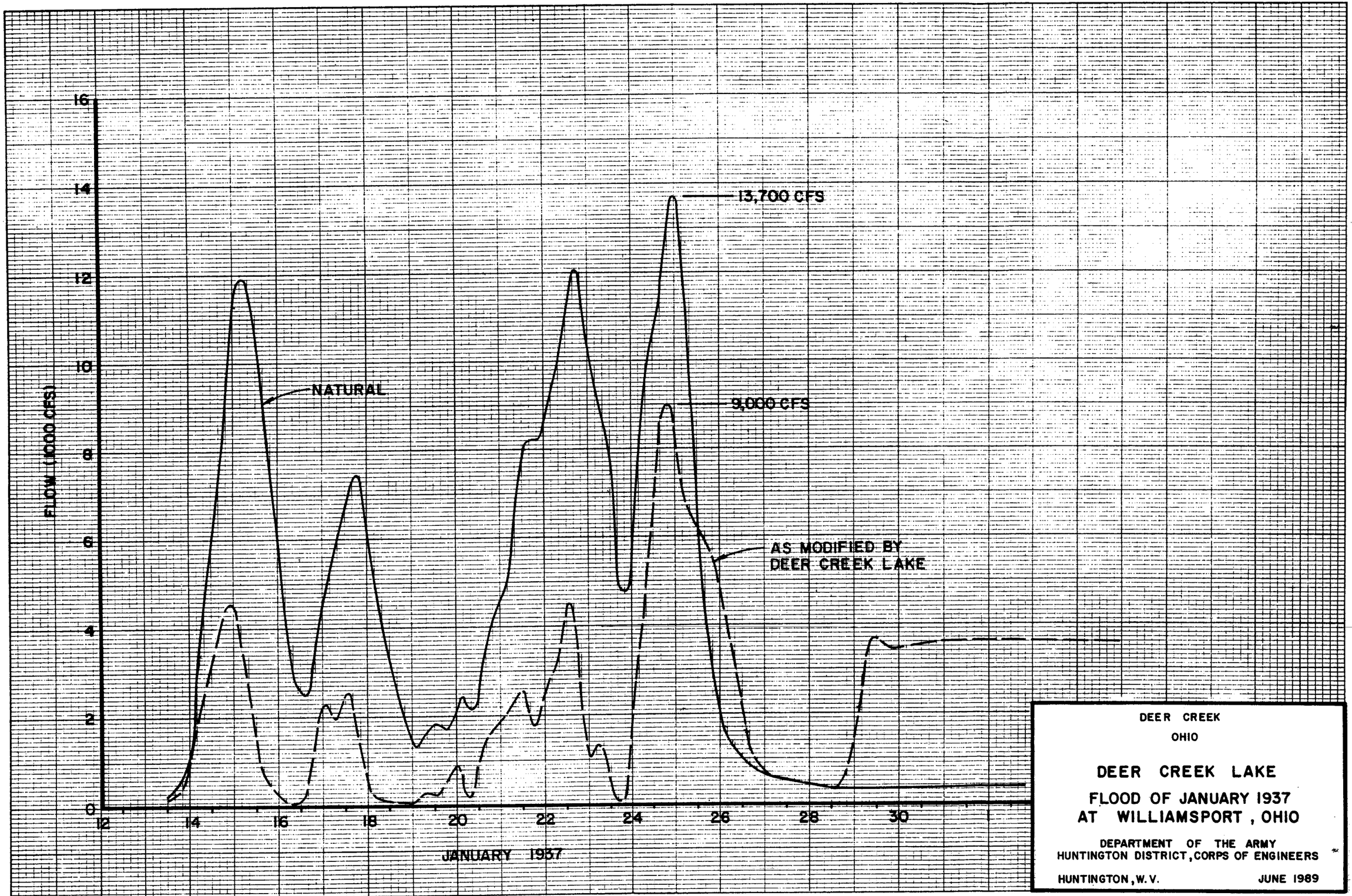
DEER CREEK LAKE

FLOOD OF JANUARY 1937 AT DEER CREEK LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. V. APRIL 1964

PLATE NO. 8-7



DEER CREEK
OHIO

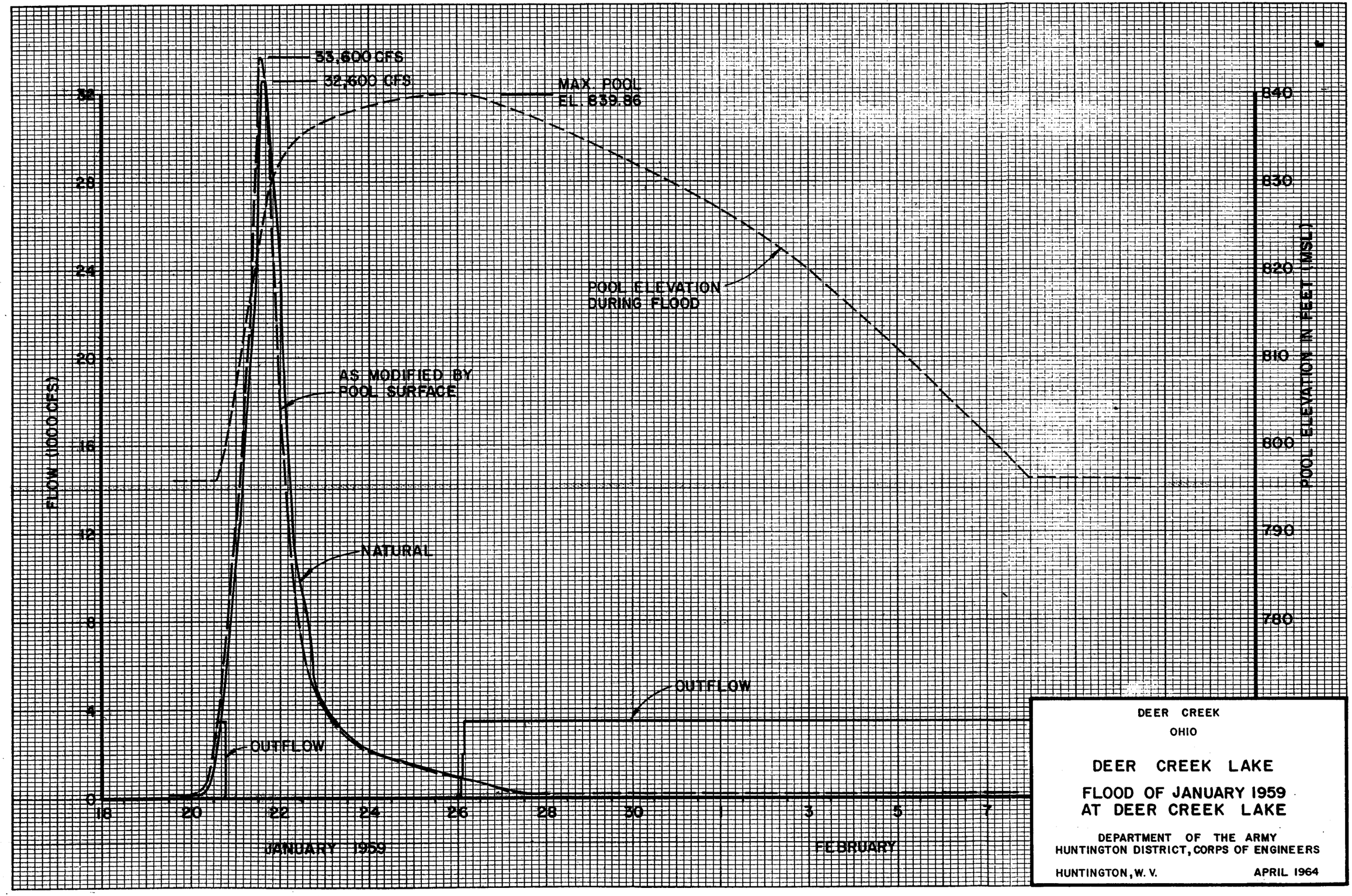
DEER CREEK LAKE

FLOOD OF JANUARY 1937
AT WILLIAMSPORT, OHIO

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. JUNE 1989

PLATE NO. 8-8



DEER CREEK
OHIO

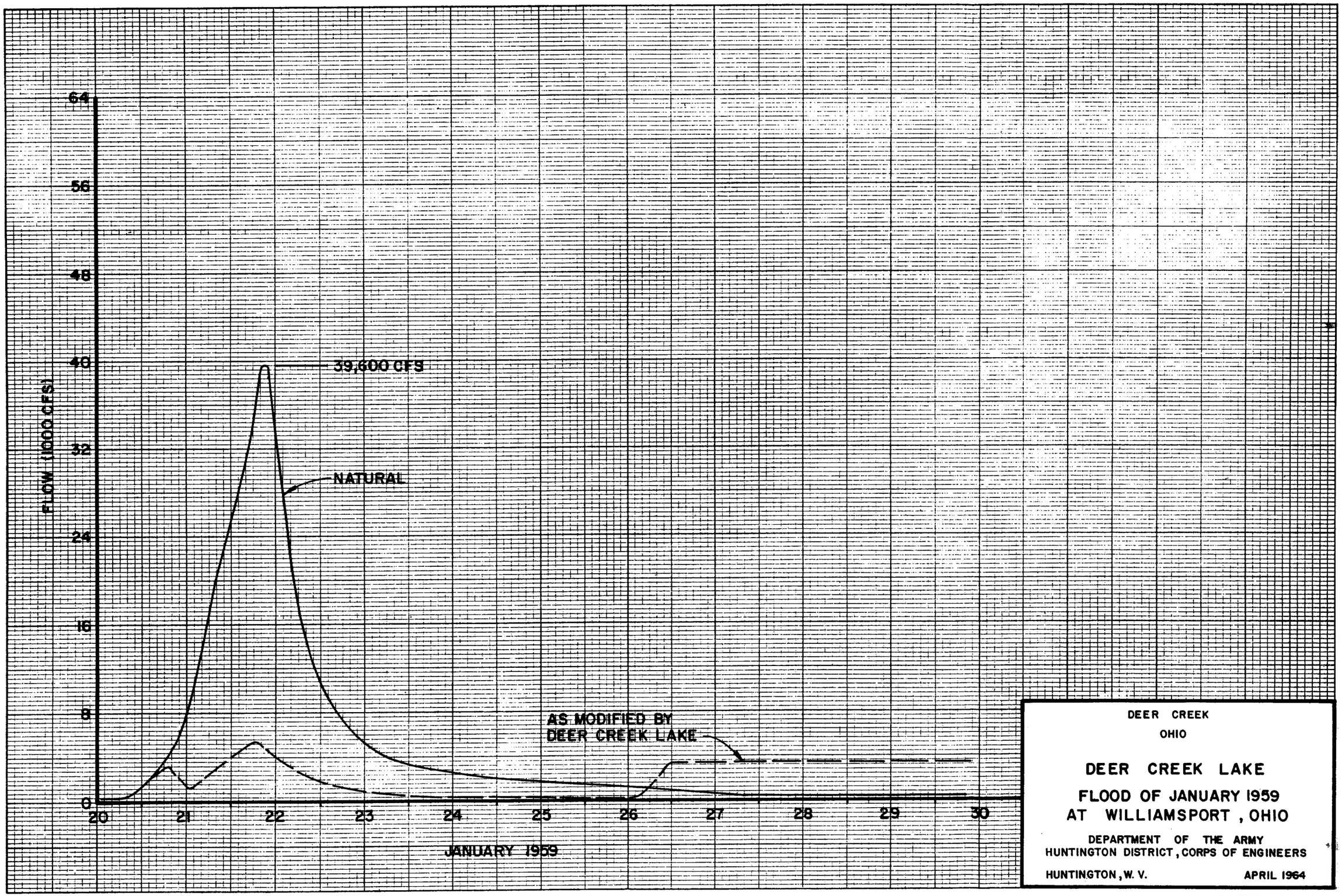
DEER CREEK LAKE

FLOOD OF JANUARY 1959 AT DEER CREEK LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. V. APRIL 1964

PLATE NO. 8-9



DEER CREEK
OHIO

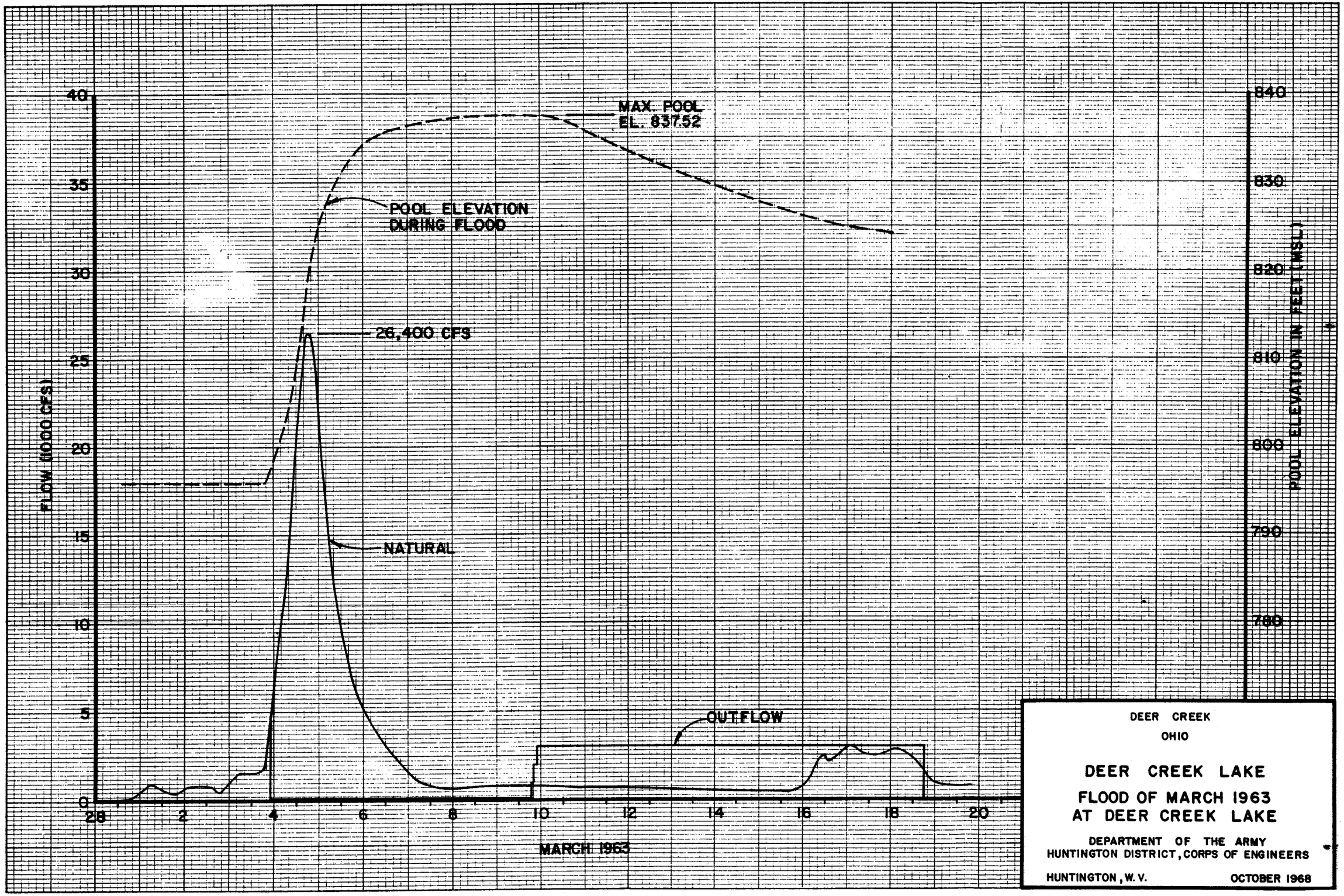
DEER CREEK LAKE

FLOOD OF JANUARY 1959
AT WILLIAMSPORT, OHIO

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. V. APRIL 1964

PLATE NO. 8-10



DEER CREEK
OHIO

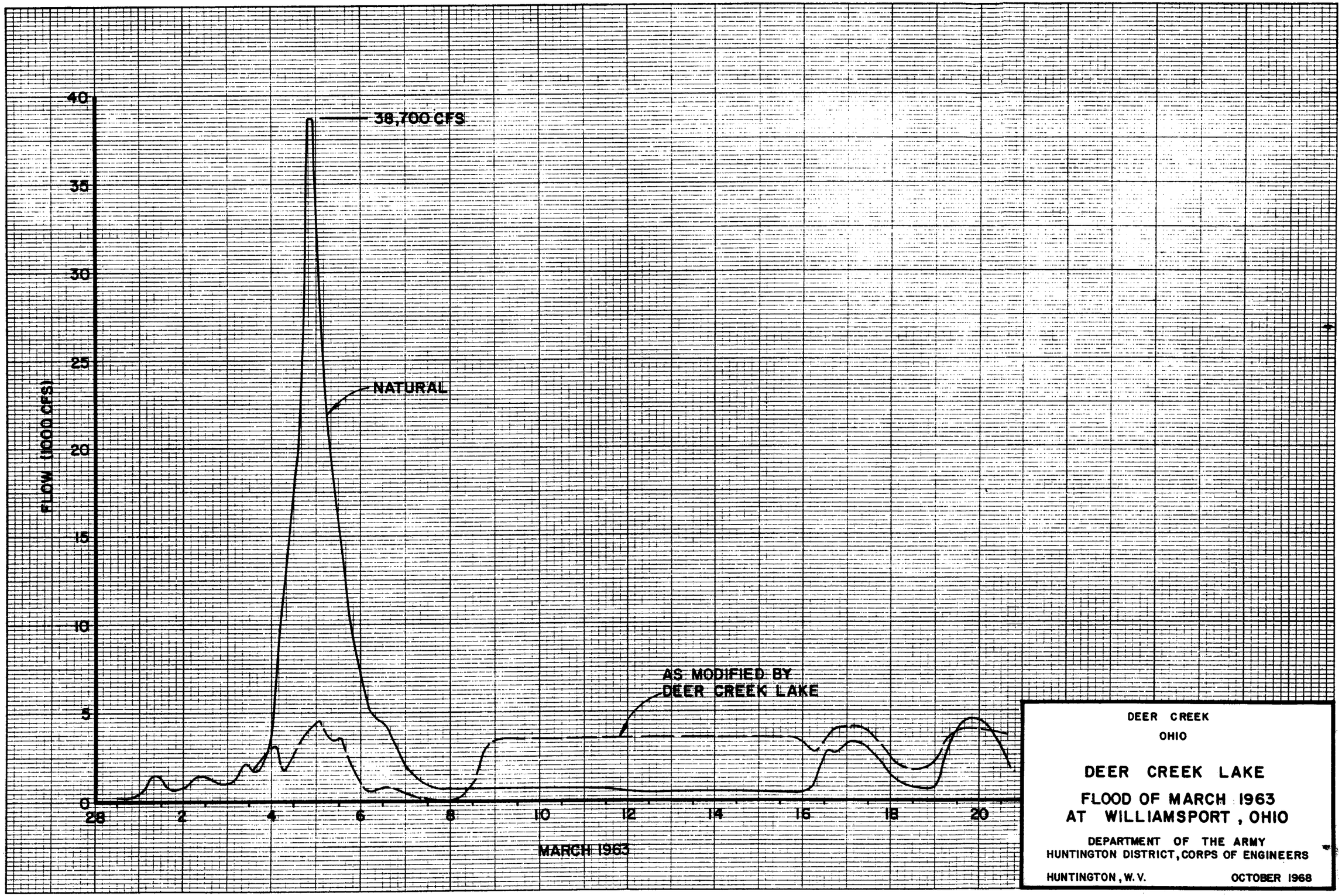
DEER CREEK LAKE

FLOOD OF MARCH 1963 AT DEER CREEK LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. V. OCTOBER 1968

PLATE NO. 8-11



DEER CREEK
OHIO

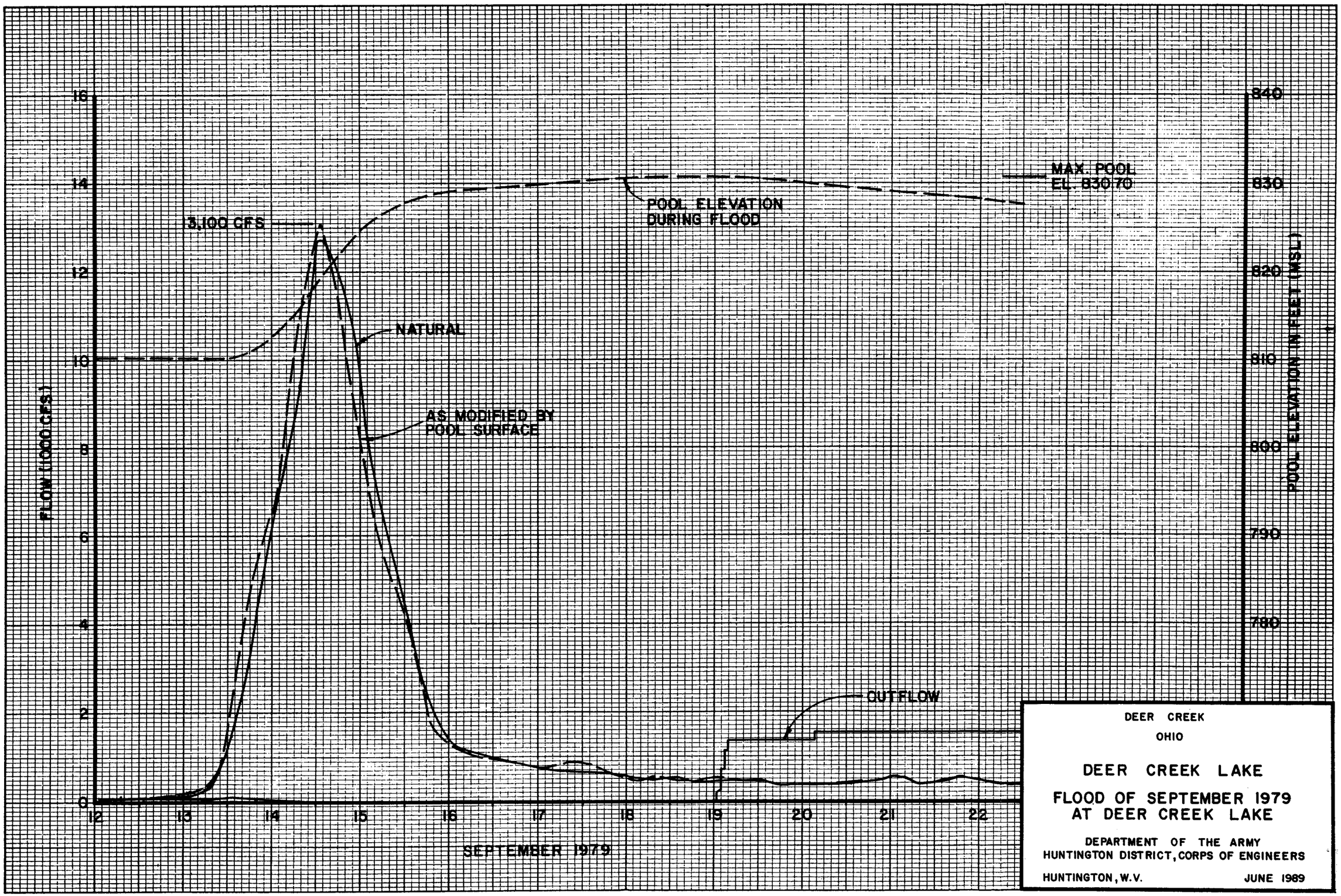
DEER CREEK LAKE

FLOOD OF MARCH 1963
AT WILLIAMSPORT, OHIO

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. OCTOBER 1968

PLATE NO. 8-12



DEER CREEK
OHIO

DEER CREEK LAKE

FLOOD OF SEPTEMBER 1979 AT DEER CREEK LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. JUNE 1989

PLATE NO. 8-13

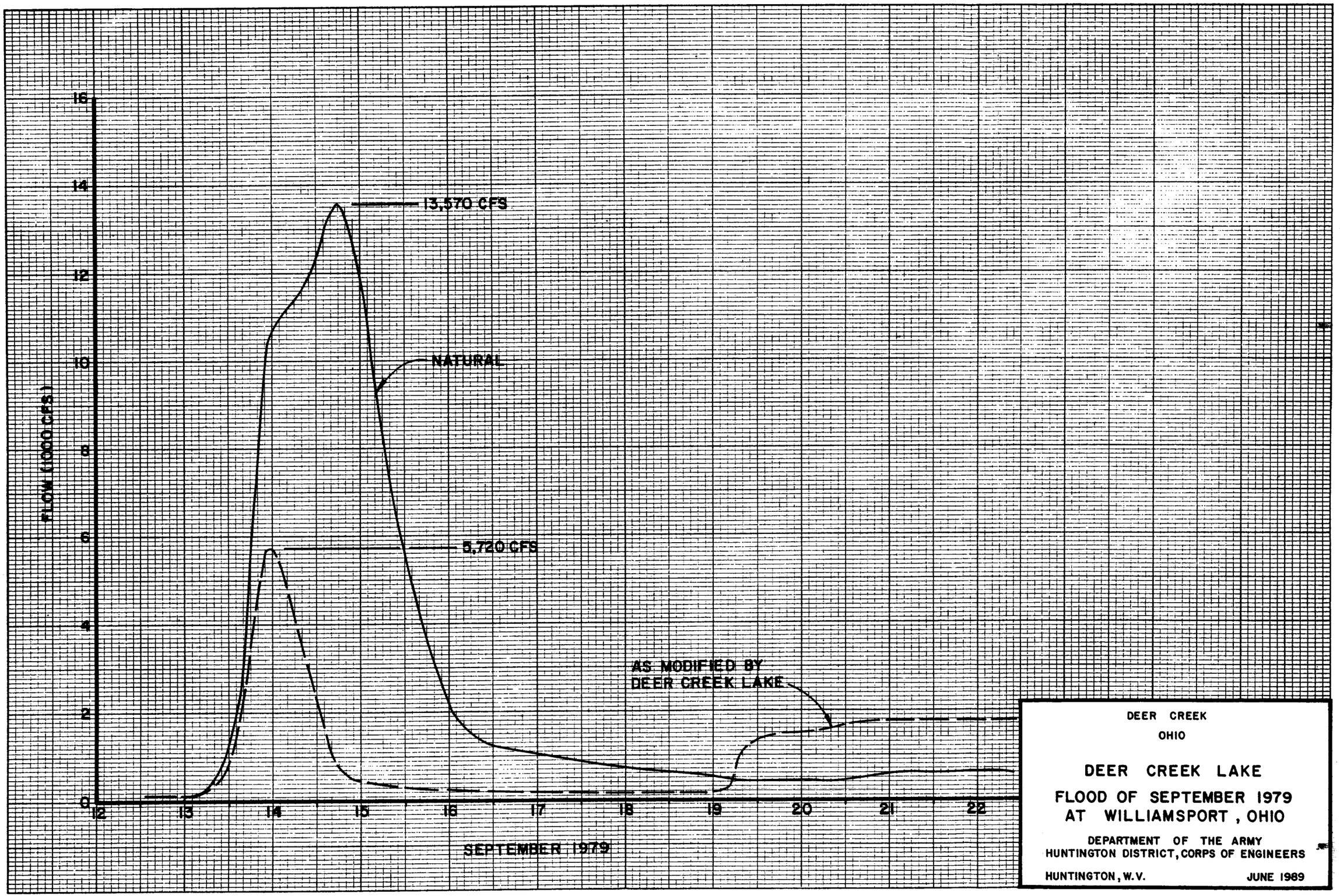
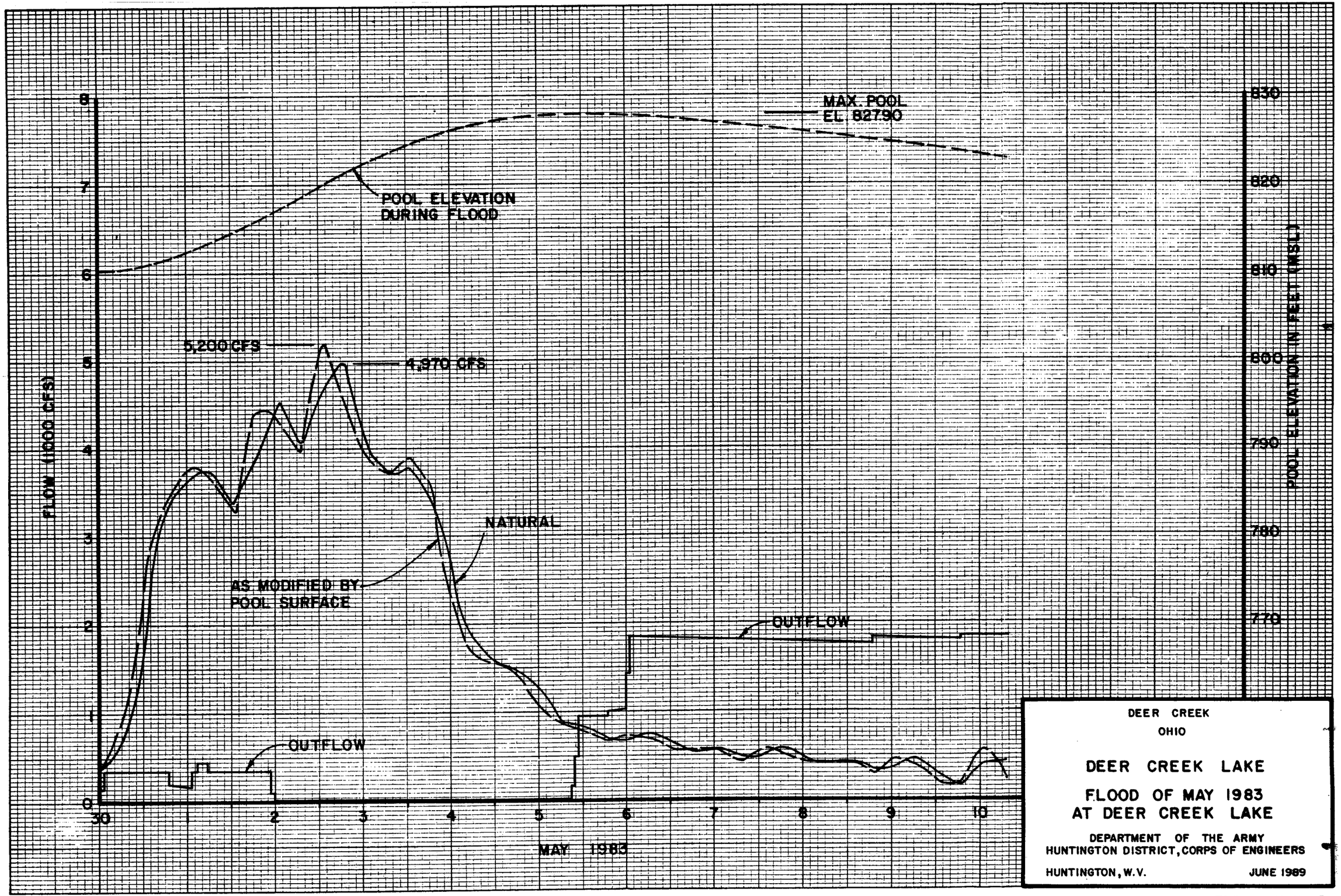

16
14
12
10
8
6
4
2
0
FLOW (1000 CFS)
13,570 CFS
NATURAL
5,720 CFS
AS MODIFIED BY
DEER CREEK LAKE
12
13
14
15
16
17
18
19
20
21
22
SEPTEMBER 1979
DEER CREEK
OHIO
DEER CREEK LAKE
FLOOD OF SEPTEMBER 1979
AT WILLIAMSPORT, OHIO
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V.
JUNE 1989

PLATE NO. 8-14



DEER CREEK
OHIO

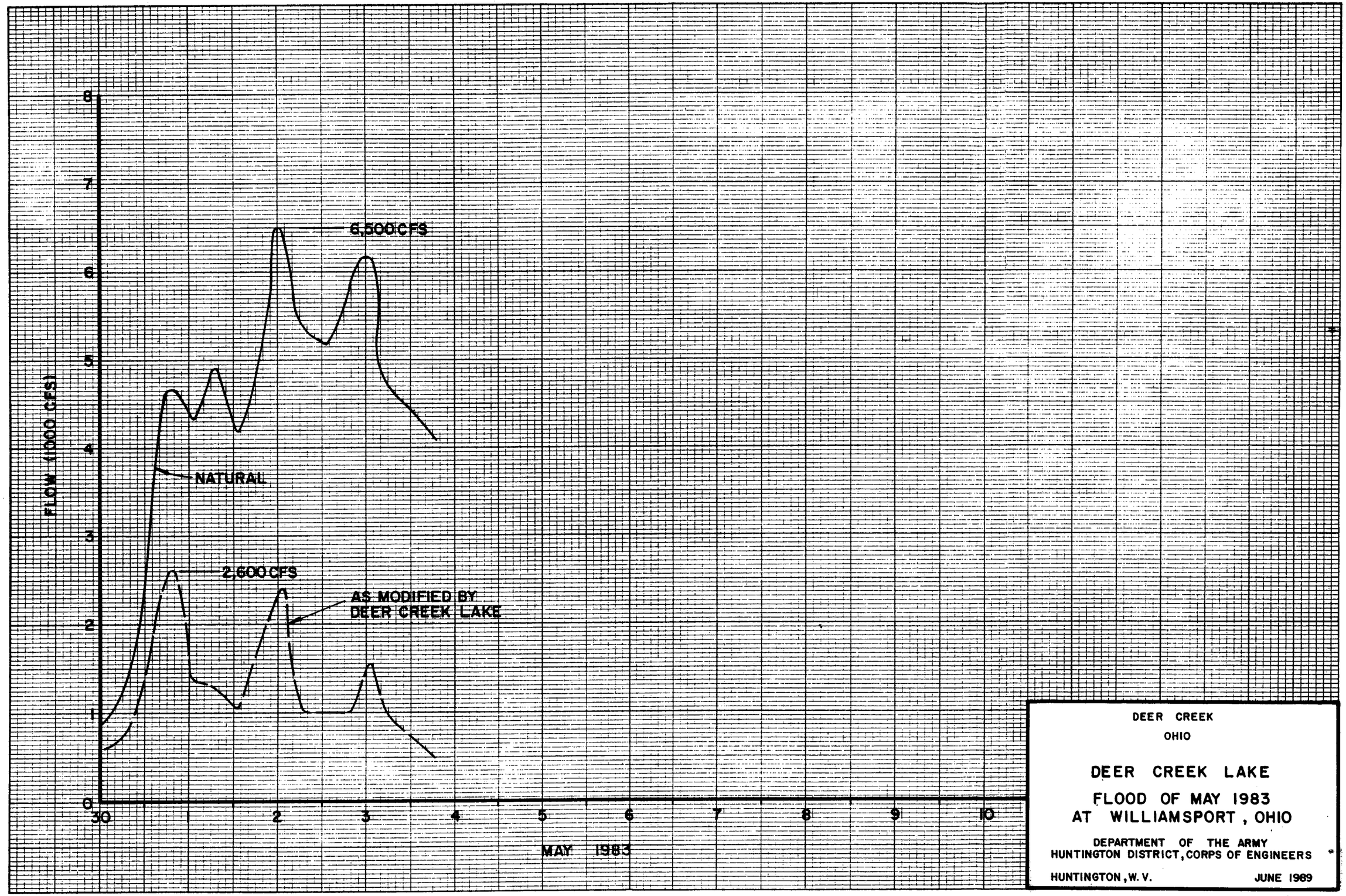
DEER CREEK LAKE

FLOOD OF MAY 1983
AT DEER CREEK LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. JUNE 1989

PLATE NO. 8-15



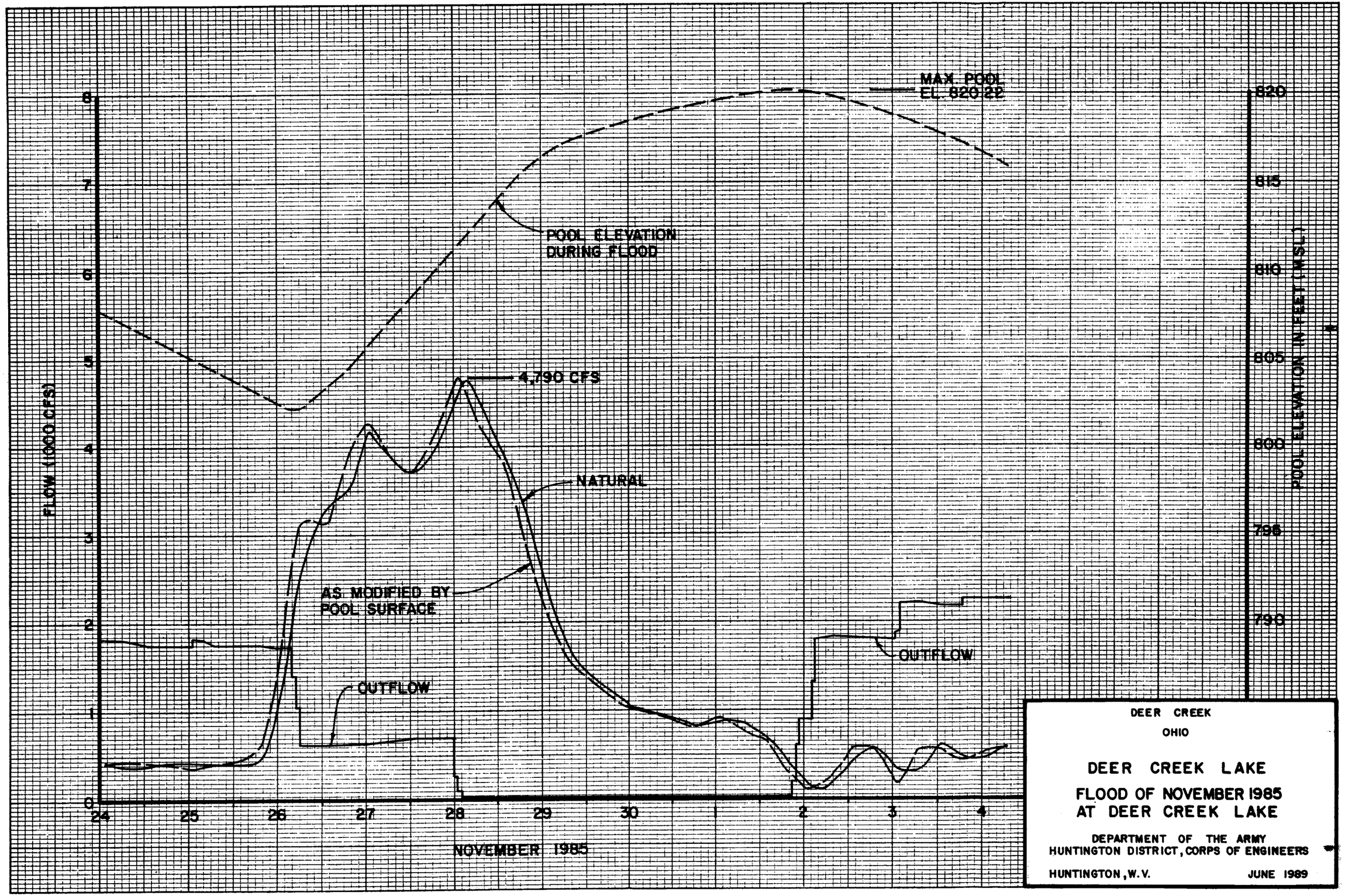
DEER CREEK
OHIO

DEER CREEK LAKE
FLOOD OF MAY 1983
AT WILLIAMSPORT, OHIO

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. V. JUNE 1989

PLATE NO. 8-16



DEER CREEK
OHIO

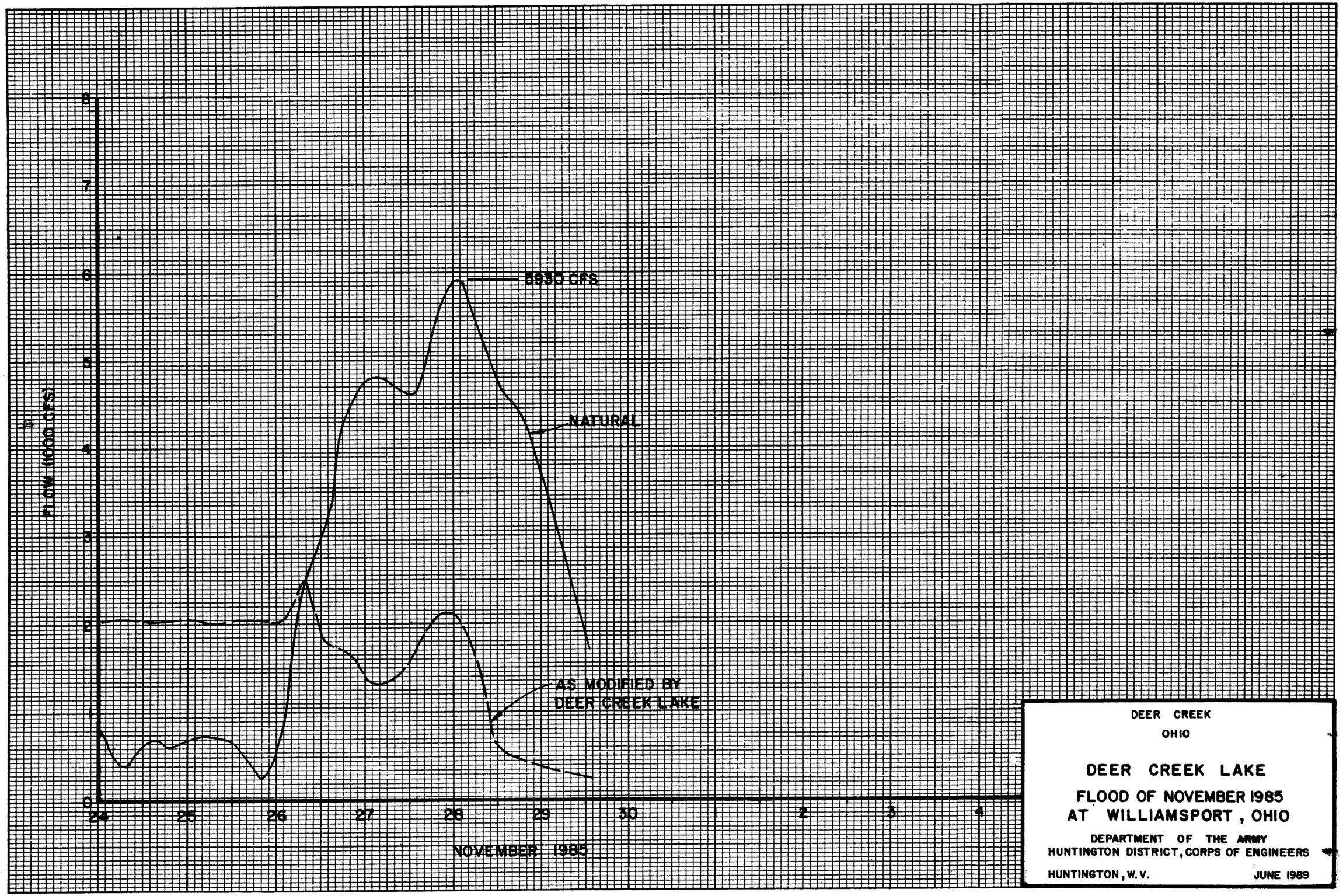
DEER CREEK LAKE

FLOOD OF NOVEMBER 1985 AT DEER CREEK LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. JUNE 1989

PLATE NO. 8-17



DEER CREEK
OHIO

DEER CREEK LAKE

FLOOD OF NOVEMBER 1985
AT WILLIAMSPORT, OHIO

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W.V. JUNE 1989

PLATE NO. 8-18

Deer Creek Lake
Water Temperature
August 30, 2001

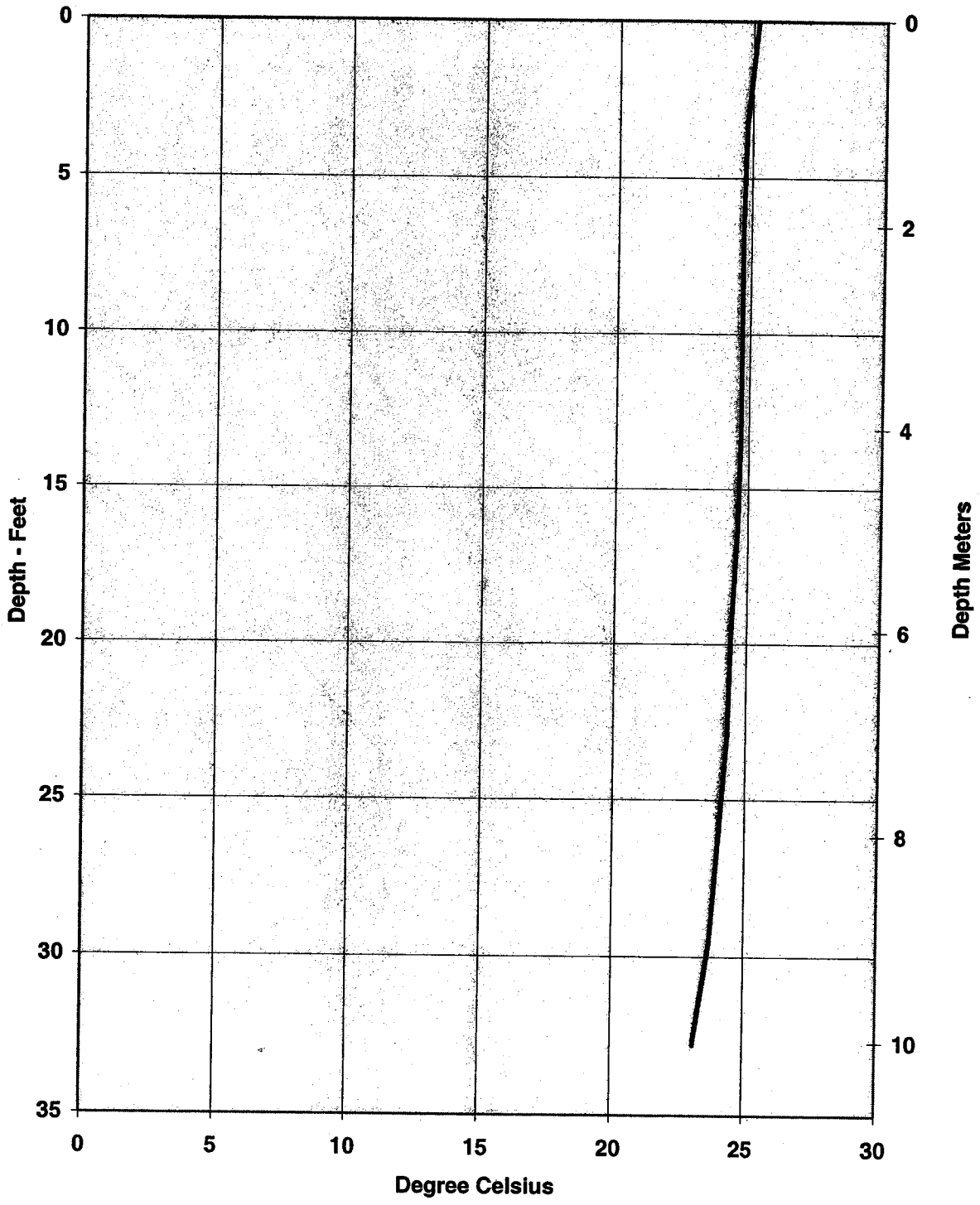


PLATE NO. 8-19

Deer Creek Lake
Dissolved Oxygen
August 30 2001

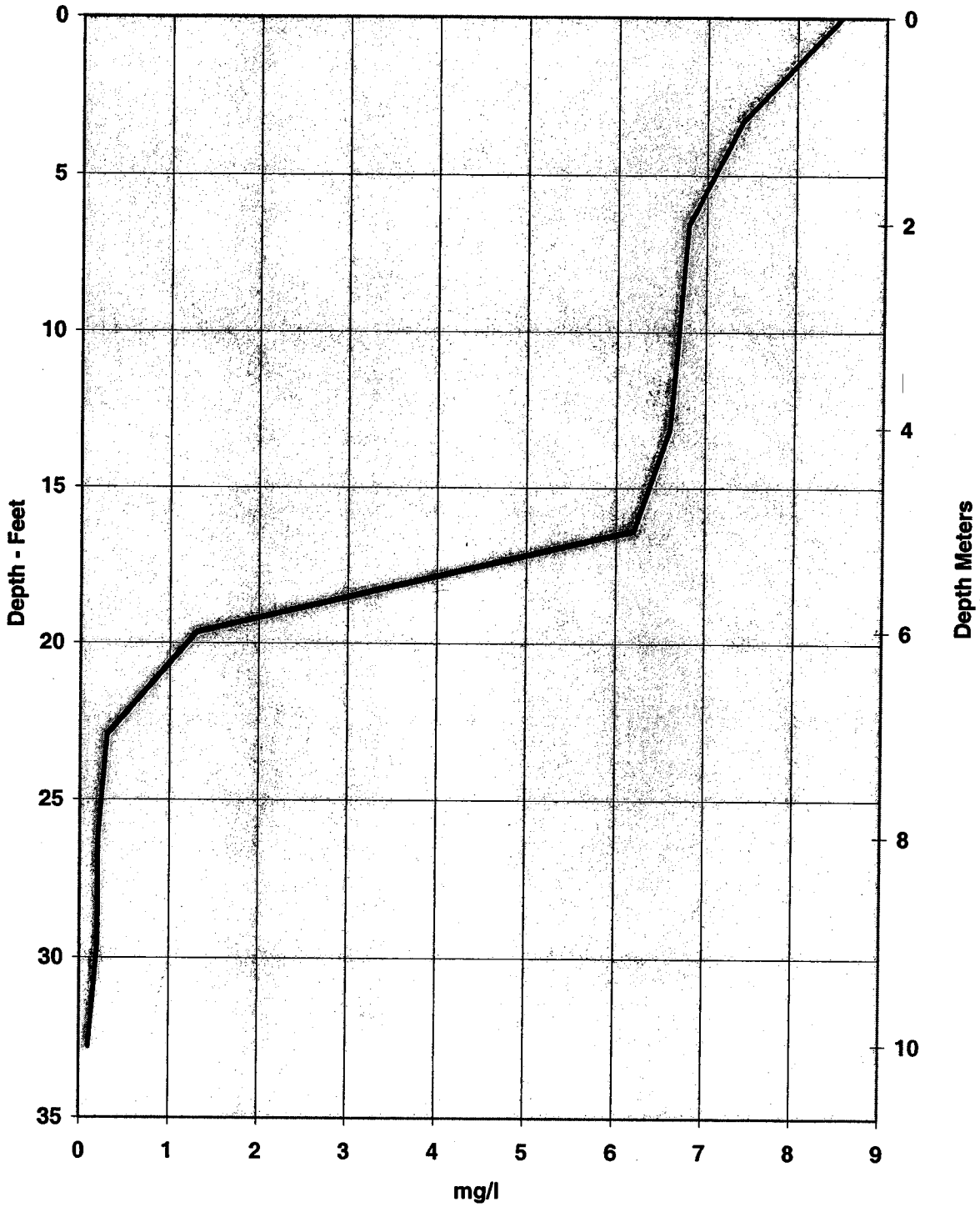


PLATE NO. 8-20

Deer Creek Lake
Total Iron
August 30, 2001

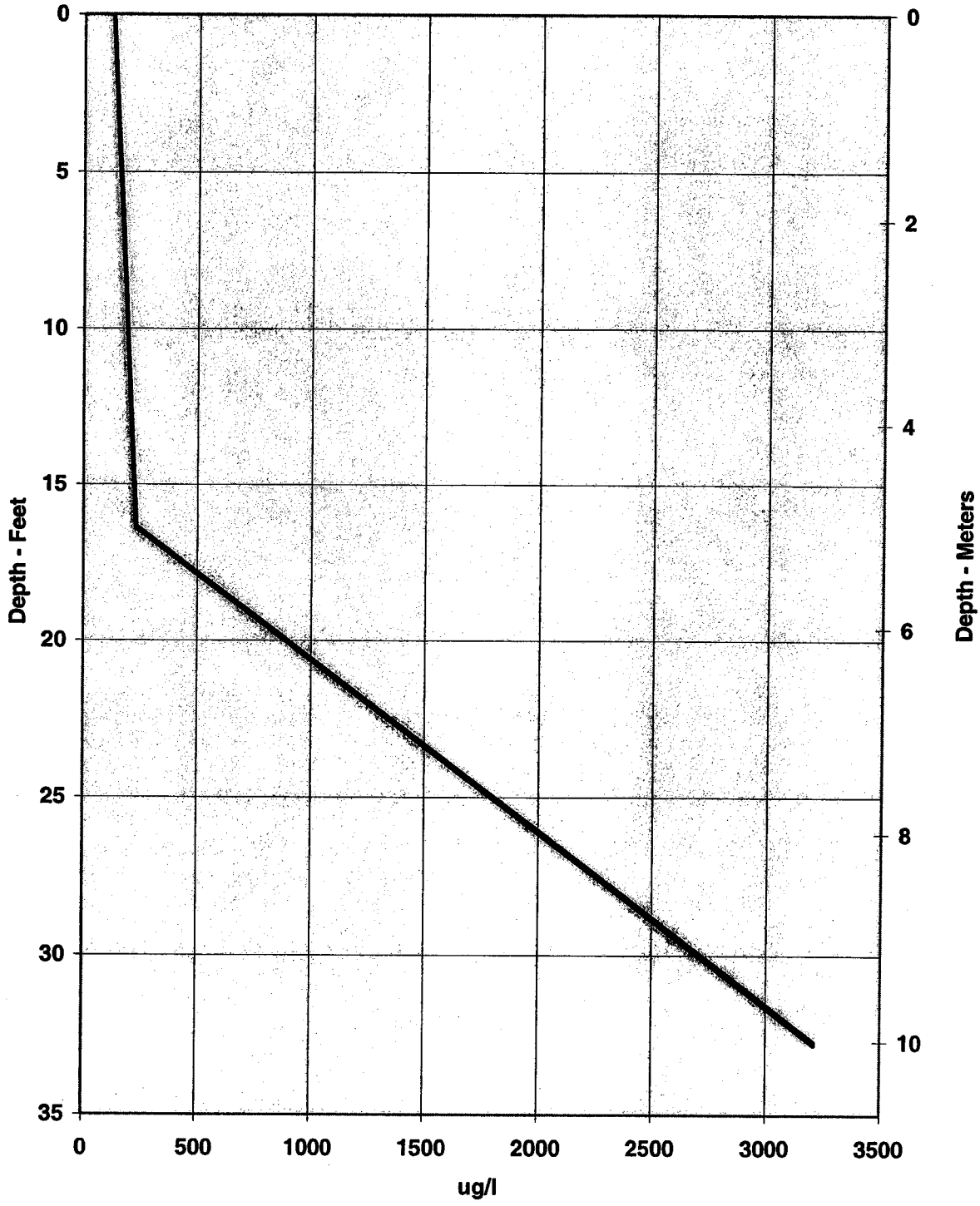


PLATE NO. 8-21

Deer Creek Lake
Total Manganese
August 30, 2001

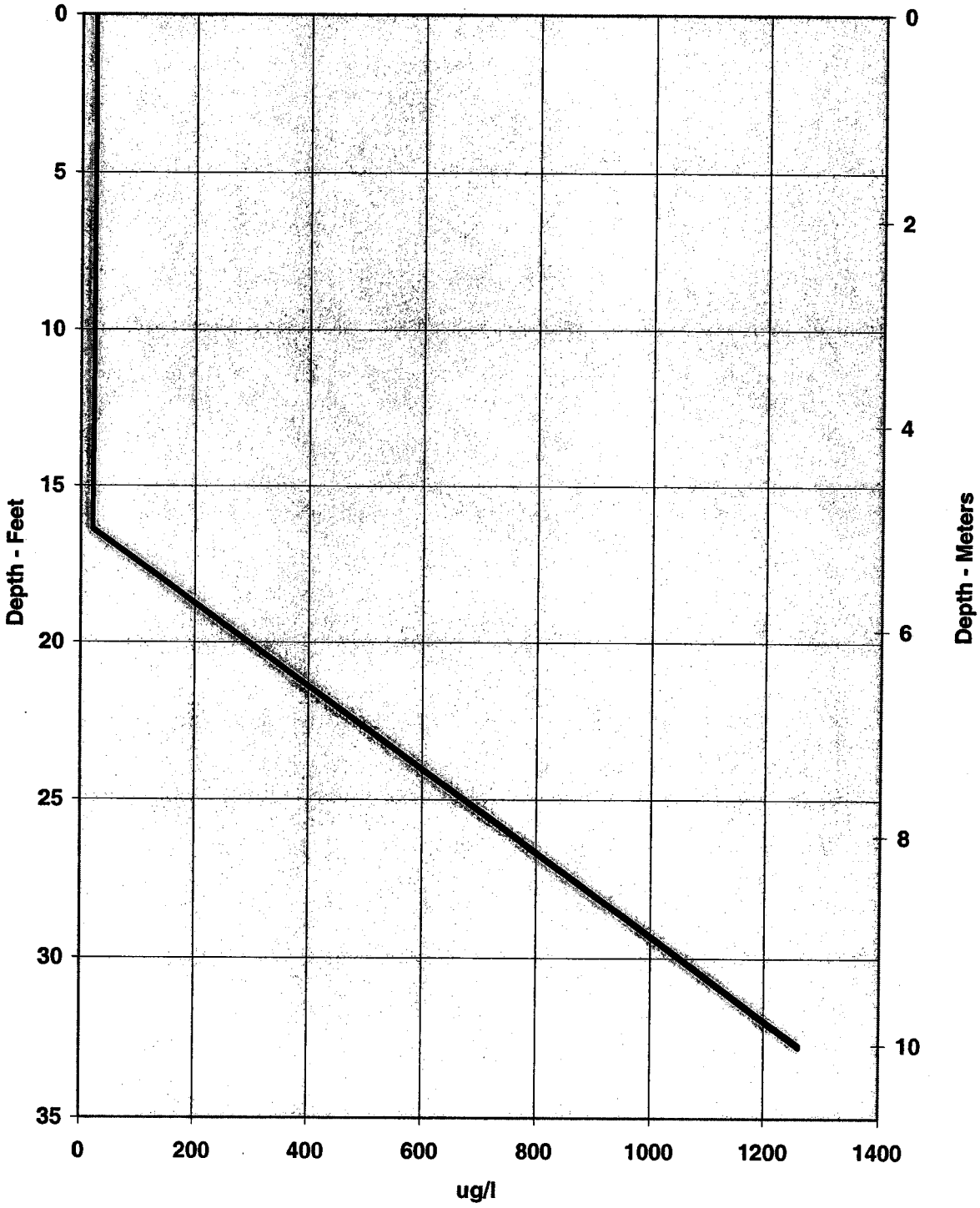


PLATE NO. 8-22

-OVERALL QUALITY RATING-

For Macroinvertebrate Stations
Deer Creek Lake, Ohio

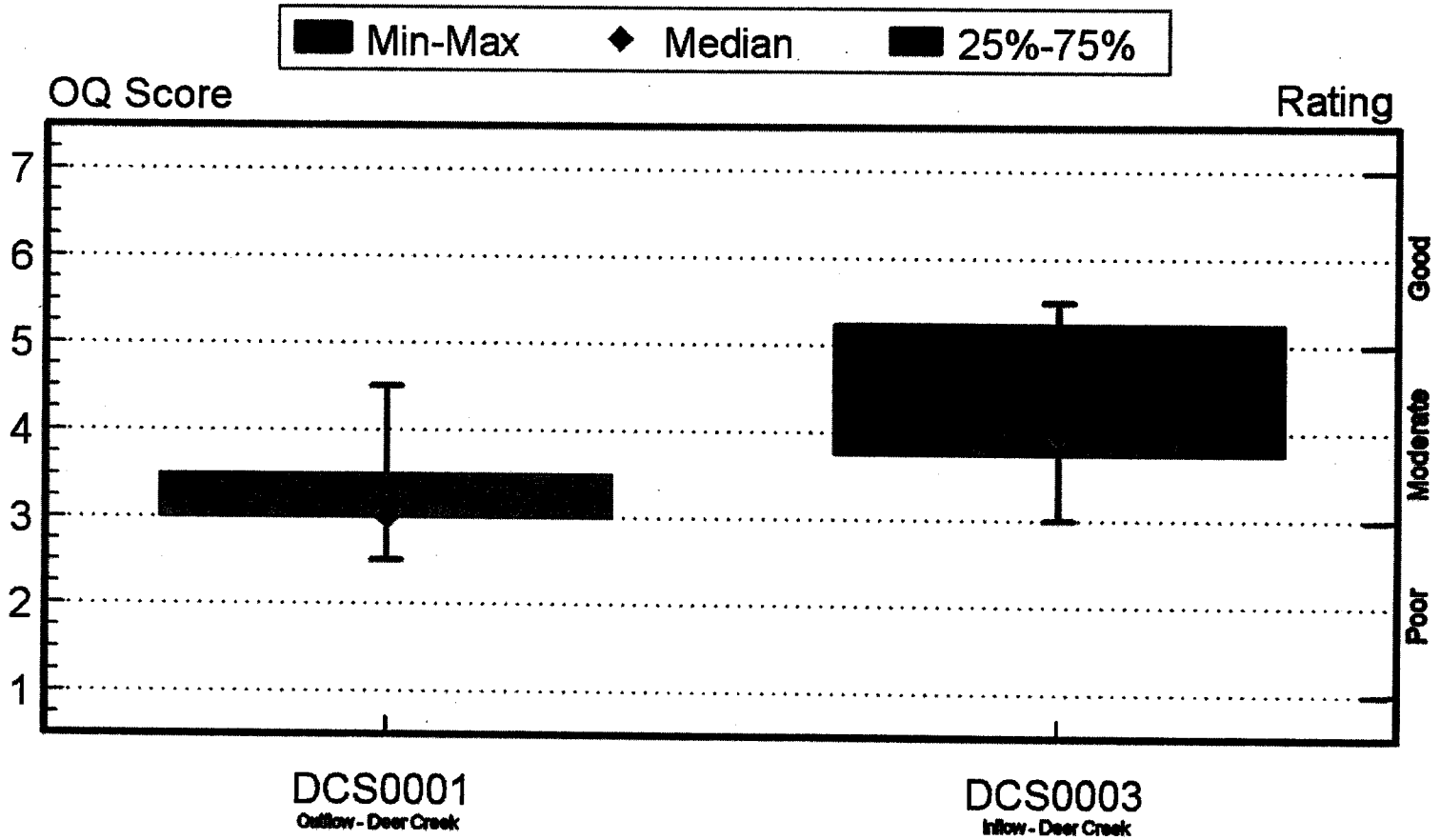


PLATE NO. 8-23

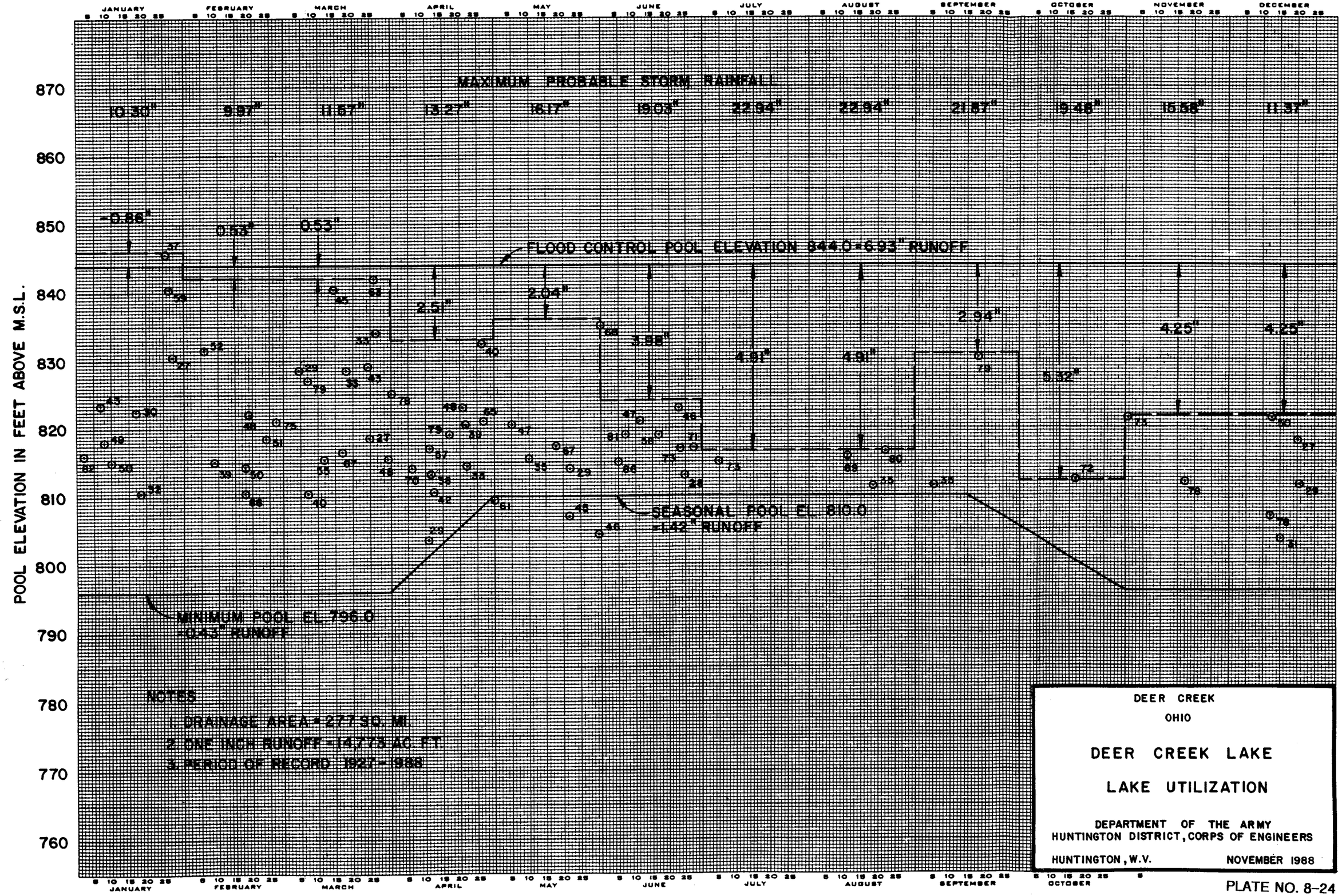
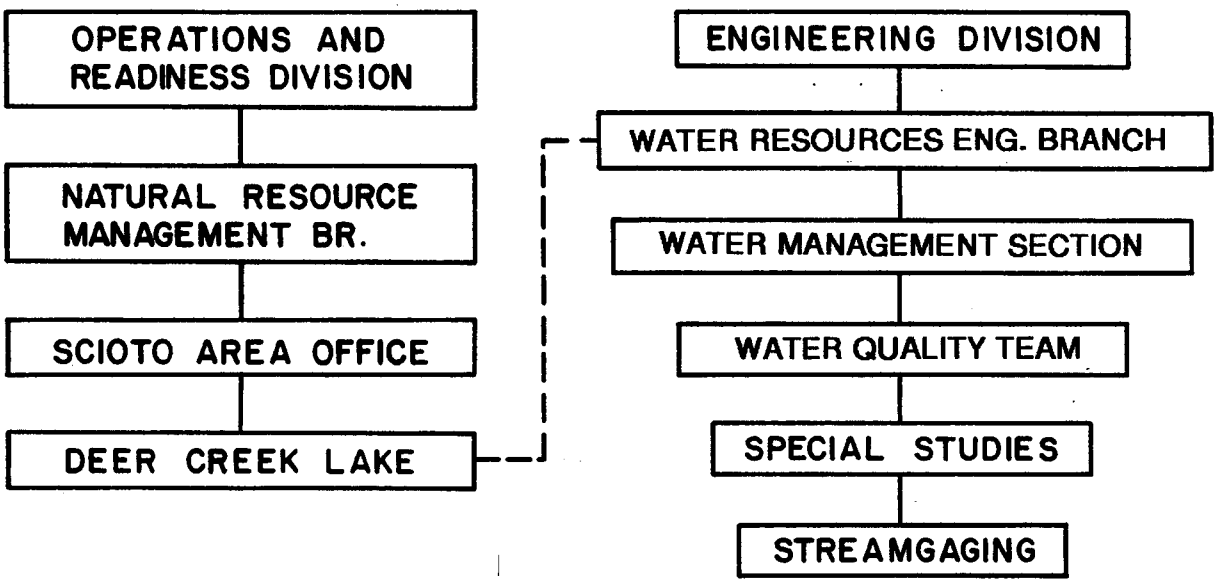

JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
5 10 15 20 25
MAXIMUM PROBABLE STORM RAINFALL
10.30"
9.97"
11.67"
13.27"
16.17"
19.03"
22.94"
22.94"
21.87"
19.46"
16.58"
11.37"
FLOOD CONTROL POOL ELEVATION 844.0=6.93" RUNOFF
SEASONAL POOL EL. 810.0
=1.42" RUNOFF
MINIMUM POOL EL. 796.0
=0.43" RUNOFF
0.86"
0.53"
0.53"
2.51"
2.04"
3.58"
4.91"
4.91"
2.94"
5.32"
4.25"
4.25"
POOL ELEVATION IN FEET ABOVE M.S.L.
870
860
850
840
830
820
810
800
790
780
770
760
NOTES
1. DRAINAGE AREA = 277 SQ. MI.
2. ONE INCH RUNOFF = 14,773 AC. FT.
3. PERIOD OF RECORD 1927 - 1988
DEER CREEK
OHIO
DEER CREEK LAKE
LAKE UTILIZATION
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V.
NOVEMBER 1988

PLATE NO. 8-24

WATER CONTROL MANAGEMENT
DEER CREEK BASIN
NORMAL ORGANIZATION



WATER CONTROL MANAGEMENT

SCIOTO RIVER BASIN
NORMAL ORGANIZATION

PLATE NO. 9-1

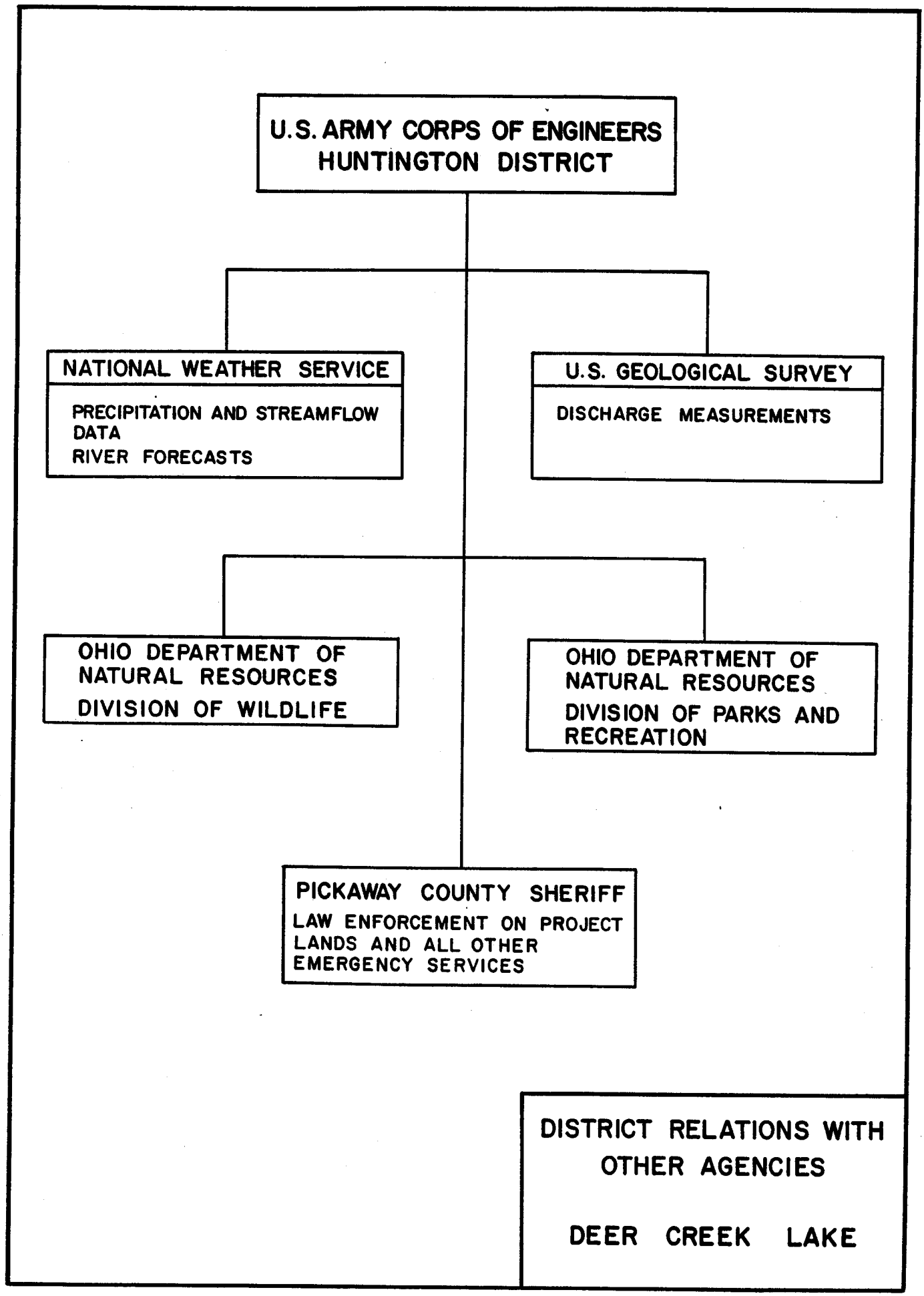

U.S. ARMY CORPS OF ENGINEERS
HUNTINGTON DISTRICT
NATIONAL WEATHER SERVICE
PRECIPITATION AND STREAMFLOW DATA
RIVER FORECASTS
U.S. GEOLOGICAL SURVEY
DISCHARGE MEASUREMENTS
OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE
OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS AND RECREATION
PICKAWAY COUNTY SHERIFF
LAW ENFORCEMENT ON PROJECT LANDS AND ALL OTHER EMERGENCY SERVICES
DISTRICT RELATIONS WITH OTHER AGENCIES
DEER CREEK LAKE

PLATE NO. 9-2